MN6-1 Island Type Structure

Erosion control structures of a permanent nature, including those which incorporate a straight drop spillway or a box inlet drop spillway, must be designed to meet the hydraulic capacity of Conservation Practice Standard 378, Pond. In flat areas typical of drainage country, it is often possible to locate the structure so that storm flows will pass around or flood out the dam with little or no hazard to the structure. This makes it possible to reduce the size of the spillway by designing it to accommodate a lower hydraulic capacity than is required by the practice standard, thereby reducing the cost of the structure. A structure designed for flooding out has been termed an "Island-Type Dam" and is particularly adaptable for use at the head end of drainage ditches to control the overfall at the end of the ditch and provide a permanent tile outlet.

This design procedures is used for island-type dams when used at the head end of drainage ditches

6-1.1 Location

This structure can only be used where there is sufficient space of nearly level land on either side of the dam that can be used as an auxiliary spillway.

The topography of the ground must be such that the path of overflow around the dam will return to the ditch location a short distance below the structure without causing damage to the field or ditch banks. It is very important to be sure that the overflow can return to the ditch below the dam and not be forced by fences, ridges, etc. over the lower fields thereby causing flood conditions greater than they were before the dam was installed. Flow into the ditch must not be obstructed by spoil banks at the point of entry.

6-1.2 Selection of Structure

Either the straight drop spillway or the box inlet drop spillway can be used with this design procedure. The hydraulic design and layout details for box inlet drop spillways are outlined in the St. Anthony Falls Hydraulic Laboratory Report SCS-TP-106 for box inlet drop spillways.

When the required weir length of the structure is over twice the bottom width of the ditch, the box inlet drop spillway should be considered. On larger ditches the cost of the drop spillway dam will probably be greater than the cost of a box inlet drop spillway.

Standard detail plans are available for most sizes of straight drop spillways. Box inlet drop spillways require a special design for each structure.

6-1.3 Design of Weir:

The capacity of the weir must be equal to the capacity of the ditch below the dam at the first point where the ditch bank will overflow and before the auxiliary spillway starts to operate. This capacity will be greater than that required for drainage design where the depth of the ditch is set for outlet purposes rather than capacity. This design practice is set so that the ditch will be full before the overflow around the dam enters the ditch, thereby reducing the possibility of bank erosion from flow over the ditch bank.

The crest of the spillway weir must be set below the bottom elevation of the auxiliary spillway. This vertical distance must be sufficient to provide a weir notch capacity equal to the bank-full capacity of the ditch at the place where the flow from the auxiliary spillways reenters the ditch.

Generally, a portion of the weir will be submerged and must be designed accordingly. Refer to Design Note 15, Submerged Weir Flow, for guidance on the design of submerged weirs.

When flow occurs over the auxiliary spillways, the crest of water over the weir of the dam will be higher than the weir design flow outlined above. This will require extending the height of the weir notch (headwall extensions of the dam) above the design depth of flow on the auxiliary spillway so that flood flows will not overtop the dam and wash away the fill material. In other words, the depth of the weir notch must be equal to the depth necessary to carry ditch capacity, plus the design depth of flow of the auxiliary spillway, plus 6-inch freeboard.

6-1.4 Design of Structure

Design of Auxiliary Spillway: The principal and auxiliary spillway capacities must meet the requirements of Conservation Practice Standard 378, Pond.

The auxiliary spillway will generally have to be located on cultivated land, and the velocity of flow must be kept quite low so that scouring will not develop. The depth of flow affects the height of the structure; therefore, as the depth of flow increases, the cost of the structure will likewise increase. A flow depth of 0.5 is about the maximum that should be considered, providing this depth will not create erosive velocities.

For design of the auxiliary spillway, estimate the discharge capacity of the auxiliary spillway using the following formula

$Q = 2.75\ L\ h^{3/2}$ (Eq. 6-1.1)

Where:

- Q = Discharge capacity (cfs)
- L = Width of the spillway (ft)
- h = depth of flow over crest of spillway (ft)

Design of Waterway Above the Dam: Another important part of the overall design of "Island-type Dam" is the waterway above the structure. This waterway must have the same capacity as the ditch below the dam at the point of over flow. This means that the discharge from the waterway must fill the ditch before the banks of the waterway are over topped and the flow is directed to the auxiliary spillways. It should also be proportioned so that its banks will overflow near the structure as soon as the ditch capacity flow has been reached. Above this point of overflow it should be designed as a grass waterway for a 10-year frequency storm if out-of-bank flow on cultivated land will cause erosion

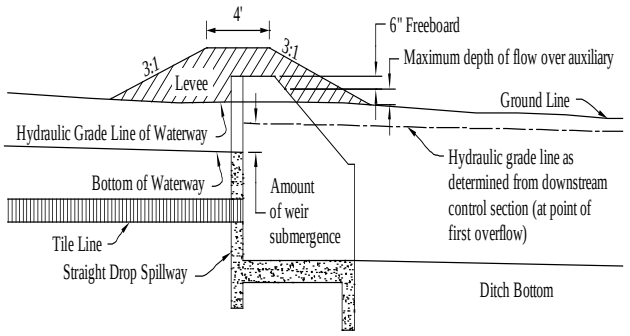

Figure 6-1.1 Profile along Centerline of Ditch

Levees: In order to force overflow water away from the dam and protect the fill from washing out around the dam, levees extending each way from the dam must be provided. These levees should extend each way a minimum of 40 feet from the edge of the weir notch of the dam. The top of the levee should be one foot higher than the top of the headwall extension. Side slopes of the levee should be 3:1. The levees should be seeded or, preferably, sodded immediately after construction.

Tile Outlet: Tile lines above the dam must be laid to one side of the waterway and then outletted through the dam near one end of the headwall. The tile must be connected to the dam either by encasing the first 20 feet above the dam in concrete, using 20 feet of cemented bell-joint sewer tile or a 20-foot section of corrugated metal pipe.

Where there is not sufficient cover over the tile between the bottom of the waterway and the top of the tile or where there is a possibility of settlement, corrugated metal pipe should be used.

When corrugated metal pipe is to be used, a section of drain tile slightly larger than the outside diameter of the pipe should be cast in the headwall of the dam. Then the pipe can be placed through this opening, and the space between the corrugations sealed to eliminate seepage. By this method the pipe can easily be replaced if and when it rusts out.

Figure 6-1.2 Plan View of Layout for Island Type Dam

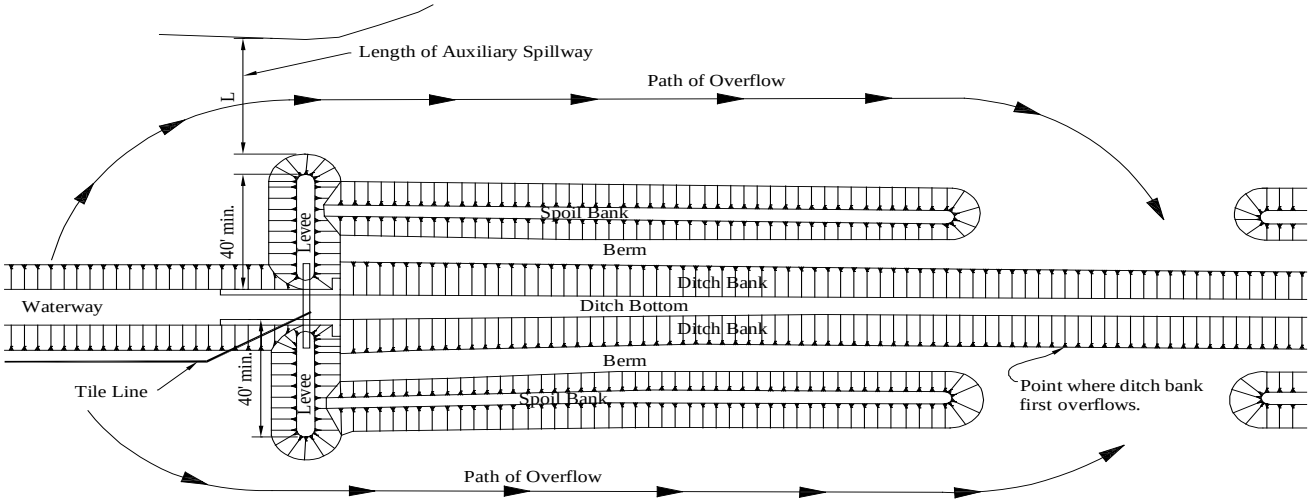

Figure 6-1.3 Half Cross Section along Headwall of Dam