Design of Sewerage Network

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Abstract-A sewage network is a system of underground pipes, manholes, and pumping stations that carries sewage from homes, businesses, and industries to wastewater treatment plants. The main purpose of a sewage network is to protect public health and water quality. It is necessary to carry sewage carefully to the waste water treatment plant, otherwise the sewage will contaminate the surrounding environment. This paper represents modelling and designing of sewage network of Walchand College of Engineering, sangli with the help of SewerGEMS. The hydraulic design section includes the calculation of total flow, diameter of pipeline and slope. This application generates reports, graph, section and elevation of profile.

Index term – Sewergems, underground sewage system, sewage network

I. INTRODUCTION

A sanitary sewer is a piping system that carries waterborne waste from residential, commercial or industrial sites to a waste water treatment plant for processing. Sanitary sewers form an extensive network of underground piping in cities and operate under gravity flow or pressure supplied by pumps.

Advantages of Sanitary System-

1] The load on treatment plant is less as only sewage is carried to the plant.

2] When pumping is required, the system proves to be economical.

3] Natural/storm water is not unnecessarily polluted by sewage.

Disadvantages of Sanitary System –

1] The self-cleansing velocity is not easily obtained.

Fig.1 Sample Design of Sewer

2] Maintenance cost is high.

3] Sewage sewers are provided below storm sewer which causes greater depth pumping at waste water treatment plant (WWTP).

II. METHODOLOGY

i. Laying out a network-

Lay out link elements to connect the nodes, as follows:

1. Click the Layout tab and select the Conduit layout tool.
2. Click on MH-1 and drag the mouse to MH-2, and click again to lay out the conduit.

Right-click and select Done from the submenu to complete the conduit.

3. Click PC-1, Drag the mouse to MH-2, and click to lay out a second conduit. The conduit tool is still active, so drag the mouse to MH-3 and click again to lay out a third conduit. Drag and click on MH-4 to lay out a fourth. Right-click and select Done from the submenu
4. Click PC-2 drag the mouse to MH-4, and click. Drag the mouse to MH-5 and click again. Drag to and click on MH-6. Right-click and select Done from the submenu.
5. Click PC-3, drag the mouse to MH-6, and click again. Drag the Mouse to OF-2 and click to lay out the final conduit. Right-click and select Done from the submenu. Press the ESC key to let go of the conduit layout tool.[1]

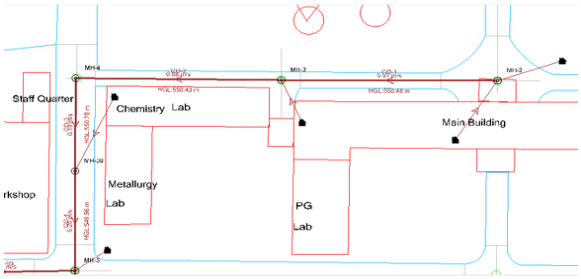

Fig.2 Manhole and Laterals in Sewer GEMS

ii.Entering data-

1. Double click on the PC-1.
2. Enter the following data in the specified fields:

FIELD	VALUE
Elevation (Ground) (m)	550.00
Elevation (Invert) (m)	549.20

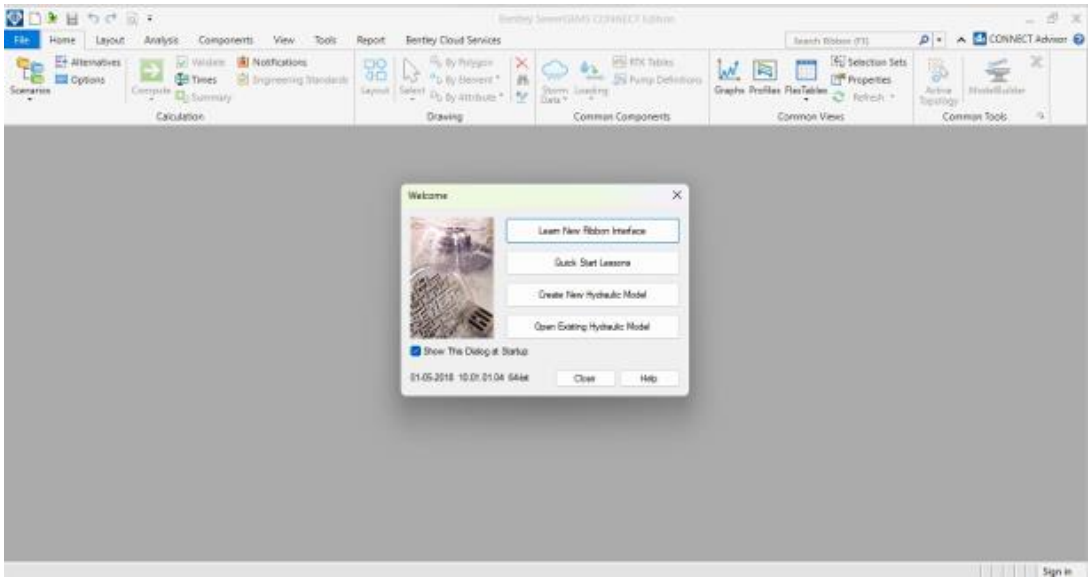

Fig. 3 Interface of SewerGEMS

3. Enter base flow (L/day). & sanitary Unit loading & it's type.[1]
4. Sanitary (Hydrograph load) .
5. Double click on MH nodes . give following properties to all MH nodes.

- Elevation (Ground) (m)
- Elevation (Invert) (m) & specify the type of sanitary load.

6. After applying loads to the laterals, flow from manhole and conduit automatically calculated by the software
7. Click the Validate button in the toolbar, or click the Analysis menu and select the Validate command.
8. A Bentley SewerGEMS Problem dialog appears, informing you that one or more validation errors were found. Click OK in this box.
9. The User Notifications dialog appears, see fig.4 . This dialog lists data entry errors that prevent the model from calculating successfully. These types of errors are marked with a red icon. The model will not compute until the red icon errors are rectified.[1]

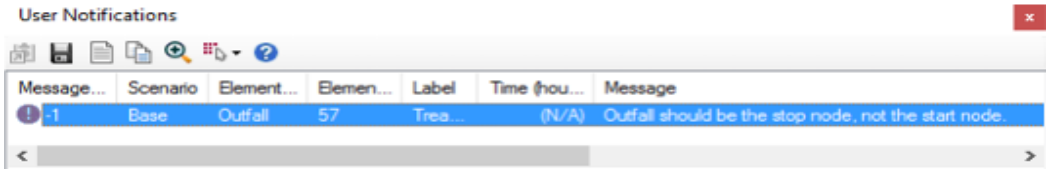

Fig. 4 User Notifications

10.Double-click the message in the list, "Outfall should be the stop node, not the start node" 11. After solving these problems, the networking will be validated.
12. Go to Analysis tool. Click on flex table

. (Table. 1)
13. Click the View tab and select the FlexTables command.
14. Under the Tables - Predefined node, double-click the Manhole Table (Table. 2)
15. Click the View tab and select the Flex Tables command.
16. Under the Tables - Predefined node, double-click the Conduit Table (Table. 3)

- Section Type : Circle
- Diameter : 0.3 m
- Manning's n – 0.0

Table. 1 Laterals Table

ID	Label	Start Node	Invert (Start) (m)	Stop Node	Invert (Stop) (m)	Diameter (m)	Length (m)	Slope (Calculated) (m/m)	Flow (L/day)
214	L-6	PC-7	551.80	MH-65	551.70	0.3	9.0	0.0111	12,000.00

216	L-7	PC-8	550.40	MH-63	550.20	0.3	11.2	0.0179	12,000.00

Table. 2 Manhole Table

ID	Label	Elevation (Ground) (m)	Elevation (Rim) (m)	Elevation (Invert) (m)	Flow (Total In) (L/day)	Flow (Total Out) (L/day)	Depth (Out) (m)	Hydraulic Grade Line (Out) (m)	Hydraulic Grade Line (In) (m)
139	MH-61	550.90	550.90	550.12	37,208.25	37,208.25	0.03	550.15	550.15
141	MH-62	551.30	551.30	550.15	37,208.25	37,208.25	0.02	550.17	550.17
143	MH-63	551.00	551.00	550.20	24,469.50	37,208.25	0.02	550.22	550.22
145	MH-64	552.40	552.40	551.60	12,000.00	12,000.00	0.01	551.61	551.61

Table.3 Conduit Table

ID	Label	Start Node	Invert (Start) (m)	Stop Node	Invert (Stop) (m)	Length (Scaled) (m)	Slope (Calculated) (m/m)	Velocity (m/s)	Depth (Middle) (m)	Flow / Capacity (Design)	Depth /Rise
142	CO-51	MH-61	550.12	MH-62	550.15	30.6	0.0010	0.15	0.03	0.01	0.09
479	CO-141	MH-63	550.20	MH-62	550.15	29.7	0.0017	0.19	0.02	0.01	0.08
146	CO-53	MH-63	550.20	MH-64	551.60	28.5	0.0492	0.42	0.02	0.00	0.05
148	CO-54	MH-64	551.60	MH-65	551.70	24.7	0.0040	0.18	0.01	0.00	0.03

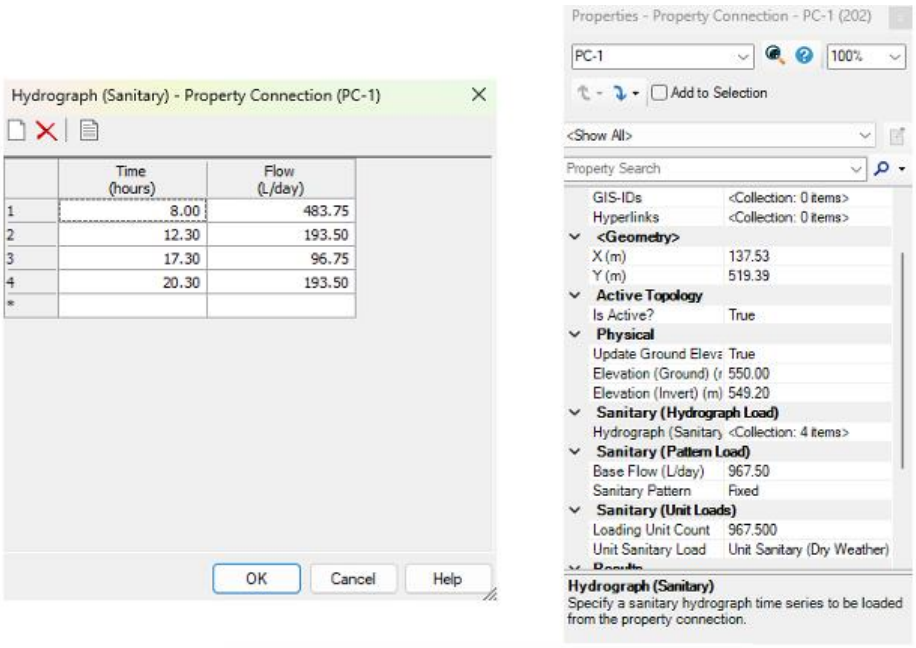

Fig. 5. Hydrograph of D1 Hostel and Property Connection

iii. Hydrograph-

Graphs display calculated result attribute values over time for any element in the model. For elements with more than one attribute available for graphing, you can display all of the attributes on the same graph.

1.Click the Compute button in the Home or Analysis tab, then close the Calculation Executive Summary dialog

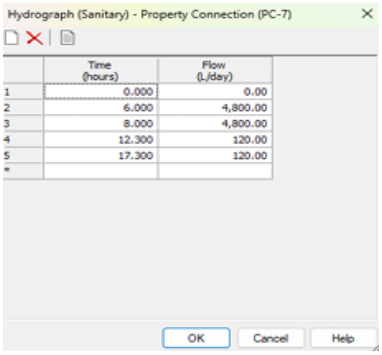

Fig. 6 Data for.Hydrograph for PC-7

2. Right-click on PC-7 and select Graph from the shortcut menu that appears.
3. Click OK on the Graph Series Options dialog that appears. The Graph dialog opens, displaying the plot of total outflow over time (the default attribute for catchment graphs) for MH-1 for the duration of the simulation.
4. You can view fig.7 the data on which the graph is based by clicking the Data tab.

iv. Generating profiles -

Profiles graphically show how a selected attribute, such as hydraulic grade, varies along an interconnected series of network elements over time.
1. Click the Compute button in the Home or Analysis tab, then close the Calculation Executive Summary dialog.
2. Click the View tab and select the Profiles command.
3. In the Profiles manager that appears, click the New button.

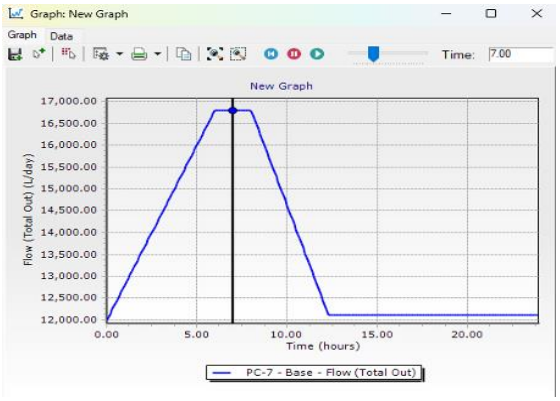

Fig. 7. Flow to Time Graph for Waste Water Discharge

4. In the Profile Setup dialog that appears, click the Select From Drawing button.
5. The mouse cursor changes to an Element Selection tool. Click on MH-65 and MH-64. MH-63, MH-62, MH-61 which is the intermediate node between them, is also highlighted, along with the link elements that join these elements. Right-click and select Done from the shortcut menu that appears, or simple click the green check mark.
6. This returns you to the Profile Setup dialog. Note that the list pane now contains the elements that were highlighted in the drawing pane. These are the elements that will be displayed in the profile, in the order they will appear from left to right in the profile view. Click the Open Profile button.[1]

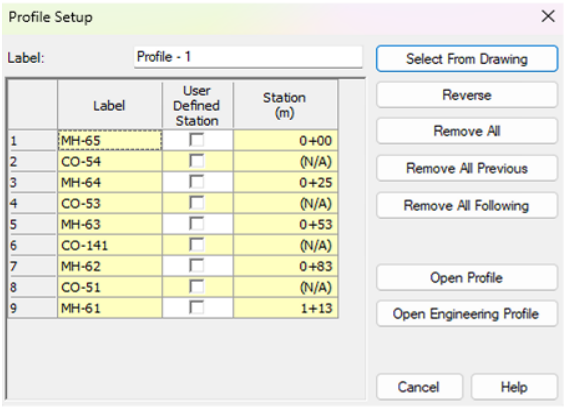

Fig: 8 Profile Setup

Fig:9 Profile Base - Time

Fig. 10 Section and elevation of profile

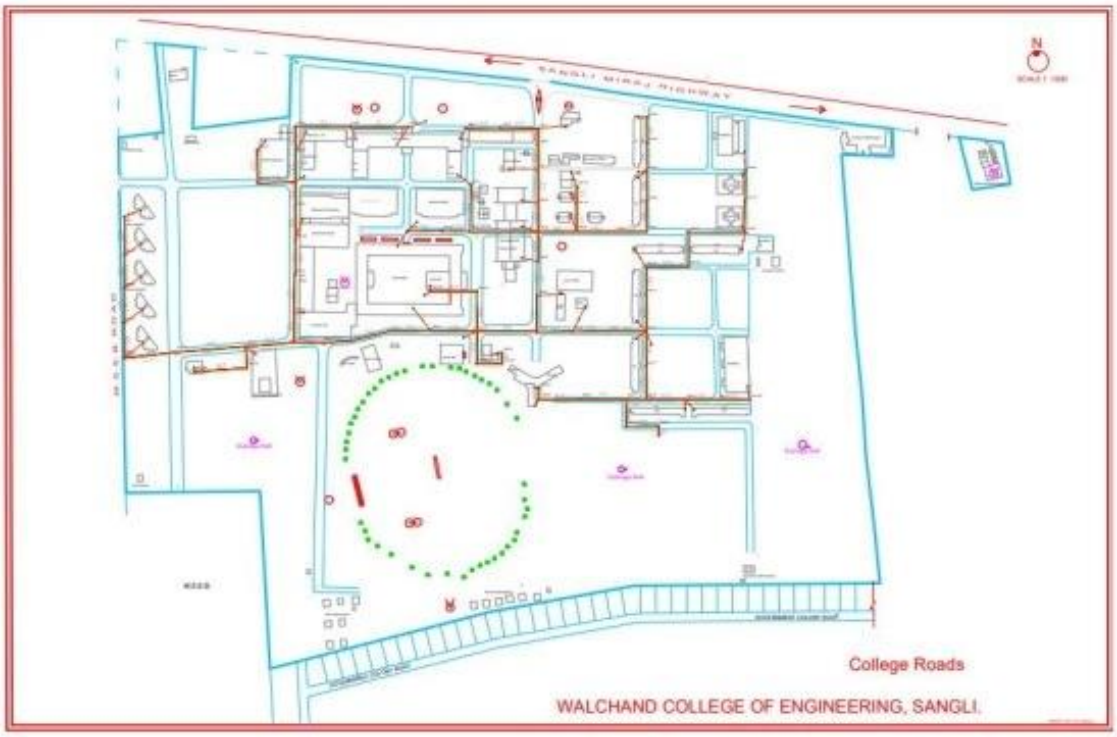

Fig. 11 Network in Walchand Campus

III. CONCLUSION

Sewage treatment plants require a reliable and efficient networking system to ensure proper functioning and monitoring of the treatment process. Networking technology can also help plant operators to monitor and control various aspects of the treatment process, such as the inflow and outflow of , the concentration of pollutants in the effluent, and the operation of equipment such as pumps, filters, and aeration systems. Using SewerGEMS designed the network for campus easy. As it is an advanced software used to design sewer network

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