Activity Report

On 11 May, 2022

Field Visit Design Thinking & Critical Thinking

In Association with

Civil Engineering Students Association (CESA)

Department of Civil Engineering

CIVIL ENGINEERING STUDENT ASSOCIATION

Shri Vile Parle Kelavani Mandal's

Institute of Technology, Dhule's

Activity
On

Field Visit Design Thinking & Critical Thinking

Water Treatment Plant Visit and Design of New WTP

IIC Self Driven Activity for Year 2021-22

"WTP Plan and Design"

11th May, 2022

Institutional IIC Certificate

MoE's INNOVATION CELL (GOVERNMENT OF INDIA)

INSTITUTION'S INNOVATION COUNCIL (Ministry of Education Initiative)

CERTIFICATE

This is to certify that

Shri Vile Parle Kelvani Mandals Institute of Technology, Dhule

has established Institution Innovation Council(IIC) as per the norms of Innovation Cell, Ministry of Education, Govt. of India during IIC Calendar year 2020-21

Prof.Anil D.Sahasrabudhe
Chairman, AICTE

Dr. Abhay Jere
CIO, MHRD,
Innovation Cell

Date : 2020-09-11

Certificate No : 4670

SVKM's Institute of Technology,Dhule.

IIC President- Dr.Nilesh Salunke
IIC Vice President - Dr. Shrikant B. Randhavane
IIC Convener - Prof.Dr. Namra Joshi
HOD Mech. Engg.- Dr. Hitesh Thakare

Departmental IIC Coordinators

- **Prof. Deepak Singh Baghel**
- **Prof. Achal Agrawal**

Event Details

Introduction:

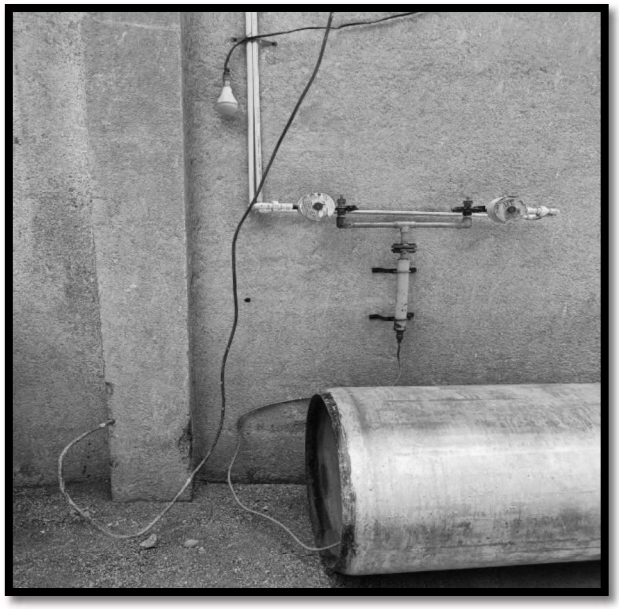
SVKM's Institute of Technology have established Institute Innovation Council (IIC) as per the norms of Innovation Cell, Ministry of Education, MHRD, Govt. of India. Under this council, all departments are conducting series of programs including IIC Calendar Activities as well as Self Driven Activities. SVKM's IOT IIC established on 11-09-2020 for the Academic Year 2021-22.

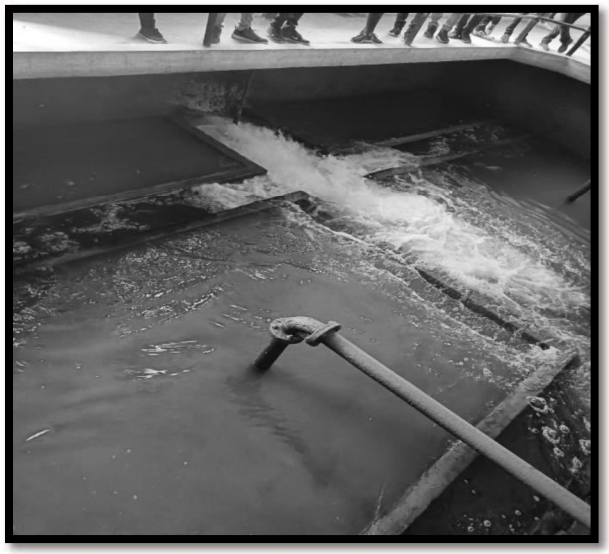
As a part of IIC self Driven Activities, Department of Civil Engineering conducted Field Visit for Design Thinking & Critical Thinking of Water Treatment Plant at Hanuman Tekri, Dhule (MS) on 11th May, 2022 at 10:00 AM.

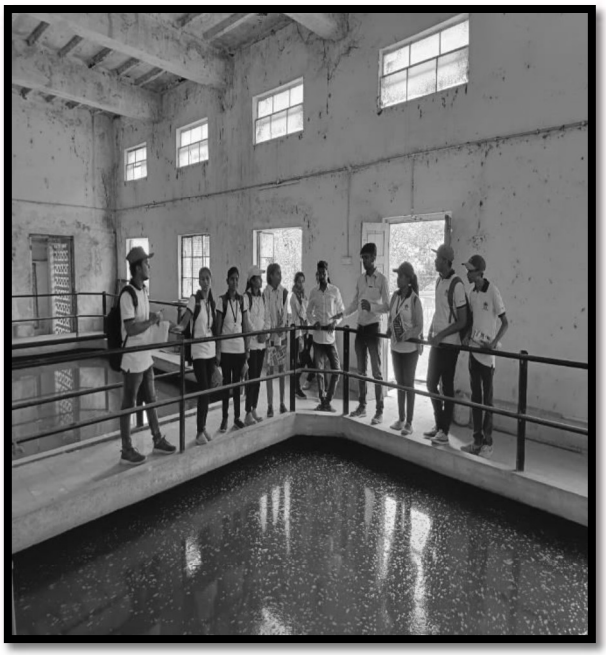
Field Visit Highlights

For this activity, the coordinators were Prof. Deepak Singh Baghel and Prof. Achal Agrawal. It included visit of students to Water Treatment Plant(WTP) at Hanuman Tekri, Dhule (MS). After the visit students have analyzed processes and units in the WTP. Based on Analysis, it was found that existing capacity of WTP (18 MLD) is insufficient to fulfill the demand. Hence, a new WTP was designed for meeting future water demand of Dhule city. The new WTP was designed for next 30 years population. The future demand was calculated using population forecasting methods. The new plan was prepared using AutoCAD and design of different units was done by students with reference to CPHEEO manual. The new design helped students to develop skill of Design thinking and Critical thinking.

Following are the some of the glimpses of the activity







The Plan and design of new WTP for Dhule City

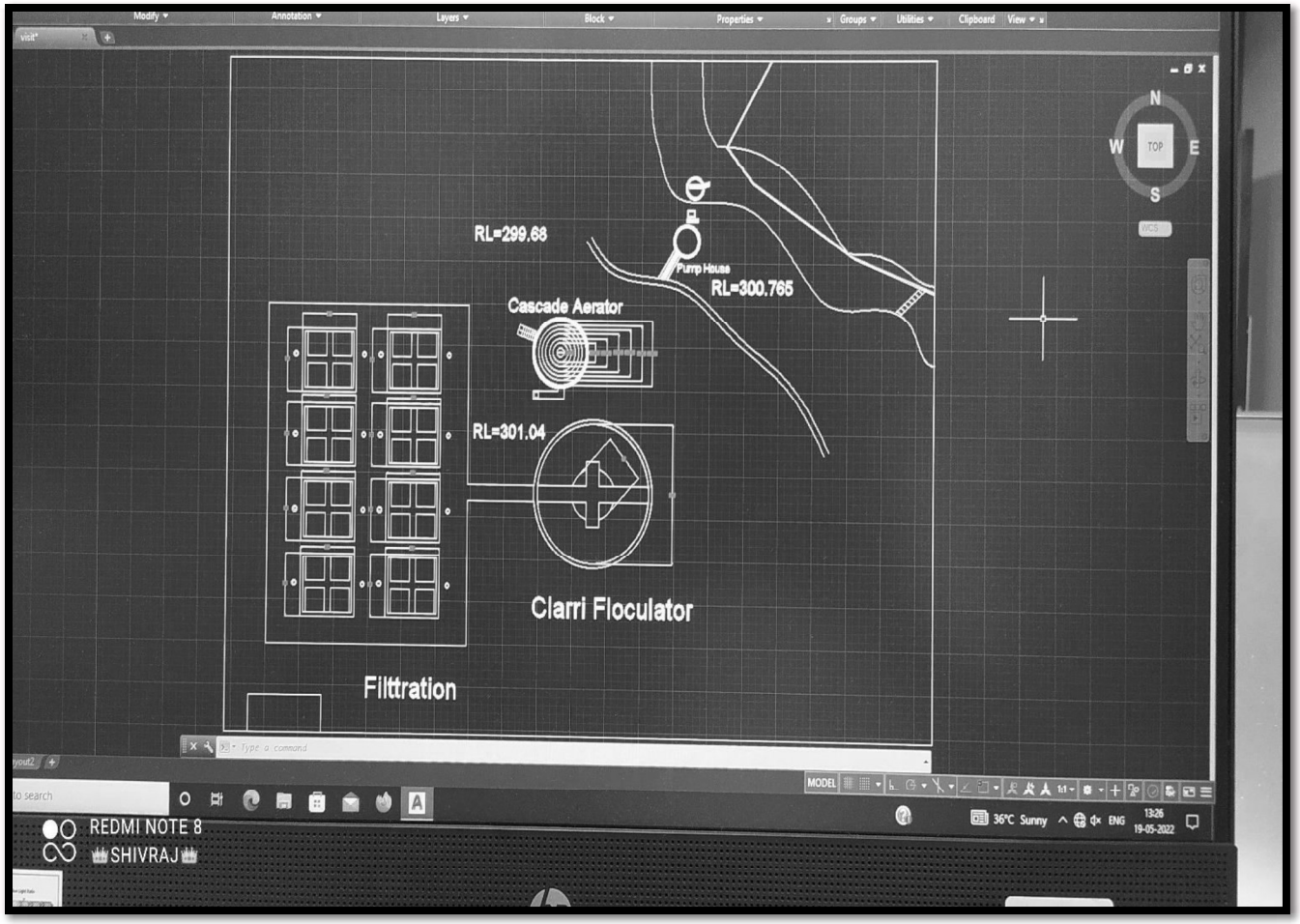
Objectives

1. To design new WTP by analyzing existing one.

Benefits:

1. This activity helps in Design Thinking and Critical Thinking of Students.
2. This helps utilization of theory knowledge in field.

We thank, Dhule Municipal Corporation and Engineers at WTP, Hanuman Tekri, SVKM's Management & our Honorable Principal Dr. Nilesh Salunke IIC President SVKM IOT, Dr. Shrikant B. Randhavane IIC Vice President, SVKM IOT, Dr Namra Joshi, IIC Convener, SVKM IOT, and all our departmental colleagues & students who participated in this activity.



Design Criteria for Design of Cascade Aerator

* Area required of Design of Aerator
  $= 0.015 - 0.045\ m^2/m^3/hr.$
* No. of cascade = 3 to 9
* Height of aerator = 1 to 3m
* Rise of each step = 20 to 50 cm
* Velocity of inlet pipe = 0.3 to 0.9 m/s.

Design a Cascade Aerator for inflow

A. **Design of Inlet pipe:**

Flow - Q = 37.125 MLD
$= \underline{0.425\ m^3/s}$

Assuming velocity through pipe = 0.9 m/s

Area of inlet pipe = $(Q/v) = 0.425/0.9 = 0.4722$
$= (\pi/4)\, d_p^2$

d_p = Diameter of Inlet pipe = 0.774 m

B. Design of Aerator:

Assuming Area required for Design of Aerator = $0.03 m^2/m^3/hr$

$Q = 1546.875\ m^3/hr.$

Area of Bottom Cascade aerator = 0.03×1546.875
$= 46.406 m^2$

Total area of bottom cascade aerator = Area of bottom Aerator + Area of inlet pipe

$= 46.406 + 0.472$
$= 46.878 m^2$

B. Design of Aerator

Total area of bottom cascade aerator = $46.878 m^2$

Assuming no. of steps = 6

Diameter of bottom Cascade :-

$(\pi/4) d_6^2 = 46.878$

$d_6 = 7.725\ m$

Assuming Height of Aerator = 3m

Rise of each step 3/6 = 0.5m

Diameter of 5th Cascade Aerator

$(7.725/3) = d_5/(3-0.5)$

$d_5 = 6.43m$

Diameter of 4th Cascade Aerator

$(7.725/3) = d_4(3-1)$

$d_4 = 5.144m$

Diameter of 3rd Cascade Aerator

$(7.725/3) = d_3(3-1.5)$

$d_3 = 3.858m$

Diameter of 2nd Cascade Aerator

$(7.725/3) = d_2(3-2)$

$d_2 = 2.572m$

Design of 1st Cascade Aerator

$$(7.725/3) = d_1 (3/ - 2.5)$$

$$d_1 = 1.286 m$$

c. **Design of Collecting Channels**

Diameter of Collecting channel = 7.725+1+1
= 9.725 m

$$q = Q/2 = 1.375 b \times h^{(3/2)}$$

$$q = \frac{0.425}{2} = 1.375 \times 1 \times h^{3/2}$$

$$h = 0.440 m$$

Where q = discharge through channel in m^3/s
b = width of channel
h = height of channel.

Assume height of freeboard = 0.5 m

Total height = 0.94 m

PST

Design a plain sedimentation tank for max. daily demand of water 74.24×10^6 lit/day Assume the velocity of flow to be 20cm/min and detention time 4 hours

Ans → Quality of water to be treated :

$= 74.25 \times 10^6$ lit/day

$= 3093750$ lit/Hr

$= 3093.750$ m^3/Hr

Capacity of sedimentation tank required

$= V = Q \times DT$

$= 3093.75 \times 4$

$= 12375$ m^3

The required capacity of sedimentation is more

Hence, we provide 4 tanks.

∴ capacity of sedimentation of tank

$V_1 = V/4 = 12375/4$

$= 3093.75$

Velocity of flow to maintained through the tank

$V = 30cm/min = 0.3m/min$

The length of tank / tank required

$$L = \frac{V}{4} \times DT$$

$$= \frac{0.3}{4} \times 4 \times 60 = 18\,m$$

The c/s area of 1 tank is required

: (capacity of 1 tank / length of 1 tank)

$$= 3093.75 / 18$$

$$= 171.875$$

Assuming the water depth in tank is 4.5 m

Total width of tank :

$$B = \text{c/s area} / \text{depth}$$

$$= 171.875 / 4.5$$

$$= 38.19\,m$$

The width of 1 tank

$$= 38.19 / 4$$

$$= 9.54\,m \; (< 12m)$$

F.B : 0.3 m

Depth of sludge : 0.3 m

over all depth of tank : 4.5 + 0.3 + 0.3

= 5.1 M

∴ Dimensions of tank

= 18 m x 9.54 m x 5.1 m

Q1] Design a circular clarriflocculator for Treating water for Required Population of 6,50,00. with a daily per capita consumption of 135 LPCD. Assume surface loading rate as 1000

Average daily Consumption = $6,50,000 \times 135$
$= 74.25 \times 10^6$ litres

Max. daily demand $= 1.8 \times 74.25 \times 10^6$
$= 133.65 \times 10^6$ litres

Surface area of tanks $= \frac{74.25 \times 10^6}{24 \times 1000} = 3093.75 m^2$

Take three tanks.

Area of each Tanks $= 3093.75 / 3 = 1031.25 m^2$

Assume detention period $= 3h$

Volume of tanks $= \frac{74.25 \times 10^6 \times 3}{3 \times 24 \times 1000} = \frac{9281.25 m^3}{3}$
$= 3093.75 m^3$

Water depth in tanks $= \frac{\text{Volume}}{\text{Area}} = \frac{3093.75}{3093.75} = 1m$

Provide 0.5m for sludge and 0.5m as free board.

Total depth of tank $= 1 + 0.5 + 0.5 = 2m$

Clarriflocculator surface area $= \frac{\pi}{4}(D^2 - D_1^2)$

$= 1081.25 m$

$D^2 = \frac{3031.25}{\pi} \times 4 \times 12^2 = 189076$

D_1 = dia of Floculatora $= 12m$ (as calculated at II)

$D = \sqrt{189076} = 36.9 = 37m$

ii) Design of Floculator:

Assume detention period for floc. formation = 20 minutes

Volᵐ of flocculation =

$$\frac{74.25 \times 10^6 \times 20}{1000 \times 60 \times 24} = \frac{1031.25}{3} \ m^3$$

$$= 343.75 \ m^3$$

Assume depth of flocculation zone = 3m

Area of flocculation zone

$$= \frac{1031.25}{3}$$

$$= 343.75 \ m^2$$

Provide three tanks

Area of each tank = $\frac{343.75}{3} = \frac{114.58\bar{3}}{3}$

$$= 38.3 \ m^2$$

Dia of flocculator

$$D_1 = \sqrt{(4 \times 38.3)/\pi}$$

$$= 6.98m \simeq 7m \quad \ldots \text{II}$$

Que. Design the approximate dimensions of a set of rapid gravity filters for treating water required for a population of 5,50,000 ; the rate of supply being 135 litres per day per person. The filters are rated to work 6000 litres per hour per Sq. m. Assume whatever data are necessary, & not given.

Ans: Population : 5,50,000

$Q = 135$ ~~LCPD~~ LPCD

Max^m water demand per day,

$= 5,50,000 \times 135$

$= 74.25 \times 10^6$ Litres

Assuming that 4% of filtered water is required for washing of the filter, everyday, we have,

Total filtered water required per day,

$= 74.25 \times 10^6 \times 1.04$

$= 77.22 \times 10^6$ litres

$= 77.22$ MLD

Now, assuming that 0.5 hour is lost everyday in washing the filter, we have

Filtered water required per hour,

$= \frac{77.22}{23.5} = 3.28$ MLD

Now, assuming the rate of filtration to be 6000 litres / hr. / Sq.m, we have

The area of filter required,

$= \frac{3.28 \times 10^6}{6000} = 546$ Sq.m

Now, assuming the length of filter bed (L) as 1.5 times the width of the filter bed (B), & 8 beds, the total area provided -

$$L = 1.5\,B$$

$$\therefore\ 8 \times (L \cdot B) = 546$$

$$8 \times (1.5\,B)(B) = 546$$

$$B^2 = \frac{546}{8 \times 1.5}$$

$$\therefore B = 7\,m$$

$$L = 7 \times 1.5$$

$$\therefore L = 10.5\,m$$

Hence, adopt 8 filter units, each of dimensions $(10.5 \times 7)\,m$.

* Design of under-drainage system :

Let a "manifold & lateral system" to be provided below the filter bed, for receiving the filtered water & to allow back washing for cleaning the filter.

This consists of a central manifold pipe, with laterals having perforations at their bottom.

To design this system, let us assume that the total area of the perforations in all the laterals is 0.2% of the total filter area

$\therefore$ Total area of perforations,

= 0.2% × Filter area

$= \frac{0.2}{100} \times (10.13) \times 7$

$= 0.141\ m^2$

Now, assuming the area of each lateral,

= 2 x total area of perforation

$= 2 \times 0.141$

$= 0.282\ m^2$

Hence, assuming the area of manifold to be about twice the area of laterals, we have,

The area of manifold -

$= 2 \times 0282$

$= 0.564 m^2$

∴ Diam. of manifold (d) is given by,

$\frac{\pi}{4} \cdot d^2 = 0.564$

$= \frac{0.564 \times 4}{\pi} = d^2$

$\therefore d = 0.718 \approx 1m$

Hence, use 100cm diam. manifold pipe laid length wise along the centre of the filter bottom.

The no. of laterals is given as -

$= \frac{10.13 \times 100}{15} = 68$ Nos

Now, length of each lateral,

$$= \frac{\text{Width of filter}}{2} - \frac{\text{Diam. of manifold}}{2}$$

$$= \frac{7}{2} - \frac{1}{2} = 3\text{m}$$

Now, adopting 13 mm diam. perforations in the laterals, we have

Total area of perforations $= 0.141\ m^2$

$$\therefore 1410 = x \times \frac{\pi}{4} \times (1.3)^2$$

$$\therefore x = 1063$$

[where,
x = Total no. of perforations in all laterals]

No. of perforations in each lateral,

$$= \frac{1063}{160} = 7$$

$\therefore$ Area of perforations per lateral,

$$= 7 \times \left[\frac{\pi}{4} \times (1.3)^2\right] cm^2$$

$$= 8.9\ cm^2$$

Now, area of each lateral

$= 2 \times$ Area of perforations per lateral

$= 2 \times 8.9$

$= 17.8\ cm^2$

∴ Diam. of each lateral, (d)

$$= \sqrt{\frac{17.8 \times 4}{\pi}} = 4.8\,cm$$

Hence, use 136 laterals each of 4.9 cm diam., @ 15 cm c/c, each having 7 perforations of 13 mm size, with 100 cm diam. manifold.

CHECK:

Length of each lateral / Diam. of lateral $= \frac{300}{4.8}$

$= 62.5$

* Design of wash water troughs:

Wash water troughs, as said earlier, are generally kept at about 1.5 - 2 m apart. So in a width of 7m of filter bed, let us provide 3 troughs, at $\frac{7}{3} = 2.33\,m$ apart.

Now,

The total wash water discharge, ~~of~~

$$= \frac{0.60\,(10.13 \times 7)}{60} = 0.709\ m^3/sec$$

The total wash water discharge of $0.709\ \frac{m^3}{sec}$ enters in these 3 troughs,

/

∴ Discharge in each trough,

$$= \frac{0.709}{3} = 0.236 \text{ m}^3/\text{sec}$$

The dimension of a concrete V-bottom trough are now designed by using an emperical formula,

$$\boxed{Q = 1.376 \times b \times y^{3/2}}$$

where,

Q = discharge in m^3/sec

b = width of trough in m = 1 (assume)

y = water depth in trough in m

Let, $0.236 = 1.376 \times 1 \times y^{3/2}$

$$y^{3/2} = 0.171$$

$$y = 0.308 \text{ m} \approx 30.8 \text{ cm}$$

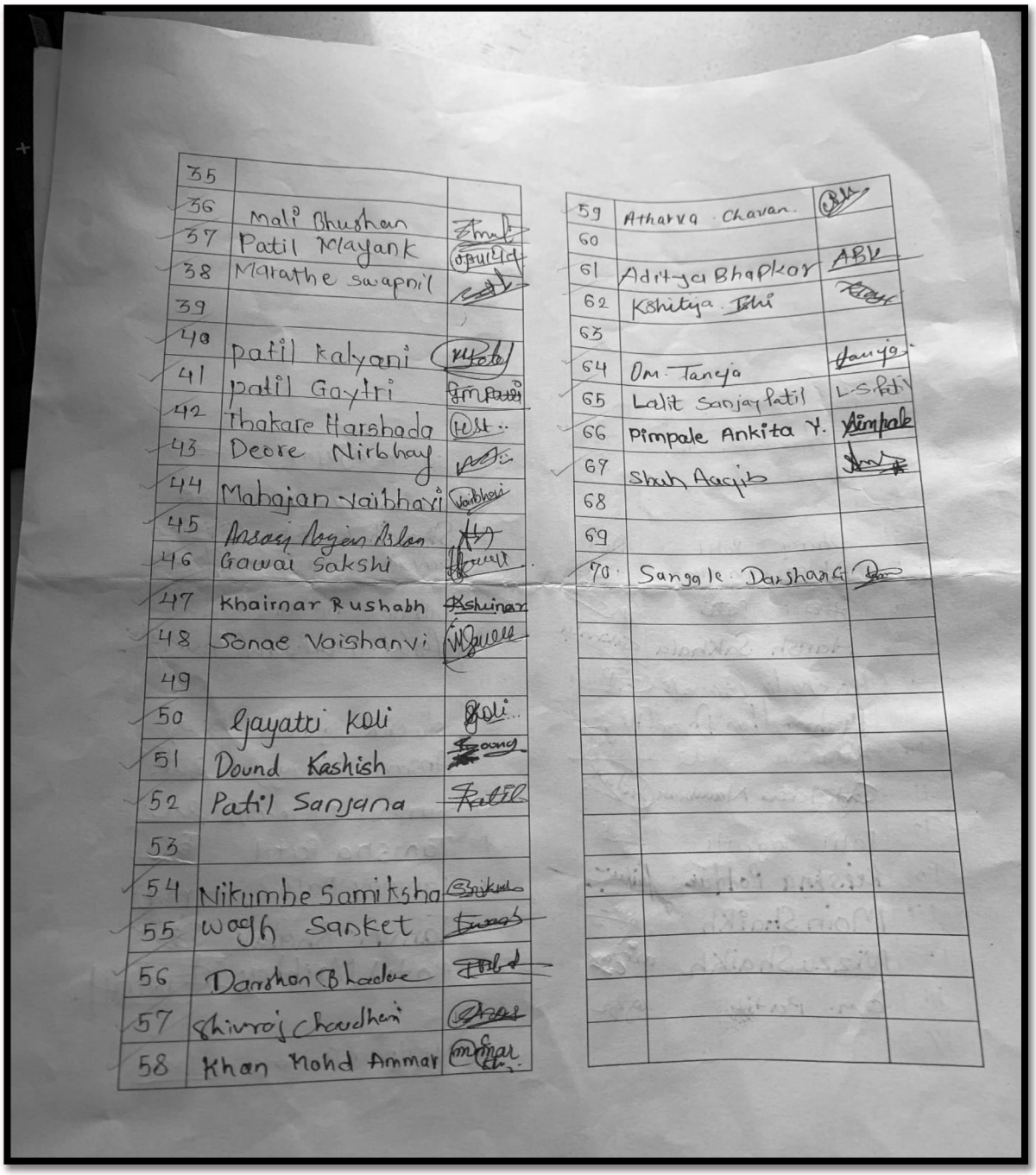
Assume, 5cm freeboard, adopt the depth of trough, -

$$= 30.8 + 5$$

$$= 35.8 \text{ cm}$$

Hence, 3 No. wash water troughs at size 35.8cm x 30.8 cm may be used.

Attendance of Participants



35		
36	Mali Bhushan	
37	Patil Mayank	
38	Marathe swapnil	
39		
40	patil kalyani	
41	patil Gaytri	
42	Thakare Harshada	
43	Deore Nirbhay	
44	Mahajan vaibhavi	
45		
46	Gawai Sakshi	
47	Khairnar Rushabh	
48	Sonae Vaishanvi	
49		
50	Gayatri koli	
51	Dound Kashish	
52	Patil Sanjana	
53		
54	Nikumbe Samiksha	
55	wagh Sanket	
56	Darshan Bhadane	
57	Shivraj Chaudhari	
58	Khan Mohd Ammar	

59	Atharva Chavan.	
60		
61	Adityaj Bhapkar	ABK
62	Kshitija Ithi	
63		
64	Om Taneja	
65	Lalit Sanjay Patil	
66	Pimpale Ankita Y.	
67	Shaikh Aaqib	
68		
69		
70	Sangale Darshan G	

ATTENDANCE

It will be our sole responsibility about our safety and conduct of behavior during the Industrial Visit organized at Water Treatment Plant, Hanuman Tekdi, Dhule by Department of Civil Engineering on 11th May 2022 for students of Second Year Civil Engineering, SYCE. We will present ourselves in a perfect professional manner during visit and throughout journey by maintaining the dignity and the respect of the institute.

We are also solemnly giving in writing that we shall be responsible for any disciplinary action taken by the college authorities regarding our mischief during the Visit.

Roll No.	Name of Student	Sign
1	Shirsath Abdullah	
2	Magar chirag	
3		
4	Dhiraj Patil	
5	Dhiraj chaudhari	
6	Yiesh Patil	
7	Harsh Sakhala	
8	Harshada Gawali	
9	Harshvardhan Deore	
10	Hitanshu Shinde	
11	Indulekha Nambiar	
12	Patil Jagruti	
13	Krishna Poddar	
14	Main Shaikh	
15	Nizzu Shaikh	
16	Om. Patil	
17		

Roll No.	Name of Student	Sign
18		
19	sai badgujar	
20	Sakshi sonar	
21	Sharthak Patwari	
22	Sayali Mehrunkar	
23	Pathan Shoaib	
24	Lokhi Shrut Sunil	
25		
26	Sneha l gavit	
27	Ansari Subayyi l	
28	Swapnil Dhanvale	
29	Tanisha Patil	
30	Tanmay Patil	
31	Tanvir Sholar	
32	Patil Vaibhav	
33		
34	Yadnya Pawar	

Dr. Shrikant Randhavane

HOD Civil Dept.