DESIGNING OF SEWER PIPELINE AT ALTERNATE ROUTE AND DEVELOPING AND TRANSFERRING TECHNICAL DATA WITH AUTOMATION IN AUTOCAD FROM MS EXCEL

[1]Ms Divya Agarwal, [2]Ms Jyoti Singh
[1] P.G Student, [2]Assistant Professor
[1]Department of Civil Engineering
[1]Noida International University, Noida, India

Abstract: There are many optimization ways to design the sewerage system by selecting from the several different commercial pipe sizes available as options for each sewer pipe stage, which are determined by a detailed hydraulic analysis, the goal of which is to meet the design criteria at a minimal cost .But there are no automation for checking the designing of sewerage pipeline through alternate routes and automatically creating the drawing of the same. This study has been undertaken to investigate how we can automatically design the sewer pipeline through different route by linking the AutoCAD in MS Excel and developing the drawing of the sewer pipeline from MS Excel to AutoCAD.

***IndexTerms* – Hydraulic Design of sewer pipeline through different routes, automation of developing drawing from M S Excel to AutoCAD.**

I. INTRODUCTION

A sewer system generally takes advantage of gravity to collect and transport sewage from house to treatment plant, through a network of hydraulically designed pipes which include household connection pipes, as well as secondary and trunk sewer pipes. The sewer pipe-network, the manholes, the pumping stations and other related appurtenances are all connected. Once the layout of a sewer network is determined, there are many optimal hydraulic design program is to select the size and the slope of the sewer pipes that best meet the design criteria and regulatory standards, at a minimal cost. If we want to change the layout of a sewer pipe network then it will be tedious task to redesign the sewer pipeline but if we link the AutoCAD with the design then just by few changes in the design we can do this task in few seconds. Developing the drawing and filling the details of sewer pipeline is again a lengthy work but if we link the design of Sewer pipeline with AutoCAD we can also generate the drawing and fill all the necessary details from MS Excel to AutoCAD.

II. GENERAL DETAILS ABOUT THE HYDRAULIC DESIGN OF SEWER AND AUTOMATION WITH AUTOCAD.

For the hydraulic design of the sewer pipe, Manning's equation is used, which is given as

V = (1/n) R2/3 S 1/2

Where,

V = Design velocity in m/s

n = Manning's roughness coefficient

R = Hydraulic radius in m

S = Hydraulic slope

AutoCAD is a commercial computer-aided design (CAD) and drafting software application .It is based on coordinate system. GIS image are also based on the coordinate system so by matching the coordinate of GIS and AutoCAD we can easily locate the exact position of pipeline on ground. If we have two coordinate points at different locations we can easily calculate the length between the two coordinate points. For Example: - 1, 2 and 2, 3 are two coordinate points, the length between the two points will be $\sqrt{(2-1)^2-(3-2)^2}$ =1.414m. If we just get the coordinate of two points we can calculate the length of the two points. The hydraulic design process of sewer pipeline starts by numbering of the nodes. Along with the numbering of nodes we will capture all coordinate of the nodes .Now, we can easily calculate the length of pipeline between two nodes with the help of coordinate. Next step is the assignment of flows based on population at different nodes. Next step is to select a set of feasible diameters out of the set of specified commercially available diameter for each pipe subject to the condition that the velocity requirement and slope requirement are satisfied (maximum and minimum slopes). This begins with the maximum permissible ratio of depth of flow in pipe (d) to the diameter of pipe (D), calculation of actual pipes slopes and their elevations, determination of velocities and depths of flows the line, checking of the minimum cover depth. The result includes the peak flows, water depths, pipe slopes for each line. Also the U/S and D/S ground elevations, invert elevations/levels calculated and accordingly excavation depth for each line is calculated. In respect of nodes the total excavation depth and the difference in elevation of the highest invert entering the node and that of leaving the node is calculated.

III. DESIGNING OF SEWERAGE PIPELINE THROUGH ALTERNATE ROUTES BY AUTOMATION

Start node with coordinates of AutoCAD and Stop Node with coordinates of AutoCAD helps a lot in designing the alternate routes of sewer pipeline. If we change the Start node and Stop node in the program of MS Excel, then with the help of coordinate we can easily redesign the whole system easily and we can also compare the best feasible route among all the available routes.

IV. AUTOMATION OF DEVELOPING DRAWING AND TRANSFERRING ALL THE DATA FROM MS EXCEL TO AUTOCAD

AutoCAD has coordinate system. As we have all the coordinate of all the start node and stop node. A pipeline is proposed between start nodes and stop node so with the syntax pline x_1, y_1 x_2, y_2 we can easily draw a pipeline between two nodes. Start node details existing ground level, invert level should be written at start node i.e. at co-ordinate of start node x_1, y_1.Length, Diameter and slope of pipe should be written at center of line i.e. middle of the line $(x_1+x_2)/2,(y_1+y_2)/2$.Stop Invert level should be at stop node i.e. at x_2,y_2.

Program for inserting text at given coordinate

```
(defun c:dotext ()
 (setq InsPt (getstring "Insert coords: "))
 (setq InsRT (getstring "Insert ROTATION: "))
 (setq tstuff (getstring T "Text:"))
 (command "text" InsPt "" InsRT tstuff);;edit for text height & rotation
 (princ)
)
```

With the help of this simple program we can easily insert the data from MS Excel to AutoCAD and develop the drawing.

V. SAMPLE EXAMPLE

Example: designing of sewerage pipeline through alternate routes by automation of AutoCAD from MS Excel

First of all, we mark the entire pipeline on the AutoCAD and capture all the coordinate of nodes in MS Excel as shown below:-

Figure 1Start node and stop node of one route of sewer pipeline

Table 1Co-ordinate of all the nodes in MS Excel

Node Number	X (m)	Y (m)	Elevation (Ground) (m)
1	-27.46	97.73	99.7
2	21.96	174.53	99.9
3	-30.50	90.56	99.9
4	31.67	1.36	100.2
5	31.67	68.66	100.1
7	5.33	67.50	100
9	153.16	147.10	100.1
10	155.68	2.06	100.3
11	155.68	59.08	100.3
12	155.68	33.34	100.25
13	115.06	2.34	100.25
14	115.06	58.66	100.25
15	115.06	33.34	100.2
16	71.00	0.95	100.2
17	71.004	33.34	100.15
18	71.004	67.704	100.12
19	71.004	147.095	100
20	57.842	151.439	99.95
21	70.924	167.635	100
19A	71.004	73.378	100
STP	124.629	167.86	100

With the help of these coordinate, length of the pipeline will be calculated and sewer network will be design in MS Excel program as soon below:

Table 2 HYDRAULIC STATEMENT OF SEWERAGE SCHEME OF ONE ROUTE

HYDRAULIC STATEMENT OF SEWERAGE SCHEME																
From node	To node	length	Peak Discharge (Qs)	Diameter of Pipe	Slope of pipe	Discharge full flow (Qf)	Velocity full flow (Vf)	Corresponding Vs/Vf	Actual Velocity (Vs)	Corresponding Ds/Df	Ground Level (m)		Invert level (m)		Depth of Manhole (m)	
											Upper Node	Lower node	Upper Node	Lower node	Upper Node	Lower node
		m	Cum/ sec	mm	1in …..	Cum /sec	m/ sec		m/ sec		m	m	m	m	m	m
1	2	91	0.001	200	50	0.05	1.7	0.4	0.6	0.1	99.7	99.9	98.8	97.0	0.9	2.9
2	20	43	0.001	200	50	0.05	1.7	0.4	0.6	0.1	99.9	100.0	97.0	96.1	2.9	3.8
3	7	43	0.000	200	50	0.05	1.7	0.3	0.6	0.1	99.9	100.0	99.0	98.1	0.9	1.9
4	5	67	0.001	200	50	0.05	1.7	0.4	0.7	0.1	100.2	100.1	99.3	98.0	0.9	2.1
5	7	26	0.001	200	50	0.05	1.7	0.4	0.7	0.1	100.1	100.0	98.0	97.4	2.1	2.6
7	20	99	0.001	200	50	0.05	1.7	0.4	0.7	0.1	100.0	100.0	97.4	95.4	2.6	4.5
9	19	82	0.001	200	50	0.05	1.7	0.4	0.7	0.1	100.1	100.0	99.2	97.6	0.9	2.4
10	12	31	0.000	200	50	0.05	1.7	0.4	0.6	0.1	100.3	100.3	99.4	98.8	0.9	1.5
11	12	26	0.000	200	50	0.05	1.7	0.4	0.6	0.1	100.3	100.3	99.4	98.9	0.9	1.4
12	15	41	0.001	200	50	0.05	1.7	0.4	0.7	0.1	100.3	100.2	98.8	98.0	1.5	2.2
13	15	31	0.000	200	50	0.05	1.7	0.4	0.6	0.1	100.3	100.2	99.0	98.4	1.3	1.8
14	15	25	0.000	200	50	0.05	1.7	0.4	0.6	0.1	100.3	100.2	99.4	98.8	0.9	1.4
15	17	44	0.001	200	50	0.05	1.7	0.4	0.7	0.1	100.2	100.2	98.0	97.1	2.2	3.1
16	17	32	0.000	200	50	0.05	1.7	0.4	0.6	0.1	100.2	100.2	99.3	98.7	0.9	1.5
17	18	34	0.002	200	100	0.04	1.2	0.5	0.6	0.2	100.2	100.1	97.1	96.7	3.1	3.4
18	19A	6	0.003	200	100	0.04	1.2	0.6	0.7	0.2	100.1	100.0	96.7	96.7	3.4	3.3
19A	19	74	0.003	200	100	0.04	1.2	0.6	0.8	0.2	100.0	100.0	96.7	95.9	3.3	4.1
19	20	14	0.004	200	100	0.04	1.2	0.6	0.9	0.2	100.0	100.0	95.9	95.8	4.1	4.1
20	21	21	0.006	200	100	0.04	1.2	0.7	0.9	0.3	100.0	100.0	95.4	95.2	4.5	4.8
21	STP	54	0.006	200	100	0.04	1.2	0.7	0.7	0.3	100.0	100.0	95.2	94.7	4.8	5.3

This is one route of sewer pipeline which we have proposed .Now we want to change the previous start node of 18 to stop 19A to start node 18 to stop node 5 then just changing the start node and stop node in MS Excel rest all the details will change automatically and redesign of sewer new network will be done.

Figure 2Start node and stop node of another route of sewer pipeline

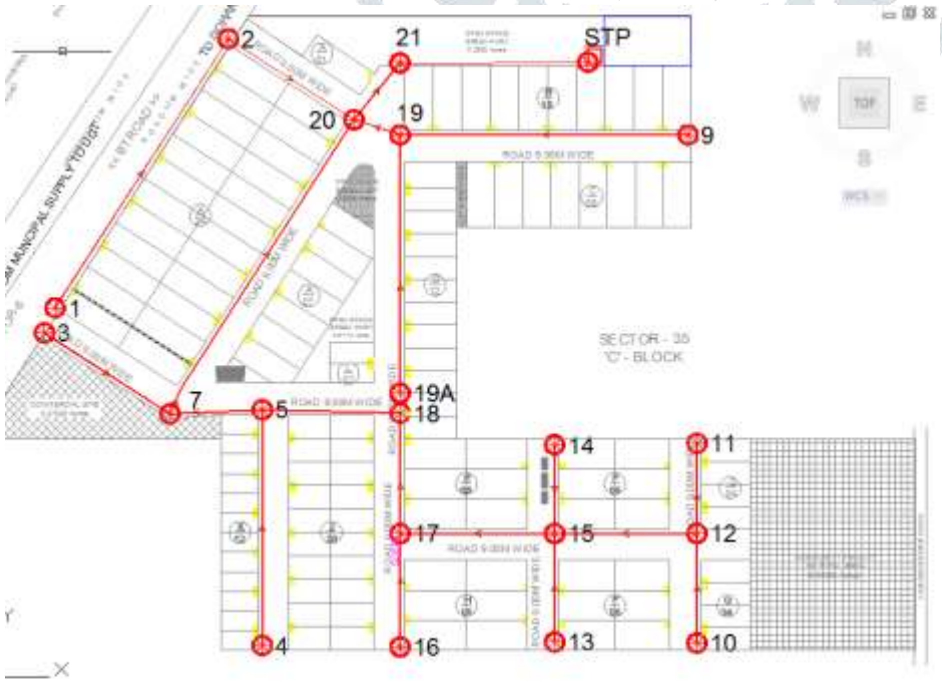


TABLE 3 HYDRAULIC STATEMENT OF SEWERAGE SCHEME OF SECOND ROUTE

HYDRAULIC STATEMENT OF SEWERAGE SCHEME																
Start node	Stop node	length	Peak Discharge (Qs)	Diameter of Pipe	Slope of pipe	Discharge for full flow (Qf)	Velocity for full flow (Vf)	Corresponding Vs/Vf	Actual Velocity (Vs) m/sec	Corresponding Ds/Df	Ground Level (m)		invert level (m)		Depth of Manhole (m)	
											Start Node	Stop node	Start Node	Stop node	Stop node	Start Node
		m	Cum/Sec	mm	1in……	Cu m/Sec	m/sec				m	m	m	m	m	m
1	2	91	0.001	200	50	0.05	1.7	0.4	0.6	0.1	99.7	99.9	98.8	97.0	0.9	2.9
2	20	43	0.001	200	50	0.05	1.7	0.4	0.6	0.1	99.9	100.0	97.0	96.1	2.9	3.8
3	7	43	0.000	200	50	0.05	1.7	0.3	0.6	0.1	99.9	100.0	99.0	98.1	0.9	1.9
4	5	67	0.001	200	50	0.05	1.7	0.4	0.7	0.1	100.2	100.1	99.3	98.0	0.9	2.1
5	7	26	0.004	200	50	0.05	1.7	0.6	1.0	0.2	100.1	100.0	96.3	95.8	3.8	4.2
7	20	99	0.004	200	50	0.05	1.7	0.6	1.0	0.2	100.0	100.0	95.8	93.8	4.2	6.1
9	19	82	0.001	200	50	0.05	1.7	0.4	0.7	0.1	100.1	100.0	99.2	97.6	0.9	2.4
10	12	31	0.000	200	50	0.05	1.7	0.4	0.6	0.1	100.3	100.3	99.4	98.8	0.9	1.5
11	12	26	0.000	200	50	0.05	1.7	0.4	0.6	0.1	100.3	100.3	99.4	98.9	0.9	1.4
12	15	41	0.001	200	50	0.05	1.7	0.4	0.7	0.1	100.3	100.2	98.8	98.0	1.5	2.2
13	15	31	0.000	200	50	0.05	1.7	0.4	0.6	0.1	100.3	100.2	99.0	98.4	1.3	1.8
14	15	25	0.000	200	50	0.05	1.7	0.4	0.6	0.1	100.3	100.2	99.4	98.8	0.9	1.4
15	17	44	0.001	200	50	0.05	1.7	0.4	0.7	0.1	100.2	100.2	98.0	97.1	2.2	3.1
16	17	32	0.000	200	50	0.05	1.7	0.4	0.6	0.1	100.2	100.2	99.3	98.7	0.9	1.5
17	18	34	0.002	200	100	0.04	1.2	0.5	0.6	0.2	100.2	100.1	97.1	96.7	3.1	3.4
18	5	39	0.003	200	100	0.04	1.2	0.6	0.7	0.2	100.1	100.1	96.7	96.3	3.4	3.8
19A	19	74	0.000	200	100	0.04	1.2	0.0	0.5	0.0	100.0	100.0	99.1	98.4	0.9	1.6
19	20	14	0.001	200	100	0.04	1.2	0.4	0.9	0.1	100.0	100.0	97.6	97.4	2.4	2.5
20	21	21	0.006	200	100	0.04	1.2	0.7	0.9	0.3	100.0	100.0	93.8	93.6	6.1	6.4
21	STP	54	0.006	200	100	0.04	1.2	0.7	0.0	0.3	100.0	100.0	93.6	93.1	6.4	6.9

We can easily compare the two designs that the first route will be more economical as the depth of pipeline is more in second route of sewer pipeline.

Example: developing AutoCAD drawing and transferring design detail from MS Excel to AutoCAD.

As shown in above example we have all the coordinates in MS Excel and we are transferring data of first route in auto cad and developing drawing automatically.

TABLE 4 START AND STOP NODE WITH COORDINATE

Start Node	Stop Node	X_1(Start Node)	Y_1(Stop Node)	X_2(Start Node)	Y_2(Stop Node)
1	2	-27.463	97.725	21.961	174.532
2	20	21.961	174.532	57.842	151.439
3	7	-30.495	90.561	5.33	67.504
4	5	31.674	1.358	31.674	68.663
5	7	31.674	68.663	5.33	67.504
7	20	5.33	67.504	57.842	151.439
9	19	153.162	147.095	71.004	147.095
10	12	155.683	2.063	155.683	33.34
11	12	155.683	59.077	155.683	33.34
12	15	155.683	33.34	115.064	33.34
13	15	115.064	2.335	115.064	33.34
14	15	115.064	58.664	115.064	33.34
15	17	115.064	33.34	71.004	33.34
16	17	71.004	0.952	71.004	33.34
17	18	71.004	33.34	71.004	67.704
18	19A	71.004	67.704	71.004	73.378
19	20	71.004	147.095	57.842	151.439
20	21	57.842	151.439	70.924	167.635
21	STP	70.924	167.635	124.629	167.86
19A	19	71.004	73.378	71.004	147.095

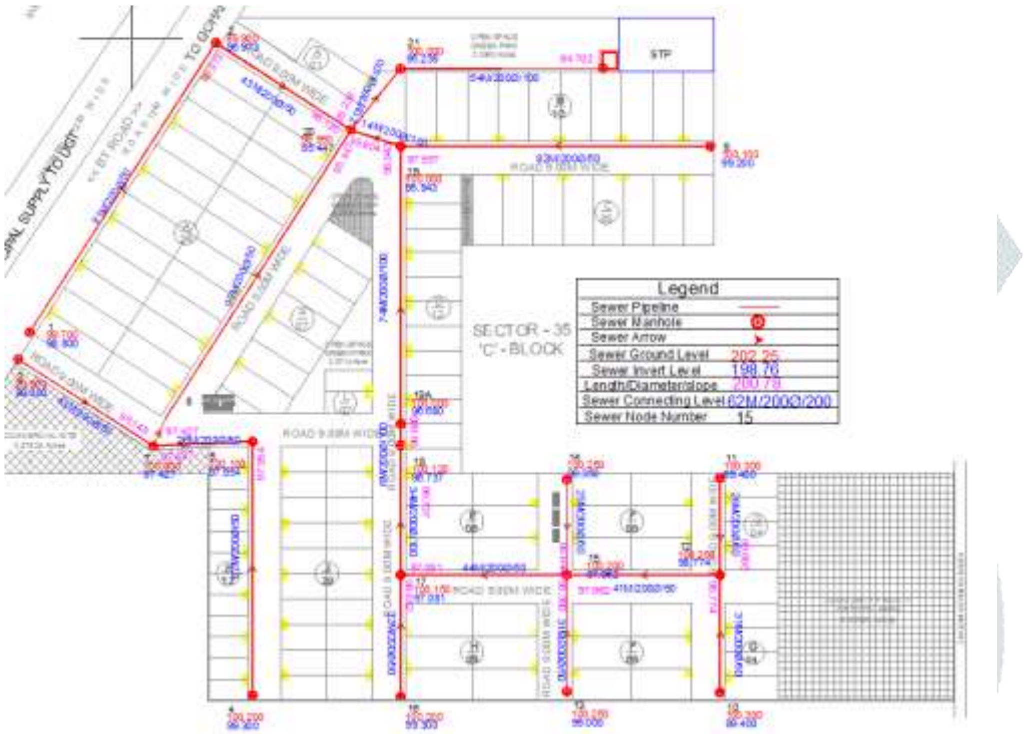
Table 5 Command for transferring data of first route in auto cad and developing drawing automatically

Start Nod e	Stop Nod e	For creating pipeline	For transferring node number	for transferring ground level	for transferring start invert level	for transferring length diameter and slope	for transferring stop invert level
1	2	PLINE -27.463,97.725 21.961,174.532	dotext -27.463,97.72 5 57.24 1	dotext -27.463,97.725 57.24 99.7	dotext -27.463,97.725 57.24 98.8	dotext -2.751,136.1285 57.24 91M/200%%c/50	dotext 21.961,174.532 57.24 96.973
2	20	PLINE 21.961,174.532 57.842,151.439	dotext 21.961,174.5 32 -32.77 2	dotext 21.961,174.53 2 -32.77 99.9	dotext 21.961,174.532 -32.77 96.973	dotext 39.9015,162.9855 -32.77 43M/200%%c/50	dotext 57.842,151.439 -32.77 96.12
3	7	PLINE -30.495,90.561 5.33,67.504	dotext -30.495,90.56 1 -32.77 3	dotext -30.495,90.561 -32.77 99.9	dotext -30.495,90.561 -32.77 99	dotext -12.5825,79.0325 -32.77 43M/200%%c/50	dotext 5.33,67.504 -32.77 98.148
4	5	PLINE 31.674,1.358 31.674,68.663	dotext 31.674,1.358 90 4	dotext 31.674,1.358 90 100.2	dotext 31.674,1.358 90 99.3	dotext 31.674,35.0105 90 67M/200%%c/50	dotext 31.674,68.663 90 97.954
5	7	PLINE 31.674,68.663 5.33,67.504	dotext 31.674,68.66 3 2.52 5	dotext 31.674,68.663 2.52 100.1	dotext 31.674,68.663 2.52 97.954	dotext 18.502,68.0835 2.52 26M/200%%c/50	dotext 5.33,67.504 2.52 97.427
7	20	PLINE 5.33,67.504 57.842,151.439	dotext 5.33,67.504 57.97 7	dotext 5.33,67.504 57.97 100	dotext 5.33,67.504 57.97 97.427	dotext 31.586,109.4715 57.97 99M/200%%c/50	dotext 57.842,151.439 57.97 95.447
9	19	PLINE 153.162,147.095 71.004,147.095	dotext 153.162,147. 095 0 9	dotext 153.162,147.0 95 0 100.1	dotext 153.162,147.09 5 0 99.2	dotext 112.083,147.095 0 82M/200%%c/50	dotext 71.004,147.095 0 97.557
10	12	PLINE 155.683,2.063 155.683,33.34	dotext 155.683,2.06 3 90 10	dotext 155.683,2.063 90 100.3	dotext 155.683,2.063 90 99.4	dotext 155.683,17.7015 90 31M/200%%c/50	dotext 155.683,33.34 90 98.774
11	12	PLINE 155.683,59.077 155.683,33.34	dotext 155.683,59.0 77 90 11	dotext 155.683,59.07 7 90 100.3	dotext 155.683,59.077 90 99.4	dotext 155.683,46.2085 90 26M/200%%c/50	dotext 155.683,33.34 90 98.885
12	15	PLINE 155.683,33.34 115.064,33.34	dotext 155.683,33.3 4 0 12	dotext 155.683,33.34 0 100.25	dotext 155.683,33.34 0 98.774	dotext 135.3735,33.34 0 41M/200%%c/50	dotext 115.064,33.34 0 97.962
13	15	PLINE 115.064,2.335 115.064,33.34	dotext 115.064,2.33 5 90 13	dotext 115.064,2.335 90 100.25	dotext 115.064,2.335 90 99	dotext 115.064,17.8375 90 31M/200%%c/50	dotext 115.064,33.34 90 98.38
14	15	PLINE 115.064,58.664 115.064,33.34	dotext 115.064,58.6 64 90 14	dotext 115.064,58.66 4 90 100.25	dotext 115.064,58.664 90 99.35	dotext 115.064,46.002 90 25M/200%%c/50	dotext 115.064,33.34 90 98.844
15	17	PLINE 115.064,33.34 71.004,33.34	dotext 115.064,33.3 4 0 15	dotext 115.064,33.34 0 100.2	dotext 115.064,33.34 0 97.962	dotext 93.034,33.34 0 44M/200%%c/50	dotext 71.004,33.34 0 97.081
16	17	PLINE 71.004,0.952 71.004,33.34	dotext 71.004,0.952 90 16	dotext 71.004,0.952 90 100.2	dotext 71.004,0.952 90 99.3	dotext 71.004,17.146 90 32M/200%%c/50	dotext 71.004,33.34 90 98.652
17	18	PLINE 71.004,33.34 71.004,67.704	dotext 71.004,33.34 90 17	dotext 71.004,33.34 90 100.15	dotext 71.004,33.34 90 97.081	dotext 71.004,50.522 90 34M/200%%c/100	dotext 71.004,67.704 90 96.737
18	19A	PLINE 71.004,67.704 71.004,73.378	dotext 71.004,67.70 4 90 18	dotext 71.004,67.704 90 100.12	dotext 71.004,67.704 90 96.737	dotext 71.004,70.541 90 6M/200%%c/100	dotext 71.004,73.378 90 96.68
19	20	PLINE 71.004,147.095 57.842,151.439	dotext 71.004,147.0 95 -18.27 19	dotext 71.004,147.09 5 -18.27 100	dotext 71.004,147.095 -18.27 95.943	dotext 64.423,149.267 -18.27 14M/200%%c/100	dotext 57.842,151.439 -18.27 95.804
20	21	PLINE 57.842,151.439	dotext 57.842,151.4	dotext 57.842,151.43	dotext 57.842,151.439	dotext 64.383,159.537 51.07	dotext 70.924,167.635

		70.924,167.635	39 51.07 20	9 51.07 99.95	51.07 95.447	21M/200%%c/100	51.07 95.239
21	STP	PLINE 70.924,167.635 124.629,167.86	dotext 70.924,167.6 35 0.24 21	dotext 70.924,167.63 5 0.24 100	dotext 70.924,167.635 0.24 95.239	dotext 97.7765,167.7475 0.24 54M/200%%c/100	dotext 124.629,167.86 0.24 94.702
19A	19	PLINE 71.004,73.378 71.004,147.095	dotext 71.004,73.37 8 90 19A	dotext 71.004,73.378 90 100	dotext 71.004,73.378 90 96.68	dotext 71.004,110.2365 90 74M/200%%c/100	dotext 71.004,147.095 90 95.943

Copy all the column of the table and paste al the column in command bar in AutoCAD .It will automatically develop the drawing and transfer all the data from MS Excel to AutoCAD. After moving all the superimposed text the drawing will be prepared as shown below

Figure 3AutoCAD drawing developed from MS Excel



VI. Results and Discussion

In this project, design of sewer line by many routes is one part of work which is done. And another part is develop the drawing and transfers all the technical drawing from MS Excel to AutoCAD. The main objective of this project with the help of coordinate we can easily link MS Excel with AutoCAD and can design the different routes of sewer pipeline and compare all the routes and take decision to opt the most economical and feasible route of sewer pipeline. Another part with the help of coordinate we can easily develop the drawing and transfers all the technical drawing from MS Excel to AutoCAD. It means developing drawing and transferring technical data is now a very easily and accurate task with this method.

References

[1] CPHEEO ―Manual on Sewer and Sewerage System, Ministry of Urban Development, Government of India, New Delhi.

[2] Garg, S.K―Sewage disposal and air pollution engineering, Khanna publishers, New Delhi.

[3] Ilaboya I.R., Atikpo E., Ekoh G.O., Ezugwu M.O. and Umukoro L. (2011), ―Application of Dynamic Programming to Solving Reservoir Operational Problems ‖ , Journal of Applied Technology in Environmental Sanitation, Vol. 1, 251-262.

[4] João Joanaz de Melo and António S. Câmara (1994), ―Models for the optimization of regional wastewater treatment systems ‖ , European Journal of Operational Research 73 EOR 01727 North-Holland .

[5] Joaquim Sousa, Alexandra Ribeiro, Maria da Conceicao Cunha and Antonio Antunes(2002), ―An optimization approach to wastewater systems planning at regional level ‖ , Journal of Hydroinformatics 2002.

[6] Md. M. Rashid, P.E.; and Donald F. Hayes, P.E., M.ASCE (2011), ―Dynamic Programming Methodology for Prioritizing Sewerage Projects ‖ , The Journal of Water Resources Planning and Management, Vol. 137, No. 2, March 1, 2011.

[7] Nagoshe S. R., Rai, R. K., Kadam, K. N (2014), ―Optimization Of Sewerage Network By Dynamic Programming ‖ . Proceedings of 3rd IRF International Conference, Goa, India, ISBN: 978‐93‐84209‐15‐5.

[8] Ong, S. and Adams, B. (1990). "Capacity Expansion for Regional Wastewater Systems." J. Environ. Eng., 10.1061/(ASCE)0733-9372(1990)116:3(542), 542-560.
[9] Swamee, P. K. (2001). ―Design of sewer line‖, Journal of Environmental Engineering, ASCE, Vol. 127, No. 9, 776- 781