STORM WATER MANAGEMENT AT APPROACH ROAD M.I.E.T. BHANDARA

Priyanka Pawar[1], Runal P. Pawar[2], Umesh B. Shende[3], Pavan Kanoje[4]

[1,2,3]B.E. Department of Civil Engineering, M.I.E.T Shahapur, Bhandara, India
[4] Professors, Dept. of Civil Engineering, M.I.E.T Shahapur, Bhandara, India

---

Abstract - *There are many problems occur in every year because of excessive rainfall. One of the main problems is storm water accumulation. Now a day this problem is occurring in our campus. Our campus area is very large and some area is under developed so water logging in that area would be the biggest problem. The developed area already has designed drainage system and built up. This paper present the suitable design of storm water drain system to drain out the storm water from campus within specific duration. The main function of this paper presentation is to avoid the interruption of transportation in NH no. 6 and also protecting urban dwellings from local flooding. When the campus and NH no. 6 will be developed in future so there should no need to develop the drainage system again in future. This paper gives a detail design of drainage for 60 acres of the partially undeveloped area of M.I.E.T. Shahapur campus. The main sewer drain at approach road is design as per the requirement and natural slope of line. All the storm water should be released in specific time as there should not be any trapped water or overflow. Knowledge of subjects like surveying, environmental, hydrology, geotechnical engineering was very useful while completing this paper.*

***Key Words*: Storm water management, construction management, quality management, M.I.E.T.**

1. INTRODUCTION

Storm water is rainwater or melted snow that runs off streets, lawns and other sites. When storm water is absorbed into soil, it is filtered and ultimately replenishes aquifers or flows into streams and rivers.

In develop areas generally natural surface areas are covered by concreting due to this water does not percolate in ground instead of water gets accumulate in ground construction of

Sewer system helps to drain water rapidly and causes:

- Downstream flooding
- Stream bank erosion
- Increased turbidity from erosion
- Habitat destruction
- Combined sewer overflows
- Infrastructure damage
- Contaminated streams, rivers and coastal water

Storm Water management is the process to manage quantity of water during heavy rains. Storm water drain is designed to drain excess rain water and ground water. Water that DOES **NOT SEEP** into the Ground but is channeled by Storm Sewers.

Storm water on highway is mainly affected by their slope & channel condition. Due to faulty construction accumulation of water gets start.

1.1 Types of Storm Water Drainage System

1. Surface Drainage

2. Sub Surface Drainage

Surface Drainage

It is the removal of water that collects on the ground surface. A surface drainage system consists of shallow trenches and required land smoothening.

This type of system is suitable for all slowly permeable soils and for soils with fragipans or clay sub soils. It involves the removal of excess water from the surface of the soil. This is done by smoothing, grading, bedding or leveling of soil surface.

Land smoothing is used to eliminate elevation in the land and making land slope free with the help of these techniques we build the surface drainage system for storm water regulation.

Sub-Surface Drainage

Subsurface drainage is used where we can get economical spacing for drain. In that area the soil is having good permeability. It is a planned construction by using high quality materials.

It consists of a outlets of surface and subsurface area, subsurface main drains and laterals. Water is drain to sewer system which is coming from outlet. Sub mains are sometimes used off the main drain to collect water.

1.2 Need For Storm Water Management

- If the water is not drain out from campus then it will disturb the entire aesthetic view of M.I.E.T. College.

- The surrounding climate becomes humid and unhygienic.
- Accumulated storm water leads to the interruption in transportation of NH no. 6
- The present study is the work done for the drainage design in Palayam area of Calicut City in Kerala, India where the excess runoff is really a threat to the environment.

1.3 Aim Of Storm Water Management

- It seeks to manage run off using distributed and decentralized control.
- Improve economic efficiency to sustain operations and investment of water.
- It reduces the water pollution & water spreading diseases.
- In some areas with salt disposition, especially in arid regions, drainage is used to leach excess salt.
- Storm water management can shorten the number of occasions when cultivation is held up waiting for soil to dry out.
- The main aim to the management of urban storm water aim at both maintaining public hygiene and protecting urban dwellings from local flooding.

1.4 Importance of Storm Water Management

Storm water runoff is water running over land during and immediately after a rain storm. Management of storm water refers to controlling the quantity of rainwater runoff, and resultant flooding, and the quality of water in our rivers, lakes, streams and even the ocean, which receive runoff. It is a result of urbanization which leads to concreting of ground surfaces. Now, when it rains, water does not seep into the ground as fast as it used to but runs over non-absorbent surfaces and picks up in quantity and velocity. Because of such condition the hydrological cycle get disturbed. Flooding and erosion often result storm water is important because it can lead to pollution, erosion, flooding and many other environmental and health issues if not properly understood and maintained.

Strom water harvesting techniques and purification can effectively make urban environments self-sustaining in terms of water. A proper storm water design means a proper knowledge of a collection of data like understanding the precipitation data clearly; know the infiltration indices, concentration time, and intensity of rainfall, runoff details & topography.

1.5 Benefits of Storm Water Management

- It regulates the water in efficient way.
- It Reduced salinity under irrigation.
- Reduced soil erosion.
- Avoid the interruption of transportation of NH 6.
- It provides the pleasant Aesthetic view to the M.I.E.T. Bhandara.
- It can maintain the public hygiene and protecting urban dwellings from local flooding.

The Following Problems Occur Due To Improper Storm Water Management:-

- Improper drainage system.
- Excessive Rain fall.
- Undulated Area or sloppy area.
- Faulty construction of approach road.
- Most of our existing storm water drains are in dilapidated stages and not working properly, losing self cleansing, no proper maintenance, and incorrect design without any scientific base, the bottlenecks go so on.

1.6 Good Storm Water Management Effects On Water Quality

- It reduced water born diseases due to accumulation of water.
- It improved the economic efficiency to sustain operations and investment of water
- It reduced the water pollution & water spreading diseases.
- It minimized the contamination of water bodies, rivers, creeks, estuaries.
- It maintains the ground water recharge

2. LITERATURE REVIEW

Several case studies, international journals are studied to understand storm water management. Through literature survey it can be concluded that storm water management technology should be implemented in construction.

1) Ale, S., L.C. Bowling, J.R. Frankenberg, S.M. Brouder, and E. J. Kladivko. 2010. Climate variability and drain spacing influence on drainage water management system operation. Vadose Zone Journal.

The effects of climate variability drain spacing, and growing season operational strategy on annual drain flow and crop yield were studied for a hypothetical drainage water management (DWM) system at Purdue University's Water Quality Field Station using the DRAINMOD model. Drainage water management showed potential for reducing annual average (1915–2006) drain flow from all drain spacing's (10–35 m) regardless of the growing season operational strategy, with reductions varying between 52 and 55% for the drain spacing considered. During non growing season 81 to 99% reduction of flow occurs. Fixed DWM operational strategies led to an increase in mean predicted yield for narrower spacing compared with conventional drainage systems. Maximum yield was achieved with no control for drain spacing wider than 20 m in 50% of the years. Overall, the height of control had more influence on relative yield than the date of initiation of control. The greatest positive impacts of DWM on relative yield (1.2%) occurred in cool, dry years, while the greatest average negative impacts (−0.2%) occurred in cool, wet years. On average, with the best-case operation selected for annual weather conditions, DWM increased relative yield by approximately 0.8, 0.4, and 0.2% for the 10-, 20-, and 30-m drain spacing, respectively. Accumulated growing degree days and antecedent precipitation index show promise for identifying appropriate operational strategies for DWM.

2) Beven, K. 1993. Riverine flooding in a warmer Britain.Centre for Research on Environmental Systems, Institute of Environmental and Biological Sciences, Lancaster University, LA1 4 YS.

A warmer Britain may also be wetter, at least seasonally, which might suggest that the frequency and magnitude of revering flooding may increase. It may be difficult, however, to distinguish the effects of climate warming from the effects of continuing land use change, given the naturally stochastic nature of the inputs into hydrological systems. Prediction of the effects of climate change on revering flooding is clearly very uncertain. These uncertainties need to be assessed, particularly for more extreme events. Further research on data collection techniques and model improvements to reduce levels of predictive uncertainty is required.

3) Robinson, M. and D. W. Rycroft. 1999. The Impact of Drainage on Stream flow. Agricultural Drainage pp 767-800. Skaggs, R and J. van Schilfgaarde eds. ISBN 0-89118-131-5.

The background to the discussions about the effects of drainage on stream flow and the competing theories are presented. Analysis of results of field drainage experiments and of simulation models is reviewed. Improvements to the main channel to increase peak flows by reducing surface storage are described and the effects of drainage systems with substantial surface and main channel improvements are evaluated.

- Surface drainage and pipe drainage counterbalanced each other
- Surface drainage will result in higher peak flows downstream
- On most occasions, pipe drainage reduced peak flows
- Considerable variation in the magnitude of reduction
- In some cases, increased peak flows

4) Wilson, B.N. 2000. History of Drainage Research at the University of Minnesota. University of Minnesota and Iowa State University Drainage Research Forum, March 23, 2000.

Drainage has been and remains an important, and often contentious, management issue for the State of Minnesota. It has substantially increased the arable lands of the State but has also dramatically altered pre-settlement landscape conditions. Because of the public interest in these important impacts, the University of Minnesota has had a long history of drainage research. This paper will focus on research conducted by departments1 associated with the Minnesota Agricultural Experiment Station. Most of the early drainage research was done by these departments. The scope of the paper will be loosely limited to research done before 1990. Research priorities have been influenced by societal views of drainage.

3. METHODOLOGY

3.1 Survey

We used Auto level instrument for taking various levels. This instrument require only approximate levelling by reference to good circular bubble, and they have no sensitive bubble.

The path of the line of sight through the telescope includes reflection at mirrors or prisms which are suspended on fine threads or on a component hanging as a pendulum and the mechanical design of the suspended portion is such that if the body of the instrument id slighty disturbed the consequence motion of the suspended component re sets the line of sight in the former direction.

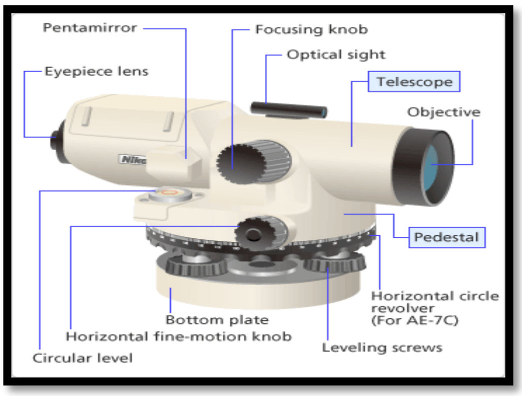

Fig 1: Auto Level Instrument

Contour Reading of Undeveloped Area:

Readings are taken by auto level. We provided four bench marks for calculation of various readings. First bench mark is set up near to the divider after that we have started to take the readings. Following are the readings which are tabulated by Rise and fall method.

Rise and Fall Method:-

Sr. No.	St	Chainage	B.S.	I.S.	F.S.	H.I.	R.L.
	A	0	0.47			100.4	100
1				1.17			99.3
2				0.85			99.62
3				0.55			99.92
4				0.62			99.85
5				1			99.47
6				1.2			99.27
7				0.75			99.72
8				0.35			100.1
9				1.35			99.12
10				1.4			99.07
11				1.03			99.44
12				0.75			99.69
13				0.85			99.62
14				0.97			99.5
15				0.85			99.62
16				0.97			99.5
17				0.82			99.65
18				0.85			99.62
19				0.62			99.85
20				0.63			99.84
21				0.75			99.72
22				0.72			99.75
23				1.23			99.24
24				1.17			99.3
25				1.13			99.34
26				0.62			99.85
27				0.5			99.95
28				0.6			97.87
29	B		1.76		0.37	101.8	100.1
30				1.56			100.3
31				1.35			100.5
32				1.44			100.4
33				1.42			100.4
34				1.36			100.5
35				1.47			100.4
36				1.17			100.7
37				1.35			100.5
38				1.74			100.1
39				0.9			100.9
40				1.19			100.6
41				1.15			100.7
42				1.23			100.6
43				1.32			100.5
44				1.72			100.1
45				1.42			100.4
46	C		2.09		0.35	103.6	101.5
47				2.64			100.9
48				1.57			102.0
49				1.54			102.1
50				2.04			101.5
51				2.15			101.4
52				2.07			101.5
53				2.25			101.3
54				2.14			101.4
55				2.22			101.3
56				2.56			101.0
57				2.69			100.9
58				2.76			100.8
59				3.03			100.5
60				3.05			100.5
61				3.36			100.2
62				2.31			101.2
63				2.45			101.1
64				2.58			101.0
65				2.95			100.6
66				2.42			101.1
67				2.09			101.5
68				2.71			100.9
69				1.89			101.7
70	D				2.1	103.9	101.5

71				2.1			101.8
72				1.76			102.1
73				1.76			102.1
74				2.2			101.7
75				1.39			102.5
76				1.54			102.3
77				1.49			102.4
78				1.33			102.5
79				0.87			103
80				1.39			102.5
81				1.78			102.1
82				1.28			102.6
83				1.07			102.8
84				0.84			103.0
85				1.06			102.8
86				0.87			102.9
87				0.8			103.1
88				1.1			102.8
89				0.94			102.9
90				1.28			102.6
91				2.12			101.7
92				0.83			103.0
93				0.68			103.2
94				0.45			103.4
95				1.54			102.3
96				0.8			103.1
97				0.44			103.4
98				0.53			103.3
99				0.65			103.2
100				0.86			102.9
101				1.24			102.6
102				0.87			102.9
103				2.27			101.6
104				2.14			101.7
105					2.6 4		101.2

3.2 Drawings & Design

Draw the layout plan of campus and drawings are made in AutoCAD. Following are the drawing required for determination of drain alignment and design:

- Topographical Plan (Contour plan)
- Design of Main Drain Pipe

Topographical plan (Contours Plan)

Topographic plan are used to identify and map the contours of the ground and existing features on the surface above or below earth surface.

The detailed graphical representation of natural features on ground surfaces called topographic map.

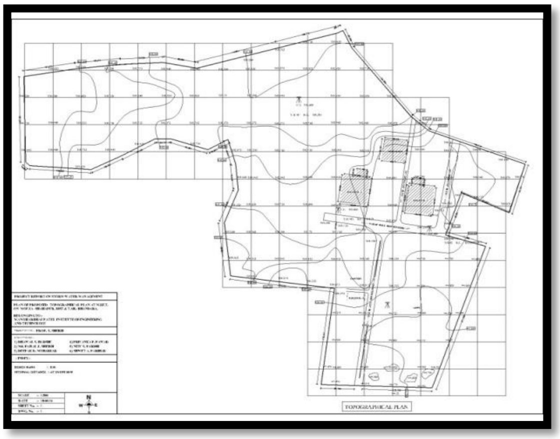

Fig 2 :- Topographical plan

Intake Chamber

Intake chamber is basically top opening to an underground utility vault. The unauthorized entry to the manhole is prevented by metal cover of manhole.
Manholes are usually outfitted with metal, polypropylene, or fibreglass steps installed in the inner side of the wall to allow easy descent into the utility space.
Manholes are generally found in developed areas.

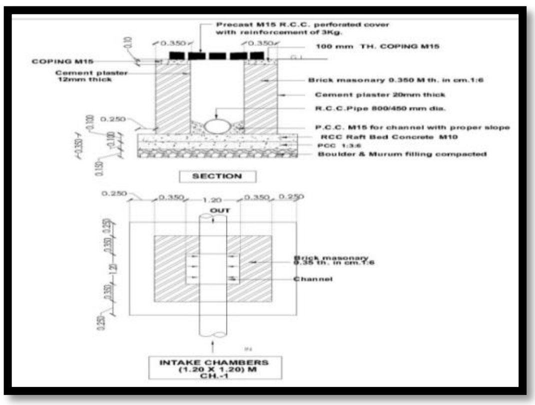

Fig 3 : - Intake Chamber

3.3 Design Of Main Drain (Approach Road)

We have, t_c = 15.19 min, Q_n=5.815m3/sec

Assume same discharge for the outer portion of M.I.E.T. Bhandara

Q = 5.815 x 2 = 11.63 m^3/sec

Now, design of cross section of drainage

$Q_n = V \times A_n$

$11.63 = 1519 / (15.19 \times 60) \times A_n$

$A_n = 6.98 m^2$

Area, $A_n = \pi/4 \times d_n^2$

$6.98 = \pi/4 \times d_n^2$

D_n=2.98m

The diameter of main drain by calculation is 2.98 m.

So, we are assuming the diameter main drain is 3 m

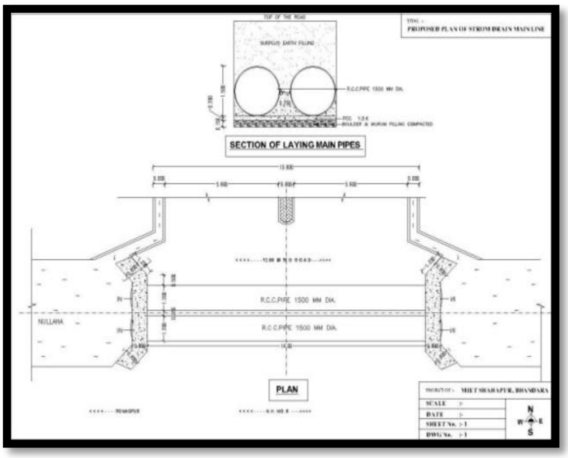

Fig 4: - Topographical plan of approach road

3.4 Estimation

Project: - Plan On Proposed Storm Water Management On Mouda -Shahapur, Dist & Tah. – Bhandara

Belonging To: M.I.E.T. Shahapur, Bhandara

Bifurcation of Estimate

- Laying of Storm Water Drain Lines of M.I.E.T. Bhandara Rs. 8084167 /-
- Laying of Storm Water Drain Lines to Approach road of M.I.E.T. Bhandara Rs. 742060 /-
- Total Amount – Rs. 8826227 /-

In Word :- (Eighty Eight Lakh Twenty Six Thousand Two Hundred Twenty Seven Sixty Seven Only)

4. RESULT

4.1 General

The drain is aligned and designed by following steps-

- Total area survey by the method of ranging, chaining and taping, levelling, etc.
- The instruments used are-

a) Tape
b) Ranging Rod
c) Pegs
d) Auto Level Instrument/ Levelling Staff
e) Lime Stone Powder

- The area is covered by making the Grids of 50 m side in all the undeveloped area.
- The last boundary points are taken by ranging and tape measurement.
- Perpendiculars are taken and levelling is done by Auto Level Instrument.
- Sheets are drawn with help of data from survey in AutoCAD
- Design is done by rational method to find Peak Flow and Manning's formula for size of drain.

4.2 Final Results

- According to the Readings came from surveying the campus, the following sheets are prepared-

a) Topographical Plan (Contour plan)
b) Layout plan of campus with catchment area

- From the calculation of branched drainage pipes, we get dimensions of main drain pipe which is situated at approach road NH No. 06
- The diameter of main drainage pipe is 3 m.

Table -1: the diameters of various branched sections are:

Sr. No.	Name	Area (m^2)	Ø of drains (m)
1	Section-1	21313.9174	0.64
2	Section-2	32755.053	0.79
3	Section-3	37496.137	0.84
4	Section-4	16007.834	0.55
5	Section-5	40629.32	0.88
6	Section-6	28960.368	0.74
7	Section-7	30450.294	0.76
8	Section-8	28588.187	0.74
9	Section-9	31734.531	0.78

Relative Information of Site [Field Area]

- All the designed drains are fit in the discharge criteria hence we assumed 5 minutes drain out time for the 500 m length of catchment area.
- Due to this the velocity in branched pipe can be proportional to average length of pipe and inversely proportional to the time.
- All the drains are designed as lined drains by concrete.
- All the drains are aligned along the proposed roads within the campus.
- For the better regulation, we assumed excess of discharge (double) for the area which is located outside the campus.
- This project is done by considering all the aspects and parameters for future.
- There should be no need for any further need for any modification.

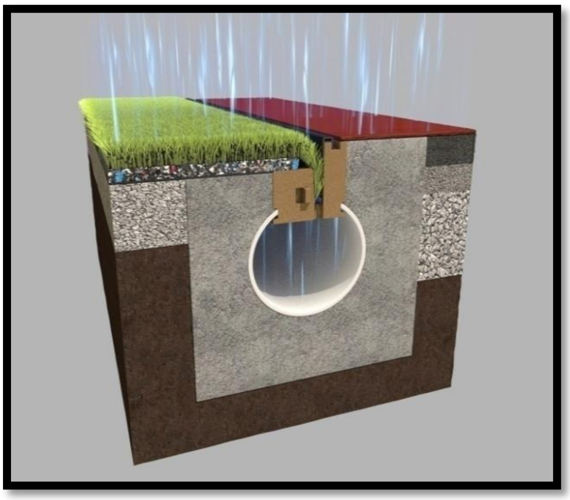

Fig 5: Storm Water Management (Expected)

5. CONCLUSIONS

With using this design approach:

- Water can be regulating in efficient way with using this design approach.
- Within 15 minutes all the storm water which is accumulated at different zone can be drain out.
- This project gives us the easiest way to avoid water logging and keep the campus area clean, protect the structures and increase the life time of structures in campus.
- It will provide the pleasant Aesthetic view to the M.I.E.T. Bhandara.
- It can maintain the public hygiene and protecting urban dwellings from local flooding.
- Laying of Storm Water Drain Lines of M.I.E.T. Bhandara – Rs. 8084167.
- Laying of Storm Water Drain Lines near To Approach road of M.I.E.T. Bhandara – Rs. 742060.
- Total Amount – Rs. 8826227 /- In Word (Eighty Eight Lakh Twenty Six Thousand Two Hundred Twenty Seven Sixty Seven Only).

5.1 Future Suggestions

- Proper maintenance should be required at approach roach especially in case of manholes and water inlets.
- Most of our existing storm water drains are in dilapidated stages and not working properly, losing self cleansing, no proper maintenance, and incorrect design without any scientific base, the bottlenecks go so on. Required proper check and maintenance in regular time interval.
- The main drain should be lined with concrete to avoid erosion of soil and weed growth.
- We can also construct raised causeway, combine sewer line and roadside channel.
- Possibility of inlet construction, provision of banking of road, culverts, ditches, channels and also provision of catch basin, manhole on roadway.

6. REFERENCES

- Ashley, R. et al., 2008. Making asset investment decisions for wastewater systems that include sustainability. Journal of Environmental Engineering, 134(3), pp.200-209.

- Balkema, A.J. et al., 2002. Indicators for the sustainability assessment of wastewater treatment systems.Urban Water, 4, pp.153-161.

- Beck, M.B., 1976.Dynamic modeling and control applications in water quality maintenance. Water Research, 10, pp.575-595.

- Butler, D. & Davies, J.W., 2011.Urban Drainage 3rd ed., London: Spon Text.