PLUMBING SYSTEM OF A BUILDING

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PLUMBING SYSTEM OF A BUILDING

Submitted by

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A Project submitted to the Department of Civil Engineering, Daffodil International University in Partial Fulfillment of the Requirements for the Degree of
Bachelor of Science in Civil Engineering

Department of Civil Engineering
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APPROVAL

This is to certify that this project "PLUMBING SYSTEM OF A BUILDING" is done by the following students under my direct supervision and this work has been carried out by them in the Department of Civil Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Civil Engineering.

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The project titled "**PLUMBING SYSTEM OF A BUILDING**" submitted by Md. Saiful Islam ID: 191-47-937, Saiful Islam Shuvo ID: 191-47-897, Atoshi Tabassum ID: 191-47-939 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Bachelor of Science in Civil Engineering on 20-Dec-2022.

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DECLARATION

It is hereby declared that except for the contents where specific reference have been made to the work of others, the design contained in this project report is the result of a detailed design exercise carried out by the author under the supervision of **Dr. Miah M. Hussainuzzaman**, Associate Professor, Department of Civil Engineering, Daffodil International University.

No part of this project has been submitted to any other university or other educational establishments for a degree, diploma, or other qualification (except for publication).

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Finally, we would like to express a very special indebtedness to our Father and Mother, whose encouragement and support was a continuous source of inspiration for this work.

DEDICATION

Dedicated

To

Our Families

ABSTRACT

A building's plumbing and sanitary system is crucial. The plumbing system must be planned and designed properly in order to meet the residents' needs for hygiene. A plumbing system will aid in ensuring that connections of the waste and clean water plumbing parts are kept apart by air gaps, physical separations, and adherence to building requirements. Plumbing preservation may stop cross-contamination, keeping your home's water pure and secure at all times. This study presents the plumbing system design for a residential structure with seven stories. This contains all necessary CAD files as well as a thorough breakdown of all calculations and factors.

সারমর্ম

আবাসিক এবং বাণিজ্যিক ভবনের জন্য প্লাম্বিং এবং স্যানিটারি সিস্টেম অত্যন্ত প্রয়োজনীয় একটি পরিসেবা। বাসিন্দাদের স্বাস্থ্য ঝুঁকি কমাতে একটি সঠিক প্লাম্বিং সিস্টেমের সঠিক পরিকল্পনা অত্যন্ত গুরুত্বপূর্ণ । প্লাম্বিং সিস্টেম সঠিকভাবে পরিকল্পনা এবং বাস্তবায়নের ফলে ভবন ব্যবহারকারীগণের স্বাস্থ্য ঝুঁকি হ্রাস পাবে এবং নির্মানে অপ্রয়োজনীয় ব্যয় কিংবা অপচয় রোধ করবে। একটি বিল্ডিং প্লাম্বিং রক্ষণাবেক্ষণ ক্রস-দূষণ প্রতিরোধ করতে পারে, যেটা আমাদের ভবন সর্বদা পরিষ্কার এবং নিরাপদ রাখে। একটি ভাল প্লাম্বিং সিস্টেম প্রত্যেকটি ভবনের জন্য জন্য অত্যন্ত উপকারী হতে পারে। এই রিপোর্টে একটি সাত তলা আবাসিক ভবনের সম্পুর্ন প্লাম্বিং সিস্টেমের নকশা উপস্থাপন করা হয়েছে। নকশাতে এর ক্যাড ফাইলগুলো ছাড়াও প্রয়োজনীয় হিসাব নিকাশ, বিবেচনাসমূহ বিস্তারিতভাবে উল্লেখ করা হয়েছে।

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CHAPTER 1
INTRODUCTION

1.1 General

Basic amenities like water supply and sanitary facilities are required in every area where people dwell. People who must stay in a residential or business building for an extended amount of time need those services built into the structure. The users' safety and economic viability are ensured by the proper design and construction of those services. Plumbing design, along with architectural, structural, and electrical designs, are therefore all included in the building's detailed design. To obtain a water and sewage connection while building in a large city, the water supply authority may require that the design be authorized. Such a plan is presented for a residential structure in this project report.

1.2 Objectives

Objective of this report is to present the design of the plumbing system which includes -

- Provide the computations necessary to establish the appropriate sizes for the system's various components.
- To supply sufficient water to each fixture.
- Provide all the design drawings (CAD) for this system.

1.3 Limitations

Some of the features of a complete design is not presented in this report which are:

- This report simply confirms the sizes that have been provided because some of the sized possibilities are fixed by architectural design.
- There is no detailed design of the structural components needed to hold the piping in place.
- Estimates of price and volume are not included.

1.4 Organization Of The Report

This report has five chapters, a bibliographic section and appendices. The first chapter describes the general background information, rational, objectives, limitations and structure of this report. The second chapter provides general information of the specific project. The third, fourth and fifth chapter includes all the calculations and required for water supply, wastewater plumbing and storm water drainage system. Bibliographic section includes the listing of all the references used for these calculations. The the drawings (CAD: Computer Aided Drawing) are provided in the appendices and are referred from the corresponding chapters.

1.5 Summary

The plumbing system is an inseparable part of a multi-stored building. The project and the report are introduced in this part of the report. The objectives and limits, as well as every design that is discussed throughout the report, are summarized in the description. The details of the individual project are presented in the next chapter.

CHAPTER 2
GENERAL INFORMATION OF THE PROJECT

2.1 GENERAL DATA

Occupancy type	: Residential
Number of floors	: 7 Storied
Number of basements	: N/A
Building height	: 80 ft / 24.39 m
Number of residents	: 80
Land Area	: (78’-0”*60’-0”) = 4680 sft
Plinth Area	: (69’-6”*50’-0”) = 3475 sft
Floor Area	: 24325 sft
Type of structure	: RCC frame

2.2 Location Of The Project

Address of the project	: Plot no -14, Road no – 01, Block – B, Aftab Nagar, Eastern Housing LTD. Dhaka.
GPS location	: 23°46'08.5"N 90°25'36.8"E

2.3 Plumbing Design Considerations

- BNBC 2020 has been followed for the design.
- Every Flat has balconies. Rain drainage from balcony is not considered.
- Water supply:
  - WASA is supplying water to the underground reservoir tank.
  - A gravity-driven system is used for water delivery (not a pressure system)
  - The water will be pumped to the overhead tank above the roof using an individual pumping system.
  - Anyone can install a geyser when they like; Hot and cold water distribution systems are taken into consideration.
  - Water will be pumped to the over head tank (OHT) twice a day.

    - All pipe material will be HDPE.
- Sewerage system:
    - Sewers systems is available in the area. So buildings have not their own septic tank facility.
    - Soil and waste water are drained separately due to the usage of a two-pipe system.
    - Black water (from soil stack) & Gray water (from waste stack) will be diverted into the drain.
    - Along with the wastewater, effluent will also run into the open drain.
- Storm / Rain Water
    - There is no rainwater collection system in this place.
    - A separate stack system will be used to collect rainwater from roof.
    - Rainwater will eventually be released into an open drain after flowing to building drains for wastewater.

CHAPTER 3
DESIGN OF WATER SUPPLY SYSTEM

3.1 General

A water supply system design requires the following components to be considered:

- Estimate the water volume and make a demand calculation.
- Determine / Check adequacy of the underground water reservoir.
- Calculate / select the capacity of the pump to deliver water to the over head tank within a certain time limit (say, about 30 minutes pumping). This will include the pump riser size.
- Determine / Check adequacy of the underground water reservoir.
- Design the distribution pipe line over the roof and the risers.
- Design the distribution pipes over each of the facilities. Generally these pipes run over the false slab of the toilets and through the walls.
- Check the pressure of the most vulnerable water fixture (predicted to have the lowest pressure). This fixture is generally located on the top floor and having the longest supply pipe network.

3.2 Supply System

3.2.1 Demand Calculation

Use total people number and per capita demand for specific occupancy type.

Total demand = Population * per capita demand

=> Q = p*q

Here, P = Number of flats/Apartment* 6 persons/flat

q = 180 Ipcd [for apartment BNBC 2020]

Determined demand for a 7-stored apartment building with 13 flats with 6 persons in each flat:

Q = p*q

= (13 * 6) *180

= 14040 Liters/ Day

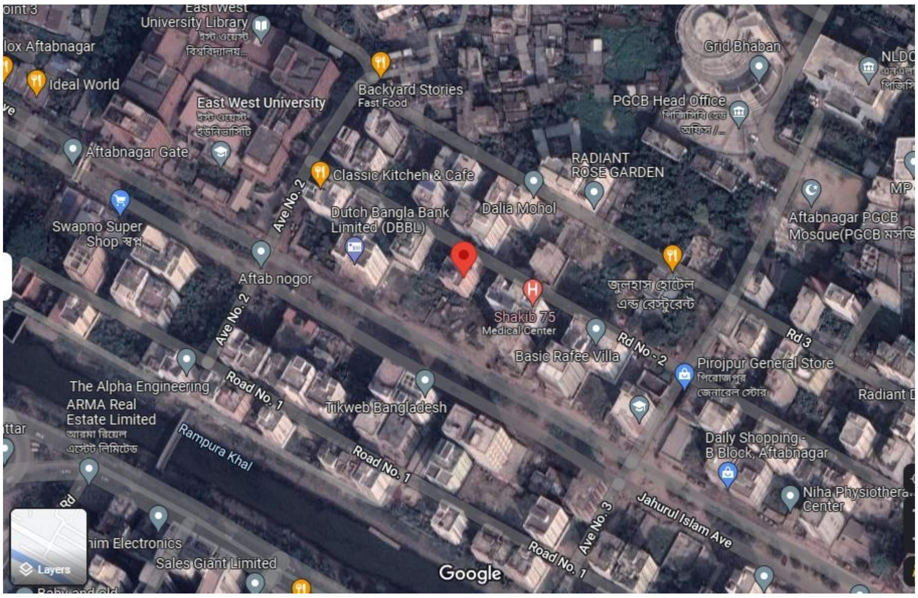


Figure 3.1: Project location on the map

$= 14.04\ m^3/day$

3.2.2 Under Ground (UG) Reservoir

Typically, such reservoirs are designed and placed by the architect. In this situation, it is important to make sure the amount is appropriate. In the case of an interruption in the water supply, the security or excess water that can be stored is provided by the volume-to-demand ratio. The actual volume of the reservoir should include dead volumes at bottom (never be pumped out) and free board (at top, which will never be filled). **CAD #15**.

Water demand $V = 14.04\ m^3/day$

Require Volume of UG water tank,

$V = (14.04 + 14.04)$ [From BNBC 2020 Table 5.9.1.2.c]

$= 28.08\ m^3$

Depth of UG water tank,

$H = V^{1\backslash 3} = (28.08)^{1/3} = 3.04\ m$

Free board, $FB = 0.15\ m$

Total depth, $H = H + FB$

$= 3.04 + 0.15$

$= 3.20\ m$

Tank Area, $A = L * B = V / H$

$\Rightarrow A = 28.08 / 3.20$

$= 8.78\ m^2$

Assume, length to width ratio of 2

$\Rightarrow L = 2B$

Now, Area, $A = L * B$

$\Rightarrow 2B * B = 8.78\ m^2$

$\Rightarrow B^2 = 8.78 / 2 = 4.39$

$\Rightarrow B = \sqrt{4.39} = 2.1\ m$

Therefore, $L = 2B$

$= 2 * 2.1 = 4.2\ m$

UG Water Tank Size

L = 4.2 m B = 2.1 m H = 3.20 m

As per ground floor size, we have to design UG Water tank as.

L = 4.0 m B = 2.5 m H = 3.0 m

3.2.3 Over Head Tank (OHT)

This subsection of the report checks the available size specified or provided by the architect. In the absence of architectural design, the size is designed. High live load is caused by larger OHT size. As it has been decided to pump twice daily, the size of OHT should provide for 50% of the daily demand as well as dead volume and free board volume. This results in the size is about 60~70% of daily demand.

Daily water demand, V= 14.04 m^3/day

It is decided that the users will pump 50% of the daily demand twice a day.

So, the required volume of OHT water tank

$V = 0.5*14.04 = 7.02\ m^3$

Depth of OHT, $H = V^{1\backslash 3} = (7.02)^{1/3} = 1.92\ m$

Free board, $FB = 0.15\ m$

Total depth, $H = H + FB = 1.92+0.15 = 2.07\ m$

Tank Area, $A = 7.02 / 2.07 = 3.39\ m^2$

Assume, $L = 2B$

$A = 2B * B = 3.39\ m^2$

$\Rightarrow B^2 = 3.39 / 2 = 1.70$

$\Rightarrow B = \sqrt{1.70} = 1.30\ m$

Therefore, $L = 2B = 2 * 1.30 = 2.60\ m$

OHT water tank Size

L = 2.6 m B = 1.30 m H = 1.92 m

As per stair room size, the size of stair room is (4.96*3.30) m, so we have to design OTH as per stair room size.

L = 4.96 m B = 3.30 m H = 1.00 m

Figure for the tank with pump and risers is shown in **CAD #16**.

3.2.4 Pump Selection

Pump capacity should be such that, it corresponds to the volt type of electricity and can pump the desired volume in around 30 minutes.

Estimation of power required for the pump

$$KW = \frac{Q\ (l/s) \times Head\ (m)}{75 \times Efficiency} \times 0.746$$

Here, Q $= 7.02\ m^3/hr. = \frac{7020\,lts}{1*60*60} = 1.95$ lps

Efficiency = 50%

and, Head = (24.39+1.95) = 26.34 m

$$KW = \frac{1.95 \times 26.34}{75 \times 0.5} \times 0.746 = 1.02$$

3.2.5 Riser Size

Riser size and pump delivery pipe diameter are connected. Head loss can be computed using the pumping rate, head, and pipe diameter. The water velocity should not exceed 1.5 m/s (to minimize water hammer). Typical figure for risers along with the OHT and UG reservoir and pump is shown in **CAD #13**.

3.3 Distribution Piping Design

CAD figures are provided showing riser, and distribution piping over the false ceiling with all the branches. BNBC provides the typical standard diameter for these pipes. For example all risers to the fixtures to be 13 mm dia (0.5 inch) pipes, while pipes running over the false ceiling are 19 mm in diameter (0.75 inch). But, those standards should be checked for pressure drop study.

3.3.1 Pressure Check For Distribution Network.

The diameters of the distribution pipelines are pressure-tested. The goal of this computation is to provide the minimum water pressure possible in the difficult setup. The most challenging fixture is typically found on the top floor, the furthest away from the source in the pipe. The calculation table also aids in finding any flaws in the initial design and in implementing corrective action, such as increasing the pipe diameter of those with severe head loss.

An isometric sketch showing the pipe layout on the roof and the risers were created to better understand this design and head-loss calculation. **CAD #04**, **CAD #06** and

CAD #09 are used to get a total picture of that part of network which are used to deliver water to the most difficult fixture.

The Hazen Williams equation is used for head-loss calculations. The equation can be written in the following form:

$$Q = 3.7\times10^{-6}C\ D^{2.63}\left(\frac{H}{L}\right)^{0.54}$$

Where, Q = Flows, lps
C = Roughness coefficient (100 – 140 for rough to smooth pipes)
D = Diameter, mm
H = Head loss, m
L = Length of pipe, m

For a definite value of C, the equation can be written as:

$$\frac{H}{L}=1.39\times10^{6}\frac{Q^{1.85}}{D^{4.87}} \quad \text{---- ---- --- [for C = 130]}$$

This above formula is used to calculate the head-loss or pressure check. WSFU were obtained from BNBC Table 1 in Appendix: BNBC Tables. Besides BNBC Table 2 is used to get the equivalent lengths for different valves and fittings. BNBC figure P1 is used to convert WSFU values to lpm values. For lower range of values a simple conversion factor is used as it is very difficult to obtain lpm values in that range.

Table 3.1: Analysis and design of distribution pipes based on head loss calculation

Pipe	**Length L (m)**	**Diameter D (mm)**	**WSFU**	**(lpm)**	**(lps)**	**Unit loss H/L (m/m)**	**Loss H_f (m)**
1	2	3	4	5	6	7	8
A-Elbow	2.13	50	84	151.2	2.52	0.04089	0.08710
AB	3.65	50	84	151.2	2.52	0.04089	0.14925
B-Elbow	2.13	50	84	151.2	2.52	0.04089	0.08710
BC	0.5	50	84	151.2	2.52	0.04089	0.02045
C-Gate V.	0.4	50	84	151.2	2.52	0.04089	0.01636
CD	3.56	50	84	151.2	2.52	0.04089	0.14557
D-Elbow	2.13	50	84	151.2	2.52	0.04089	0.08710
DE	15	50	84	151.2	2.52	0.04089	0.61336
E-Elbow	2.13	50	84	151.2	2.52	0.04089	0.08710
EF	3.4	50	84	151.2	2.52	0.04089	0.13903
F-Elbow	2.13	50	84	151.2	2.52	0.04089	0.08710
FG	0.91	50	84	151.2	2.52	0.04089	0.03721
H-Tee, St	0.46	19	12	21.6	0.36	0.12435	0.05720
GH	0.08	19	12	21.6	0.36	0.12435	0.00995

Pipe	Length L (m)	Diameter D (mm)	WSFU	(lpm)	(lps)	Unit loss H/L (m/m)	Loss H_f (m)
H-Elbow	0.76	19	12	21.6	0.36	0.12435	0.09451
HI	0.15	19	12	21.6	0.36	0.12435	0.01865
I-Elbow	0.76	19	12	21.6	0.36	0.12435	0.09451
IJ	0.18	19	12	21.6	0.36	0.12435	0.02238
J-Elbow	0.76	19	12	21.6	0.36	0.12435	0.09451
JK	0.63	19	12	21.6	0.36	0.12435	0.07834
K-Elbow	0.76	19	12	21.6	0.36	0.12435	0.09451
KL	0.18	19	12	21.6	0.36	0.12435	0.02238
L-Elbow	0.76	19	12	21.6	0.36	0.12435	0.09451
LM	0.25	19	12	21.6	0.36	0.12435	0.03109
M-Elbow	0.76	19	12	21.6	0.36	0.12435	0.09451
MN	0.66	19	12	21.6	0.36	0.12435	0.08207
N-Tee	1.22	19	12	21.6	0.36	0.12435	0.15171
NO	0.66	19	10.5	18.9	0.32	0.09713	0.06411
O- Elbow	0.76	19	10.5	18.9	0.32	0.09713	0.07382
OP	0.21	19	10.5	18.9	0.32	0.09713	0.02040
P-Tee	1.22	19	10.5	18.9	0.32	0.09713	0.11850
PQ	0.78	19	5.5	9.9	0.17	0.02937	0.02290
Q-Tee	1.22	19	5.5	9.9	0.17	0.02937	0.03583
QR	0.49	19	1	1.8	0.03	0.00125	0.00061
R	0.76	19	1	1.8	0.03	0.00125	0.00095
							2.93463

Total Head = 5.945 m

Head loss = 2.934 m

Available Head = 3.010 m = 4.278 psi

3.3.2 Typical Figure For Connections

Typical standard for valves, joints, clumps etc. are also provided in the CAD.

CHAPTER 4
DESIGN OF SEWERAGE SYSTEM

4.1 General

The detailed calculations for the design of different components are presented in this chapter. The sewerage plumbing pipes for each floors are generally located below the floor slab and the vertical stacks run through the designated voids to the building drains.

A waste water drainage system design requires the following components to be considered:

- Determine the waste water load in terms of fixture unit from each bathroom or other units which produces wastewater.
- Selection / Check adequacy of the size (diameter) of the branch pipes according to BNBC.
- Selection / Check adequacy of the size (diameter) of the vertical stack pipes according to BNBC.
- Determining the grade and diameter of the building drain.
- Design the septic tank.

4.2 Wastewater LOADS

There are six toilet unit locations and two kitchen location in the 1st to 6th floors. All these kitchens and toilets are using a total of six (6) voids to run down the vertical stacks. Waste water loads are calculated based on the Fixture Unit (FU) system. In this system a load value is assigned for each type of wastewater fixture. The relevant table from BNBC [Table 8.7.14] is provided in Appendix: BNBC Tables. FU values are picked up from that table to determine the total FU load coming from each toilet to each type of vertical stacks. The fixture unit loads to different stacks from these toilets are listed in the following table:

Table 4.1: Listing of fixutue unit loads from each toilet and kitchen (1st & 6th floor)

Sl. #	Description	Fixture Unit (FU) for Waste Stack (WS)	Fixture Unit (FU) for Soil Stack (SS)	Void Area
1	Toilet 1	Floor Trap (1) + Shower (2) + Wash Basin (1) + Laundry (3)	Water Closet (6)	1
2	Toilet 2	Floor Trap (1) + Shower (2) + Wash Basin (1) + Laundry (3)	Water Closet (6)	2
3	Toilet 3	Floor Trap (1) + Shower (2) + Wash Basin (1) + Laundry (3)	Water Closet (6)	3
4	Toilet 4	Floor Trap (1) + Shower (2) + Wash Basin (1) + Laundry (3)	Water Closet (6)	4
5	Toilet 5	Floor Trap (1) + Shower (2) + Wash Basin (1) + Laundry (3)	Water Closet (6)	5
6	Toilet 6	Floor Trap (1) + Shower (2) + Wash Basin (1) + Laundry (3)	Water Closet (6)	6
7	Kitchen 1	Sink (2)	-	2
8	Kitchen 2	Sink (2)	-	5

These pipe generally runs below the floor and above the false ceiling of the floor below. The ground floor has a different orientation as well. This floor has to accommodate the garage or the limited parking area. Besides the underground water reservoir and the septic tank is located in this floor. The listing is as follows:

Table 4.2: Listing of fixutue unit loads from each toilet and kitchen (Ground floor)

Sl. #	Description	Fixture Unit (FU) for Waste Stack (WS)	Fixture Unit (FU) for Soil Stack (SS)	Void Area
1	Toilet 1	Floor Trap (1) + Shower (2) + Wash Basin (1) + Laundry (3)	Water Closet (6)	5

Total fixture load on each stack is listed below:

Table 4.3: List of Wastewater fixture loads on different stacks (Ground floor ~ 6th floor)

Void area	Fixture unit load on Waste Stack (WS)								Fixture unit load on Soil Stack (SS)							
	GF	1F	2F	3F	4F	5F	6F	Total	GF	1F	2F	3F	4F	5F	6F	Total
1	0	7	7	7	7	7	7	42	0	6	6	6	6	6	6	36
2	0	9	9	9	9	9	9	54	0	6	6	6	6	6	6	36
3	0	7	7	7	7	7	7	42	0	6	6	6	6	6	6	36
4	0	7	7	7	7	7	7	42	0	6	6	6	6	6	6	36
5	7	9	9	9	9	9	9	61	6	6	6	6	6	6	6	42
6	0	7	7	7	7	7	7	42	0	6	6	6	6	6	6	36

CAD #03 includes the section detail of fixtures.

4.3 Selection Of Branch And Stack Pipe Size

All branch pipes are selected to be 100 mm in diameter. This uniform size selection will eliminate the need of reducers and will reduce the hassle of maintaining different sized pipe stocks for any repair work. According to Table 8.7.16 from BNBC (Appendix: BNBC Tables) this 100 mm branch pipe can take up to 160 FU load and hence this selection is more than enough. That table also indicate that the vertical stacks of this size can take upto 500 FU load and hence this design or selection is enough. **CAD #01** includes a sketch of stack with velocity reducer arrangement. **CAD #08** includes typical wastewater and rain pipe joint details.

4.4 Design Of Building Drain

Total load on building drains for SS and WS are 222 and 283 FU accordingly. Therefore, according to BNBC Table 8.7.17 (Appendix: BNBC Tables), Ø150 mm pipe is selected with a slope of 1/100. This setup has a capacity of 700 FU load.

Layout of the building drain with, building sewer etc are shown in **CAD #01**. A layout of the UG reservoir for water supply is shown in **CAD #16**. These two elements are separated by sufficient distance to prevent any chance of cross contamination. **CAD #11, CAD #14** and **CAD #12** shows the detailed of stack connections and detailed sections of typical inspection pits for building drains.

4.5 Design Of Septic Tank.

According to BNBC 2020 every residential building has need septic tank. But our project is situated at Aftab Nagar, Dhaka there has well drainage system, so there is no need to septic tank. During design this project we did not consider septic tank.

CHAPTER 5
DESIGN OF STORM WATER DRAINAGE

5.1 General

There is no special arrangements to store and manage storm water for this building. Arrangements were made to discharge rain water easily from roof through several rain stacks to the building drain.

5.2 Storm Water Management System

There are six zones of vertical pipe groups in this building. Six (6) of these zones include a rain drainage pipe / stack. **CAD #08** shows the drainage plan for the storm/ rain water from roof with the slope directions and rain pipe locations.

REFERENCES

1: McGraw hill book company, Water quality and treatment, 1990

2: Ahmed, F. and Smith, P.G., Design and performance of a community type iron removal plant for hand pump tube well., 1987.

- BNBC 2020 Table 5.9.1.2.c
- BNBC 2020 Table 8.7.14
- BNBC 2020 Table 8.7.16
- BNBC 2020 Table 8.7.17

Bibliography

1: McGraw hill book company, Water quality and treatment, 1990

2: Ahmed, F.and smith,P.G., Design and performmance of a comunity type iron removal plant for hand pump tubewell., 1987

APPENDICES

Appendix: BNBC Tables

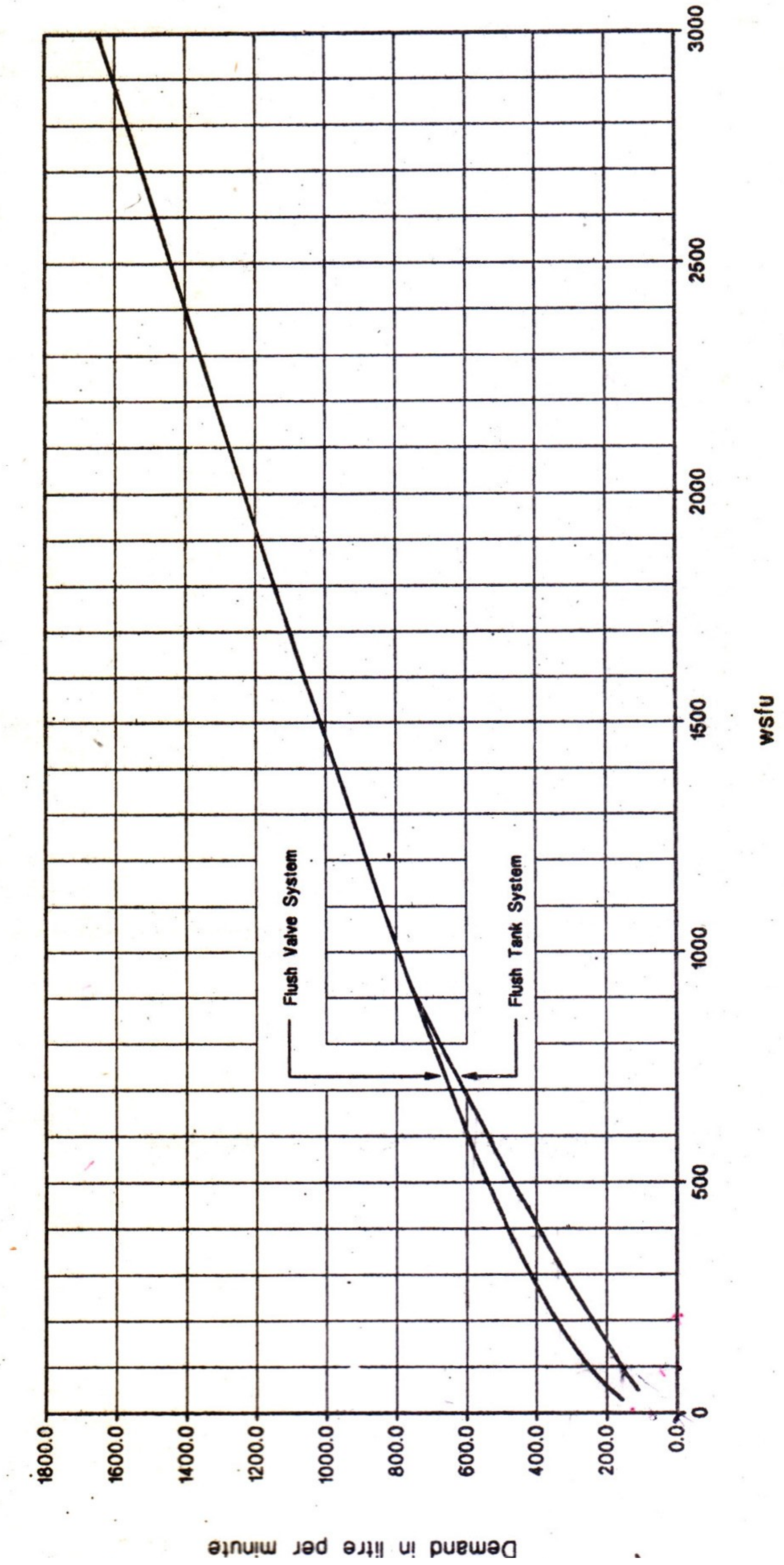


Fig. P 1 Water Supply Demand for Various Loads in Water Supply Fixture Units (wsfu)

Table 1: Water Supply Fixture Unit (WSFU) Values for Various Plumbing Fixtures (BNBC Table P1)

Fixtures of Group	**Supply Control**	**wsfu**		
		Cold	**Hot**	**Total**
Bath Group	Flush tank	4.5	3	6
Bath Group	Flush valve	6	3	8
Bathtub	Faucet	1.5	1.5	2
Bidet	Faucet	1.5	1.5	2
Combination	Faucet	2	2	3
Kitchen sink	Faucet	1.5	1.5	2
Laundry tray	Faucet	2	2	3
Laundry	Faucet	1.5	1.5	2
Pedestal urinal	Flush valve	10	-	10
Restaurant sink	Faucet	3	3	4
Service sink	Faucet	1.5	1.5	2
Shower head	Mixing Valve	3	3	4
Stall or wall urinal	Flush tank	3	-	3
Stall or wall urinal	Flush valve	5	-	5
Water closet	Flush tank	5	-	5
Water closet	Flush valve	10	-	10

* Fixture with both cold and hot water supplies, the weight for maximum separate demands may be considered 75% of total wsfu.

Table 2: Equivalent Length of Pipe for Friction Loss in Valves and Fittings (BNBC Table P2)

Valves or Fittings	Equivalent Length (m) of Pipes Against Diameter (mm) of Fittings												
	10	13	19	25	32	38	50	63	75	88	100	125	150
Angle Valve	1.22	2.44	3.66	4.57	5.49	6.71	8.53	10.36	12.19	15.24	16.76	21.34	24.38
Gate Valve	0.06	0.12	0.15	0.18	0.24	0.30	0.40	0.49	0.61	0.73	0.82	1.01	1.22
Glove Valve	2.44	4.57	6.10	7.62	10.67	13.72	16.76	19.81	24.38	30.48	38.10	42.67	50.29
90° Standard Elbow	0.30	0.61	0.76	0.91	1.22	1.52	2.13	2.44	3.05	3.66	4.26	5.18	6.10
45° Standard Elbow	0.18	0.37	0.46	0.55	0.73	0.91	1.22	1.52	1.83	2.13	2.44	3.05	3.66
90° Side Tee Coupling	0.46	0.91	1.22	1.52	1.83	2.13	3.05	3.66	4.57	5.49	6.40	7.62	9.14
Straight Run of Tee	0.09	0.18	0.24	0.27	0.37	0.46	0.61	0.76	0.91	1.10	1.22	1.52	1.83

Table 8.7.14
Fixture Units for Different Sanitary Appliances or Groups

Type of Fixture	Fixture Unit Value as Load Factors
One bathroom group consisting of water closet, wash basin and bath tub or shower stall :	
a) Flush Tank water closet	6
b) Flush-valve water closet	8
Bathtub*	3
Bidet	3
Combination sink and tray (drain board)	3
Drinking fountain	0.5
Floor traps†	1
Kitchen sink, domestic	2
Wash basin, ordinary‡	1
Wash basin, surgeon's	2
Shower stall, domestic	2
Shower (group) per head	3
Urinal, wall lip	4
Urinal, stall	4
Water closet, tank operated	4
Water closet, valve operated	8

* A shower head over a bath tub does not increase the fixture unit value.
† Size of floor trap shall be determined by the area of surface water to be drained.
‡ Wash basin with 32 mm and 40 mm trap have the same load value.

Table 8.7.16 [BNBC]:
Maximum number of Fixture Units that can be Connected to Branches and Stacks

Diameter of Pipe (mm)	Maximum Number of Fixture Units that can be Connected			
	Any Horizontal Fixture Branch	One Stack of 3 Stories in Height or 3 Intervals	More than 3 Stories in Height	
			Total for stack	Total at One Stories or Branch Interval
30	1	2	2	1
40	3	4	8	2
50	6	10	24	6
65	12	20	42	9
75	20	30	60	16
100	160	240	500	90
125	360	540	1100	200
150	620	960	1900	350
200	1400	2200	3600	600
250	2500	3800	5600	1000
300	3900	6000	8400	1500
375	7000	b	b	b

a Does not include branches of the building sewer.

b Sizing load based on design criteria.

Table 8.7.17 [BNBC]: Maximum number of Fixture Units that can be Connected to Building Drains and Sewers

Diameter of Pipe (mm)	Maximum Number of Fixture Units that can be Connected to any Portion* of the Building Drain or the Building Sewer for Various Slopes			
	1/200	1/100	1/50	1/25
100	-	180	216	250
150	-	700	840	1000
200	1400	1600	1900	2300
250	2500	2900	3500	4200
300	2900	4600	5600	6700
375	7000	8300	10000	12000

* Includes branches of building sewer

Appendix: CAD Files

NOTATION:

BNBC = Bangladesh National Building Code.

UGWT = Under Ground Water Tank.

OHT = Over Head Tank.

WSFU = Water Supply Fixture Unit.

HDPE = High density polyethylene.

FB = Free Board.

ASTM = American Society for Testing and Materials.

ACI = American Concrete Institute.

MPa = Mega Pascal (N/mm^2)

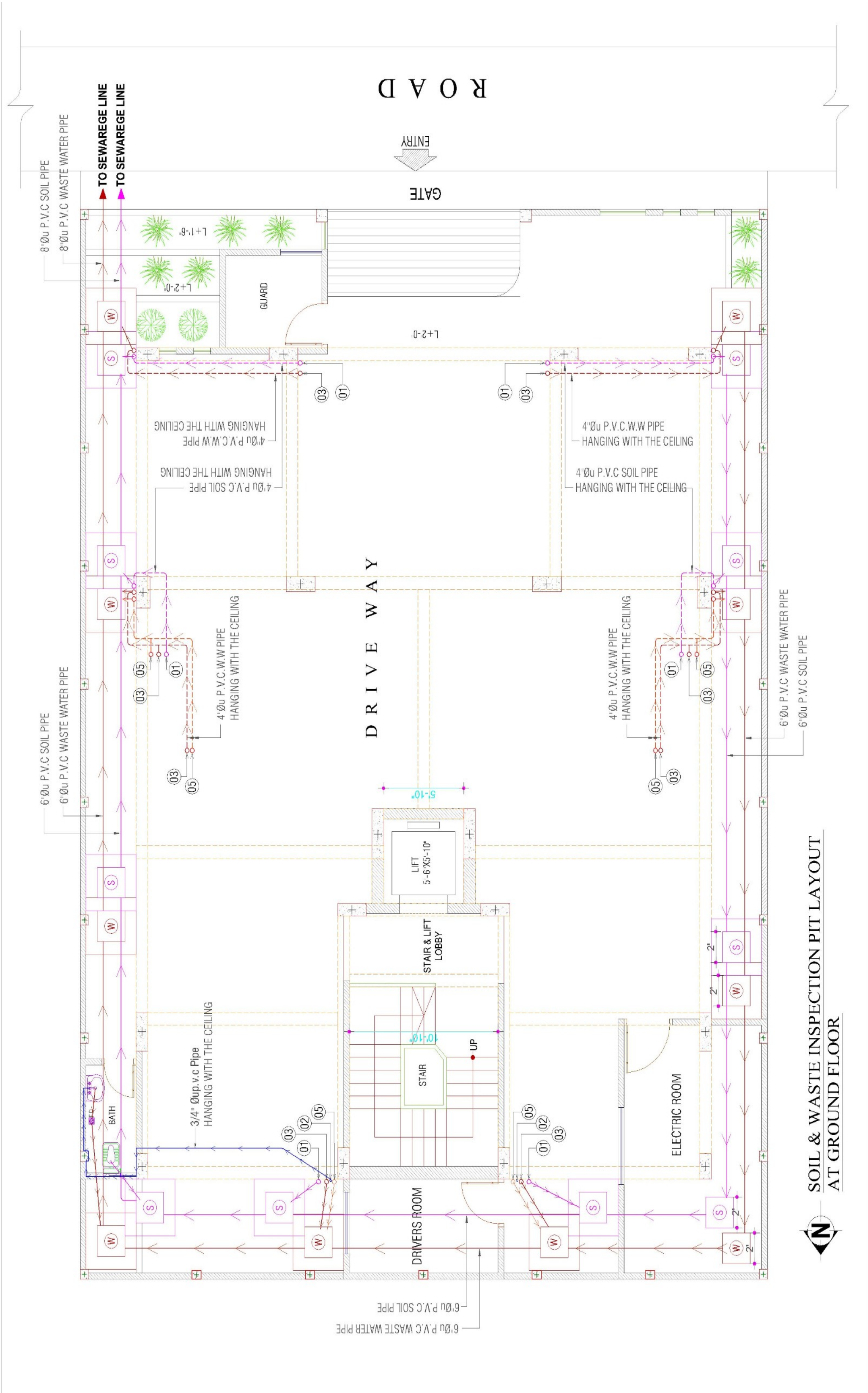
psi = Pound per square inch.

kN = Kilo Newton.

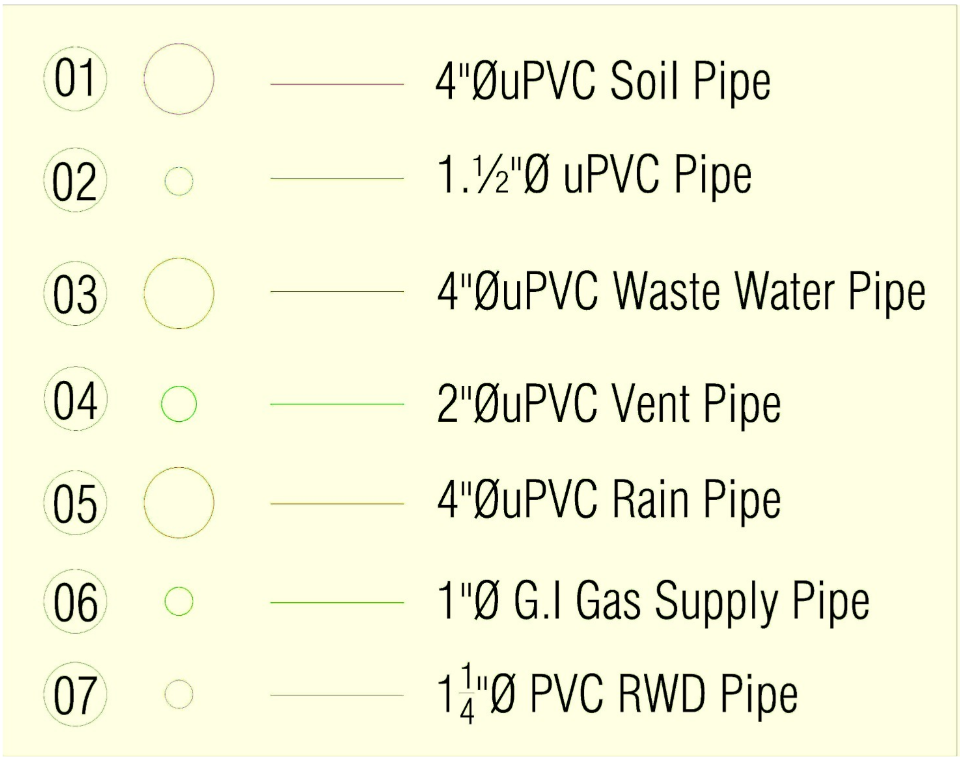
kg = Kilogram.

mm = Millimeter.

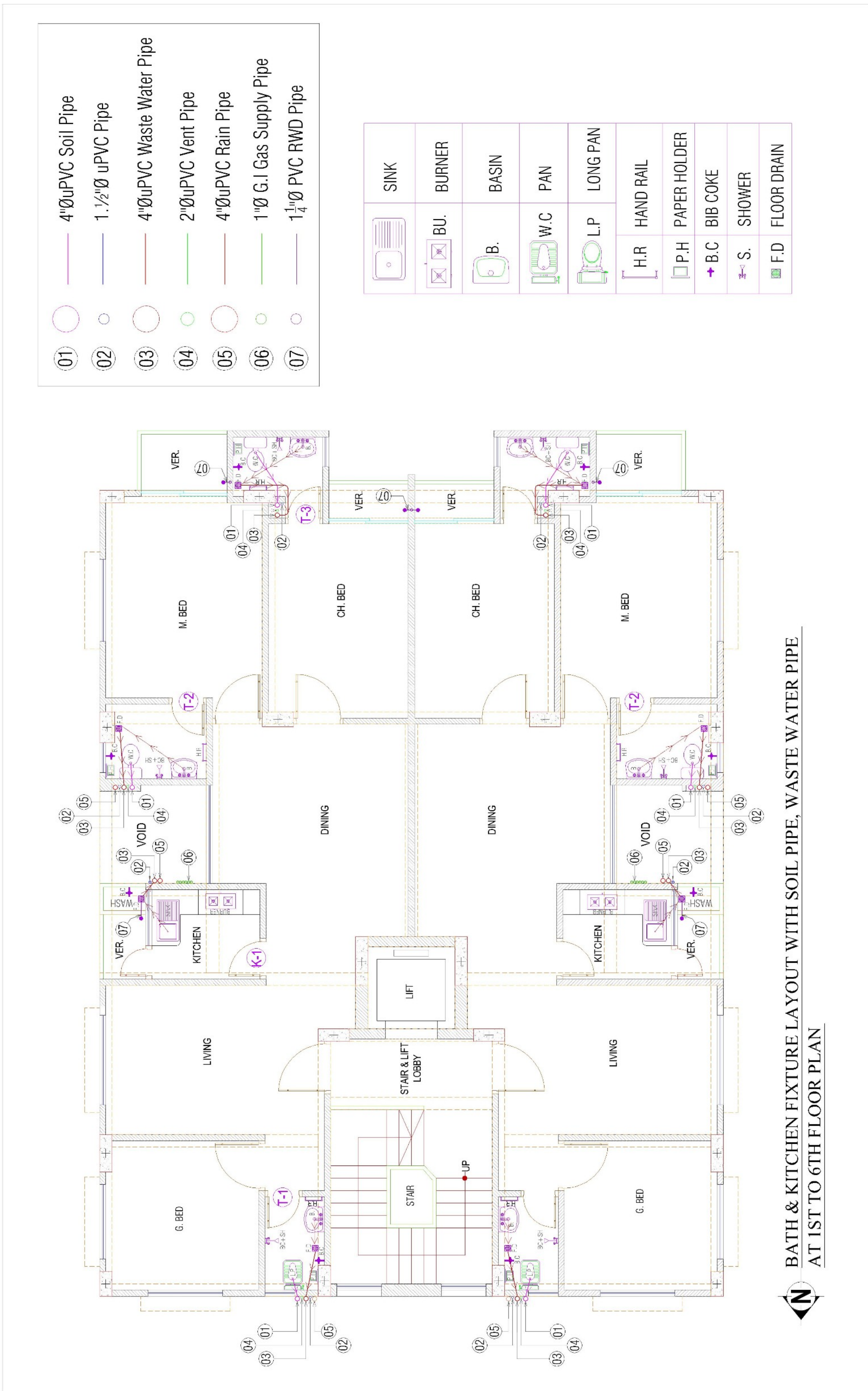
cm = Centimeter.


ROAD
ENTRY
GATE
TO SEWAREGE LINE
TO SEWAREGE LINE
8'Øu P.V.C SOIL PIPE
8'Øu P.V.C WASTE WATER PIPE
GUARD
DRIVE WAY
4"Øu P.V.C.W.W PIPE HANGING WITH THE CEILING
4"Øu P.V.C SOIL PIPE HANGING WITH THE CEILING
6'Øu P.V.C SOIL PIPE
6'Øu P.V.C WASTE WATER PIPE
LIFT
5'-6"X5'-10"
STAIR & LIFT LOBBY
STAIR
UP
ELECTRIC ROOM
DRIVERS ROOM
BATH
3/4" Øup.v.c Pipe HANGING WITH THE CEILING
SOIL & WASTE INSPECTION PIT LAYOUT AT GROUND FLOOR

CAD-1

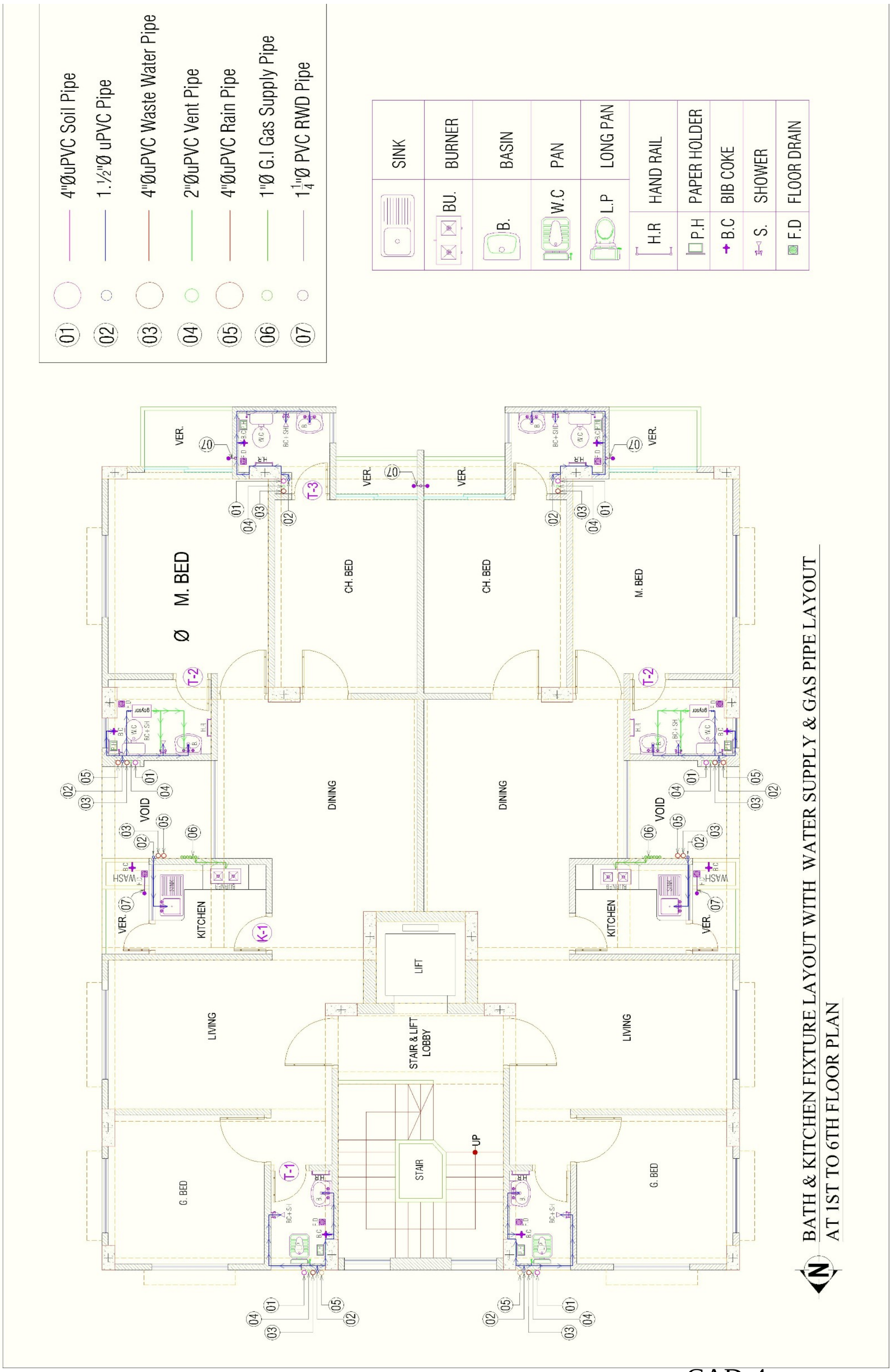

01
4"ØuPVC Soil Pipe
02
1.½"Ø uPVC Pipe
03
4"ØuPVC Waste Water Pipe
04
2"ØuPVC Vent Pipe
05
4"ØuPVC Rain Pipe
06
1"Ø G.I Gas Supply Pipe
07
1¼"Ø PVC RWD Pipe

CAD-2

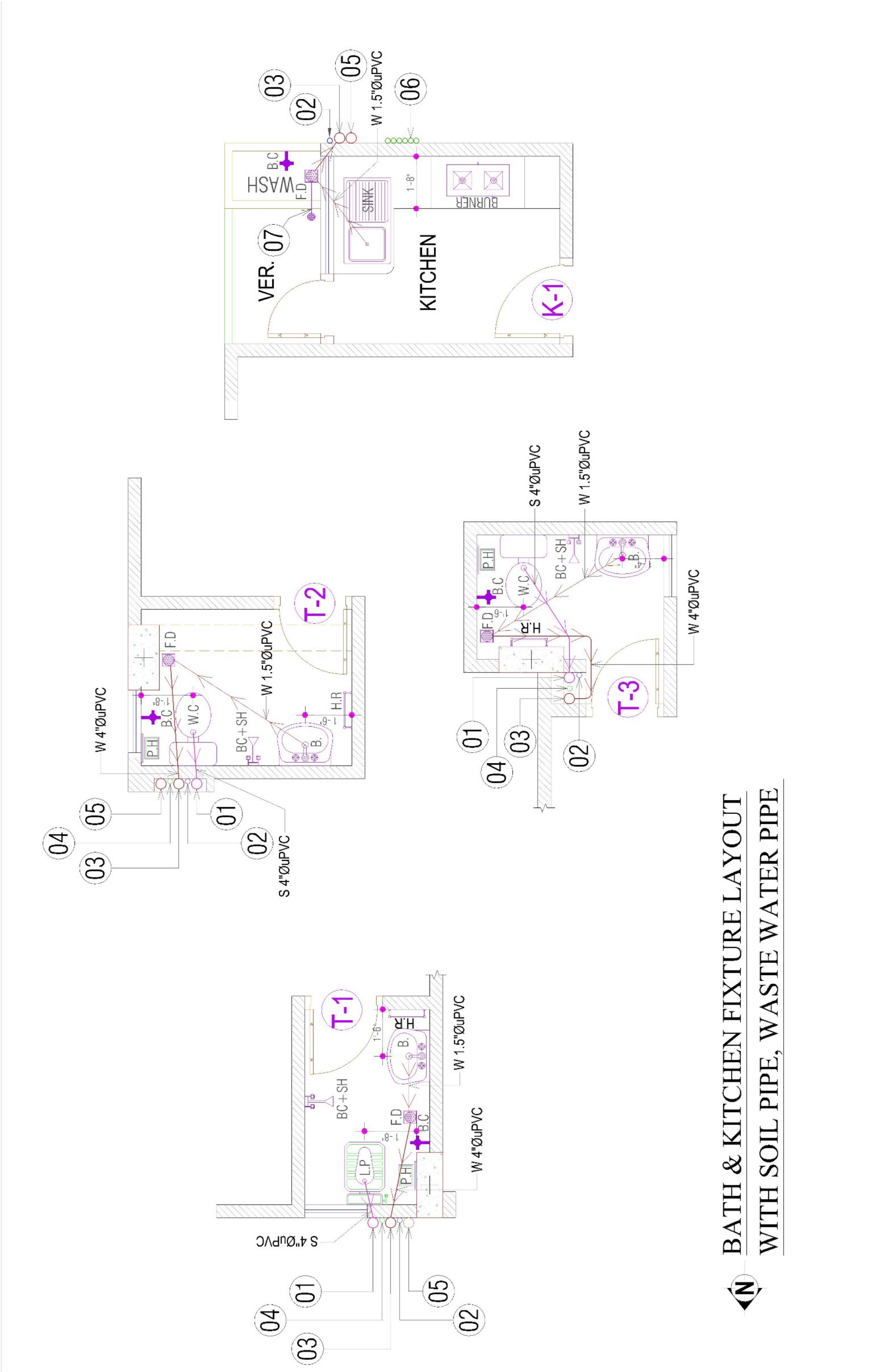


01 4"ØuPVC Soil Pipe
02 1.½"Ø uPVC Pipe
03 4"ØuPVC Waste Water Pipe
04 2"ØuPVC Vent Pipe
05 4"ØuPVC Rain Pipe
06 1"Ø G.I Gas Supply Pipe
07 1¼"Ø PVC RWD Pipe
SINK
BU. BURNER
B. BASIN
W.C PAN
L.P LONG PAN
H.R HAND RAIL
P.H PAPER HOLDER
B.C BIB COKE
S. SHOWER
F.D FLOOR DRAIN
VER.
M. BED
CH. BED
DINING
KITCHEN
WASH
VOID
LIFT
STAIR & LIFT LOBBY
LIVING
STAIR
UP
G. BED
T-1
T-2
T-3
K-1
N
BATH & KITCHEN FIXTURE LAYOUT WITH SOIL PIPE, WASTE WATER PIPE
AT 1ST TO 6TH FLOOR PLAN

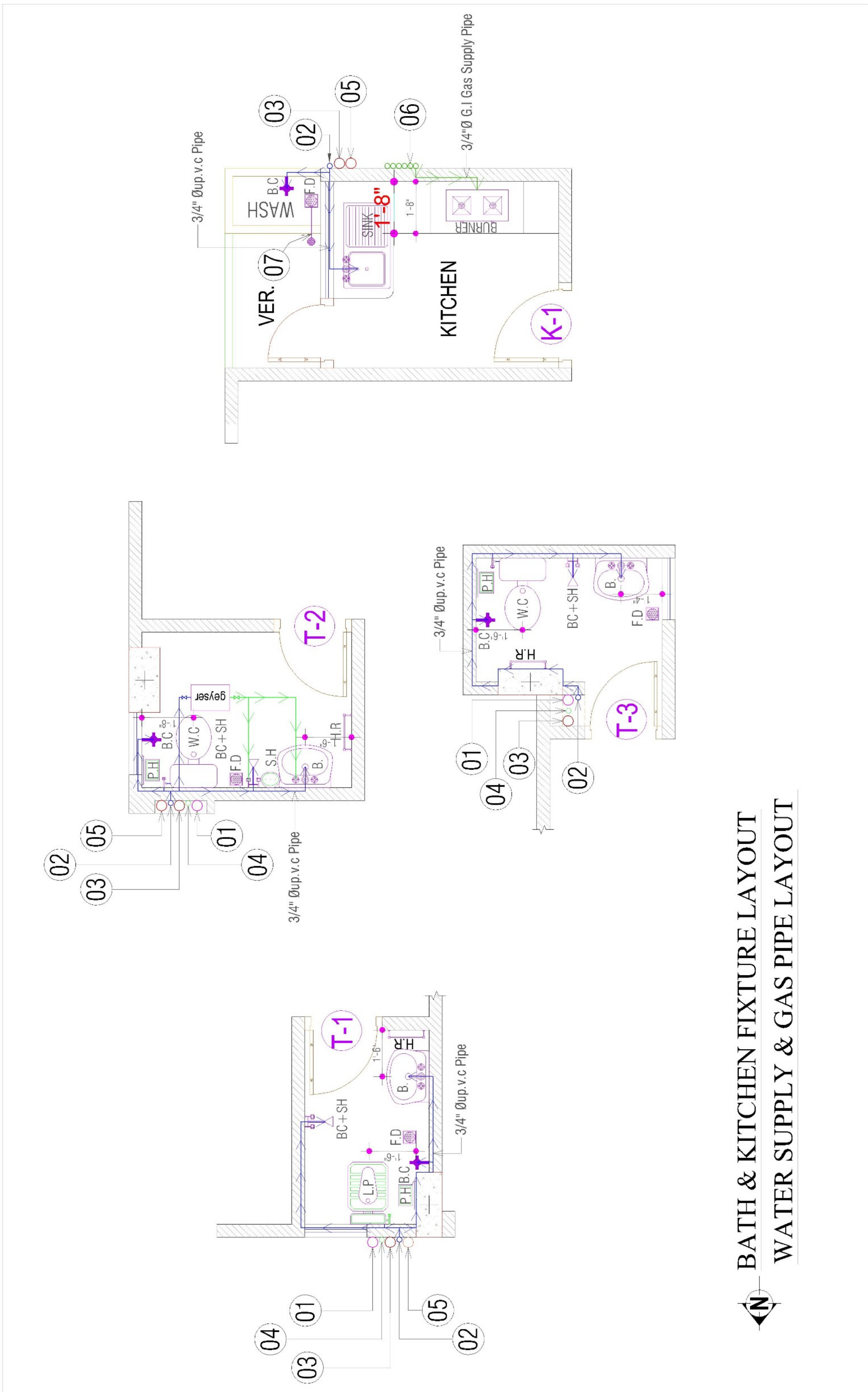
CAD-3


01 4"ØuPVC Soil Pipe
02 1.½"Ø uPVC Pipe
03 4"ØuPVC Waste Water Pipe
04 2"ØuPVC Vent Pipe
05 4"ØuPVC Rain Pipe
06 1"Ø G.I Gas Supply Pipe
07 1¼"Ø PVC RWD Pipe
SINK
BU. BURNER
B. BASIN
W.C PAN
L.P LONG PAN
H.R HAND RAIL
P.H PAPER HOLDER
B.C BIB COKE
S. SHOWER
F.D FLOOR DRAIN
M. BED
CH. BED
DINING
KITCHEN
LIVING
G. BED
LIFT
STAIR & LIFT LOBBY
STAIR
UP
VER.
VOID
WASH
BATH & KITCHEN FIXTURE LAYOUT WITH WATER SUPPLY & GAS PIPE LAYOUT
AT 1ST TO 6TH FLOOR PLAN

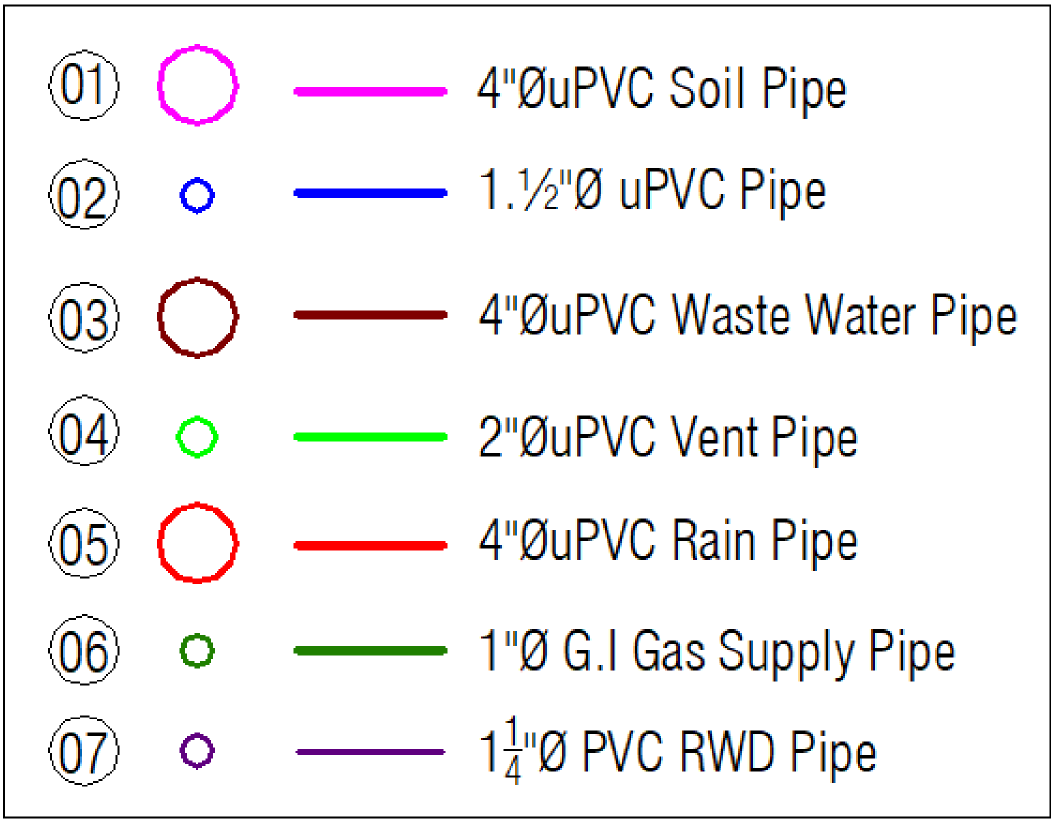
CAD-4


BATH & KITCHEN FIXTURE LAYOUT
WITH SOIL PIPE, WASTE WATER PIPE
T-1
T-2
T-3
K-1
KITCHEN
VER.
WASH
SINK
BURNER
W 4"ØuPVC
W 1.5"ØuPVC
S 4"ØuPVC
BC+SH
W.C
B.C
F.D
P.H
H.R
L.P
01
02
03
04
05
06
07

CAD-5


BATH & KITCHEN FIXTURE LAYOUT
WATER SUPPLY & GAS PIPE LAYOUT
N
K-1
KITCHEN
VER.
WASH
SINK
BURNER
1'-8"
3/4" Øup.v.c Pipe
3/4"Ø G.I Gas Supply Pipe
T-1
T-2
T-3
geyser
W.C
BC+SH
B.C
P.H
F.D
S.H
H.R
B.
L.P
01
02
03
04
05
06
07

CAD-6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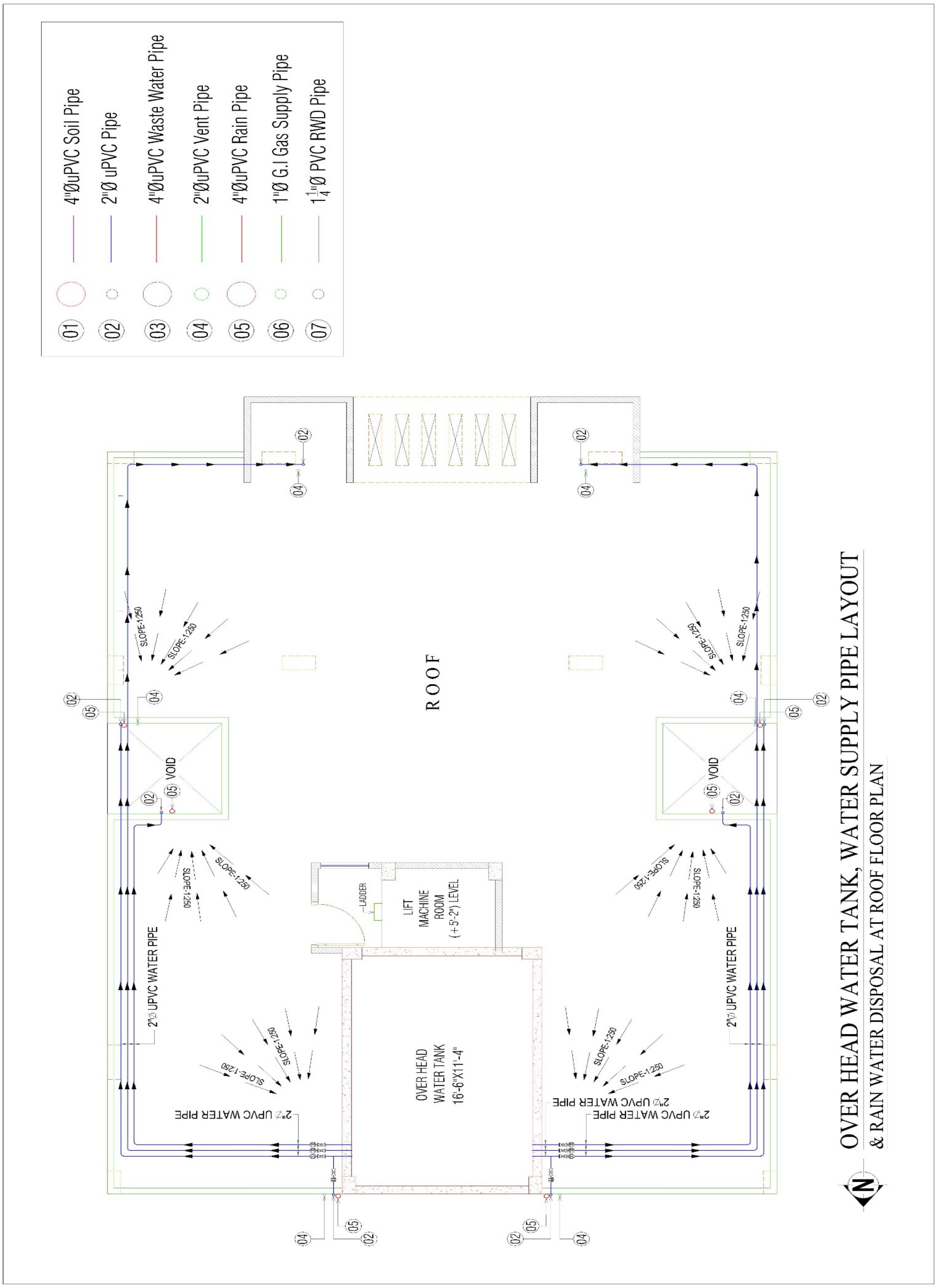
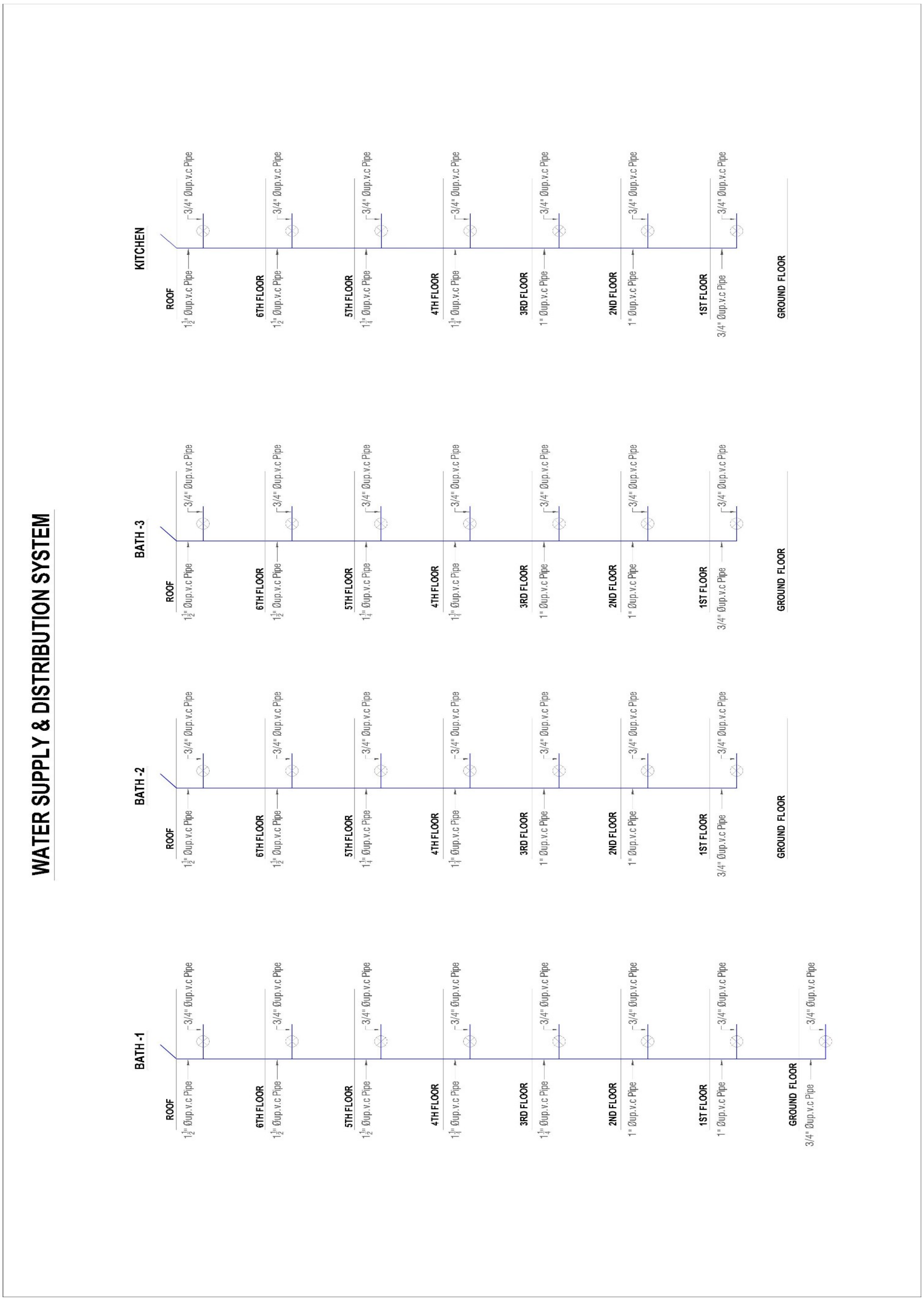
4"ØuPVC Soil Pipe
02
1.½"Ø uPVC Pipe
03
4"ØuPVC Waste Water Pipe
04
2"ØuPVC Vent Pipe
05
4"ØuPVC Rain Pipe
06
1"Ø G.I Gas Supply Pipe
07
1¼"Ø PVC RWD Pipe

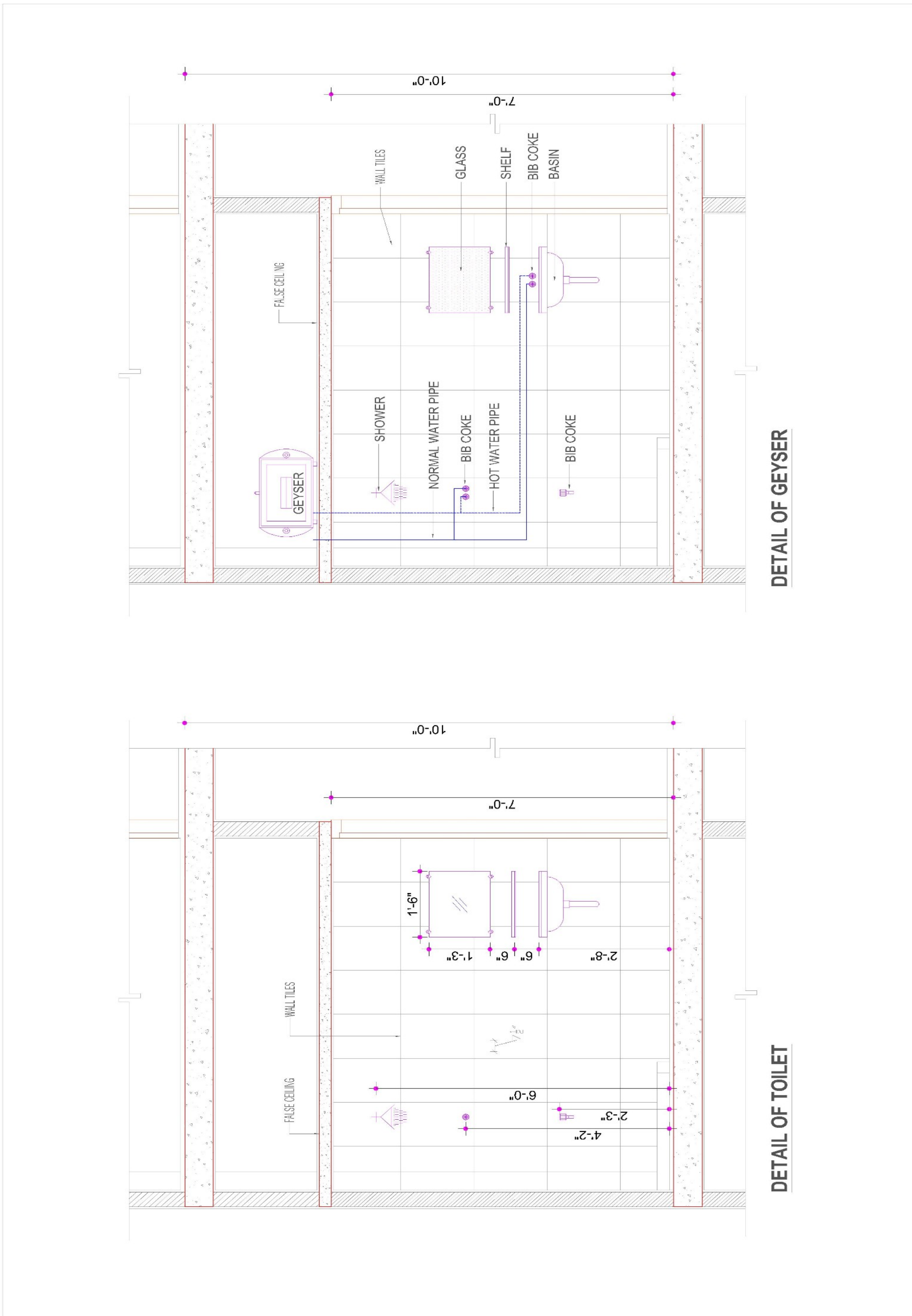
CAD-7


01 4"ØuPVC Soil Pipe
02 2"Ø uPVC Pipe
03 4"ØuPVC Waste Water Pipe
04 2"ØuPVC Vent Pipe
05 4"ØuPVC Rain Pipe
06 1"Ø G.I Gas Supply Pipe
07 1$\frac{1}{4}$"Ø PVC RWD Pipe
ROOF
VOID
SLOPE-1:250
2"Ø UPVC WATER PIPE
LADDER
LIFT MACHINE ROOM (+5'-2") LEVEL
OVER HEAD WATER TANK 16'-6"X11'-4"
OVER HEAD WATER TANK, WATER SUPPLY PIPE LAYOUT
& RAIN WATER DISPOSAL AT ROOF FLOOR PLAN
N

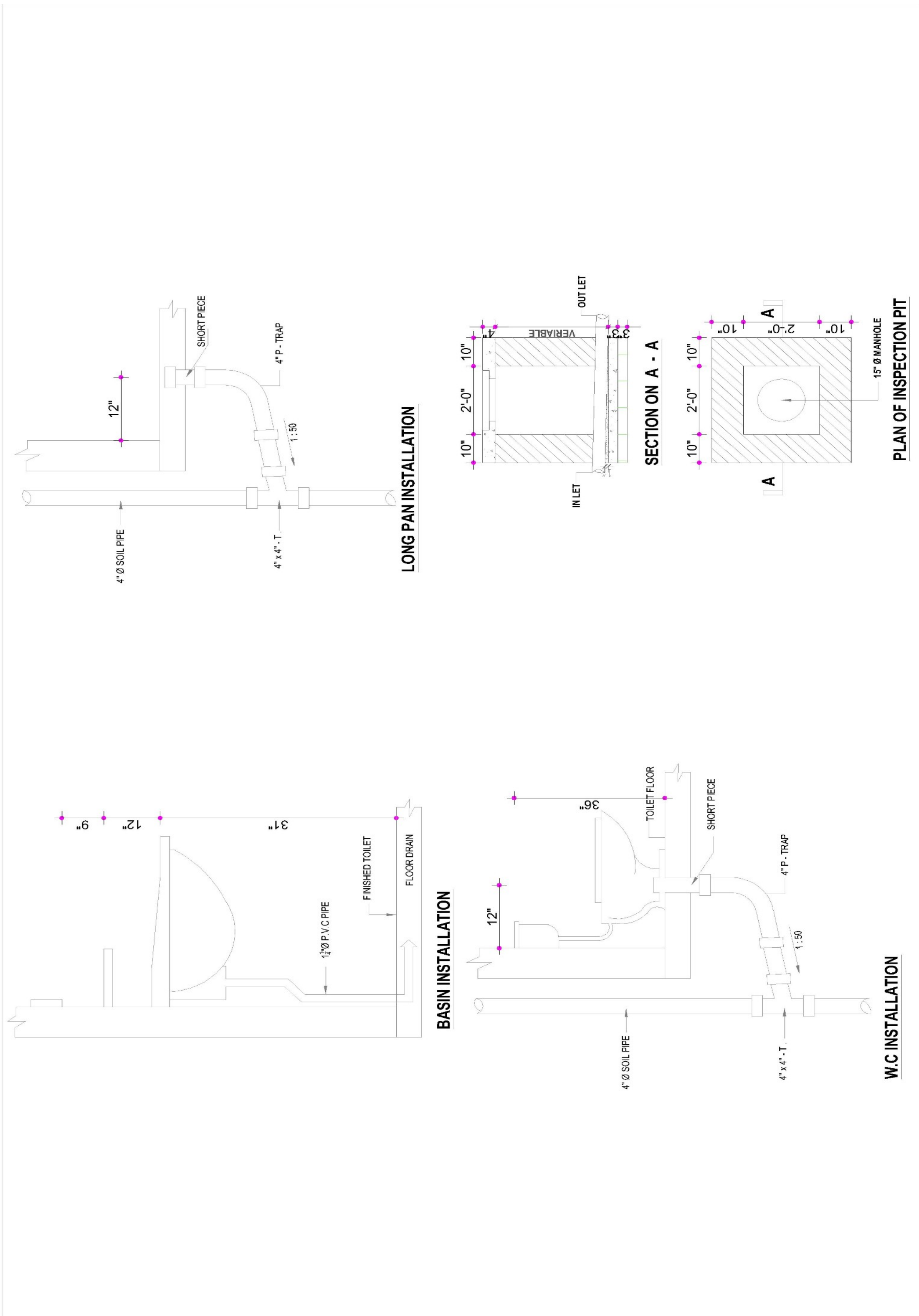
CAD-8


WATER SUPPLY & DISTRIBUTION SYSTEM
KITCHEN
BATH -3
BATH -2
BATH -1
ROOF
6TH FLOOR
5TH FLOOR
4TH FLOOR
3RD FLOOR
2ND FLOOR
1ST FLOOR
GROUND FLOOR
3/4" Øup.v.c Pipe
1" Øup.v.c Pipe

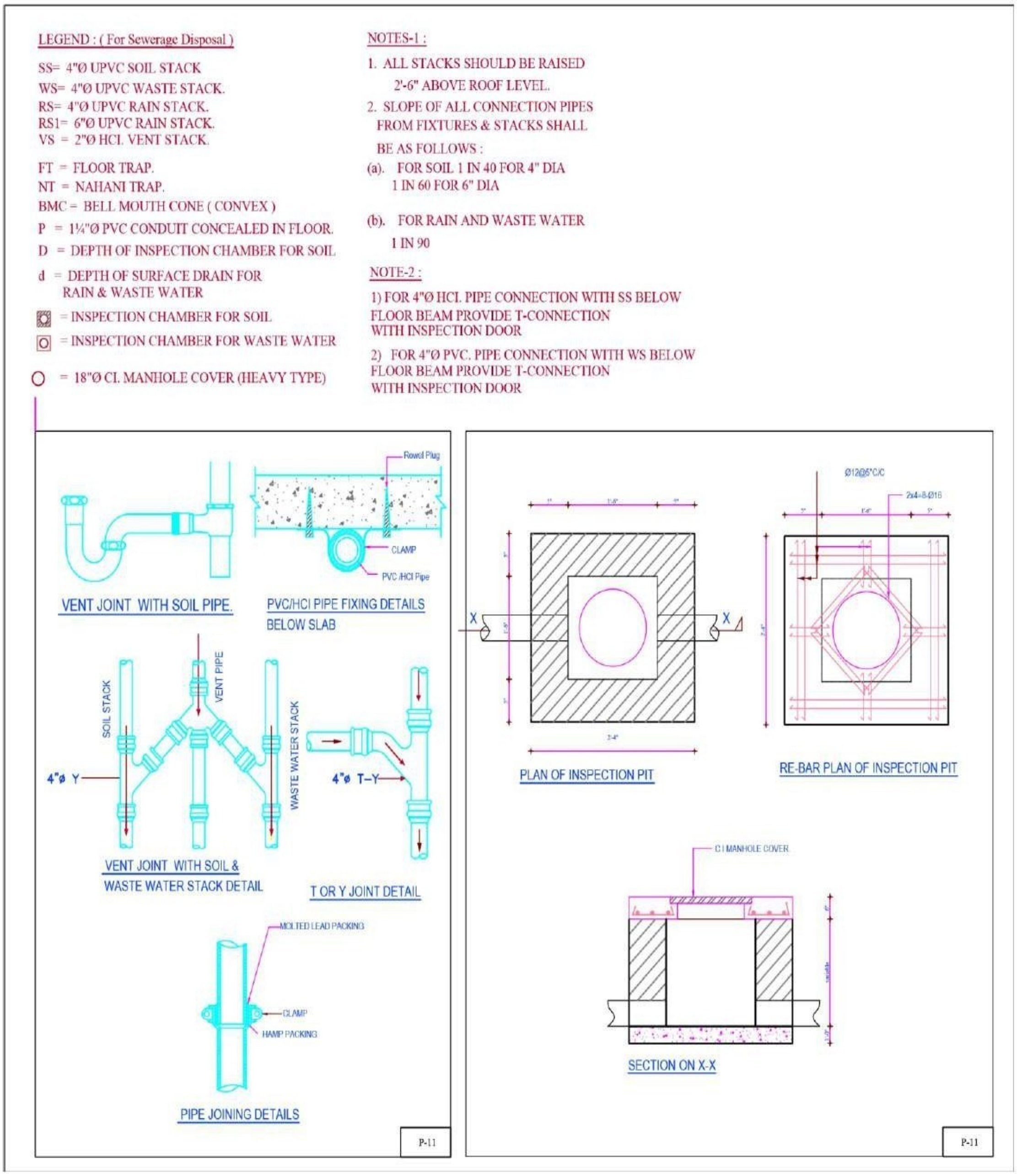
CAD-9


DETAIL OF GEYSER
10'-0"
7'-0"
WALL TILES
GLASS
SHELF
BIB COKE
BASIN
FALSE CEILING
GEYSER
SHOWER
NORMAL WATER PIPE
BIB COKE
HOT WATER PIPE
BIB COKE
DETAIL OF TOILET
10'-0"
7'-0"
1'-6"
1'-3"
6"
6"
2'-8"
WALL TILES
FALSE CEILING
6'-0"
2'-3"
4'-2"

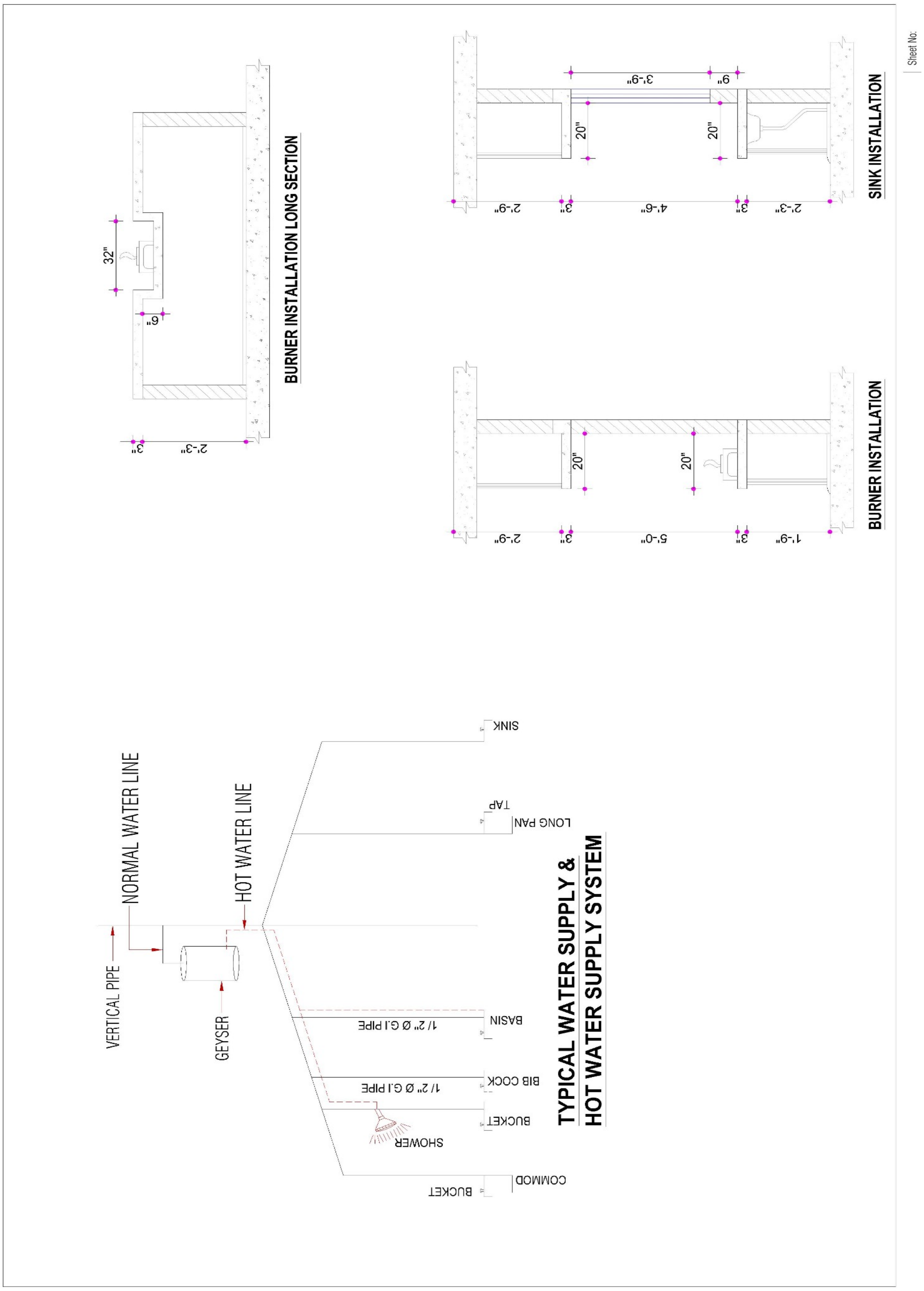
CAD-10


LONG PAN INSTALLATION
4" Ø SOIL PIPE
4" x 4" - T.
4" P - TRAP
SHORT PIECE
12"
1 : 50
SECTION ON A - A
IN LET
OUT LET
VERIABLE
10"
2'-0"
PLAN OF INSPECTION PIT
15" Ø MANHOLE
A
BASIN INSTALLATION
FINISHED TOILET
FLOOR DRAIN
1½"Ø P.V.C PIPE
31"
9"
W.C INSTALLATION
TOILET FLOOR
36"

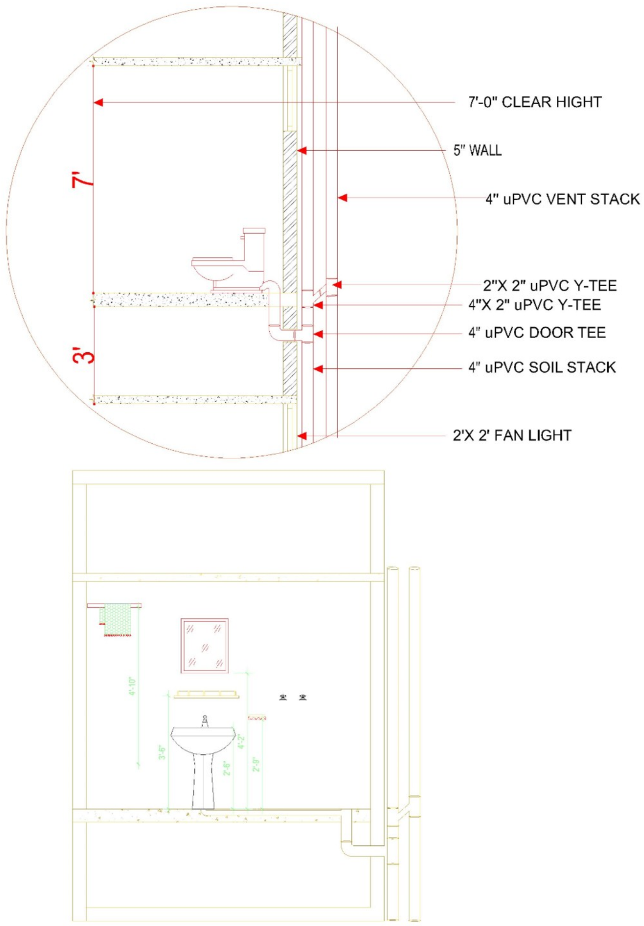
CAD-11


LEGEND : (For Sewerage Disposal)
SS= 4"Ø UPVC SOIL STACK
WS= 4"Ø UPVC WASTE STACK.
RS= 4"Ø UPVC RAIN STACK.
RS1= 6"Ø UPVC RAIN STACK.
VS = 2"Ø HCI. VENT STACK.
FT = FLOOR TRAP.
NT = NAHANI TRAP.
BMC = BELL MOUTH CONE (CONVEX)
P = 1¼"Ø PVC CONDUIT CONCEALED IN FLOOR.
D = DEPTH OF INSPECTION CHAMBER FOR SOIL
d = DEPTH OF SURFACE DRAIN FOR RAIN & WASTE WATER
= INSPECTION CHAMBER FOR SOIL
= INSPECTION CHAMBER FOR WASTE WATER
= 18"Ø CI. MANHOLE COVER (HEAVY TYPE)
NOTES-1 :
1. ALL STACKS SHOULD BE RAISED 2'-6" ABOVE ROOF LEVEL.
2. SLOPE OF ALL CONNECTION PIPES FROM FIXTURES & STACKS SHALL BE AS FOLLOWS :
(a). FOR SOIL 1 IN 40 FOR 4" DIA
1 IN 60 FOR 6" DIA
(b). FOR RAIN AND WASTE WATER
1 IN 90
NOTE-2 :
1) FOR 4"Ø HCI. PIPE CONNECTION WITH SS BELOW FLOOR BEAM PROVIDE T-CONNECTION WITH INSPECTION DOOR
2) FOR 4"Ø PVC. PIPE CONNECTION WITH WS BELOW FLOOR BEAM PROVIDE T-CONNECTION WITH INSPECTION DOOR
Rowel Plug
CLAMP
PVC /HCI Pipe
VENT JOINT WITH SOIL PIPE.
PVC/HCI PIPE FIXING DETAILS BELOW SLAB
SOIL STACK
VENT PIPE
WASTE WATER STACK
4"ø Y
4"ø T-Y
VENT JOINT WITH SOIL & WASTE WATER STACK DETAIL
T OR Y JOINT DETAIL
MOLTED LEAD PACKING
CLAMP
HAMP PACKING
PIPE JOINING DETAILS
P-11
X
X
PLAN OF INSPECTION PIT
Ø12@5"C/C
RE-BAR PLAN OF INSPECTION PIT
C.I MANHOLE COVER
SECTION ON X-X
P-11

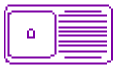
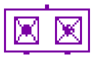
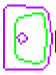
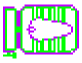
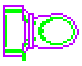
CAD-12


BURNER INSTALLATION LONG SECTION
32"
6"
2'-3"
3"
SINK INSTALLATION
3'-9"
9"
20"
20"
2'-9"
3"
4'-6"
3"
2'-3"
BURNER INSTALLATION
20"
20"
2'-9"
3"
5'-0"
3"
1'-9"
NORMAL WATER LINE
HOT WATER LINE
VERTICAL PIPE
GEYSER
SINK
LONG PAN
TAP
BASIN
1/2" Ø G.I PIPE
BIB COCK
1/2" Ø G.I PIPE
BUCKET
SHOWER
COMMOD
BUCKET
TYPICAL WATER SUPPLY &
HOT WATER SUPPLY SYSTEM
Sheet No:

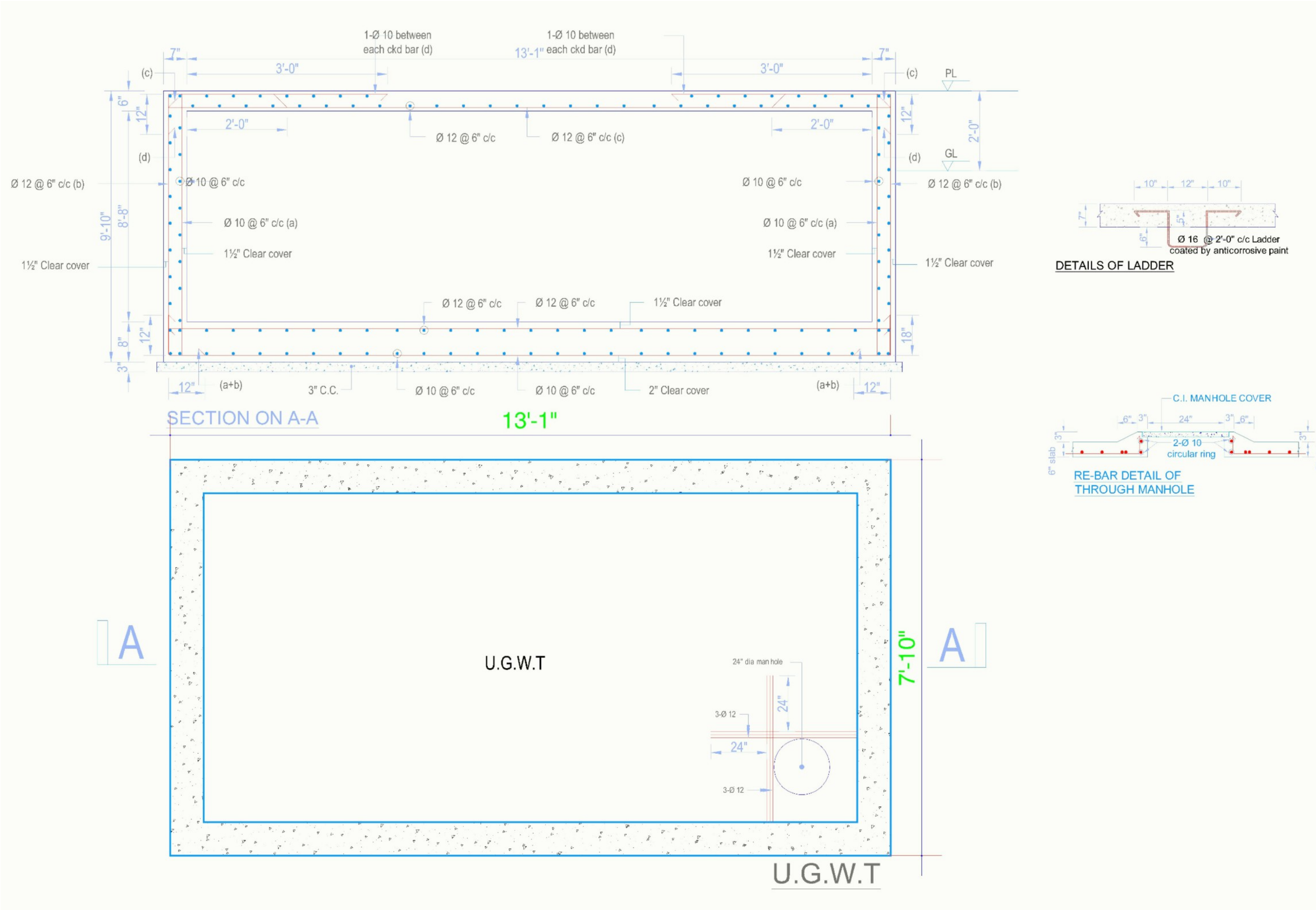
CAD-13


7'-0" CLEAR HIGHT
5" WALL
4" uPVC VENT STACK
7'
2"X 2" uPVC Y-TEE
4"X 2" uPVC Y-TEE
4" uPVC DOOR TEE
3'
4" uPVC SOIL STACK
2'X 2' FAN LIGHT

CAD-14

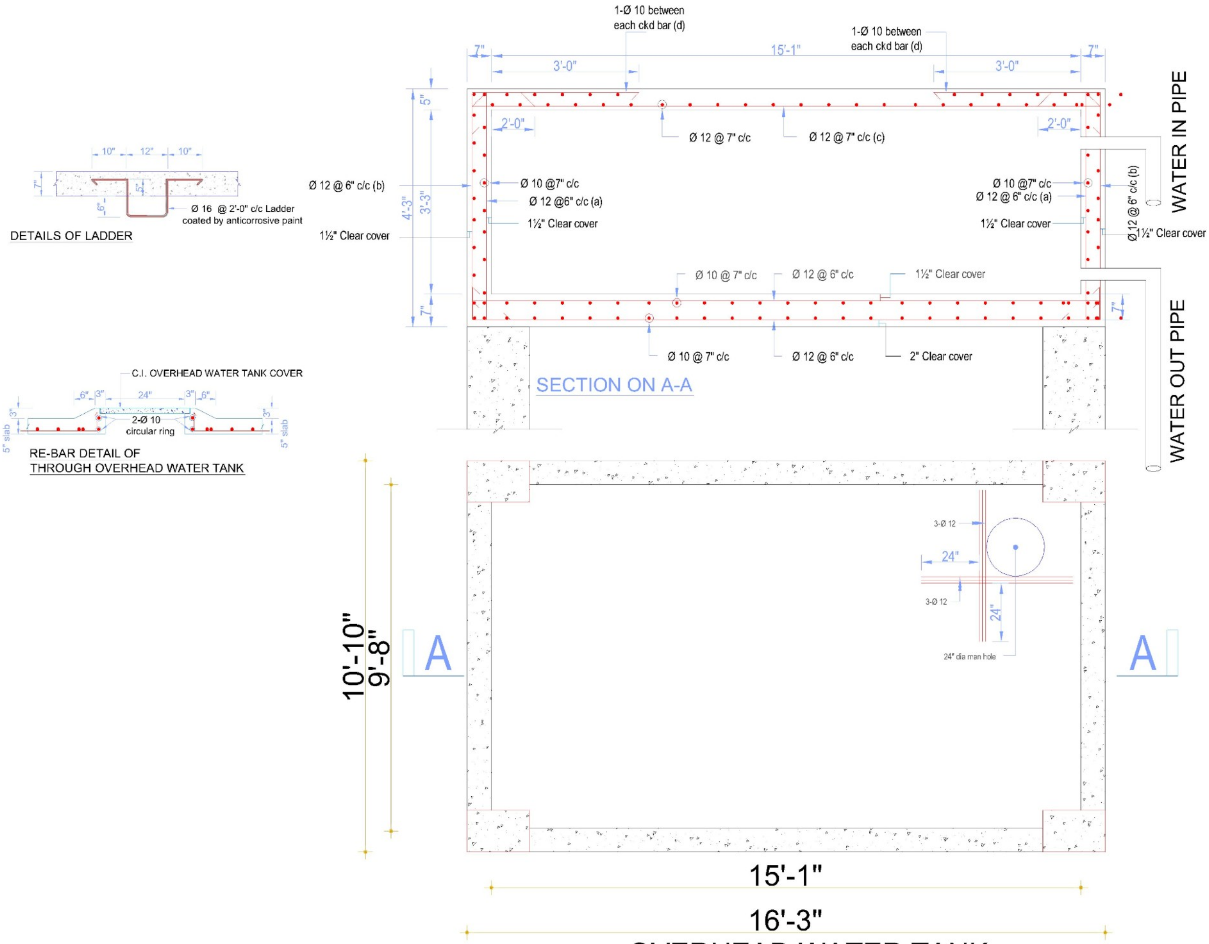
		SINK
	BU.	BURNER
	B.	BASIN
	W.C	PAN
	L.P	LONG PAN
	H.R	HAND RAIL
	P.H	PAPER HOLDER
	B.C	BIB COKE
	S.	SHOWER
	F.D	FLOOR DRAIN

CAD-15



1-Ø 10 between each ckd bar (d)
1-Ø 10 between each ckd bar (d)
13'-1"
7"
3'-0"
3'-0"
(c)
PL
6"
12"
2'-0"
2'-0"
2'-0"
Ø 12 @ 6" c/c
Ø 12 @ 6" c/c (c)
(d)
GL
Ø 12 @ 6" c/c (b)
Ø 10 @ 6" c/c
Ø 10 @ 6" c/c
Ø 12 @ 6" c/c (b)
9'-10"
8'-8"
Ø 10 @ 6" c/c (a)
Ø 10 @ 6" c/c (a)
1½" Clear cover
1½" Clear cover
1½" Clear cover
1½" Clear cover
Ø 12 @ 6" c/c
Ø 12 @ 6" c/c
1½" Clear cover
8"
18"
3"
12"
(a+b)
3" C.C.
Ø 10 @ 6" c/c
Ø 10 @ 6" c/c
2" Clear cover
(a+b)
SECTION ON A-A
13'-1"
A
U.G.W.T
24" dia man hole
3-Ø 12
24"
24"
3-Ø 12
7'-10"
A
U.G.W.T
10"
12"
10"
Ø 16 @ 2'-0" c/c Ladder
coated by anticorrosive paint
DETAILS OF LADDER
C.I. MANHOLE COVER
6"
3"
24"
3"
6"
2-Ø 10
circular ring
6" slab
RE-BAR DETAIL OF THROUGH MANHOLE

CAD-16



OVERHEAD WATER TANK

CAD-17