Rubber Dam: Design and Construction Aspect for Pune

Mr. Rahul Matkar[1]* Prof. P. R. Minde[2]

[1,2] TSSM's Padmabhooshan Vasantdada Patil Institute of Technology Pune-21

Abstract – The research was set with the objective of investigating the possibilities of constructing the rubber dam compared with the traditional dam. The rubber dam concept is relatively new in construction technology in India. Rubber dam concept is application wise used in the specific cases where it may be prove to be alternative, very few countries are widely developed rubber dam like Australia , china, Japan. Rubber dam has many advantages from various aspects like Irrigation, water supply, flood control, groundwater recharge, electric generation in hilly areas and water storage. Due to simple sophisticated design and its construction time is less as compared to conventional dam construction.

Rubber dam is a useful technology, which can control water in flexible way. It is important and priority in urban and rural sector not only for irrigation but also industrial and for daily use. Rubber dam can minimize the crisis of flood and maximize the proper use of available water resources. This paper aims to study different flood hazardous, dry areas where rubber dam can be used in Pune and also point out the general description of system various configuration and types, working principle and comparative analysis between rubber dam and conventional dam.

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I. INTRODUCTION

He Water plays vital role in human living. Rubber dam irrigation system for impounding surface water is a new technology in India. It is important and priority in agricultural sector for sustainable irrigation water management due to scarcity of groundwater. The rubber dam project was evaluated to facilitate irrigation through proper use of water resources in the project area by conserving water for rabbi crops.

The term 'Rubber Dam' sounds strange and gives an obvious impression that it might be a dam made of rubber. The concept of rubber dam is developed very recently in India and comparatively new. Though the system has been used in great extent in countries like China, Australia and in Scandinavia till date very few countries have used. It is used in site specific cases where it may prove to be very good alternative. A rubber dam has many advantages, such simple hydraulic structure, short construction time, perfect seismic performance, and low resistance to water flow in flood season etc. General description of the system and functional principle has been presented in this paper.

Indian cities are experiencing an increasing use of utilities. As a matter of fact there is a wide gap between the utility availability and need for the utilities, which is reportedly due to the perennial influx of rural population to urban center. As a result the existing infrastructure gets burdened. Pune Municipal Corporation (PMC) in India, growing at a very fast rate, acquired a complex urban structure over the city.

1. Necessity of the Project

The PMC (Pune Municipal Corporation) developed mainly due to the rapid growth in the information technology sector, industrial, people migrating from rural area to Pune city e.g. Solapur, Nagar Nashik, Osmanabad etc. Pune district has a growth rate of 38.58 %, while the state is experiencing the growth rate of 22.5 %. Therefore it is necessary to add the past and present growth trends of these rapidly growing cities, for effective urban management (S. Shekhar 2005). In order to prepare a development plan for utility planning of a city, there is a need of good and reliable information regarding the location of existing facilities, their accessibility, adequacy and development trends in relation to the socioeconomic structure of the city. The significance of the present study is to represent various kinds of utility services like blood banks, hospitals and ambulance services, school and colleges, in the Pune Municipal Corporation for providing better facilities to the civilians. Rubber Dam can utilize for various purposes like irrigation and flood management.

II. AIM OF THE STUDY:

The Main aim of the study is to evaluate the technical feasibility of the rubber dam in terms of design and construction aspect in Pune to minimize the flood crisis and maximize the irrigation

III. OBJECTIVES OF THE STUDY:

1. The main objective of the study is to evaluate the technical feasibility of the rubber dam in terms of design and construction aspect in Pune to minimize the flood crisis and maximize the irrigation.

2. To study and analysis of flood prone areas and irrigation development in the khadakwasala basin.

3. Find out the cost benefits.

4. Evaluate the benefits of rubber dam by considering variable parameter like: Flood control, Irrigation, diversion of the water, water reservoir for urban and rural development.

IV. Scope of Work:

- Due to the simple sophisticated design construction technique is simple as compared to conventional dam. There is no special expertise to focus till the end of the process.

- The Cost of conventional dam construction is more, as well as time.

- The demand of water of any smart city or the highly populated city is high so current water conservative schemes needs to improvise the water storage system.

- Rubber dam's application wise advantages are more than the conventional rubber dam like flood control which is major serious problem in major cities like Pune.

V. METHODOLOGY:

1. The study of different types of dam's application and advantages from the literature reviews by considering the technical construction, maintenance and installation.

2. Site visit for at flood hazardous area, and feasible location to construct rubber dam in Pune.

3. To evaluate the rubber dam site selection and design aspect.

4. Comparative analysis between conventional dam construction and Rubber dam. And also conclude the cost efficiency and time of construction and benefits for the nearby area.

A. Rubber Dam Theory

Rubber dams are long tubular-shaped fabrics placed across channels, streams and medium sized rivers to raise the upstream water level when inflated and thus play a vital role in enhancement of irrigation capacity. In Rajasthan, there is very low rainfall in winter. So, the requirement of water in winter for irrigation must be met from groundwater source and by conserving a part of monsoon surface water in suitable storage. To use the river water in winter, Rubber Dams were introduced. It is a new type of hydraulic structure compare to conventional dams with un-gated spillways. Rubber dam is a structure made up of high strength fabric (EPDM-ethylene propylene dyne monomer) adhering to the rubber. Rubber dams are the cheaper water conservation structures compared to conventional gated structures like barrages especially in small and medium rivers. Conventional dam may not install or construct for small project because cost and time consumption are more in conventional dams. Rubber dam are the modern type of completely automatic structure used to store the water and to increase water level of a watercourse. Rubber dam is a cost effective technology for retention and conservation of surface water

B. Construction procedure of Rubber:

Dam The rubber bag of the dam is attached with the concrete floor. At the beginning of the construction sheet pile wall or cut off wall is constructed at both the upstream and downstream side for controlling soil corrosion due to seepage. After that, the upstream, downstream, and the rubber bag is cast with concrete. At last, abutment wall, block, pump house, valve chamber etc. is constructed. But the main attached concrete structure of rubber bag is constructed very carefully. By using M.S. pipe, pad and platen; rubber bag is anchored with the floor bed.

C. Selection of Dam Site:

- The site should be such that the dam at that location can command the maximum cultivated land.

- The beneficiaries have to be consulted and the site of proposed dam will provide them the desired benefits of irrigation of the neighboring lands.

- The site should be easily approached by road

- The channel reach should be relatively straight and smooth water flow
- Bank of the river/channel should be stable one
- Land should have uniform slope.

D. Necessity of Rubber Dam:

- Pune is going to become smart city in next few years so the water demand and flood control is major concern for the Pune municipal corporation.
- Dam construction is very lengthy, costly, and time consuming process.
- From few decades the frequency of the flood and demand of water is high in Pune
- Irrigation is major issue in India (Especially in Maharashtra) rubber dam can cultivate the agricultural development.
- Currently Pune is going to become a smart city, in smart city the requirement of water is very high, for the futuristic sustainability and development the rubber dam is good alternative for the traditional dam.

E. Study area:

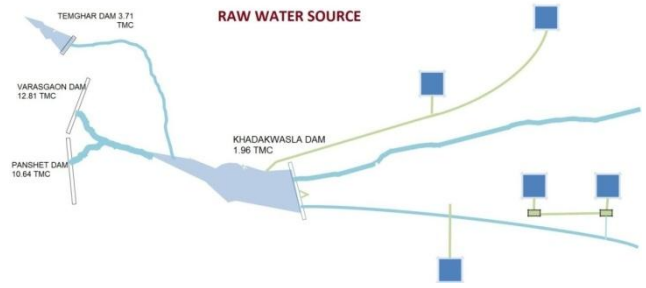
The main purpose of the study to identify and study the feasible area for rubber dam ,the flood hazard areas in the khadakwasala as stated Complex basin to assist the future policy design makers to prepare the policy for the mitigation plan or planning within the area with minimum investment with new technology. The study area consists of major dam and one Khadakwasla. There are major flood caused which flush the entire Pune city on 12 July 1961 due to bursting of the Panshet dam. However Khadakwasla dam is constructed on river Mutha. The minor dam Temghar is situated on the River Mutha.All of the three major dams are the source of water for drinking, irrigation and industrial Pune city.

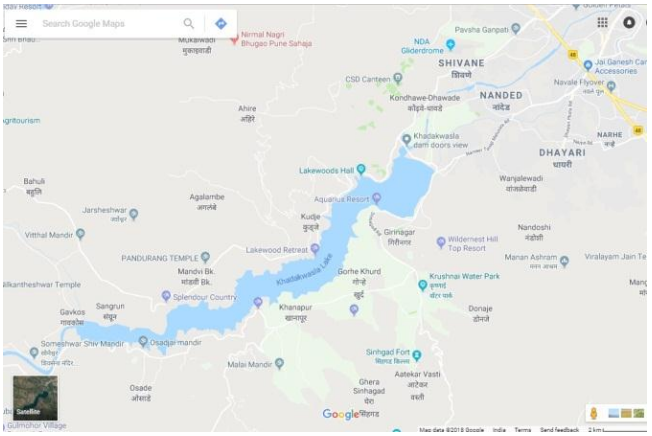
GEOGRAPHICAL SETUP:

Location:

Khadakwasla Dam is a dam on the Mutha River 20 km (12 mi) from the city of Pune in Maharashtra, India. This dam across the river Mutha created an attractive lake, now known as Khadakwasla Lake. This lake is the main source of water for Pune and its suburbs.

The largest lake in the area is Mulshi lake, some 50 km (31 mi) northwest of Khadakwasla, which has a rather large dam confining it. It releases water into the Mula River, which meanders some 75 km (47 mi) before reaching Pune district near Dapodi and meets up with the Mutha River in Central Pune at the Sangam Bridges and continuing Eastwards via Bund Garden to Daund before joining the River Bhima. Though there is a water supply set-up near Holkar Bridge, next to Bombay Engineering Group and Centre (BEG), there is very little water in the hyacinth-choked Mula River, except during the monsoons





Climate:

Temperature:-

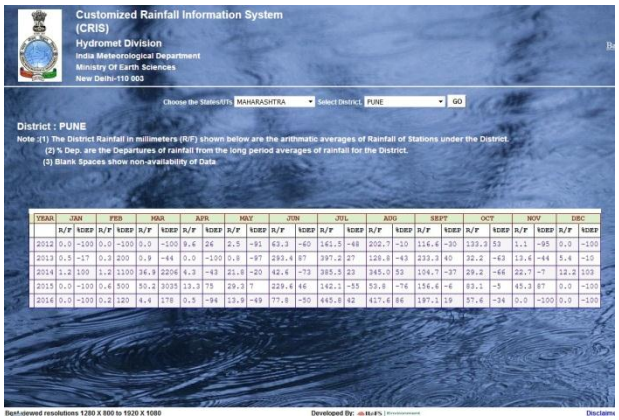
The months of the summers are March, April and May which are having variation in range of temperature. The mean annual temperature is 24.6°C while, mean summer temperature is 27.4°C. There is a significant variation in temperature conditions in western Maharashtra throughout the year. Seasons mainly summer, rainy and winters persist more or less four months duration, temperature recorded to be highest in the month of May which exceeds 38°C whereas winter is a season

where temperature is recorded to be minimum generally less than 15°C. Average condition of temperature variations are displayed in (Fig. 2.3)

In the Temghar catchment, the temperature distribution varies from east to west. It decreases towards west from 25.9°C to 23.9°C due to the physiographic variation i.e. undulating nature of the surface.

Rainfall:-

Monsoon starts in the month of June & receives up to the end of September. Average annual rainfall is 2740 mm. The rainfall variations in the region show considerable increase towards west. Rest of the months are without spells and the months April and May sometimes gives torrential rainfall due to local climatic conditions.



Soil environment:

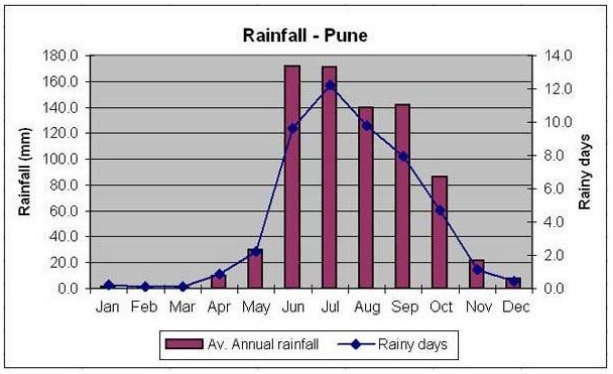
The study area is characterized by various slope segments. There is a considerable variation in soil properties. Sandy material is generally confined to higher slopes, whereas agriculture land shows silty, clayey and loamy and loamy sand in abundance.The general colour of soil along hill slope area is dark reddish and it is dark brown to yellowish brown in the Mutha valley floor. It seems the soils in the valley floor are rich in the amount of organic matter and humus content. Most of the valley floors are presently submerged. Along most of the hill slopes are barren, devoid of vegetation and thus exhibits very high potential land surfaces for surface runoff and soil loss, therefore top soil layer is very thin and almost lost at same places.

Data Collection:

Rainfall Data:-

25 Years Average (1982-2006)

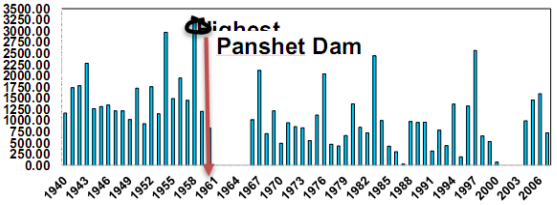
Months	Av. Annual Rainfall (mm)	Rainy Days
Jan	1.7	0.2
Feb	1.5	0.1
Mar	0.6	0.1
April	9.8	0.9
May	30.0	2.2
Jun	171.4	9.6
July	171.0	12.2
Aug	139.5	9.8
Sept	141.7	7.9
Oct	85.8	4.7
Nov	21.5	1.2
Dec	7.4	0.4
Total	**781.9**	**49.4**



Rainfall Data :- 25 Years Average (1982-2006

Graph No : 4.1

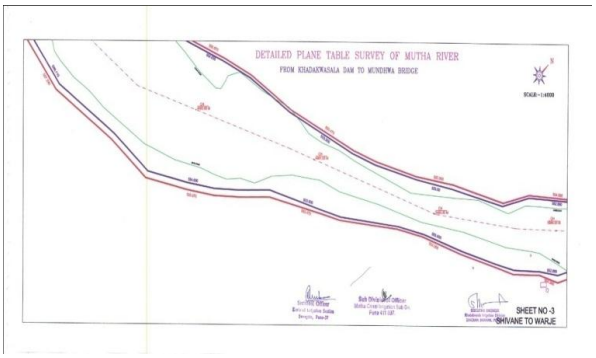
Flood Data:



It has being observed that the flood event of 261495 Cumecs of flood the Warje Karvenagar will be

highest affected with a population of 60000 citizens under the flood impact.

Ref: "Application of GIS for Flood Mapping: A Case Study of Pune City" Pawar Amol D 1, Jyoti Sarup 2, Sushil Kumar Mittal.



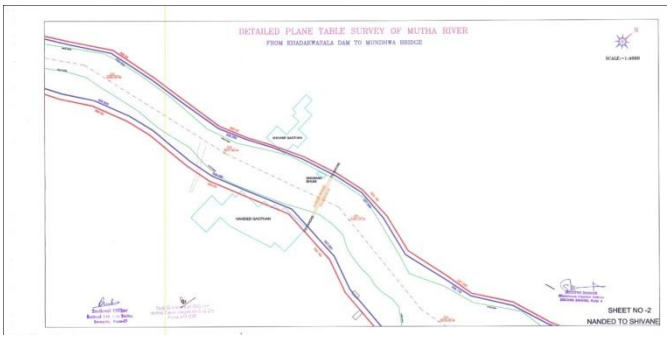
Flood Prone Zone Map

Fig No : 4.8

Based on the Flood control department (Pune) Data and last few years Data.

- Shantinagar slum, Vishrantwadi
- Poolachi Wadi slum, Deccan
- Anandnagar, Sinhagad Road
- Kamgar Statue slum, Shivajinagar
- Khillare Patil slum, Yerawada
- Ambil Odha slum, Dandekar Bridge
- Shivne and Uttamnagar areas
- Katraj Lake area
- Old Aundh Bridge area
- Baner and Pashan areas
- Warje
- Tingarenagar
- Vitthalwadi

Other Flood Zone:



Khadakwasala to Shivane

F. Site Survey:

Site visit Date : 12/09/2017

Location: 18°28'20.4"N 73°48'29.6"E

Address: Pandurand Industrial area, Nanded city, Pune

Second Site

Site visit Date : 19/09/2017

Location : 18°27'43.3"N 73°47'22.9"E

Address : Shree swami samartha math

Nanded, Pune, Maharashtra 411041

Third Site

Date of visit : 22/10/2017

Location : 18°27'04.3"N 73°46'13.7"E

Address : Nanded city Cement mixture plant Nanded, Pune, Maharashtra 411024

G. Site Selection Parameters

The site selected on the following considerations:

The beneficiaries have to be consulted and the site of proposed dam will provide them the desired benefits of irrigation and flood control of the neighboring lands.

The site should be easily approached by road

The channel reach should be relatively straight and smooth water flow

Bank of the river/channel should be stable one

Land should have uniform slope.

Canal network should be such that water can flow by gravity

Case study Location :

CASE STUDY DETAILS

Location : 18°27'44.1"N 73°47'23.2"E.

Catchment area : Total area: 25,762.61 m² (277,306.45 ft²)

Dam Length : Total distance: 30.00 m (98.4252 ft)

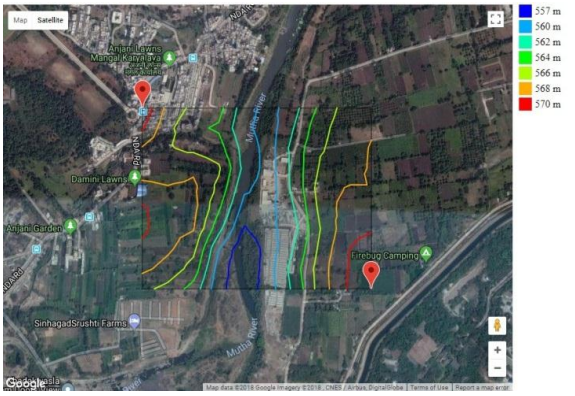
Size of the Inlet structure : Rectangular; (Width: 1.5 m, Height: 1.8 m)

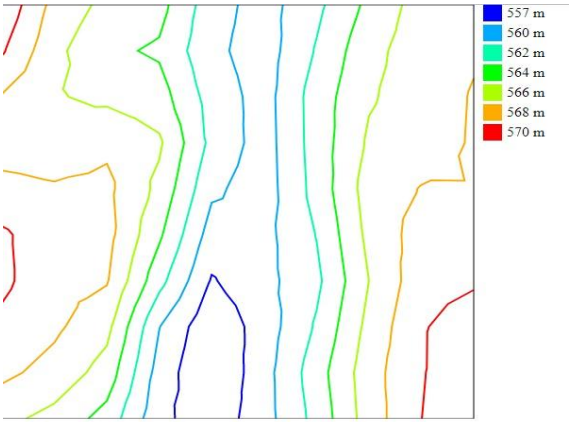
Type of irrigation system: Gravity Flow.

Approximately discharge capacity :

Available height : Min : 0.5 m

Max : 1.5 m





Contour Of the selected site

H. Population Data :

According to the 2011 census, the population of Pune District is 94,29,408 Over past 7 decades, the population of district has increased from 19.5 to 94.29 lakh i.e an increase by about five times. There was change of 27 percent in the population compared to population as per 2001 census

Year	Population	Increase in Decade	% Increase	Incremental Increase
1961	606777			
1971	856015	249238	0.41	
1981	1203363	347348	0.41	98110
1991	1691430	488067	0.41	140719
2001	2381273	689843	0.41	201776
2011	3115431	734158	0.31	44315
Average		501731	0.39	121230

I. Correlation between Rainfall and Groundwater level

The observations of groundwater level of Pune district shows that Groundwater level rises after monsoon due to natural recharge. The R square values obtained through analysis of rainfall and water level for the entire district are <1, which indicate that there is less correlation between rainfall and dug well groundwater level.

Year	A	B	C	(A+B)/2	(B+C)/2
	Arithmetic Increase	Geometric mean	Incremental Increase		
2012	3165604	3218659	3172272	3192131	3195465
2017	3416469	3788427	3474660	3602448	3631543
2022	3667335	4459055	3807356	4063195	4133205
2027	3918200	5248399	4170359	4583299	4709379
2032	4169066	6177472	4563669	5173269	5370571
2037	4419931	7271010	4987287	5845470	6129149
2042	4670796	8558126	5441213	6614461	6999670
2047	4921662	10073088	5925446	7497375	7999267

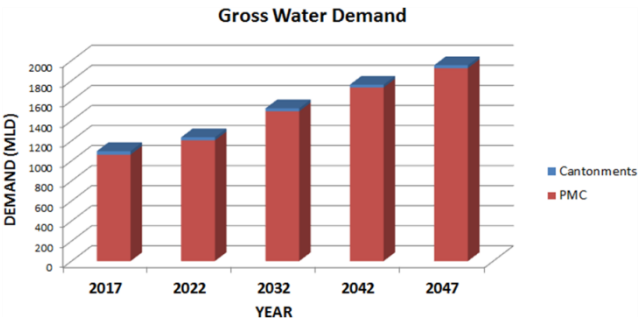
J. Groundwater:

The groundwater event in a specific area relies upon meteorology, Lithology and Geomorphology.

In the uneven zone however the precipitation is high going from 2000 mm to 3000mm, they are clearly not exceptionally ideal for improvement of groundwater due to high inclination.

The tough slopes offer place to the lower region skylines in the tahsils of Junner, Khed, Ambegaon, Bhor, Velhe and Purandhar. The precipitation got in such territories however less when contrasted with the uneven areas, yet there exists some degree for building up the groundwater assets on the grounds that the moderate inclination of land surface allows a captured streams of surface run-off and the valleys being relatively more extensive help some cultivable land.

Year	Net Demand (MLD)			
	PMC	Pune Cantonment	Khadki Cantonment	Total
2017	712.63	12.53	12.06	737.28
2022	926.97	12.53	12.06	951.56
2032	1231.99	12.53	12.06	1256.58
2042	1431.64	12.53	12.06	1456.23
2047	1596.71	12.53	12.06	1621.30



K. Cost Benefit Analysis:

Contrasted and steel doors, the elastic dam turns out to be more practical with the expansion in the length of its span(s). Steel doors are costly and require middle of the road structures, (for example, solid wharfs) that gather garbage amid surges. Al-however flashboards are cheap to build, they are un-solid and costly from a task and support perspective. The elastic dam is nearly upkeep free contrasted and a steel door, which requires occasional support, for example, repairs to the lifting instruments, sandblasting, and painting. On account of raising the peak of a current dam, the elastic dam is substantially less expensive to introduce than any of the different kinds of steel entryways; actually, given the de-indication of a current structure, numerous sorts of steel doors might be non-suitable choices. Moreover, the expanded water stockpiling limit with regards to extra power age and water supply can bring about quick payback of the development cost of the elastic dam.

L. Future Scope:

I) Continuing study of Rubber Dam analysis and updating results will be proved to be

useful, as more data become available in future.

II) During such study special attention may be paid for evaluation of Rubber Dam project in irrigation.

M. Water Demand:

I) Possible of this project on the entire irrigated area the surrounding environment and also on the river may also be studied.

II) If all the studied are done attentively then it may be a great project having vast effect on agriculture evaluation in the entire area.

A. Advantages

1. Simple development process
2. Elastic dam have a just expand on and flattening component
3. A light upper structure and uniform heap of elastic dam body limit uneven establishment settlement
4. The adaptable structure of elastic dam for all intents and purposes wipe out the impact of d/s soil and residue
5. The elastic dam can be introduced on for all intents and purposes any side slop
6. Elastic dam just requires just light establishment prompting significant sparing in time and cost
7. Elastic dam have bring down support cost.

B. Disadvantage:

Harm to the dam when collapse the body managing extensive and sharp questions that reason harm to the body.

Escape and air leave: When collapse the dam may sharp questions make cut and furthermore in surges

Time the dam hit by vast questions, for example, logs and scratches or openings are made on dam.

C. Application Of rubber dam:

- Rubber Dam for Flood Control
- Rubber Dam for Irrigation
- Rubber Dam in Watersheds
- Rubber Dam for Water Conservation
- Rubber Dam for Groundwater Recharge
- Flood control and regulating river flow
- Control of river sediment
- Temporary storage of the base flow of the river
- Separation of fresh and salt water
- Increase the storage capacity of dams
- replace with steel valves
- Shrimp
- provide tourism and recreational areas for
- swimming and sailing
- Feeding the underground aquifers

D. Cost Benefit Analysis

Compared with steel gates, the rubber dam becomes more cost-effective with the increase in the length of its span(s). Steel gates are expensive and require intermediate structures (such as concrete piers) that collect debris during floods. Although flashboards are inexpensive to construct, they are un-reliable and expensive from an operation and maintenance point of view. The rubber dam is almost maintenance free compared with a steel gate, which requires periodic maintenance such as repairs to the lifting mechanisms, sandblasting, and painting. In the case of raising the crest of an existing dam, the rubber dam is much cheaper to install than any of the various types of steel gates; in fact, given the de-sign of an existing structure, many types of steel gates may be non-viable alternatives. Furthermore, the increased water storage capacity for additional power generation and water supply can result in rapid payback of the construction cost of the rubber dam.

VI. CONCLUSION

Due to extensive applications and multi-purpose of dams, and also the cited advantages, with respect to the construction and maintenance of this type of dams do not required many experts and complex technology, In the case of fundamental research, due to the available facilities and expertise in the country, we can use this technology sufficiently in a recent half century. In the country of India with different climatic characteristics and the characteristics that noted, in many cases rubber dams can be a good alternative.

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Corresponding Author

Mr. Rahul Matkar*

TSSM's Padmabhooshan Vasantdada Patil Institute of Technology Pune-21

E-Mail – rahulmatkarpvpit@gmail.com