INFLATABLE DAM MODERN SOLUTION OF WATER MANAGEMENT: REVIEW

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Abstract :- A hydraulic Structure that is inflatable and deflatable is called an Inflatable Dam. Inflatable dams are flexible elliptical inflatable and deflatable structures made of rubberized material, fixed to a hard base, and inflated by water or air, or both. There is growing interest in inflatable dams because they are easy to install and construct. The concept of the rubber dam is very new in India but has been used for many years in countries such as Australia and overseas abroad and numerous rubber dams have been installed around the world for a variety of purposes, including irrigation, water supply, flood control, power generation in hills and maintenance of water table. Rubber dams are a new technology that controls water in a flexible way.

1.0 Introduction :-

The rubber dam was developed in the 1950s, and the first dam was built on the Los Angeles River, California for groundwater cultivation and flood control. These types of dams have been constructed in canals, streams, and medium-sized rivers, and they raise the water level upstream when it expands, thus playing an important role in increasing the amount of water for irrigation capacity. increase. Today, rubber dams are also known as Fabric Dams, Rubber Dams, and Inflatable Dams. In China, the inflatable dam was used 40 years ago as it is a cheaper water management structure compared to traditional fenced structures such as weirs, especially in small and medium-sized rivers. A Rubber structure that is placed on canals, streams, weirs, and dams and raises the water level upstream when expanded is a rubber dam. A synthetic fibre. The membrane is a multi-layer fabric (usual nylon) that is rubberized on one or both sides. As the fabric has good flexibility as well as its abrasion resistance is good.

2.0 Objective :-

- To make people familiar to the inflatable rubber dams applications
- Economic benefits towards other conventional dam.
- Study and Review on Design of Inflatable dam .

3.0 Scope :-

- Due to its simple and well thought out design, construction technology is simpler than traditional dam walls.
- The Cost of building a traditional dam is as high as the time required.
- Water demand is high in each smart city or densely populated city, so current water-saving systems require improvisational water storage systems.
- The advantages of rubber dam applications are superior to traditional rubber dam applications such as flood control, which is a serious problem in big cities.

4.0 Methodology:-

- **Inflation System:** The dam needs to inflate with the help of blowers or water pumps or other devices such as valve .
- **Deflation System:** There are three types of deflationary systems. Quick installs are buckets, floats, and streams. In the bucket type, water flows into the bucket, falls into the upstream hydro concrete dam, and rises to the shrinkage level. When the outlet valve and equipment open, the dam body contracts.
- **Construction Process Of Rubber Dam:** The rubber bag is connected to the concrete floor. At the beginning of construction, sheet piles and barriers are installed above and below to prevent the intrusion of soil corrosion. Then pour the concrete up, and down, into a rubber bag. Finally, abutment walls, blocks, pump houses, valve chambers, etc. will be built. However, the main concrete structures of rubber bag fixed concrete structures are very carefully designed. Tubes, pillows, M.S. With plate; rubber bag is attached to the floor bed.

Fig .1 inflated and deflated condition of rubber dam

5.0 Literature Review :-

Tam and Paul [1] build rubber dam technology in Hong kong in place of agricultural low dam built across a river which used to raise the level of water upstream and this method was still in use. As the Rubber Dam is made up of rubber material only so they concluded that there is a possibility or concern regarding dam material will get damage due to on purpose damage. Also they talked about the flow-induced vibration damage or the damage due to objects which are carried from upstream of the agricultural low dam.

Adil Dawood Alwan [2] Adil Dawood Alwan has stated an analysis topic and design of inflatable dam in Nov 1997 by publisher Imagine services north, west Yorkshire. He found another way to beat the height cost and duration needed for the design

Chanson [3] Accelerators attached to the membrane wall indicate an overflow of an inflated rubber dam. Instabilities in the fluid-structure and hydrodynamics can occur, which must be avoided. To redirect the flow away from the flexible membrane wall, current design options include installing a fin (or deflector) in the upper quadrant of the rubber dam.

Dayton Tagwi [4] Inflatable weir hydraulics is a topic he has proposed. Stellenbosch University published the book in March 2015. His goal was to use diameter circular weirs to assess the hydraulics of an inflatable weir from completely inflated to totally deflated.

Yousuf Parish [5] Rubber, which is widely employed in the construction of dams or short dams, is one of the newest materials in the construction of water structures in recent years. Rubber dams have been used in large and small water projects due to their remarkable flexibility of materials against external factors, compatibility with the environment, simplicity of design, quick construction time, safety and stability of these structures, such dams than rigid, simplicity and ease of use, and ultimately reduced operating cost. Because there is a scarcity of information in the topic of rubber dams, this page explains how to design, construct, and maintain rubber dams.

Zhang and Diao [6] The maximum fall discharge was determined by analyzing the fall discharge, fall velocity, and duration of various cascade rubber dams, as well as other factors such as control and operations that influence maximum discharge. It was concluded that the greater the dam fall velocity and the shorter the time, the greater the maximum fall discharge.

Anwar H.O. [7] Inflatable weirs can be deflated when not in use and inflated with water or air in flood scenarios. Weir can be placed in a deflatable way and can be inflated if water flow is high with help of air or water. The maintenance cost is low as compared to other weirs and installation is a bit easy.

Zhang X. [8] Used rubber dams in places where the temperature is less than degrees Celsius and concluded that it is not preferred in chilled temperatures conditions. Also, they talked about the research methodology, the operation mechanisms, and the construction of the rubber dam. Also, useful and preventive ways of maintenance of the dam are also discussed.

Shahid ul Islam and Arun Kumar [9] The huge Himalayas, as well as hilly terrain in the peninsular and central regions of India, provide opportunities for hydropower on a large scale, including Suitable diversion structures are used to divert water from streams for hydropower generation. The inflated dam, also known as the rubber dam, is a form of diversion construction used to control and regulate water for the generation of electricity.

Abdullah Ali Nasser Alhamati [10] In standard, the coefficient of discharge for diverse sorts of measuring systems built in an open channel may be located from a trendy formula. These systems including a broad-crested weir, sharp-crested weir, and circular-crested weir have a steady form below all overflow conditions; consequently, the connection between the top and discharge over the systems may be found. In the case of inflatable dams, this dating is extra complicated than conventional measuring systems due to the fact the scale of inflatable dams can be various because of inner pressure, overflow head, and downstream water head.

6.0 Economic advantages of rubber dams over other types of dams:-

Including the economic benefits to dams and concrete dams, it states:

- Minimum maintenance is required for these dams. Mostly, repairs are related to the mechanical system of the dam. Maintenance, as well as tire repair, is exactly similar to the dam.
- Inflatable dams work in a low resistance, loamy soils, as opposed to concrete and embankment dams, which require very detailed geoengineering studies to implement the dam body due to the very low force on the foundation. Has a simple foundation to do and generally does not require a complex foundation.
- A rubber dam in a crater up to 150 meters long. Unlike dams, which require a foundation every 15 to 20 meters to install the valve, no foundation is required.
- The stretchability of rubber is one of the most important material of a dam which responds to earthquakes. Due to this, flooding downstream and breaking is prevented.
- Improved performance of spillway to lakes, concrete dams and dams.
- Ability to perform with large inclines and lack of firm lateral support.
- Construction time is reduced compared to other types of dams.
- Reduce river disturbance regimes.
- Superior to other types of dams due to its ability to change the height of rubber dams and adapt to different flood and drought conditions.
- Less labor and skilled workers are needed.
- Simple, requiring less maintenance and control after running the operating system.
- Reduces the risk of drowning adjacent land towards a rigid concrete structure or embankment.
- Cost reduction and rapid implementation.

7.0 'Life cycle cost' comparison of traditional weirs versus inflatable dams for small hydropower plants :-

Lifecycle cost is a comparative evaluation of competing design alternatives based on their respective life cycle costs over their economic life. The method used to determine life cycle costs is the present value (PW) method. In this method, all costs are converted to present value. Expenses over different time periods need to be multiplied by a present value factor (PWF) to convert to a present value. and stand-alone costs, (c) present value of lost revenue due to pressure loss, flushing, scale and water losses. For repair and (d). Present price of annual costs (operations and maintenance).

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Project	Discharge (Cumecs)	Raised Gravity	Trench Weir	Bush and Boulder	Mathu Bund	Inflatable Dam
Jhanjhavati	100	12.86	154.89	64.74	111.71	3.83
Zunkur	5	18.42	42.58	30.88	48.03	5.28
Pahalgam	28.9	9.22	37.78	37.90	68.38	2.77

Life Cycle Cost (INRx10^5) per unit length of different types of weirs for different discharge values

8.0 Force acting on the dam membrane The force acting on the dam under hydrostatic conditions:

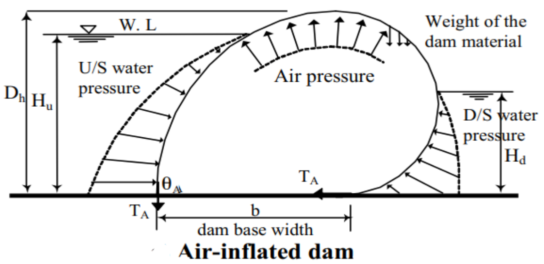
I. **These forces act on the inflated air**

II. Internal air or water force.

III. upstream water force .

IV. Downstream water force.

V. Dams weight



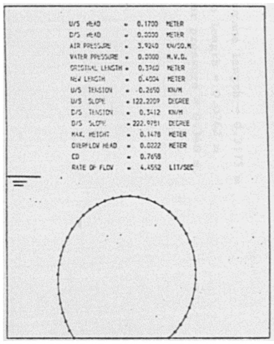


Figure [2]. Forces acting on the dam (Hydrostatic condition)

These depends on the positions of each components in the dams profile. Some components are subject to an upstream hydrostatic power (upstream components). The others experience only the hydrostatic force downstream (downstream components) and all the components receive internal pressure. When the force transfers from one component to the nearby components, and the analysis gradually continues until the last component. When the force acting per unit length on the upstream and downstream components of the dam. Therefore the force that acts on an component is transferred to the node of that component.

And the conclusion of these are the stress on the nodes. The intensity that acts on a component can be outlined by the following equation: $Fu = \gamma \cdot hc1 \cdot L$

Where Fu = upstream hydrostatic pressure of the component per unit length, γ is the specific gravity of water, and is the vertical distance between the upstream water surface and the center of gravity of the water length of component (Figure 3), and L is the component.

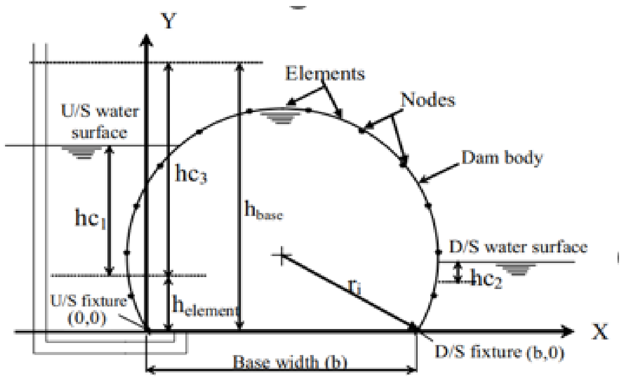


Fig. [3]. Dam membrane length into (n) components

The result is stress on the node. The force acting on an element can be expressed by the following equation. Fu = γ. hc1. L where, Fu is the upstream hydrostatic force on the element per unit length, γ is the specific The water weight hc1 of is the vertical distance between the upstream water surface and the center of gravity of the component's underwater length (Figure 2). Where L is the length of the component.

Fa = pia. L

Where Fa is the component's internal aerodynamic force per unit length (Fa is equal to zero for a water-filled dam) and pia is the dam's internal air pressure. Fw = w. L Where Fw is the weight of the component per unit length and W is the weight of the component per unit area.

Conclusion:-

- Numerous inflatable dams have been installed around the world and are used for a variety of purposes, including Irrigation, water supply, flood control, power generation in hills, groundwater table maintenance etc.
- Rubber dams are an alternative solution as a separation structure for streams and rivers to mitigate the flood problems of irrigation and gravity dams.
- Under the same internal pressure conditions, above and below the water head, the height of the dam filled with air was higher than the height of the dam filled with water.

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