




भारत सरकार
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Central Water Commission
फाटक अभिकल्प ; उ.ए. प. नोडल निदेशालय
Gates Design (N&W) Nodal Directorate
8th floor (South)
रामा कृष्णा पुरम क्षेत्र- I, नई दिल्ली -110066

Subject: Installation of Automatic Gates

Kindly find enclosed herewith frequently asked questions during presentation at library building on 6th June, 2018 on the topic "automatic gates (patented) is the most economic solution for raising the storage capacity of existing dams and resolving water crisis" for uploading on CWC website.

Encl: As above


Branch Officer

Deputy Director, SMD, CWC, Sewa Bhawan, R.K.Puram
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pls discuss

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दिनांक/Date 14-8-18

FREQUENTLY ASKED QUESTIONS

ON

AUTOMATIC GATES
DURING PRESENTATION

ON

INSTALLATION OF AUTOMATIC GATES (PATENTED)
IS THE MOST ECONOMIC SOLUTION FOR RAISING
THE STORAGE CAPACITY OF EXISTING DAMS
AND RESOLVING WATER CRISIS

AT

AUDITORIUM
CENTRAL WATER COMMISSION
NEW DELHI

ON

JUNE 6, 2018

Automatic Gates are patented by **M/s Godbole Gates Pvt. Ltd., Nagpur** and are popularly known as ‘**Godbole Type Automatic Gates**’ or ‘**Godbole Type Automatic Tilting Gates**’.

A. GENERAL QUESTIONS

Question 1: What is principle and mode of operation of Godbole Type Automatic Gates?

Answer: Godbole Type Automatic Gates work on principle of balance of moments caused by hydraulic and gravity forces. Typically, hydraulic forces (eg. water pressure acting on gate) provide “opening” moments & gravity forces (eg. self-weight of the gate) provide “closing” moments.

Normally, the gate is designed in such a way that opening moments acting on the gate remains lower than closing moments, when upstream water level is below Full Reservoir Level (FRL).

When the upstream water level reaches FRL, the opening moment become equal to closing moment and the gate is on the verge of opening. When upstream water level exceeds FRL, the opening moment becomes more than closing moment, and the gate opens out by a small extent. As the extent of opening of gate increases, the opening moment due to water load goes on reducing, and when it becomes equal to closing moment, the gate achieves an equilibrium or stable position. With further increase in upstream water level in rising floods, the opening moment due to water load increases, and the gate further increases its extent of opening before achieving another stable equilibrium position. This process continues till the gate achieves fully open position. The gate remains in this position for any further rise in upstream water level.

During receding floods, as the upstream level falls down, the opening moment reduces and becomes less than closing moment. This results in gate reducing its extent of opening and achieving another stable equilibrium position. For further fall in upstream water level, this behavior continues till the gate achieves fully closed position corresponding to an upstream water level that is lower than FRL.

This mode of operation, which is common to both Godbole Type Automatic Tilting Gates as well Automatic Radial Gates is depicted in figures 1A & 1B respectively.

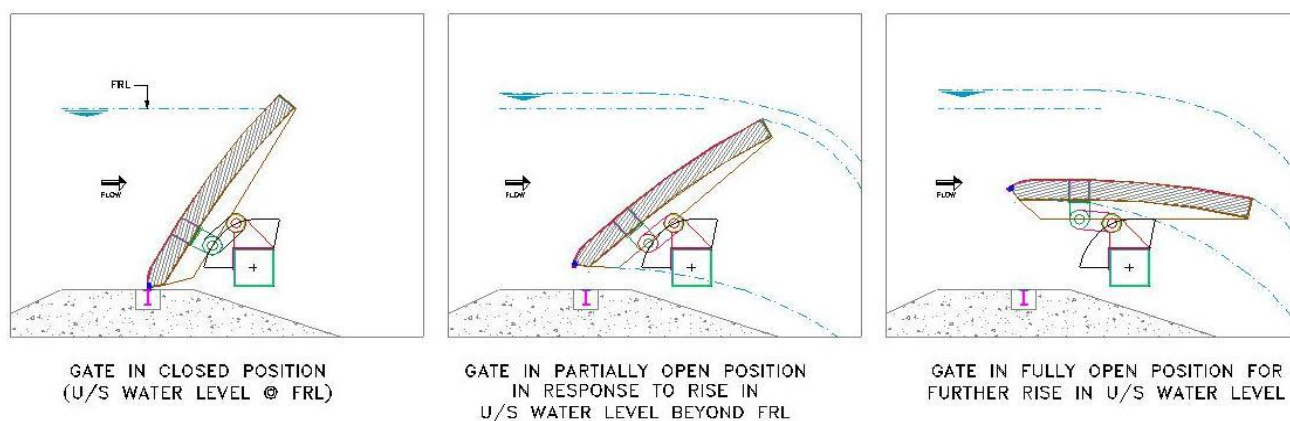


FIGURE 1A – OPERATIONAL BEHAVIOUR OF AUTOMATIC TILTING GATE

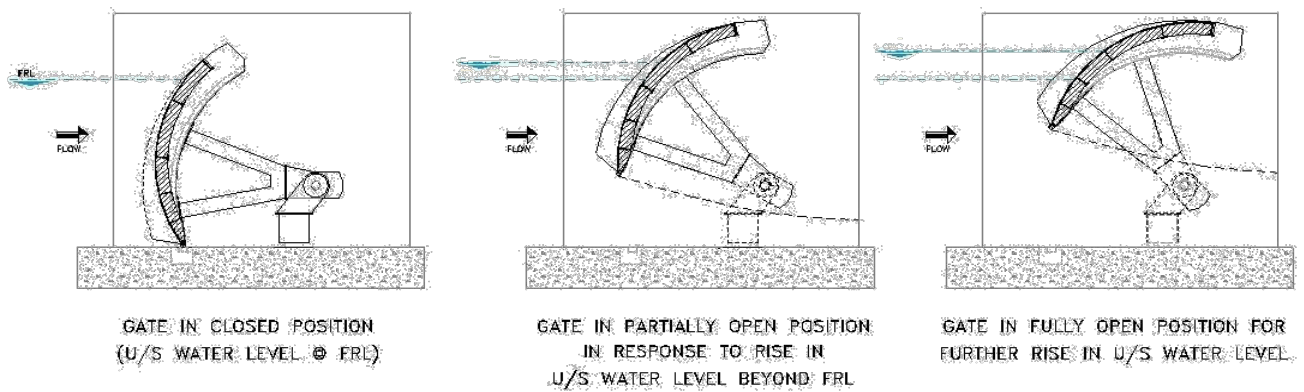


FIGURE 1B – OPERATIONAL BEHAVIOUR OF AUTOMATIC RADIAL GATE

Question 2: During monsoons, Automatic Gates would generally get submerged, particularly in Bridge cum Bandhara Structures. How this submergence will impact the Gates, especially with the flowing debris, floating logs, tree trunks, pebbles, sand etc.

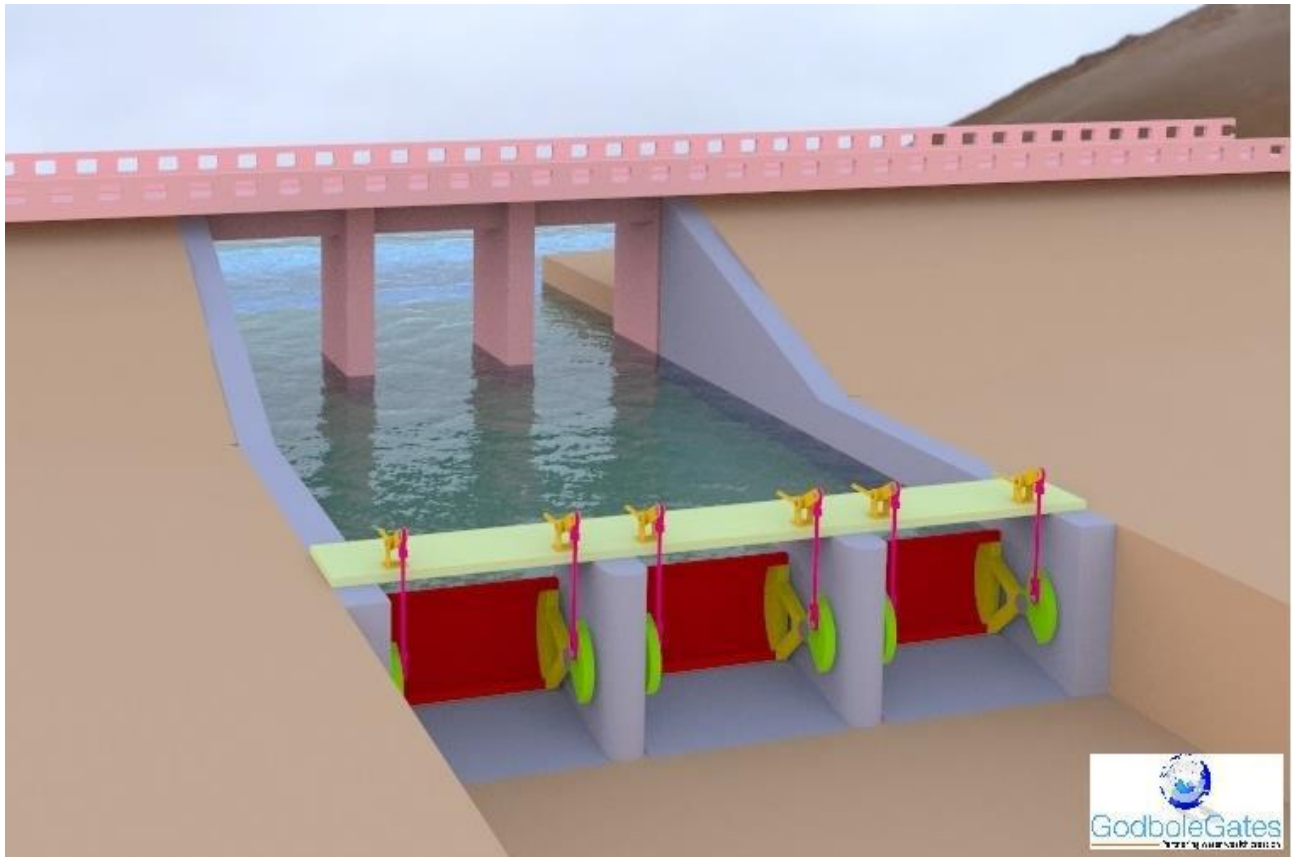
Answer: Godbole Type Automatic Tilting Gates as well as Automatic Radial Gates are designed for submersible conditions. While the Automatic Tilting Gate is a combined undershot and over shot flow type gate (which allows flow both from below as well as above it), the Automatic Radial Gate is undershot flow type gate which allows flow below it. Since the gate structure is substantially rigid in both cases, and both the gates are provided with friction dampers, the impact of floating debris, logs, tree trunks etc. do not have any detrimental effect on the Gates. This has also been observed in field, eg. in case of 8 No. of 10 m x 4 m size Automatic Gates installed on **Paunar Weir**, no adverse effect has been noticed despite of their submergence during floods in last 34 years.



8 No. of 10 m x 4 m size Godbole Type Automatic Tilting Gates on Paunar Weir, Maharashtra.

It is observed that the floating debris, logs & tree trunks are **flushed out due to the high velocity of the flood**. However, if any object may occasionally get stuck up, it doesn't affect opening of the Gate. Such entangled/stuck debris can be flushed/removed by opening the gate manually to greater extent using the emergency hoist. Furthermore, there is a very low radial clearance of 0.1 mm to 0.2 mm between Bronze Bushes and Axles, making it impossible for sand or other minute particles to penetrate between them.

For Bridge cum Bandhara Structures, since the gate height is often restricted to 3 m, Automatic Radial Gates are recommended as they provide larger bottom opening for the same gate height compared to Automatic Tilting Gates.



3 No. of 5 m x 2 m size Godbole Type Automatic Radial Gates proposed on a typical Bridge cum Bandhara (BCB) Structure near Nagpur, Maharashtra.

Question 3: How the siltation and jamming problems are handled?

Answer: The silt can get accumulated on upstream side of gate only when gate achieves a closed position after recession of floods. When there is subsequent flood in the river i.e. when upstream water level exceeds FRL, the gate again opens automatically and the accumulated silt gets washed out automatically. Since not much silt gets accumulated between two successive floods, no such problem of siltation and/or jamming of gate have been encountered in last 35 years.

When the gates are installed in northern/eastern part of India where river water is heavily silt laden and enormous silt accumulation is noticed, opening the gate for a short extent and duration using the emergency hoist can easily carry out de-silting operation.

Question 4: Can these gates be opened below FRL, if need be?

Answer: Yes, all gates are provided with Emergency Hydraulic Hoists. When the u/s water level is below FRL, any gate can be opened manually with the help of emergency hydraulic hoist to the desired extent and held in that position to allow discharge on the downstream side. The gate can later be closed using the aforementioned hoist.



2 No. of Automatic Gates on Marda weir near Warora opened partially using Emergency Hydraulic Hoists to let out water on d/s side

Question 5: What is the saving in time in installing Automatic Gates vis-a-vis the conventional Gate system?

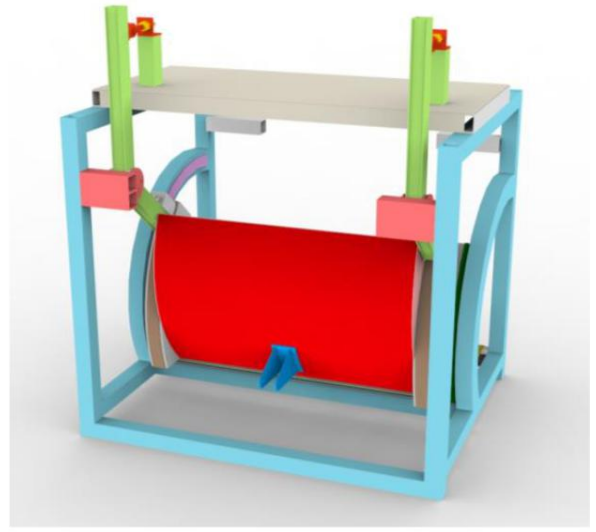
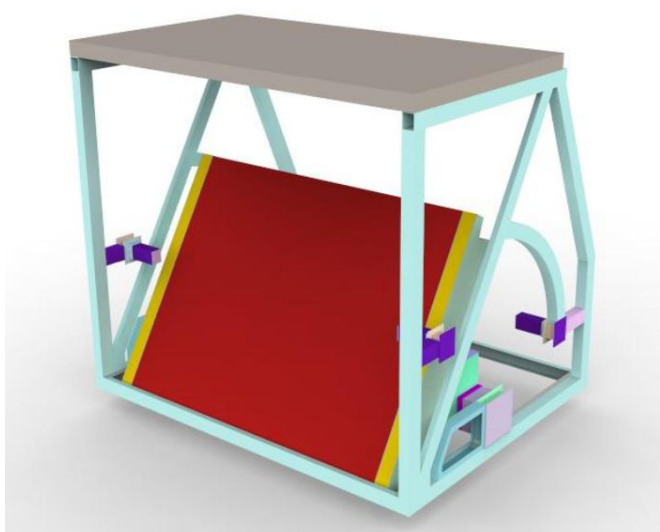
Answer: In case of installation on spillways of dams, where the gates are supported on steel portal frames, the entire gated structure i.e. steel portal frames, gates, emergency hydraulic hoist & steel service bridge can be pre-fabricated and sent to site. The installation time in such case can be as short as **1 - 2 months**, depending on number and size of gates.



17 Godbole Type Automatic Tilting Gates of size 4.5 m x 1.5 m with their supporting steel portal frames and steel service bridge were installed on waste weir of Chandpatha Tank, Shivpuri, Madhya Pradesh in only 30 days (Feb-March 2018)



In case of installations on Low Weirs and Bridge cum Bandhara (BCB) Structures, the gates upto 2.5 m height with their support frames are pre-fabricated and transported to site. The installation time in such cases is very short i.e. **2 - 6 weeks** depending number & size of gates.



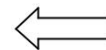
Godbole Type Automatic Tilting & Radial Gates for Low Weirs/Bridge cum Barrage Structures are pre-fabricated with their frames to facilitate transportation & speedy installation at site

In case of installation of large size gates (length more than 9 m and height more than 3 m), the gates are normally supported on RCC piers.

The embedded parts of the gates are placed in position before casting of piers so that they are anchored in first stage concrete itself.



Erection of embedded parts of 10 m x 6 m size Automatic Gates on Marda Weir



The gate leaves are fabricated in 3 - 5 parts and assembled in factory on a jig to ensure the accuracy of assembly. The said parts of gate leaves are then dismantled and sent to site. These parts are assembled in-situ in the gate bays and welded together to form a rigid gate leaves. The emergency hoist are than installed at site. This entire procedure takes **2 - 6 months** depending on the number & size of gates. Thus, the time required for installation of Automatic Gates in such cases is only 50% - 60% of that required for conventional gates, as no second stage concrete as well as erection of steel trestles, hoist bridge & bulky wire rope drum hoist is required.

Question 6: What are the locations where such Automatic Gates can be gainfully installed?

Answer: The Automatic Gates can be gainfully installed on:

- Spillways of medium and minor Irrigation Projects (under construction/in planning stage) to enhance dam safety and storage reliability, as no electricity or human intervention is required.
- Ungated spillways of existing medium & minor Irrigation Projects for raising their storage capacity in a very economical manner, short time and without need for land acquisition.
- Bridge cum Bandhara (Barrage) structures on downstream side of existing road bridges to create thousands of small storages for ground water recharging.
- Submersible bank type and confined flow type barrages to drastically reduce the capital and operation and maintenance costs.
- Spillways of minor tanks (under construction/in planning stage) so as to reduce the height of earthen dam (reducing weir crest level), saving huge amount of earthwork as FRL & MWL can be same.



Question 7: Can these Gates be installed above the top of an existing spillway radial gate to store water between FRL & MWL? Has this been done anywhere?

Answer: No. This is not possible.

Question 8: What are the cost benefits of Automatic Gates vis-a-vis the conventional gates?

Answer: The capital cost of Automatic Gates (including emergency hoisting system & steel operating platforms) is approximately 80 - 90 % of conventional electrically operated vertical lift and radial gates (including cost of hoists, hoist bridge, steel trestle structure for hoist bridge etc.). The operation and maintenance cost of Godbole Type Automatic Gates is practically nil, as no electrical connection, stand by generator sets & round the clock availability of operating personnel during monsoons etc. are required.

Question 9: Is the technology of Automatic Gates truly indigenous?

Answer: Yes, we are proud that the technologies of Godbole Type Automatic Tilting Gates & Automatic Radial Gates have developed indigenously over last 40 years through continuous research and development work. During this period, **over ten Indian Patents have been granted** to Late Mr. Damodar Godbole, Mr. Prabhakar Godbole and Mr. Prashant Godbole of **M/s Godbole Gates Pvt. Ltd., Nagpur.**

World Intellectual Properties Organization (WIPO), Geneva has awarded a Gold Medal to Mr. Prabhakar Godbole for his invention of Automatic Tilting Gate and recognized this technology.

Question 10: What are the geographical locations where Automatic Gates have been installed, Particularly in India?

Answer: Over 2000 Godbole type automatic gates have been installed in the states of Maharashtra, Karnataka, Chhattisgarh, Madhya Pradesh, Andhra Pradesh, Gujarat and Uttarakhand.

Question 11: Does M/s Universal Hydro Structures Pvt. Ltd. has tie-up with any foreign manufacturer?

Answer: M/s Universal Hydro Structures Pvt. Ltd. is manufacturing and erecting the works of Automatic Gates under license and stringent Quality Assurance Plan from **M/s Godbole Gates Pvt. Ltd. (Patent Holder).**

Question 12: Has any Automatic Gates malfunctioned in the past? If yes, what is the frequency?

Answer: Automatic Gates installed on spillways of dams have not faced any major issue in last 40 years. Minor issues like leakages were resolved in early stages by developing special shapes of rubber seals & adopting molded corner seals. Small differences in operating levels due to fabrication and erection errors were resolved by implementing stringent Quality Assurance Plan (QAP) and Dry Tests on Gates.

However, Automatic Tilting Type Gates installed on few barrages, where gates were exposed to highly turbulent flow conditions (like development of submerged hydraulic jump or submerged roller of bucket type energy dissipater immediately on downstream side of gate), the gates exhibited self-excited oscillations, and hit the sill beam causing damage to bottom rubber seal assembly and fulcrum assemblies. This phenomenon was researched at depth, and a solution in

the form of variable friction damping arrangement was developed and implemented to safeguard the gates from such oscillations. This arrangement is performing very well.

All the aforementioned issues have been taken care of by regular R&D and present versions/designs of Automatic Gates are working well without any malfunction since 2000.

For installations of Gates on Barrages, where they are likely to get exposed to turbulent conditions mentioned above, the magnitude of frictional moment need to be developed by friction dampers to damp the oscillations becomes substantially high. In such cases,

- a) the Gates are either designed as semi-automatic (auto-opening and unidirectional self locking) type, and need to be closed after recession of floods with the help of emergency hoists OR
- b) the Gates are designed as automatic opening and closing type, but are kept mechanically locked in fully open position during monsoons when heavy floods are experienced and are commissioned in post monsoon season.

Question 13: How is installation of Automatic gates the most economic solution for raising the storage capacity of existing dams and resolve water crisis?

Answer: Water is basis of life and an essential element for the growth and development. However, factors like Rapid Urbanization, Industrialization, and Population Explosion etc. have **increased the demand of water and led to its scarcity**. Global Warming also has an adverse effect such as high evaporation rates.

Advantages and Economics of installing Automatic Gates to raise the storage capacity of existing dams and resolve water crisis:

- a) Though we have limited potential to build more dams because of social, economical and environmental issues attached with it, but we can address the problem of scarcity of water by **optimally utilizing existing dam** i.e. raising the FSL and gaining additional storage by installing Automatic Gates on their ungated spillways.
 - b) There are many small and medium dams with ungated weir. Every year **gallons of water is wasted in rainy season** through spillway of these dams, which can be tapped by installing Automatic Gates.
 - c) By installing Automatic Gates at spillways between FRL and MWL, we can optimally utilize the **capacity of dam and can effectively store up to 160%** the capacity of water than existing capacity without modifying civil structure as Automatic Gate can be installed on portal frame made of steel.
 - d) **Cost Saving:** In present scenario, construction of minor and medium dam costs somewhere between Rs. 10 Crores to Rs. 50 Crores. By installing Automatic Gate, dam capacity can be **increased up to double the capacity at a meager cost of Rs. 3 Crores to Rs. 5 Crores.**
 - e) **Time Saving:** Construction of new dam takes 12 to 18 months of time whereas **Automatic Gates can be installed within a short time of 2 to 4 months.**
 - f) **Land Saving:** Construction of new dam requires certain area of Land (100 Hect. to 500 Hect.), whether Government owned or privately acquired. By increasing the capacity of existing dam, this **valuable land can be saved for future projects** as land acquisition is already done up to the submergence area of MWL.
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70 No. of 4 m x 1 m size Godbole Type Automatic Gates installed on Anjanpura Tank, Karnataka.

B. TECHNICAL QUESTIONS

Question 1: What are the standard materials used for Automatic Gates?

Answer: Standard material used for automatic gates are as under:

| S. No. | Component | Materials Used | Reference |
|--------|---|-------------------------------------|-----------------------|
| 1 | Structural Parts of Gates - Embedded parts, Gate leaf, Lever Systems, Supporting Portal Frames, Service Bridge etc. | Structural Steel | IS-2062 |
| 2 | Track Plates of Gates, Friction Tracks | 1.5 % Manganese Steel Alloy/Casting | SAIL Hard/ IS-2708 |
| 3 | Bush Bearings | Aluminum Bronze | IS-305 |
| 4 | Axles | Corrosion Resistant Steel | AISI-410 |
| 5 | Seal Seats, Clamping Nut Bolts of Rubber Seals | Stainless Steel | AISI-304 |
| 6 | Rubber Seals | Natural Rubber/Neoprene | Custom Specifications |

Question 2: Can some hoisting arrangement be attached with the Automatic Gates?

Answer: All Godbole Type Automatic Tilting Gates & Automatic Radial Gates are provided with emergency hydraulic hoisting arrangement, which can be used to open and close the gate when upstream water level is below FRL. These hoists do not interfere with normal automatic operation of Gates.



Emergency Hydraulic Hoisting Arrangement for Automatic Gates on Marda weir

Question 3: What types of bearing are used in Automatic gates?

Answer: Bush bearings (Material – Aluminum Bronze as per IS-305) are used in Automatic Gates. These bush bearings have no requirement of Oiling or Greasing.

Question 4: Are these gates invariably radial? What is largest size of Automatic Gate so far that been designed & operated?

Answer:

- a) Automatic Tilting Type Gates are designed to suit the spillway profile. Hence shape of gate leaf is flat (for sloping weirs) or curved - normally parabolic (for ogee type spillways).
- b) Automatic Radial Gates have invariably a radial shaped gate leaf.

The largest size of gates designed & operated till now (June 2018) is 10 m (width) x 6 m (height). 22 gates of this size are installed on Marda weir near Warora in Maharashtra, while 3 gates of this size along with 7 gates of size 10 m x 5.4 m are installed on Ammamuda Barrage in Chhattisgarh. In Bargi RBC, Automatic Tilting Gates of size 10 m x 5 m were installed in 2009 and are functioning well since then.

Largest size of Automatic Radial Gates designed and being installed presently is 4 m (width) x 3.25 m (height). 14 gates of this size are being installed on Senapura Salt Water Exclusion Dam on Kollur River near Mangalore in Karnataka.

Proposals for higher gate sizes for both, Automatic Tilting Gates and Automatic Radial Gates, are under consideration with various project authorities and awaiting approval.

Question 5: Is the weight of Automatic Gate enough for effective sealing of the gate?

Answer: Weight of the gate is used to give seating pressure on bottom seal. However, for side seals special shape of rubber seals is used to effect proper sealing due to water pressure.

Question 6: Are there any wheels attached with the Automatic Gates?

Answer: No, wheels are not attached with the Godbole Type Automatic Gates.

Question 7: Does the Side Seal pose any difficulty in operation of Automatic Gates?

Answer: No, the side seals are designed in such a way that they leave the seal seats once gate opens out from its closed position. The seals therefore do not interfere in operation of Automatic Gates.

Question 8: Can Automatic Gates be automated with any control system such as SCADA?

Answer: Yes, this is normally done if the Gates are to be opened out using emergency hoist when upstream water level is below self-actuating level for the gates (normally FRL).

C. QUESTIONS ON OPERATION & MAINTENANCE

Question 1: What is expected lifespan & installation & maintenance costs relating to Automatic Gates?

Answer: The expected life span of the gates with good maintenance is around **40 - 50 years**. Gates installed on Paunar Weir (8 Gates of size 10 m x 4 m), Gorewada Tank (4 Gates of size 10 m x 3.6 m) are serving satisfactorily for last 34+ years & could easily be in service for another 10 - 20 years.

Installation as well as maintenance cost for first 2 years is included in the supply and installation contract. Operation and Maintenance Cost beyond this period is generally limited to 1% - 2% of contract.

Question 2: How the maintenance issues in Automatic gates are addressed and what is the frequency /schedule of maintenance?

Answer: Practically, no maintenance is required as the Gates functions automatically responding to the changes in the upstream water levels. No Oiling/Greasing of bushes is required. There is no need of electrical connections and stand by Generators. However, Rubber Seals have to be changed and Painting has to be carried out in a span of 5 - 7 years.

Question 3: How the Gates are lifted during maintenance? Is there a provision of stop logs where Automatic Gates are used?

Answer: The gates are operated with the help of emergency hydraulic hoisting arrangement during maintenance.

Stop logs are normally not considered necessary when the gates are installed on dams/barrages where there is no storage in summer.

Question 4: Is there any warranty attached with these Gates?

Answer: Yes, initial 2 years warranty is included with Supply and Installation Contract.

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|--|---|---|
| Manufacturer and Contractor | : | M/s Universal Hydro Structures Pvt. Ltd. 218, Krishna Plaza, Lakadganj, Nagpur – 08 sunjai@universal-structures.com www.universal-structures.com 98260 34260, 93720 34260 |
| Patent Holder and Technical Consultant | : | M/s Godbole Gates Pvt. Ltd. 2/B, Buty Plots, Dharampeth, Nagpur – 10 |
