Modeling of Screens and Grits for the Big Conduit of Nanakheda in Ujjain

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Abstract: ***As per the study done recently by us [2], the design of the screens and grits of Shipra River should be proposed for the peak flow of the Nanakheda Sewer. That is the peak flow of 25.5150 MLD. This designing consist of the chamber, size of the screens and grits, as well as the bar sizes in between them. The cast iron has been generally used in India for these purposes. [3] One of the main drawbacks of the various models present till day is that they don't get and analyze the data of the hydraulic resistance time at their peak flow so here in this research; we have taken it to assess the perfect model out to our standards. [1] The river Shipra is been suffering from 13 big Conduits (Sewers) which directly dump into the river, their waste waters. [5] This water leads the physical and chemical qualities of the river water to get to its worst condition. [6] If this research is been adopted by the local government, nearly all the solid pollution present in the sewers can be stopped before the sample leading to a better water quality. [7]***

Keywords: Nanakheda, Shipra, design, Sewers, screens, grits, hydraulic resistance, peak flow, Conduits.

1. Introduction

Ujjain is one of the oldest holy cities of India which still exists. Ujjain is located 10 at the heart of India. [4] The word Ujjain has many meanings, it means victory and joy. Different names of Ujjain are Avantika and Avanthipuri etc. [8] Ujjain occupies an important place in ancient times. It is an important and solid tourist place of the country. Ujjain is proud of Mahakaleshwer Temple which is one of the 12 Jyotirlings is present throughout the country. [9, 10]

Ujjain tries to justify the rigid economy and the culture based fabrication and heritage, while retaining the various experiences and stories about the city, social customs and real characters like King Vikramaditya, Kalidas etc. [15]

Importance of Shipra River

Shipra starts its cycle in the windy mountains from a large local hill call Kokri Tikri on the Camps Road which was 11 km is from the Ujjain and about 14 km is from Indore city. [11] It flow about one third of the way through Dewas district near various villages and the Shipra River passes about 10 km away from Dewas at last the river passes 14 km bisecting the Ujjain city. [12] The water way is total 195 km of Shipra River of which is 93 km is passes through the Ujjain district. The sea area of the Shipra check is approximately 560 m^2 per kilometer before joining the Chambal near Ratlam and Mandsaur. [13]

Shipra is mentioned not only in the ancient Hindu Puranas but also in the Buddhist and Jains, who runs rumors from far away which suggest that the destroyer of the word the Lord Shiva one use the skull of the Lord Brahma the creator of the world as an equation ball in Ujjain causing the birth of Shipra River. [16]

The flood plain of the Shipra River is designed to support us across. Similarly 5 MCFT of the usual water for Ujjain daily is been supplied as because Gambhir was drained this year. The drinking water from the Ujjain since 1980 comes from the Gambhir river, because the Shipra river is instable and it flows only through the important cities of Dewas and Ujjain only in rainy season. So a dam is been made in 1980 on the Gambia River. She has to be an important as because in Ujjain Singhastha festival comes every 12 years. Most recently it came into 2016 on Shipra River in Ujjain only. [17, 20]

The Shipra River is a long river people all over the world gathered in Ujjain. Why? As because it is said that there was a conflict between the gods and the diamonds when they brought a Amrit out of the sea during the work, the few drops of the Amrit spilled into the canals of Ujjain, Nasik, Prayag and Haridwar. This is why the Kumbh Mela is been celebrated in Ujjain and rest all places. [18, 19]

The pollution sources of Shipra:

The Nanakheda Naala – The area is densely populated and also has several marriage Gardens and Holiday homes, resorts and nurseries all these dump their wastes directly into the sewer, the waste and along the Nanakheda nalla peaks concentrations of 25.5150 MLD since the gravity of the pipe is on the channel. It appears to be with the development of the horseshoe where we can take water from here to the treatment Centre in L shaped Nalla gravitationally. After the Nanakheda, most of the water can be transformed to a free land between the bypass and Indore bypass in the Nanakheda Road.

We have can plant breeds to make Phythoremedation in the area. These plants can Drink a lot of water they can use this garbage easily. These plants are eucalyptus, bamboo spices, Reed Grass etc. which can be used again and again; this will help us in limitation of the pollution as well as generate the income from the sale of wood of these plants by offering them different treatments.

Screening

It is the basic primary water treatment process, the screen limit solid big objects like paper, plastic, metals, clothes and organic matter from water. These objects were removed in primary treatment that to not damage the process. Line equipments like pipeline wall. Same does increase the productivity and efficiency of the process.

What's a screen? – The screens of the iron bars welded very close to each other with an opening. Both circular as well as rectangle, that is able to hold various floating objects found in waste water.

Screens are of two types 2 sizes.

1) **The core screen–** this eliminate the big particles and solid from waste water. If the iron bars are present at a distance of more than 6 mm, it is known as the core screen. The course screen is manually hand clean or mechanically now a day's Clint cleaners are been there for mechanical cleaning.
2) **The fine screen** – These are more important and generally placed after the core screens. These eliminate the material left out of the course screen which can create problem in the downstream. The downstream maintenance if the iron bars are placed at the opening between 1.5 mm to 6 mm, it is known as the fine screen. The fine screens are of two types drum type and disk type, generally these are manually hand clean but nowadays various mechanical machines are present to clean them with a low-cost maintenance.

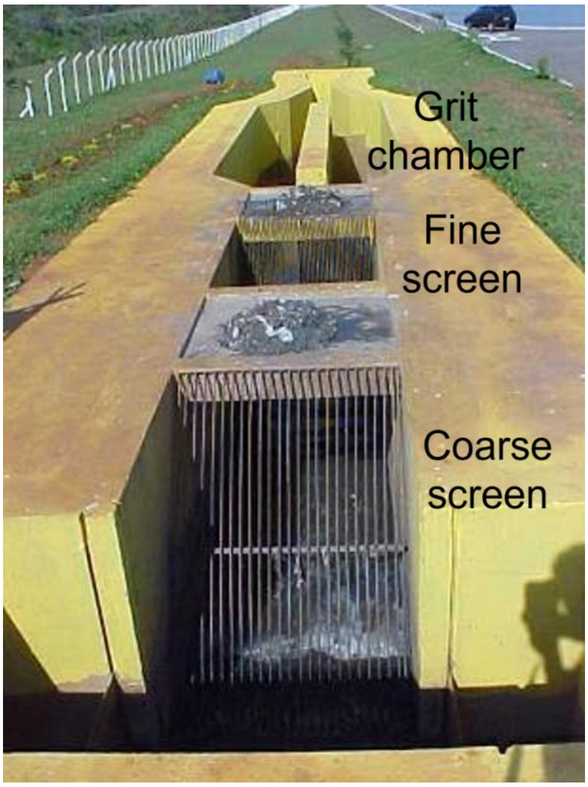

Photo 1: Photo of screen proposed

Grits

The grits are explained as the solid materials present which are having a higher specific gravity as send gravels etc. This can be organic biodegradable particles to in the waste water grits, these particles can be seeds, food waste, bone chips, bone brakes etc.

These particles should be removed as they will cause problem in the mechanical process like irrigation, aerobic digestion etc and will cause we are and tear in various parts. So the grit removal should be done before aeration process.

There are various grit removal main methods present nowadays which includes vortex types, removal, Jet removal, detritus tank removal, sedimentation basin, aerated grit chamber, vertical flow grid chambers and the best is the cyclonic initial separation by water and air. A large space is required for the grit removal as well as the cost is very high. So while selecting the grit removal technology, we should keep in mind the gravitational downstream flow, quality and quantity of grits, head loss, requirements, space requirements, removal efficiency and economics of the area.

2. Material and methods

The flow of the sewer whole year is not at its max. It is nearly uniform throughout the year, but maximum in the rainy season at its peak flow of 25.5 150MLD so here we will have to design the screens first keeping the peak flow in the mind. The screen is been adopted with a flight bars of 10 mm weight and about 50 mm clear area So a calculation of the gross area of the screen is been taken and then we calculate that the angle will be at least best for the particular screen.

In the designing of the grit, a whole new level is been needed with various specifications of the sewage from its specific gravity to its kinematic velocity. Also the settling effect is to be calculated by the strokes law method. Then we will have to calculate that and also number if it comes greater than 0.5, then the strokes law will not be applied.

After this, we have to calculate the surface flow rate with 75% efficiency which will lead us to the maximum overflow rate that can be there in the drain.

The calculation of the flow wire is the most critical in the grit modeling as this will be the basic in the grit base width so these have to be taken extra care of.

Calculations and the results –

For Zone 1 Screen

S. No. Screens Values

1) Peak Flow = Avg. Flow x 2.25 = 11.34 x 2.25 = **25.515** MLD
2) Design Velocity (v) of Screen = 0.8 met / sec.
3) Net Area of the Screen = 0.26 / 0.8 = 0.208 m^2
4) Adopting Screen with flat bars of = 6 / 5 x 0.208

10 mm width and 50 mm clear = 0.25 m^2

Opening, Gross Area

5) Velocity above Screens (Vs) = 5 / 6 x 0.25 = 0.208 met / sec
6) Head loss Throw the Screen = $0.0729 \times (Vv^2 - vsVs2 = \quad 0.0729 \times 0.252 - 0.2082 = 0.001\ m$
7) If the Screen opening half plugged = 0.0729 x 2 x (0.25^2 - 0.208^2) / 2
   Then the velocity through the screen = 0.0007 met.

Is doubled and head loss.

8) Gross Area of the Screen = 0.25 x sin 75° = 0.2414 m^2

(Inclination of Screen at 75°)

Provide Screen of 0.5m x 0.5m with inclination of 75° to horizontal by 5 mm wide bar’s with clean opening of 50mm.

For Zone 1 Grit

1. Peak Flow = 11.34 x 2.25 = 25.515 MLD
2. Specific Gravity for particle size 0.15 mm= 2.65
3. Kinematics velocity of sewage at 15°c = 1.14 x 10^{-6} m^2/sec
4. Settling Velocity by Strokes law (Vs)

$$= \frac{9.81\left\{(1.34-1)\left(0.15 \times 10^{-3}\right)^2\right\}}{18 \times 1.14 \times 10^{-6}}$$

= 0.001 m / sec

5. Check for Reynolds’s number = $\frac{\{0.001 \times 15 \times 10^{-3}\}}{18 \times 1.14 \times 10^{-6}}$

= 0.74

Since 0.74 > 0.5 hence Strokes law does not apply

6. Applying Transition Law for $0.5 < R < 10^3$

$= [0.707\{(2.65 - 1)(0.15 \times 10^{-3})^{1.6}\} \times (1.14 \times 10^{-6})^{-0.6}]^{0.714}$

= 0.0168 m/sec.

7. Surface Overflow rate = 1451.8 cum /m^2 /day
8. Actual SOR at 75% efficiency and = $\{1451.8 \times 0.125\}/\{(1–0.75)^{0.125}–1\}$

Good performance n = 1/8 = 959cum / m^2 / day

9. Plan Area of Grit Chamber = 25.515 x 1000 / 959 = 26.60m^2 = 5.15m x 5.15m
10. Critical Velocity for re suspension Vc = $\{BK\}^{0.5}$ / {f(s - 1) gd}

[Given k = 0.04, f = 0.03, gs = 2.65] = {8 x 0.04}0.5 / {0.30(2.65 – 1) x 9.81 x 0.15x10^{-3}}

= 0.161 m/sec

11. Depth of the Channel = 1 meter
12. Horizontal Velocity = 0.723 / (1 x 2.5) = 0.2892 m/sec

So 0.2892 m/sec is > 0.161 m/sec

13. Hydraulic residence time at Peak Flow = Volume / Peak Discharge

= (2.5 x 11.25 x 1)/ (0.43) = 65.40 sec

14. Total Depth = Water depth + free board + grit Storage space = 1 + 0.5 + 0.25 = 1.75 met.
15. Proportional flow wire = Q / [c $(2 a)^{½}$ {g h – (a/3)}]

= 0.486 / [0.61$(2 \times 0.035)^{½}$ x {9.81 x 1 – 0.035 / 3)}]

= 0.31 m.

Provide one grid chamber of size 5.15m x 5.15m x 1.75m with a proportional flow of base width of 0.31 m.

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