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3.4 SWING BRIDGES

3.4.1 Introduction

The movable span of a swing bridge, also termed the draw, rotates about a vertical axis (pivot axis). If the pivot axis is at mid-length of the draw, the draw is said be symmetrical or to have equal length arms. Sometimes, the arms are not of equal length and the draw is termed unsymmetrical or bobtailed. The dead load (self-weight) of a swing span is usually balanced about the pivot. Hence, bobtailed spans require counterweights at the ends of the shorter arms. Some bobtail draws are only nominally balanced about the pivot, with a definite excess of counterweight. The reason for the tail-heavy condition is to tilt the structure and raise the toe of the channel arm above its rest pier. This condition aids in closing the span. This tilting is sometimes referred to as secondary motion.

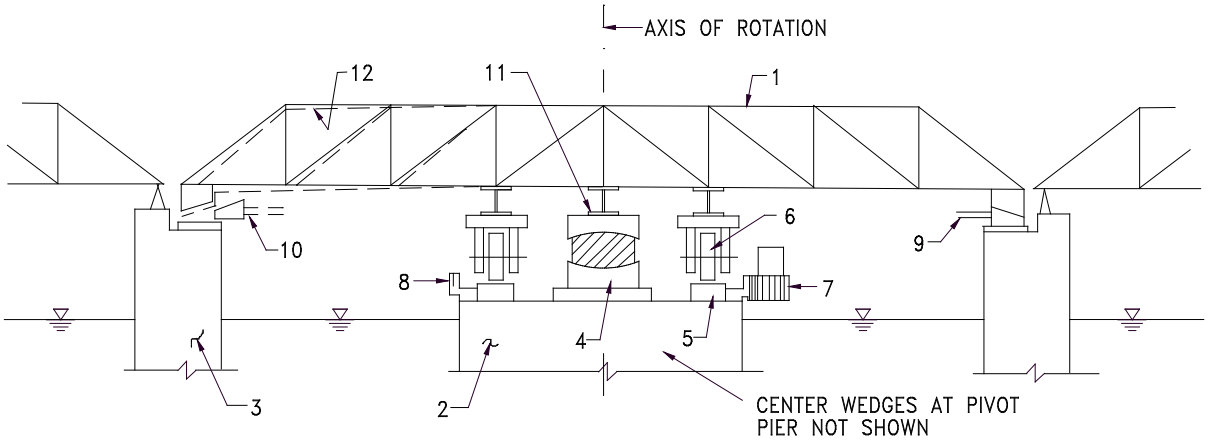
Swing bridges are also categorized according to type of pivot bearing. If all the dead load is supported at the center, the swing span is said to be center bearing. If all, or most, of the dead load is supported by a large-diameter ring of rollers concentric with the pivot axis, the bridge is termed rim bearing.

3.4.2 Center-Bearing Swing Bridges

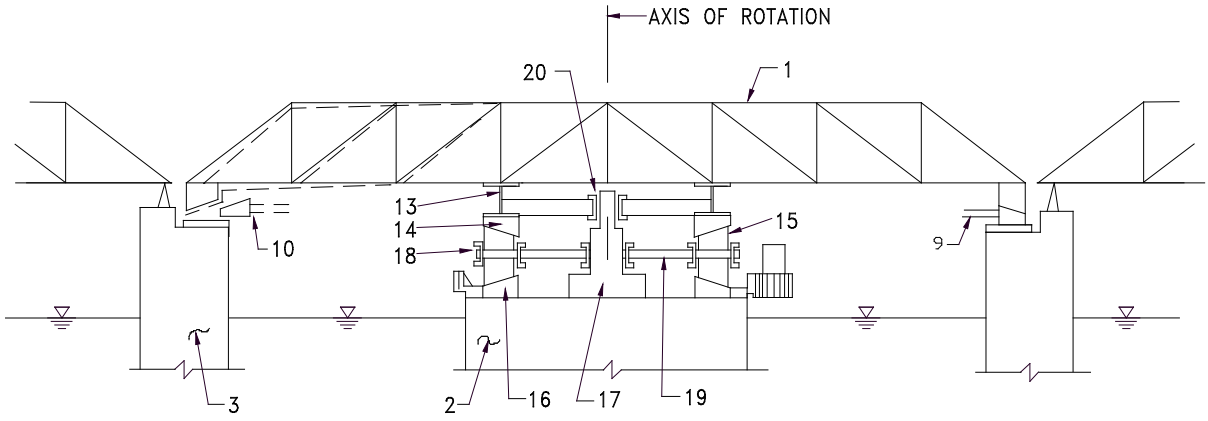
Figure 3.4.2-1 (a) is a diagram of an equal-arm center-bearing swing bridge. The spanning member is shown as a truss; it could as well be a girder. The draw weight is balanced on the pivot bearing, which is mechanical in the figure, but could be hydraulic. To prevent the draw from tipping under unbalanced loads, such as wind, balance wheels are provided that roll on a large-diameter circular track concentric with the pivot bearing. When the draw is balanced these wheels normally clear the track by about 0.2 inch (5 mm). The design intent is that the center bearing support all the dead load when the draw is open. Figure 3.4.2-1 (a) shows a center bearing swing bridge with a plain mechanical pivot bearing, comprised of a lenticular bronze disc between hardened steel concave discs. Sometimes two-part bearings are used. Plain bearings are most common. However, spherical antifriction rolling element bearings are being specified more frequently for new bridges. Hydraulic bearings that support the entire dead load have been used for some center bearing swing bridges.

In the United States live load on center bearing swing bridges is usually supported by center and end lift devices (often wedges) which are actuated when the draw is returned to the closed position. They provide the load path for the free ends of the girders and also provide a firm intermediate live load support for the girders at the pivot pier.

Rotation of the draw is by means of mechanical or hydraulic machinery, or a combination thereof. When the mechanical span drive is mounted on the draw one or more downward extending pinion shafts engage a rack mounted on the pivot pier and rotate the draw, as shown in Figure 3.4.2-1 (a).



(a) CENTER BEARING



(b) RIM BEARING

1. SWING SPAN (DRAW)
2. PIVOT PIER
3. REST PIER
4. CENTER BEARING
5. TRACK
6. BALANCE WHEEL
7. PINION
8. RACK
9. END WEDGES (EXTENDED)
10. END WEDGES (WITHDRAWN)
11. DISTRIBUTION FRAMING
12. DEFLECTED POSITION (WEDGES WITHDRAWN)
13. DRUM GIRDER
14. TREAD PLATE
15. TAPERED ROLLER
16. TRACK PLATE
17. PIVOT POST
18. LIVE RING
19. SPIDER
20. DRAW PIVOT BEARING

Figure 3.4.2-1: Types Of Swing Bridges.

3.4.3 Rim-Bearing Swing Bridges

Swing bridges in which all the dead load of the superstructure is supported by tapered rollers when the draw is in the open position are termed rim bearing. The superstructures of rim bearing swing bridges are supported by a minimum of two longitudinal spanning members (trusses). As shown in Figure 3.4.2-1, (b), the tapered rollers run on a circular track whose diameter is usually about the same as the transverse spacing of the outer swing span trusses or girders. Tapered rollers (the common term) are really frustums of cones. It is necessary that the rollers be conical because the distance traveled by the outer end of a roller is longer than that traveled by the inner end, for the same angle of bridge rotation. When the bridge is closed, the rim bearing supports both dead load and live load. Rim bearings are used for wide heavily-loaded swing bridges. Special load-equalizing framing is provided to transfer the loads from the bridge trusses to the circular drum girder at a number of points around the periphery so that it is uniformly loaded along its length (at least for dead load). The load is transferred through the drum girder to a tapered tread plate supported by tapered rollers. Rotation of the draw may be by the same means as for the center-bearing swing bridge.

Alternatively, the mechanical span drive may be mounted on the pivot pier, in which case the pinion shafts extend upward to engage a rack mounted on the periphery of the drum girder. If the span drive uses hydraulic slewing cylinders, no rack is necessary.