# Chapter 2
# Applications

## 2-1. General

*a*. *Application*. Controlled spillways include crest gates that serve as a movable damming surface allowing the spillway crest to be located below the normal operating level of a reservoir or channel. Information on the use of various crest gates and related spillway design considerations is provided in EM 1110-2-1603, EM 1110-2-1605, and EM 1110-2-2607. Tainter gates are considered to be the most economical, and usually the most suitable, type of gate for controlled spillways due to simplicity, light weight, and low hoist-capacity requirements. A tainter gate is a segment of a cylinder mounted on radial arms that rotate on trunnions anchored to the piers. Spillway flow is regulated by raising or lowering the gate to adjust the discharge under the gate. Numerous types of tainter gates exist; however, this manual includes guidance for the conventional tainter gate described in Chapter 3, paragraph 3-2. Figures 2-1 and 2-2 show photographs of actual dams with tainter gates. Figure 2-3 presents a downstream view of a typical tainter gate.

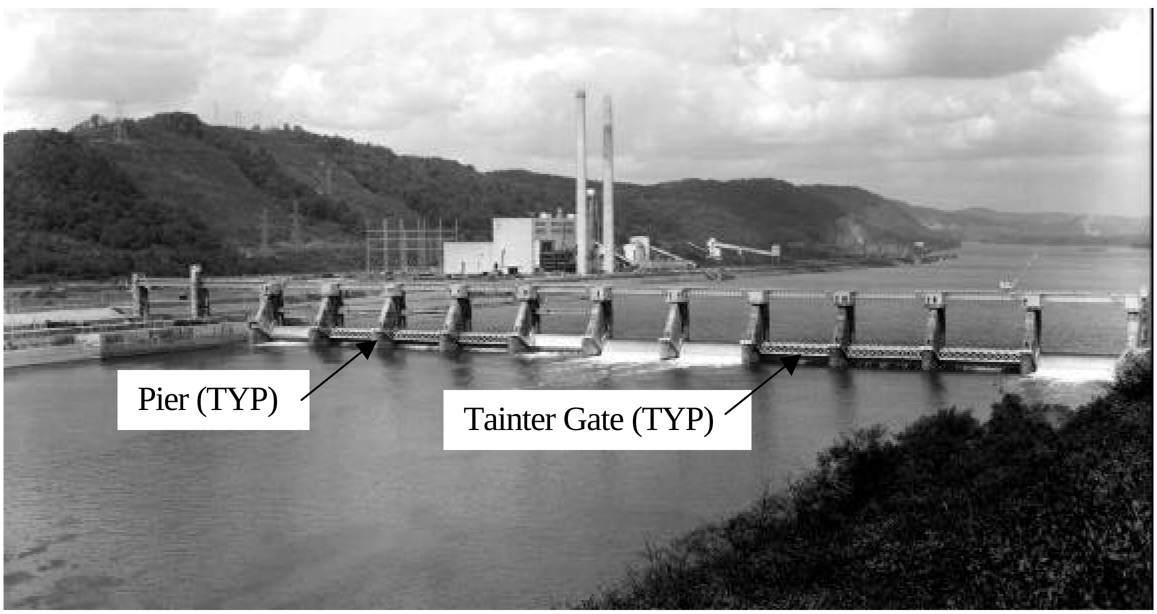


**Figure 2-1. Overall view of navigation dam from downstream**

*b*. *Tainter gate construction*. Gates are composed primarily of structural steel and are generally of welded fabrication. Structural members are typically rolled sections; however, welded built-up girders may be required for large gates. Various components of the trunnion assembly and operating equipment may be of forged or cast steel, copper alloys, or stainless steel. Based on project requirements, trunnion girders are either posttensioned concrete girders or steel girders as described in Chapter 6.

## 2-2. Advantages and Disadvantages of Tainter Gates vs Other Spillway Crest Gates

*a*. Tainter gates have several unique advantages compared to other spillway gate types (lift gates, roller gates, hinged or flap gates).

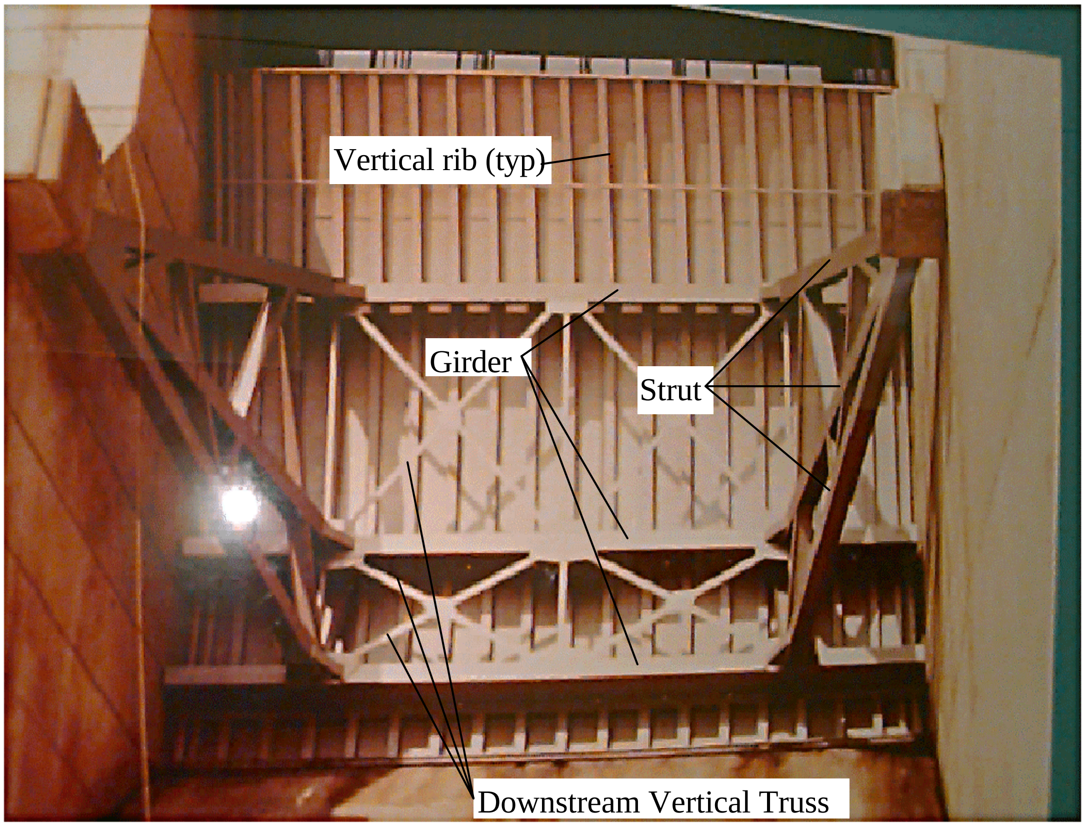


**Figure 2-2. Closeup view of tainter gate from downstream**

(1) The radial shape provides efficient transfer of hydrostatic loads through the trunnion.

(2) A lower hoist capacity is required.

(3) Tainter gates have a relatively fast operating speed and can be operated efficiently.

(4) Side seals are used, so gate slots are not required. This reduces problems associated with cavitation, debris collection, and buildup of ice.

(5) Tainter gate geometry provides favorable hydraulic discharge characteristics.

*b*. Disadvantages include the following:

(1) To accommodate location of the trunnion, the pier and foundation will likely be longer in the downstream direction than would be necessary for vertical gates. The hoist arrangement may result in taller piers especially when a wire rope hoist system is used. (Gates with hydraulic cylinder hoists generally require shorter piers than gates with wire rope hoists.) Larger piers increase cost due to more required concrete and will usually result in a less favorable seismic resistance due to greater height and mass.

(2) End frame members may encroach on water passage. This is more critical with inclined end frames.

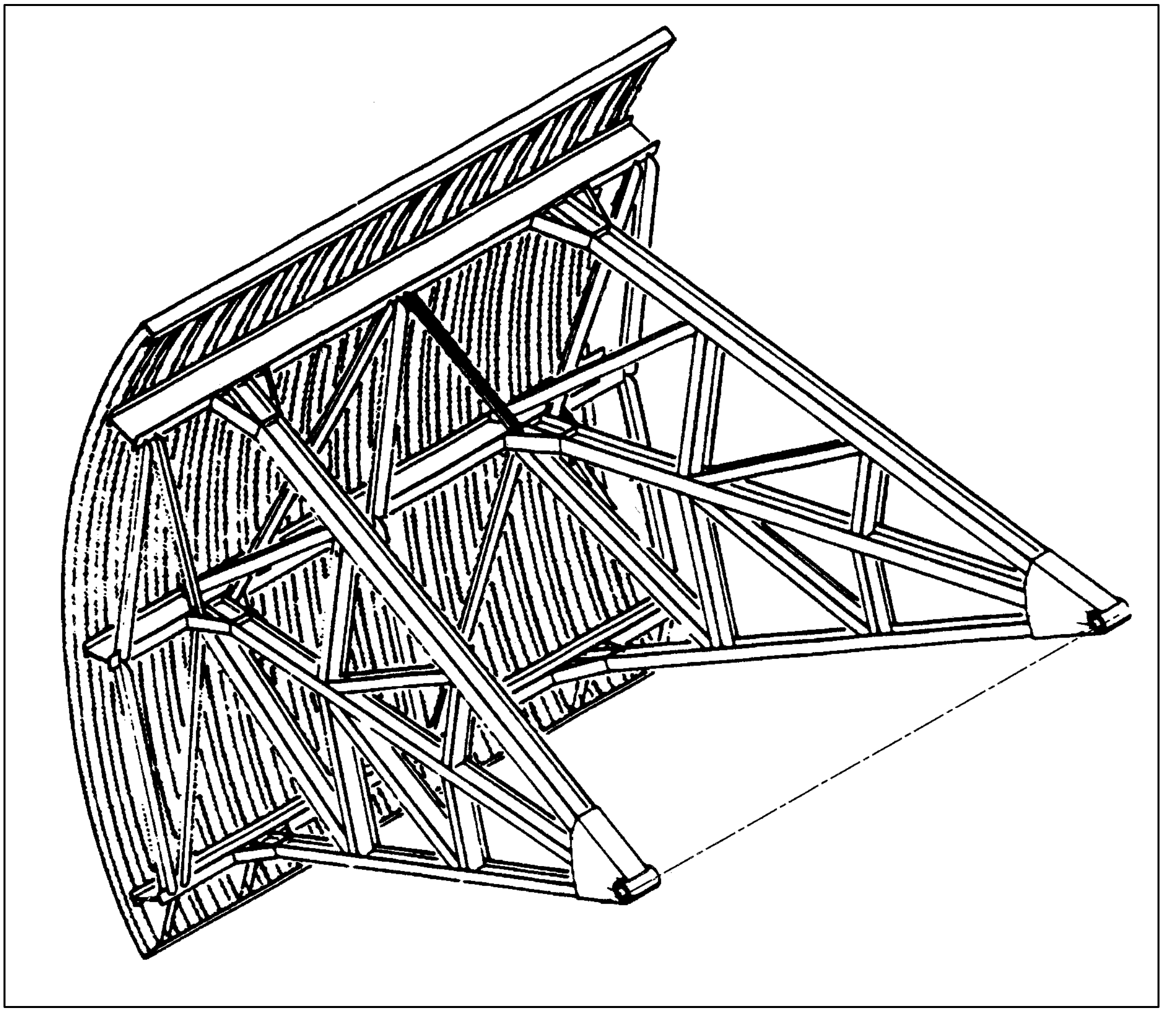

**Figure 2-3. Downstream view of a typical tainter gate**

(3) Long strut arms are often necessary where flood levels are high to allow the open gate to clear the water surface profile.

## 2-3. Use on Corps of Engineers Projects

Spillway tainter gates are effectively applied for use on spillways of various projects due to favorable operating and discharge characteristics. Gates are used on flood control projects, navigation projects, hydropower projects, and multipurpose projects (i.e., flood control with hydropower). Although navigation and flood control tainter gates are structurally similar and generally have the same maximum design loads, the normal loading and function may be very different. In general, gates on navigation projects are subject to significant loading and discharge conditions most of the time, whereas gates on flood control projects are loaded significantly only during flood events. These differences may influence selection of the lifting hoist system, emphasis on detailing for resistance to possible vibration loading, and selection of a corrosion protection system.

*a. Navigation projects.* Navigation projects are normally built in conjunction with a lock. Navigation gates are designed to maintain a consistent pool necessary for navigation purposes, while offering minimum resistance to flood flows. Gate sills are generally placed near the channel bottom, and during normal flows, damming to the required upper navigation pool elevation is provided by tainter gates. Under normal conditions, most gates on a navigation dam are closed, while several other gates are partially open to provide discharge necessary to maintain a consistent upper lock pool. During flood events, gates are open and flood flow is not regulated. The upper pool elevation often rises significantly during flood events and the open gate must clear the water surface profile to pass accumulated drift. As a result, the trunnion elevation is often relatively high and the gate radius is often longer than gates designed for other applications. Under normal conditions, navigation gates are generally partially submerged and are significantly loaded with the upstream-downstream hydrostatic head. In addition, these gates are more likely to be subject to flow-induced vibration and cavitation. A typical cross section of a navigation dam with tainter gates is presented in Figure 2-4.

*b. Flood control and hydropower projects.* Flood control projects provide temporary storage of flood flow and many projects include gated spillways to provide the capability to regulate outflow. On flood control projects with gated spillways, gate sills are generally located such that the gates are dry or only partially wet under normal conditions. In general, gates are exposed to the atmosphere and are subject to slight loads, if any. Only during infrequent flood events are gates loaded significantly due to increases in pool, and during subsequent discharge hydraulic flow-related conditions exist. Trunnions are typically located at an elevation approximately one-third the height of the gate above the sill. Some unique multipurpose projects (projects that provide flood control and reservoir storage) and most hydropower projects include aspects of flood control and navigation gates. Gates on these projects are normally subject to significant hydrostatic loading on the upstream side and may be used to regulate flow on a regular basis. A typical cross section of a flood control or hydropower dam with tainter gates is presented in Figure 2-5.

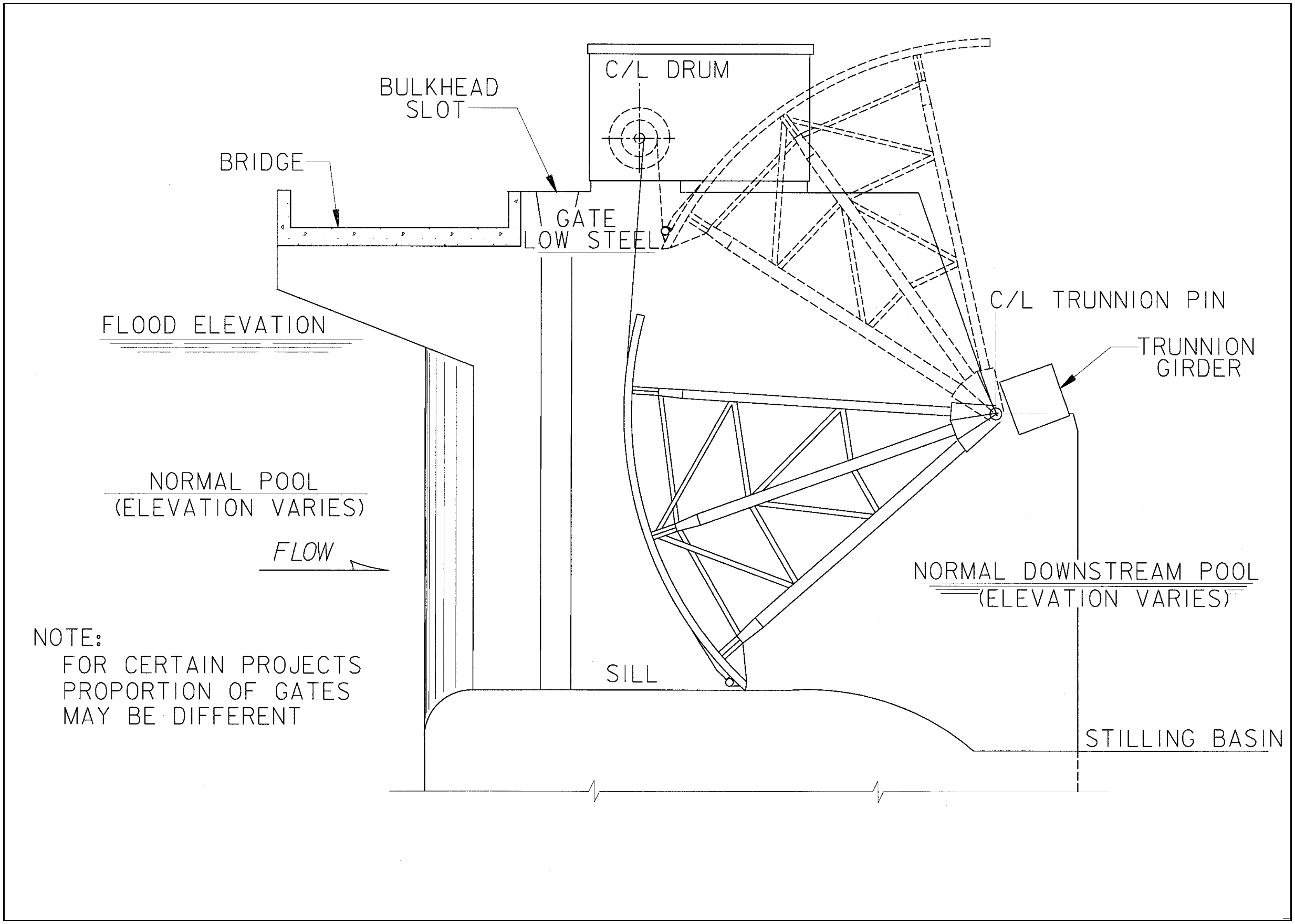


**Figure 2-4. Typical navigation tainter gate**

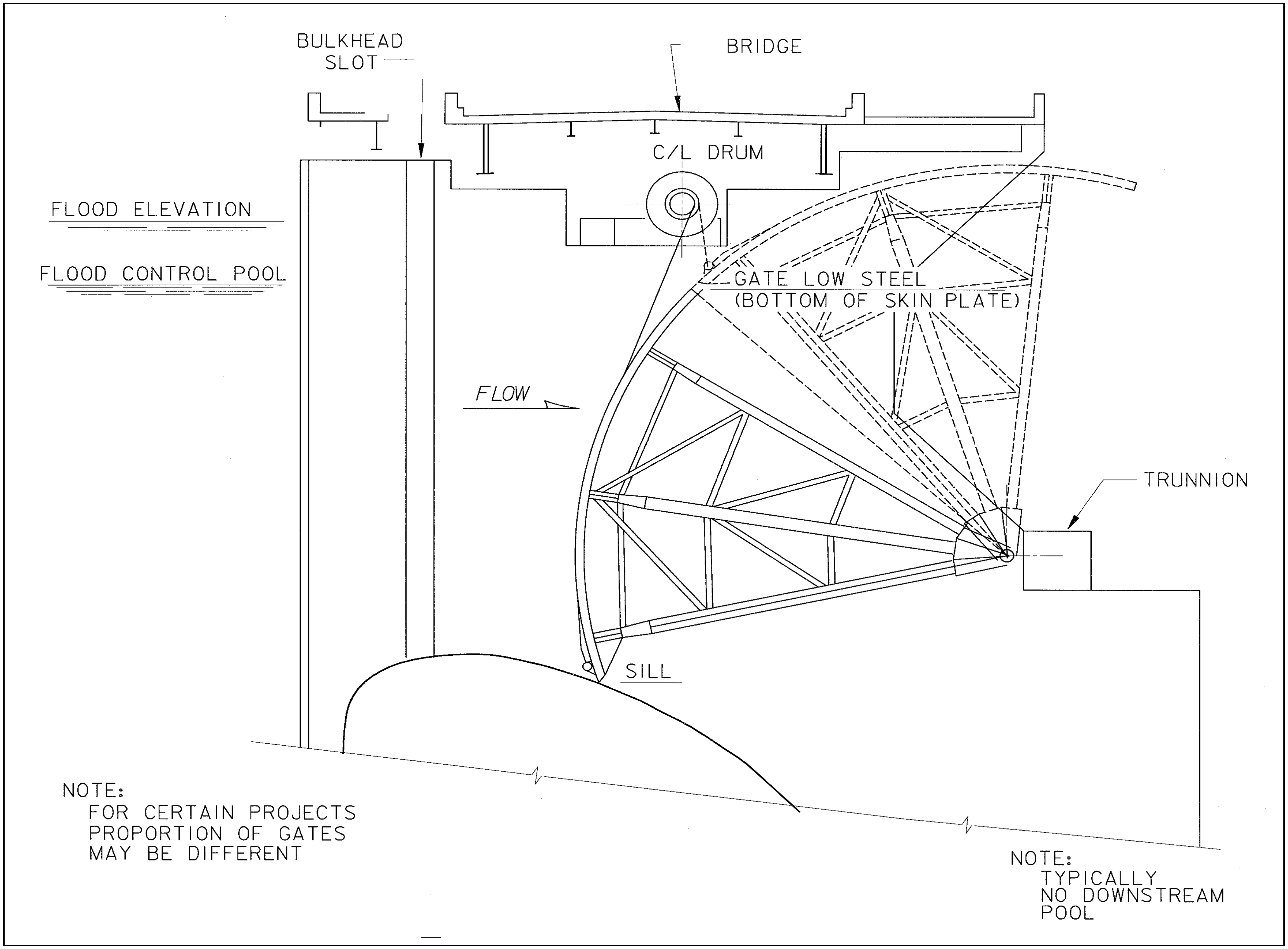


**Figure 2-5. Typical flood control or hydropower tainter gate**