Under Ground Utilities Of Pre-Planned Cities

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Abstract: Many of today's underground utilities are reaching the end of their practical life and need to be replaced or repaired. At the same time, new utility installations due to urban expansion and development of technologies such as communication line (Telecommunications, internet line, television cable etc…) water pipe line, sanitary sewer pipe line, Strom water pipe line, Gas pipe line are in progress. The communications lines are placed on ISA channel section. Hence accurate information of these utilities is essential for utility owners, engineers, contractors or surveyors, particularly as for reference. This all utilities are placed in R.C.C. box culvert with proper planning. The R.C.C. box culvert is placed on below the road level at one meter depth. There are also put a manhole for inspection. This facility provides easy maintenance and repair for work. These all work is carried out for new constructions and preplanning cities. The cross-section of culvert is 4.00 m x 2.50 m (in to in).In now days the developing countries are adopting this facilities. All designs are carried out as per IS code specification.

Index Terms: R.C.C. Box Culvert, Water pipe line, Sanitary sewer pipe line, Storm water pipe.

1 INTRODUCTION

The demand of basic utilities services such as a communication line (Telecommunications, internet line, television cable, etc.) water pipe line, sanitary sewer pipe line, Strom water pipe line, Gas pipe line which response are rose rapid for urban growth and development for new generation. The underground services are widely used in developed country (U.S.A., Dubai, U.K.,) and now a day it's also use in some parts of Gujarat (Dholera Sir, Adani santigram, Ahmedabaad,) are Grouped by many different type of utilities. This designed is used for domestic area. This type of project is used for pre-planned city and these are more suitable for Grid-Iron (Rectangular system plan). The Grid-Iron plan has one good benefit over self-cleaning velocity which is very suitable for Water, Storm water, and sanitary pipe line. The growing demand of utilities has result in new construction, maintenance and repair system. Many of this utilities were placed under a street road or footpath many year ago, and at the time of repair or placing new one by different companies the location data on depth and even maps of where they are laid are either unavailable or lost. When new cable or pipes are putting in the ground at time of excavation the situation is has led to many case of power interruptions, cable or pipe broken case are made at that time. At time of excavation if the electricity cables are broken it's chance of shock circuit and also time of excavation if gas pipe was broken it chance of exploration and it is dangerous. At time of installing of new facilities or repairing or maintenance due to excavation also people facing some problem like traffic jam, sometime road was closed for big work main problem of dusting and health problem for people. Above all thing we see and make easy, efficient with proper planning Underground Utilities which performers best than all other utilities for more than 50 years easily. The R.C.C. box culvert is use for underground utilities and placed all the utilities properly in it which was place below the ground level at 1 meter depth. It is well known in preplanning cities, all the utilities are provide in the Box culvert. It has mainly two types, namely, box or slab or arch culvert. The box culvert has more advantages than other culvert. The box is one which has its top and bottom slabs monolithically connected to the vertical walls. So it is very preferable. The size of box culvert is depending on the earth pressure. The R.C.C. box culvert dimension is 4.0 m x 2.5 m (inside). In the box culvert there is provide a main hole which use for inspection and maintenance. Communication lines are placed on the ISA channel which is designed base on IS 800-2007 also try to maximum use of fiber optical cable for communication. The basic concept of pipe designing is safe and economically transport steam to the destination with acceptable pressure loss. The scope of this will be in the pipe designing and the process is divided in the following main categories are design criteria, dimension design, pressure design, design codes. The water pipe line is designed for one lakh population and also consider for future population with help of population forecast method. The per capita demand with full flushing is 135 liters/day is taken from IS1172-2009 for water pipe line. Water is an essential natural resource for domestic use for example, cocking, bathing, washing, cleaning etc. water is essential input to achieve some desired outcome, including heath and income. The sanitary waste water is considering 80% of the water which are used in domestic area. For water pipe line PVC pipes are used and for storm water and sanitary pipe line asbestos cement pipe line are used. Storm water pipe is also considered as a sanitary pipe line but difference is that this pipe is not including human waste. In the R.C.C. Box culvert the water pipe line are provide on the top due to maximum pressure. The storm water pipe line is provided in the corner-bottom and the sewer line is put near the storm water pipe line. There are also given the sump, if any liquid pipe line leaking the liquid fluid goes in the sup with gravity and drain out along the culvert. The communication lines are provided on ISA channel Section on the wall of culvert which is not disturbed when entering in the culvert. The main hole is put on the foot path for inspection. All the design criteria are same as sanitary waste water.

2 METHODOLOGIES

2.1.1 R.C.C. Box culvert

The main emphasis is on the methodology of design which naturally covers the type of loading as per relevant IRC Codes and their combination to produce the worst effect for a safe structure. The IS 1893 (Clause 6.1.3.) provide the box culvert no need to designed for earthquake forces. For a box culvert the top slab is required to withstand dead loads, live loads form the moving traffic, earth pressure on top and side wall and pressure on the bottom slab besides self-weight of the slab.

2.1.2 Earth pressure

The earth can express pressure, minimum as active and maximum passive or in between cell pressure at rest. It's depend on the obtained at site. In case of box culvert, it is confined with earth with all side. The co-efficient of the earth

pressure in case of box culvert is taken to be 0.5 for soil having φ= 30.

2.1.3 Distribution reinforcements

The code IRC 21:2000 in Clause 305.18 provides for distribution reinforcements. The distribution reinforcements shall be such as to produce a resisting moment in the perpendicular direction to the span equal to 0.3 times the moment due to concentrated live loads plus 0.2 times the moment due to other loads such as dead load, shrinkage, temperature etc. consider as dead load, live load together. Design typical box Based on the above discussions and clarifications. Various loads cases have been given for the maximum design moment. The box has been also checked in the shear and shear reinforcement provide as required the relevant parameters are mentioned in the design. Detailed design of box culvert with and without cushion has been consider. The bending moment is obtained by moment distribution of loading and design of section accomplished for final bending moment for member. A drawing furnishing details of the box based on detailed design and general arrangement for site work. The R.C.C. box culvert is 4 m x 2.5 m x10 m. Analysis of this box culvert is done in Excel and from the analysis we got the SF and BM for the box at various points. The designing of the box is done using relevant is codes.

2.1.4 R.C.C. BOX CULVERT DESIGN

SALIENT FEATURES

Concrete grade (Fck) M25 = 25 N/mm^2
Steel grade Fe 415 = 415 N/mm^2
ESc (Concrete) = 8.33 N/mm^2
ESt (Steel) = 200 N/mm^2
Effective cover = 45 mm
Load Factore = 1.5
Coefficient of thermal = 1.30 E
Expansion = 0.5
Modular Ratio, m = 10.98
Working stress = 16.00
Elastic Modules of steel Es = 2.00 E + 0.5 N/mm^2
Elastic Modules of concrete Ec = 2.50 E + 0.4N/mm^2

Table-1
SUMARY OF REINFORCEENT FOR WALL FOUNDATION

Required area of steel				
	Toe		Heel	
	Top (mm^2)	Bottom (mm^2)	Top (mm^2)	Bottom (mm^2)
Case-1	0.00	204.40	195.86	0.00
Case-2	0.19	0.00	0.00	200.78
Case-3	120.00	120.00	120.00	120.00
Required Max Area	120.00	204.40	195.86	200.78

Table-2
SUMARY OF REINFORCEENT FOR WALL FOUNDATION

Provided area of steel				
	Toe		Heel	
	Top (mm^2)	Bottom (mm^2)	Top (mm^2)	Bottom (mm^2)
Dia 1 mm	12.00	12.00	12.00	12.00
Spacing mm	200.00	200.00	200.00	200.00
Dia 2 mm	0.00	0.00	0.00	0.00
Average Spacing mm	0.00	0.00	0.00	0.00
Total Steel Provided	251.33	251.33	251.33	251.33

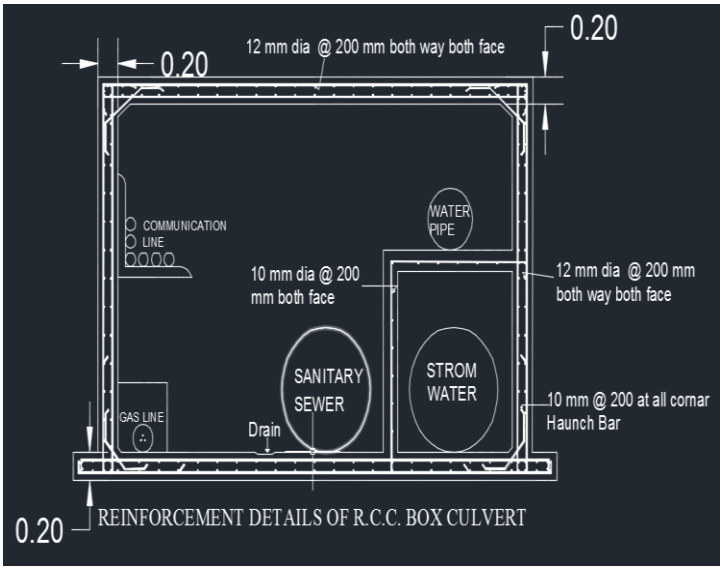

Figure 1. *Reinforcement details of R.C.C. Box culvert*

2.2 Water pipe line

Now a day generally PVC pipes are used for water supply. It is generally recognized that plastic pipe is resistant to corrosion caused by most naturally occurring chemical found in wide ranging soil types. The major question as to the long term durability of plastic pipes is in regards to resistance to slow crack growth and oxygen degradation. Over long years in service at a very acidic and abrasive site little to no wear was observed on the leading edge of the single wall corrugations. The designing of pipe diameter from TVL software which is well known for pipe design.

$\Delta\rho = \mu.\upsilon^2.l / (2d/SG)$

Where,

$\Delta\rho$ = Pressure Loss (pa)
μ = Coefficient of friction
υ^2 = Water Velocity (m/s)
l = Pipe Length (m)
d = Pipe Inner Diameter ($m^{\wedge 3}$/h)
SG = Water Gravity (kg/$m^{\wedge 3}$)

2.3 Sanitary sewer

Just like any other infrastructure, sanitary sewer systems are in need of renewal at some point in time. There are generally three type of renewal, including repair, rehabitation and replacement. The rehabitation pipe size and its capacity are design on Mannig's Formula, expressed as follows. For sewer pipe line asbestos cement pipes are most suitable. In the sanitary sewer pipe line waste is partially filled about one-fourth because it was containing human solid waste and other suspended partials.

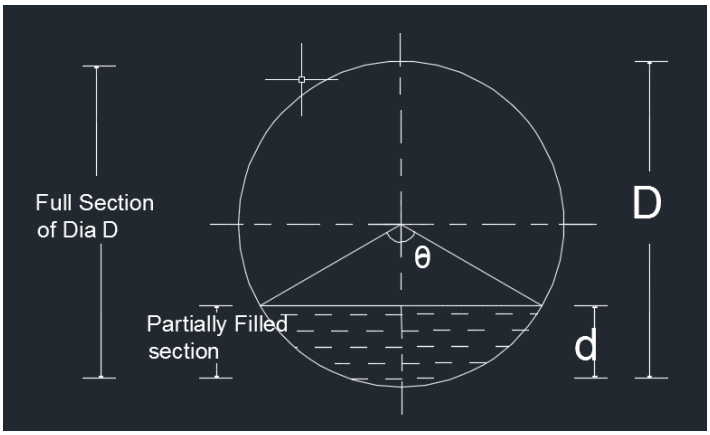

Figure 2. *Sewer pipe line cross section*

Q = (A/n) x R^(2/3) x S^(1/2)

Where,

Q = Design flow ($m^{\wedge 3}$/sec)
n = coefficient of roughness
R = Hydraulic Radius (m)
S = Slope (m/m)
A = Cross-Section Area of Pipe

The coefficient of roughness for all pipes shall be n = 0.013.

2.4 Strom water pipe line

Storm water pipe is also considered as a sanitary pipe line but difference is this pipe is not including human waste. All the design criteria remain same as sanitary waste water. For Storm water pipe line asbestos cement pipe lines are most suitable.

Conclusion

The study shows that Under Ground facilities have a more advantages than other separated Underground services or over ground services. This facility is suitable for preplanning cities in domestic area. All the facilities like Water Pipe line, Storm pipe line, Sanitary sewer pipe line, Communication pipe line etc. are provide in R.C.C. Box culvert with systematic planning. In fact, cost benefits accrue from reducing day-to-day maintenance and operation costs, improving reliability, enhancing public safety and improving aesthetics and property values. This facility is little higher cost then other separated underground facilities, but it is easy to maintain and repair without disturbed traffic and public. This system is economic and durable for long years.

References

[1] IRC: 5-1998 Standard Specification and Code of Practice for Road Bridge, Section 1.

[2] IRC 21: 2000 Standard Specification and Code of Practice for Road Bridge, Section 2.

[3] Ramamurtham S., Standard Specification and Code of Practice for Road Bridge, Section 2.

[4] IS 456-2000 Plain and Reinforced Concrete – Code of Practice (CED 2: Cement and Concrete).

[5] IS 800-2007: General construction in steel – Code of Practice (CED 7: Structure Engineering and Structural Sections).

[6] IS 1172-1993 Code of Basic Requirements for Water Supply, Drainage and sanitation (CED 2: Public Health Engineering).

[7] Huston, S.S. Morris, A.J., 1992 Public water-supply systems and water use in Tennessee, Water-Resources Investigation Report.

[8] TROM WATER DRAINAGE DESIGN MANUAL, James Robertson P.E., Bill Greathouse, P.E. Rene Franks, P.E. City of Midland, Taxes.

[9] DRAFT VA DCR STORM WATER DESIGN SPECIFICATION No. 4, SOIL COMPOST AMENDMENT, VERSION 1.5 June 22, 2009.

[10] REGION OF PEEL, Public Works Design, Specification & Procedures Manual, Linear Infrastructure, Sanitary Sewer Design Criteria, Revised July 2009.