

De-Silting Artifice for Dams

Mr. Pratik R Ghorpade¹, Mr. Anand R Chavan², Ms. Harshada P Kadam³, Mr. Sanjay N Patil⁴

¹ Diploma Student, Civil Engineering Department, Sanjay bhokare group of institutes faculty of Polytechnic Miraj, Maharashtra, India.

^{2,3} lecturer, Civil Engineering Department, Sanjay bhokare group of institutes faculty of Polytechnic Miraj, Maharashtra, India

⁴ HOD, Civil Engineering Department, Sanjay bhokare group of institute's faculty of Polytechnic Miraj, Maharashtra, India

Abstract - Siltation is most often caused by soil erosion or sediment spill. Sometimes siltation is called sediment pollution. Hence, due to siltation storage capacity of dam is decreases and it requires silt removing technique. This paper explains reservoir silting causes, effects and mitigation of silt by De-Silting Artifice. The sediment is present in the dead storage of dam, it consist of gravels, clay, sand, rocks which is known as sediment particles. Due to silting capacity of live storage of reservoir decreases rapidly as well as silt also effects on the durability of structure of dam. By using the technique of DE-SILTING ARTIFICE we can improve the storage capacity means live storage of reservoir and it will removes the sedimentation of reservoir or decrease amount of silt present in dead storage of dam. This paper explains objectives and methodology of De-silting Artifice.

Key Words: Sedimentation causes and effects, De-silting for dams,

1. INTRODUCTION

Dams are said to be an important source of water supply and high importance for various other reasons. They supply the water for the various means like domestic use, irrigation purposes and also for the industrial uses. Dams are also involved in the hydroelectric power generation and in the river navigation. Dams and the reservoirs also provide recreational areas for the purpose of fishing and also boating. They also cater the security needs of humans by reducing or by preventing the floods. During the times of excess flow of water, the dams store the water in the reservoir, later they release that water during the times of low flow, also when the natural flows of water are inadequate to meet the demand. When engineer designs and also maintains the dams, they are expected to make sure to keep all purposes in their mind. But all rivers contain sediments. When a river is stilled behind a dam, the sediments it contains sink to the bottom of the reservoir. As the sediments accumulate in the reservoir, so the dam gradually loses its ability to store water for the purposes for which it was built means storage capacity of reservoir is reduced. In India more than six decades of research, sedimentation is still probably the most serious technical problem faced by the dam industry.

Siltation is caused by soil erosion or sediment spill. Sometimes siltation is called sediment pollution. Hence, due to siltation storage capacity of dam is decreases and it requires silt removing technique. This paper explains objectives and methodology of work and reservoir silting causes, effects and mitigation of silt by De-Silting Artifice. By using the technique of de-silting artifice we can improve the storage capacity means live storage of reservoir and it will removes the sedimentation of reservoir or decrease amount of silt present in dead storage of dam.

2. SCOPE OF THE WORK

The DE-SILTING ARTIFICE is an artificial technique mainly used for the management of silting of reservoir. By using D-silting artifice decrease the volume of dead storage and increasing the live storage of reservoir with improving storage capacity of dam. Also improve life of dam structure with management of sediment and silting in reservoir.

3. SEDIMENTATION OF RESERVOIRS

Generally, reservoirs are built in rivers for water supply, power generation, discharge regulation and flood control. The reservoir capacity can be divided in three portions, the dead storage, the active or live storage volume and the flood control storage volume.

Reservoir sedimentation is caused by the flow of water and sediment into the reservoir. Basically, all sediment (gravel, sand and mud) transported to a reservoir by a river is derived from erosion of the land surface. When the river flow enters a reservoir, its velocity and hence transport capacity are reduced and the sediment load is deposited in the reservoir

The amount of sediment deposited depends on the types of sediment in the river system, the shape of the reservoir, the detention storage time and the operating procedures. Often, more than 90% of the incoming sediment load is trapped and deposited in horizontal strata or thin bands across the bottom of the reservoir. Worldwide around 40,000 large reservoirs suffer from sedimentation and it is estimated that between 0.5% and 1% of the total storage capacity is lost per year.

3.1 CAUSES OF SILTING

Reservoir Sedimentation is a difficult problem for which an economical solution has not yet been discovered, except by providing a "dead storage" to accommodate the deposits during the life of the dam. Disintegration, erosion, transportation, and sedimentation, is the different stages leading to silting of reservoir. The main Causes of sedimentation are Nature of soil in catchment area, Topography of the catchment area, Cultivation in catchment area; Vegetation covers in catchment area, Intensity of rainfall in catchment area

4. EFFECTS OF SILTING

4.1 Storage loss

It is usually the main impact for dams devoted to water storage as their benefit is quite proportional to the storage. This impact is lower for dams devoted to hydropower: their benefit may possibly be reduced by 20% when the reservoir is 80% filled (including a large part in the designed dead storage).

4.2 Turbines abrasion

Sediment coarser than 0.1 mm may greatly accelerate the erosion of turbines parts; even smaller grain sizes may cause damages if containing quartz. It may be the main siltation problem for high head hydropower. Also sediment concentration and total head are important factors.

4.3 Downstream impacts

River reaches downstream of dams suffer large environmental impacts due to flow changes, reduction of sediment load, altered nutrient dynamics, temperature changes, and the presence of the migration barrier imposed by the structure and the upstream impoundment. Clear water released from the reservoir will cause downstream erosion and possibly bank failures. Sediment trapping by dams can even affect coastal morphology. It sometimes becomes a major factor contributing to the rapid shoreline recession and subsidence. One way of reducing this impact may be to build run-of-river hydroelectric projects which would allow passage of 100% of the fines and an important portion of the bed load.

4.4 Concepts of Reservoir Life

With reasonable levels of maintenance, the structural life of dams is virtually unlimited, and most reservoirs are designed and operated on the concept of a finite life which will ultimately be terminated by sediment accumulation rather than structural obsolescence. Design life is the planning period used for designing the reservoir project. Planning and economic studies are typically based on a period not exceeding 50 years, whereas engineering studies often incorporate a 100-year sediment storage pool in the design. The target of a very long reservoir life should be a

key point of a right design and management of siltation problems.

5. CONTROL OF RESERVOIR SEDIMENTATION

Essential measures to alleviate the sedimentation of reservoirs are to reduce the sediment entering the channel and increase the sediment flushing rate. Using water and soil conservation and check dams to decrease sediment yield, to reduce sediment entering the channel, and finally to alleviate reservoir sedimentation. Using the operation of storing clean water and discharging muddy flow it is also mitigate reservoir sedimentation. Low water levels are used during flood season to discharge more sediment, and high water levels can be operated during dry season.

6. CONCEPT OF DE-SILTING ARTIFICE

The De-silting Artifice is the most important technique for management of silting. By using the De-Silting Artifice minimize the percentage of the silting. In this method the mechanical stirrer are connected with De-silting Artifice with self-rotational movement. The mechanical stirrer can inserted into the dead storage of dam and loose the silt of upstream side of dam. Then the silt is passing through the sluice way of dam.

In this method mainly consider the horizontal hydraulic pressure and gravitational force present on the silt. The sediment particles are loose with mechanical stirrer that time the gravitational force and horizontal hydraulic pressure are compress the sediment particle and easily pass the silt upstream side to downstream side of dam from the sluice way arrangement of dam.

The De-silting Artifice is very economy and simply process for de-silting of reservoir. This artificial article are rest on the rail track for move one place to the another place of dam. The de-silting artifice technique is more helpful for environmental and irrigational issues. The de-silting artifice is also decrease the rate of soil erosion and water pollution. By using the technique of De-silting artifice removing the sediment particles present into the upstream side of dam.

7. COMPONENT PARTS OF DE-SILTING ARTIFICE

7.1. Stirrer Bladed.

The Stirrer Blades are most important components part of mechanical stirrer. The 8 number of blades are used for mechanical stirrer in arrangement of circular path. The diameter of this path is 3.0m to 3.2m approximately and 1.5m to 1.6m length of each blades. The all blades connect each other by equal spacing. The galvanized steel used for blades of mechanical stirrer. Galvanized steel is locally available material in market with 57 Rs. per Kg. The blades of mechanical stirrer are do not rust easily with contact of Sulphate content and other chemicals content in water of reservoir. The galvanized steel is non-rusting material then the maintenance cost of bleeds is very low or null.

7.2. Axel.

The stirrer blades and stirrer rod join each other with help of the Axel. In this mechanical stirrer the Axel works like as connector. The galvanized steel is also used for the Axel. The axel plays an important role for connection of stirrer bleeds and stirrer rod.

7.3 Stirrer Rod.

The stirrer rod is circular leg of mechanical stirrer in approximately diameter 0.7m to 0.9m and its height depends on height of the dam and rate of silting in reservoir. The galvanized steel used for stirrer rod then the stirrer rod not easily rust and its maintenance is low. The stirrer rod helps to support and rotate the stirrer bleeds. The stirrer rod connect the stirrer bleeds, axel and rotational motor each other and helps to rotating the mechanical stirrer of de-silting artifice.

7.4. Rotational Motor

The rotational motor is rotating the mechanical stirrer in low speed of 10 RPM. The mechanical stirrer easily insert into the silt or dead storage of dam with 10 RPM rotational speed. The capacity of rotational motor depends on weight of mechanical stirrer, rate of silting and measurements of structure of dam. The rotational motor plays an important role for rotating stirrer rod, axel and stirrer bleeds.

7.5 Artifice Connector.

The artifice connector is top most portion of the de-silting artifice. The Fe415 steel is used for artifice connector. Fe415 steel is locally available in market with 40 /- Rs per Kg. The artifice connector is move with two directions first is upward – downward direction and arm rotate direction. The artifice connector helps to the mechanical stirrer and artifice base connect each other.

7.6 Artifice Base

The artifice base plays an important role for moving de-silting artifice on rail track one place to another place of dam. The Fe415 steel is also used for artifice base. The mechanical stirrer and de-silting artifice is move one place to another place on rail track with the help of artifice base. The artifice base also supports mechanical stirrer and artifice connector.

7.7 Rail Track

The rail track construct on the upstream side of service road of dam for movement of de-silting artifice from one place to another place. Rail track constructed with Fe415 steel. Rail track also carry the load of de-silting artifice and distribute load on service road of dam.

8. WORKING OF DE-SILTING ARTIFICE

The De-silting Artifice is newly invented advanced technique for removing silt from upstream side to downstream side of

dam. By using this technique we can reduce the rate of silting. By means of following points we can proceed for De-Silting Artifice.

1. The De-silting Artifice is connected with rail tracks on service road with the adjustment of carrying artifice one place to another place.
2. The De-silting Artifice has four movement like self-rotate, arm rotate, upward-downward direction and one place to another place move. Due to these working movements the de-silting artifice is preferable for any kinds of dam.
3. The De-silting Artifice has provided mechanical stirrer which rotates with 10 RPM speed and it inserts in dead storage of dam with the use of stirrer blades it loses the silt particles or lose the sediment partials of underwater of dam.
4. The force is exerted on sediment partials are impacted on silt and it changes its movement by getting hydraulic pressure and gravitational force.
5. By the application of mechanical stirrer the sediment particles are drawn outside of dam with the help of sluiceway.
6. This sediment particles are flows down at downstream side of dam and water is pass in channel with the help of arrangement of V-Notch.

8.1 Controlling of De-silting artifice

1. The gate of sluiceway are controlling with rate of silting. When De-silting Artifice is in working position that time open the sluice gate and remove silt from upstream side of dam.
2. The switch time of de-silting artifice is depends on area of siltation in reservoir.
3. The de-silting artifice is control with on-off switch and this method is totally automatic.
4. The sluice way is control with sluice gate and rate of silting controlled.
5. The rate of silting is control with sluice gate and de-silting artifice.

8.2 Maintenance

1. The de-silting artifice maintenance cost is very low because the material used for de-silting artifice is galvanized steel and this steel is non-rusting material.
2. The material used for rail track of de-silting artifice is very hardest material then its maintenance is very low.
3. The sluice way of dam is easily pass sediment particles upstream side to downstream side of dam very easily without any choked.

8.3 Use of removed silt

1. The removal silt is used as construction material for construction.
2. This silt is used like filling material and sand in construction.
3. This silt is also used for Agricultural purpose.

Proposed model of De-silting artifice



Fig -1: Model of De-silting artifice

9. CONCLUSION

The De-Silting Artifice is newly invented technique for remove silt from the upstream side to downstream side of dam. The De-Silting Artifice is low cost as well as low maintenance technique as compare to the other silt removal methods or de-silting technique. The De-silting Artifice helps to the social domestic water needs and irrigation purpose. By using the technique of De-silting Artifice we can improve the storage capacity means live storage of reservoir and it will lose the sedimentation of reservoir or decrease amount of dead storage of dam.

The De-silting Artifice is an artificial technique mainly used for the management of silting of reservoir. By using D-silting artifice decrease the volume of dead storage and increasing the live storage of reservoir with improving storage capacity of dam. Also improve life of dam structure with management of sediment and silting in reservoir. The de-silting artifice maintenance cost is very low. This technique is in low cost and fastest or speedy than other silt removal techniques it can helps to the irrigation department of government. The De-Silting Artifice is most helpful technique for irrigation department.

10. REFERENCES

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