



USE OF EARTHEN BERMS FOR EROSION CONTROL

(Revision of Factsheet "Use of Earthen Berms for Erosion Control," 90-226, November, 1990)

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Earthen berms are frequently required as an integral component in many erosion control systems. They can be used as a dam to temporarily hold back water (floodwater storage) or they can be used to deflect or collect water.

ADVANTAGES

1. Earthen berms used as a component of a floodwater storage system can:
 - achieve the same objective as a grassed waterway, however, do not require the land area or associated problems related to the grassed waterway;
 - work as a slope length reducer. This can reduce sheet erosion problems yet allow the farmer to continue intensive farming practices;
 - reduce the size of outlet pipe required. By storing the water for a period of time the outlet pipe can be reduced in size and be used at full capacity for a longer period of time;
 - reduce the peak flow occurring further down in the watershed;
 - reduce the plugging potential at the drop inlet grate. The ponding will slow down the flow of water allowing debris to settle out before it reaches the grate.
2. An earthen berm used as a deflector or collector can:
 - divert water flow to a less erodible location;
 - collect water from many locations and move it to one large drop structure;
 - dam water high enough to create sufficient head on a drop structure to allow it to operate at maximum capacity.

DISADVANTAGES

1. Any overtopping of the berm can have disastrous effects both on the immediate project and the environment and structures further down the watershed. Provisions should be made to handle any overtopping in an erosion resistant manner.

2. Berms (especially narrow based) are vulnerable to rodent damage which could cause failure of the berm.
3. Tillable berms normally can only be cultivated in a direction parallel to the top of the berm.
4. Capital costs of an erosion control system utilizing a berm can sometimes exceed the cost of a comparative system such as a grassed waterway.
5. The ponding of water behind the berm can cause some crop damage especially in the vicinity of the drop structure.

DESIGN CONSIDERATIONS

1. When designing an earthen berm for use in a floodwater storage system the following steps are required.
 - The total incoming volume and peak flowrate of water must be determined. These values depend on the watershed's characteristics
 - The maximum available water storage area and volume should be determined by initially performing a grid survey of the proposed impoundment area. Once this is completed, the volume of impounded water can be determined by using charts or mathematical calculations. Any earth to be excavated within the storage area will increase the overall holding capacity.
 - Based on the above, the outlet size and/or spillway dimensions can be determined. Under most conditions the outlet should be sized to ensure that the ponding time is limited to less than 24 hours which is the maximum flood time tolerable to most crops.

2. When designing an earthen berm for use as a deflector or collector the following steps should be taken.
 - With this type of structure, the drop structure or spillway will be large enough to handle the peak flow expected. Normally the maximum head of water required over a drop structure or spillway should dictate the maximum height of the berm.
 - Necessary reinforcement of the berm should take place at locations where high water velocities may erode the berm. This reinforcement could consist of rock riprap or a vegetative lining.
5. The berm should never be placed on potentially unstable soils. An example of this is a berm located at the top of an existing gully. This berm should be located far enough back from the crest of the gully to not be affected by any future settlement.

3. The following design considerations are required for both types of berms.
 - Protection for the potential overtopping of the berm must be installed. This protection can be as simple as making sure that the crest of the berm is completely level to ensure that this flow will be distributed over a wide area. However, in larger or more vulnerable structures an emergency spillway should be constructed. This could consist of a grassed waterway or a rock chute underlain by proper filter material.
 - Side slopes of the berm should be determined. If farm equipment is to cross, the slope should not exceed 1:10. If no equipment is expected to cross, the slope should not exceed 1:3 in sandy soils and 1:2 in clay soils.
 - Access for maintenance operations such as mowing of the berm and maintenance of other structures must be considered.

6. Differential settlement must be controlled. This can happen when a tile is installed under the berm. Settlement in this trench may cause a void or an uneven crest in the berm.

An alternative is to install the tile at least 1 year before the berm is completed. Any settling over the tile will have time to take place before the berm is installed.

MAINTENANCE

1. A tillable berm should not be plowed. However, if significant settlement occurs, they may be plowed, starting at the base of each side and turning the furrows upward to build up the berm.
2. Non-tilled narrow-based berms should be left in permanent sod cover.
3. Regular checks for cracks, settlement and outlet obstructions should be made especially before major runoff events occur. It is much easier and more economical to alleviate potential problems at an early stage than to suffer the consequences and potentially be required to rebuild the entire berm. This holds true for most erosion control measures.
4. An emergency spillway often has to be repaired after an extremely large storm has taken place. If this repair is frequent, consideration should be given to major improvement to the capacity of the system.

CONSTRUCTION CONSIDERATIONS

1. The area from which the soil for the berm construction is obtained, normally known as the borrow area, should be as close to the site of the proposed berm as possible. Depth of existing field tile can be a limiting factor. Location of the borrow excavation should be chosen to prevent any unwanted changes in surface drainage direction.
2. Top soil should be scraped and stockpiled at the sites of both the borrow area and the area of the proposed berm and should be replaced after removing and forming subsoil. Grades should be taken during construction to ensure that the necessary berm height is achieved and to ensure that it is level.
3. If sufficient clay content is not available in the subsoil, fill should be brought in from off-site. Technical expertise will often be required for such decisions.
4. Where rodents are a potential problem, wire mesh should be installed below the soil surface to prevent burrowing, especially in narrow-based berms.

ASSISTANCE

Qualified erosion control contractors and consulting engineers are available for the design and construction of erosion control structures. Conservation Authorities may offer technical assistance and construction supervision in some areas of the province. Other erosion control factsheets and information are available by calling 1-888-466-2372.

All erosion control projects must comply with existing legislation, for example the *Lakes and Rivers Improvement Act*, and the *Fisheries Act*.

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