Design & Analysis of Radial Dam Gate Using Glass Fibers

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Abstract— Standard radial gates are designed for a wide, clear waterway opening. These (or traitor) gate acts similar to a section of a drum. Pressure is transferred from the curved face through the horizontal support beams to the radial arms which is at the sides of the opening. The support beams act as columns and transfer thrust to a common bearing located on either side of the gate opening. Flow is underneath the curved face when the gate gets opened. This design results in a light in weight, economical gate that can be opened and closed with minimum work requirement and with comparatively small number of turns of the hand-wheel on the hoist. Glass fibers is used in manufacture of structural of wide range of special purpose product. In the case of glass fiber reinforced plastics (GFRP) have the same tendency due to the influence of reinforcement and its internal orientation in the layers (anisotropy).

Hydraulic Gate radial gates are made with two types of installations. The first, and the most commonly used, is an overflow type. This gate is designed for 1 fit of water flowing over the top of the gate when the gate is in closed position. Adequate safety factors prevent damage to the gate if there is a moderate, additional overflow beyond that limit for a short period.

The second type of radial gates employs the use of a breast-wall. This is a vertical concrete wall above the top of the gate opening, as a result there is an additional storage capacity in front of the gate. Most radial gates are “raise to open type” a variation is the “lower to open type”. This requires a weir wall for mounting a seal that must make contact with the curved face plate.

Keywords— Hydraulics, fluid, Horizontal Support Rod, Vertical Support Rod.

I. INTRODUCTION

The following designed structure can be designed by two methods the one has horizontal support rods and the other onet has vertical support rods in the support of the dam gate structure. That strengthens the whole radial dam gate structure.

1. Horizontal Support Rod

Horizontal face support beams are made up of structural steel channels. These beams size vary with the width of the gate and maximum head of water. They also varies in quantity and spacing with the height of the gate. Welded to the end of each channel is a heavy steel gusset with holes punched to receive the side arms. These support beams are normally painted for long life. They can be hot-dip galvanized for additional corrosion protection.

2. Vertical Support Rod

Vertical face support beams are made up of the same structural steel channels that of the horizontal. Other physical characteristics of the structures of both types are almost the same.

II. SPECIFICATIONS FOR THE RADIAL

Gates, hoist and accessories shall be of the size, material, and construction shown on the manufacturer's drawings and specified manuals. They shall be Hydraulic overflow type or breast wall type radial gates or approved equal. Similar installations shall have operated successfully over ten years or more. All component parts shall be of the type material as per in the "Materials" section of the specification. An installation list showing five similar projects will be required.
A. Design

Overflow type gates shall be designed to withstand a water depth of 1 feet greater than the vertical height of the gate. The breast wall type gate shall be designed to withstand a water depth of 10 fit on the invert. Maximum deflection of face shall be 1/360 of the width. Design loads placed on the structural reinforcing channels shall not induce excess stresses than those specified in Section 1.5.1.4 of AISC specification for structural steel building. The slenderness ratio of the radial arms shall not exceed to 200. The curved face plate shall be 1/4 minimum.

B. Adjustable Sill and Side Rubbing Plates

For improvisation the operation and water tightness of a radial gate, adjustable side rubbing plates and an adjustable bottom sill are recommended. These plates are available in stainless steel or galvanized steel material.

During construction, a recess is left at the sides and bottom of the gate opening where the adjustable rubbing plates and the bottom sill are to be mounted and Anchor bolts are set in the forms and extend into the recesses. Projection of these anchors is less than depth of the recess.

When forms are get stripped, the adjustable plates are installed on the projecting anchors by use of double nuts on each anchor, the side rubbing plates and bottom sill can be properly aligned. Side rubbing plates are adjusted with the gate closed to obtain a good seal fit and compression during the operation. Side seals and side rubbing plates should be adjusted so that a slight wedge shaped opening is formed to reduce seal drag and wear when the gate opens. The bottom sill plate must be flat across its entire width and it should be in good contact with the bottom gate seal, and as flush as possible with the invert.

As an alignment check, the gate should operate to ensure that proper contact with the rubber seals on the gate. All plates are then grouted into complete the gate installation. The drawings on page below shows details of adjustable side rubbing plates and of the adjustable bottom sill.

![Fig. 1 Structure of Radial Gate](image)

III. GATE FACE ASSEMBLY DRAWING

The face assembly shall consist of horizontal structural part and a curved face plate. Horizontal structural members shall be of adequate size and correctly located to transmit the thrust from the dam water to the radial arms. The steel face plate shall be attached to the structures by welding. Sufficient numbers holes shall be located around the perimeter of the assembly for attaching the seals. The side seals and the top seal for breast-wall-type gates shall be flat rubber held in place by steel retainer. The bottom seal shall be rubber of the hollow J-seal types.

IV. FASTNERS

All anchor bolts, assembly bolts, screws, nuts, etc., shall be of bountiful size to safely withstand the forces created by operation of the gate under the specified head. Quantity and size of fasteners shall be as per recommended by the manufacturer. Anchor bolts with two nuts shall be provided, each to facilitate installation.
V. MATERIALS

Materials shall conform to the requirements of the following standards:

1. Hot-Rolled Steel (Plates, Structural, Flat Bars)
   ASTM A36 or A306, Grade 60
2. Cold-Rolled Steel (Shafting and Pins)
   ASTM A108, Grade 1045
3. Stainless Steel (Fasteners)
   ASTM F593 or F594 Group 1
4. Cast Iron
   ASTM A126, Class B
5. Rubber
   ASTM D2000, Grade 1AA625
6. Stainless Steel
   ASTM A167 or A240, Type 304L
7. Glass fibre
   Alkaline Resistance, Effective bonding, high strength

VI. RESULT

![Fig. 2 Analysis of Radial Gate](image1)

![Fig. 3 Deign of Radial Gate Using CREO](image2)

VII. CONCLUSIONS

In the above context the material used is of a specific kind (as mentioned above) and of calculated metrics for their strain, stress and durability another important thing is that on the two upper corners of the radial gate are situated two pistons of the hydraulic pumps and hence other mechanisms that are developed out of it is very easeful for operation.

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REFERENCES


