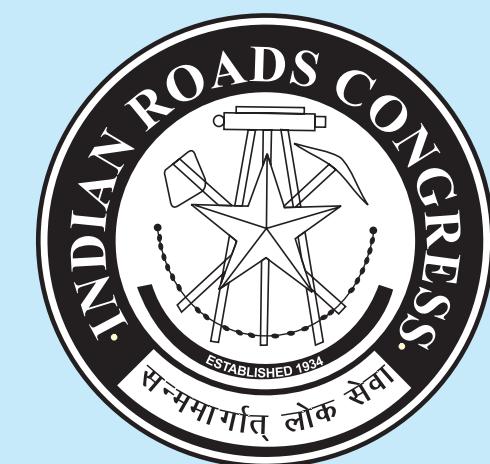


**GUIDELINES ON
ACCOMMODATION OF UTILITY
SERVICES ON ROADS IN
URBAN AREAS**

(Second Revision)

(The Official amendments to this document would be published by
the IRC in its periodical, 'Indian Highways' which shall be
considered as effective and as part of the code/guidelines/manual,
etc. from the date specified therein)



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GUIDELINES ON ACCOMODATION OF UTILITY SERVICES ON ROADS IN URBAN AREAS

(Second Revision)

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GUIDELINES ON ACCOMMODATION OF UTILITY SERVICES ON ROADS IN URBAN AREAS

1 INTRODUCTION

1.1 Due to upgradation of communication technology and with the advent of optic fiber cables to provide customer connectivity service, provider preferring to lay cables below the ground, the need for revision of guidelines was has been under the consideration of Urban Roads, Street and Transport Committee (H-8), since December, 2009.

1.2 Relocation of utilities due to infrastructure projects like widening of roads to multiple lane facilities, construction of flyovers, subways, monorail, metro rail, lamniscate etc. have put greater stress on accommodation of utilities at right location within the right of way of urban roads covering present scenario of urbanization.

1.3 In the recent past, codes and supplementary guidelines have either been revised or are under revision.

In view of the changes and modifications in the associated codes and guidelines and other parameters it has become necessary to revise IRC:98.

1.4 The Urban Road, Street & Transport Committee (H-8) was reconstituted with the following personnel:

Sinha, Late V.K.	Convenor (till 21.12.2010)
Kurian, Jose	Co-Convenor, Convenor (w.e.f. 3.03.2011)
Joshi, Dr. G.J.	Member Secretary

Members

Ahmad, M. Imtiyaz	Raina, Ramesh
Arasan, Dr. V.T.	Rastogi, Dr. Rajat
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1.5 The erstwhile Committee could discuss the revision and finalized few clauses but later under the convenorship of Late Shri V.K. Sinha, took up the assignment afresh and discussed clause by clause. Initial draft covering revisions and deliberations was prepared and presented by a Sub-group comprising of the then Convenor, Late Shri V.K. Sinha, Shri R. Jaiprasad and R.K. Jaigopal as members, Later, Dr. B.P. Bagish was also included in the Sub-group and the entire draft was prepared and finalized in December, 2010. In the meantime, Convenor Shri V.K. Sinha passed away and he himself could not present the draft before the HSS Committee and the Council.

1.6 It was the motivation, interest, experience, dedication and leadership of late Shri V.K. Sinha that the revision and the modified draft could be completed. After due consideration, the revised draft was recommended for placing before Highways Specifications and Standards Committee.

1.7 The revised draft was approved by HSS Committee in its meeting held on 22.04.2011 and the Executive Committee on 26.04.2011 authorized Secretary General IRC to place the same before the Council. The revised draft document was approved by the council in its 194th meeting held on 15.05.2011 at Agartala (Tripura) for printing by the IRC.

2 SCOPE

2.1.1 These guidelines are intended for use by the authority responsible for roads in the urban limits vested with powers to regulate the location, design, installation and maintenance of public utility services laid or proposed to be laid within the right-of-way of urban roads. The objective is to provide a uniform approach, based on mutual interests of the utility agencies and the road authority, which will minimize interference between the operations of various agencies and also to ensure safe and smooth traffic flow by reinstating the trenches after installation or after completion of ducting works.

2.1.2 Construction/Installation of poles, pillars, advertisement towers, bill boards, transformers, cables, pipe, drain, sewer, canal, railway line, tramway, metro rail, mono rail, telephone boxes, repeater stations, street, path or passage of any kind on Urban Road land or across, under or over shall not be undertaken by any person/agency/organization without prior permission in writing, by officer designated by Urban Road Authority in the format prescribed by such authority.

The person/agency/organization shall give a undertaking that the cost of removal/ shifting shall be borne by them. Further it shall be deemed to have agreed by the person/agency/organization to whom permission is given will shift/remove at his/their cost within the time stipulated by road authority. In case the service owner fail to shift/remove the service in reasonable time on a notice by the Urban Road Authority, who will be free to enter and remove/bury the service at the cost of the person/ agency/organization and any consequent damage/loss shall be the responsibility of the person/agency/organization.

2.1.3 Accommodation of utility services in urban areas shall be categorised as:

2.1.3.1 *Open trenching*

Open trenching shall be carried out wherever service provider with option for others, will lay the lines once only for that category of service and second trenching is not allowed for that particular service. This shall not apply to local streets.

2.1.3.2 *Ducts under existing roads*

Ducts under existing roads is intended for, when the road is excavated more than once. A suitable duct arrangement shall be designed for present and future services to be installed in the urban road land and duct shall be designed accordingly.

2.1.3.3 *Ducts under new roads*

Ducts under new roads is intended for, when duct is installed at construction stage itself which is being followed in many new layout formation in the country.

2.2 These guidelines are intended for existing as well as new roads where laying of new service or relocation of existing service along/across the roads is proposed. These guidelines also cover relocation due to widening of right of way, construction of grade separators/elevated roads/metro/mono projects.

2.3 Utility agencies have various degrees of authority to install their lines within the right-of-way of roads. These guidelines are not intended to alter or infringe on such powers, but are suggested in the interest of developing and preserving safe operation of the road facility with least interference to it by the utility services, thus ensuring least inconvenience to the road users during the installation of such services and after reinstatement of road to its original operational & functional condition.

2.3.1 The utility agencies are:

- i) Water supply and underground drainage authorities of respective Local/ State/Central Governments.
- ii) Electricity cables by Electricity Authority under respective Governments, Private Companies in charge of supply and maintenance.
- iii) Telecommunication lines/cables under BSNL/MTNL – Government of India undertaking.
- iv) Optical Fiber cables of different private agencies approved/authorized by Government of India.

As roads are essential, so are Water, Sewer, Electricity, Gas and Telecommunications. Each of these service providers (other than private agencies laying OFC) have their own acts approved by State Government/Central Governments.

3 GUIDELINES

3.1 Planning

3.1.1 For new roads, there should be advanced planning to earmark the position of each utility line expected along the road, and provide space therefore in such a manner that it does not interfere with other services or safe operation of the road. For this purpose formal meetings and consultations with the concerned utility agencies should be held by the road authority to arrive at mutually acceptable locations for the various utilities. Combining more than one service using common utility duct or multi utility duct shall be the norm due to its advantage of installation and maintenance. Incase of new formations, new layouts, prior meetings with utility agencies may be held to assess their requirements to provide additional width in ROW for ducts, totally avoiding utilities underneath the carriageway. An MOU between road authority and service provider covering the rights and responsibilities of each shall be drafted and executed to ensure successful laying of utility lines without affecting traffic and quality standards of the restored pavement after opening and laying services.

For all new roads and roads proposed for widening arterial/sub arterial/feeder roads in urban areas duct shall be provided compulsorily. In respect of existing roads where open trenching is restrained due to limited ROW, ducts shall be provided.

3.1.2 For existing roads, proposals for new utility line should be carefully examined by the road authority to ensure that the existing service lines and future infrastructure development needs like widening, grade separators, mono-metro rail, requiring relocations leading to avoidable expenditure. Such locations shall be provided with common utility ducts or multi utility ducts taking into consideration existing and proposed utilities to be accommodated.

3.1.3 While forming new layouts the concept of common utility duct or multi utility duct shall be implemented along with service drops to respective properties/plots, so that during construction/completion of structures, services can be tapped inside the property itself avoiding repeated road opening by property owners. The service drop shall be for all services which will greatly reduce hardship to service providers, service receivers and road authority.

3.2 Considerations to Satisfy Specific Locational Requirements of Utility Lines

3.2.1 Utility lines can be grouped under the following five categories, each having distinct characteristics:

- i) Sewer and drainage lines
- ii) Water supply lines

- iii) Electricity cables
- iv) Telecommunication cables and Optic fiber cables
- v) Gas pipelines and those carrying combustible materials

Some utility lines have interactive characteristics with other lines, and as such their relative location warrants careful consideration. Some others, e.g., telecommunication lines have certain specific requirements of laying as prescribed by the concerned authority. All these are brought out in the following paragraphs.

3.2.2 Sewer and drainage lines have generally gravitational flow and are laid at substantial depth, the actual depth depending on the topography of the area. They normally require deeper and wider trenches for installation, and are provided with manholes at intervals. Because of the presence of manholes which get choked due to discarded materials there is possibility of overflow and it is preferable to avoid laying sewer lines underneath the carriageway as far as possible. However, due to limitation of ROW, sewer lines can be laid preferably at the edge of carriageway, where ROW is more than 24 m, same can be laid along both the edges of the carriageway to facilitate service connection to properties on both sides.

Incase of existing manholes (a protective concrete transition shall be provided from asphalt surface to manhole as a strengthening measure for durability.) during overlay/surface renewal of carriageway the existing manholes can be covered with sand, subsequently sand can be removed and manhole can be raised avoiding digging of newly laid surface later to trace the manhole and to prevent damage to manhole during laying of overlays, **Photo-1 and Fig. 1.**



Photo-1 A Manhole Buried during Overlay Being Opened

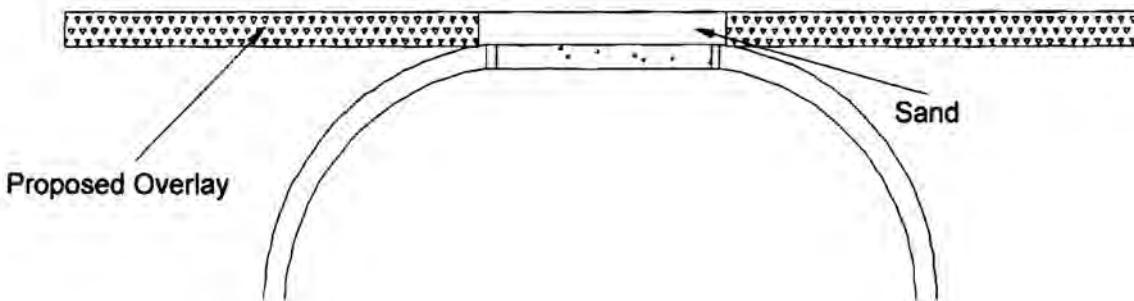


Fig. 1 Sand Filling Over Existing Manhole before Providing Overlay

Tertiary Drains shall be in the form of open channels or pipelines provided at the extreme edges of the right-of-way.

3.2.3 Water supply lines carry water under pressure, and any leakage causes damage to road pavement. These lines should not be close to sewer lines to avoid contamination in case of any leakage or pipe burst.

3.2.4 Electricity cables are of different types, namely, lighting cables (LT), and high tension (HT) cables. These cables should not be close to water supply lines to avoid short circuit. HT cables should not be laid in the proximity of telecommunication cables and optic fibre cables because of possible electrical interference due to induced voltage. Also, all types of service lines and cables should be away from the tree line to avoid possible entrapment and dislocation by tree roots. All Electrical Cables shall be 1m away from waterline.

3.2.5 The privatization of telecom, power, gas and other utilities has put immense pressure on urban roads. Multi utility ducts or common utility ducts are easy solutions for urban roads, excepting sewer lines all other services can be accommodated in utility ducts which criss cross across the city and opening of road will be totally minimized. Gas mains and other pipelines carrying combustible materials should be away from electricity cables, as they are sources of heat and should be located at extreme ends of right-of-way.

3.2.6 Whenever any OFC and/or any telecommunication cable agency is given permission to lay lines, it shall be by common utility duct or duct bank only. Other similar agencies can be addressed to give their plan so that all intending agencies place cables at one go. Open trenching of carriageway shall not be allowed by road authority except for sewerage lines.

3.2.7 While designing the common utility duct or multi utility duct separate enclosures shall be provisioned keeping in view future expansions for all services.

3.2.8 The concept of common utility duct or multi utility duct shall become a part and parcel of road utility for new as well as existing roads.

3.3 Depth of Laying Service Lines along Roads

3.3.1 The depth of installation depends on the type of service line accommodated. The minimum depth is from considerations of providing a minimum cover to safeguard the line from any superimposed loads or impact, or from erosion and this should not be less than 0.6 m. The different service lines are also to be located at different depths so that a cross connection of a service line is not obstructed by another line.

3.3.2 Gravity sewer lines, from operational angle are required to be laid at substantial depth, more than 1.5 depending on the topography of the area. As regards electricity cables, HT lines should be at greater depth than LT ones from safety considerations.

3.3.3 From the above considerations, broad recommendations about the depth of laying (denoting the bottom of the trench) of the various service lines along the road are given below:

i)	Trunk sewer line	-	more than 1.5
ii)	Water supply line	-	
	Service line	-	0.6 to 1 m
	Trunk line	-	1.0 to 6 m
iii)	Electric cable	-	
	LT cable	-	0.6 to 1 m
	HT cable	-	1.5 to 2 m
iv)	Telecommunication cable	-	
	Directly laid	-	0.6 to 1 m
	Laid in ducts	-	1 to 2 m
v)	Gas mains and lines	-	2 to 3 m
	Carrying combustible material	-	
vi)	Distance between		
	Electric cables & W/S lines	Vertical – 1 m	
	HT/LT	Horizontal - 1 m	
vii)	Distance between Electric	Vertical - 1 m	
	Cables & OFC	Horizontal – 1 m	

3.4 Location and Space for Services

3.4.1 Location of the various utility services will depend on several factors such as class of road, the land width available, the size and type of utility lines to be accommodated and other related factors. Land width recommended by the Indian Roads Congress, vide IRC: 69 "Space Standards for Roads in Urban Areas" for various classes of urban roads is given in **Table 1**.

Table 1 Recommended Land Width for Roads in Urban Areas

Category of Road	Land Width (m)
Expressways	50-60
Arterial Streets	50-60
Sub-Arterial Streets	30-40
Collector Streets	20-30
Local Streets	10-20

As far as possible, the utility lines should be accommodated in the space specially earmarked for the purpose. The space required will vary depending on the type, size and number of service lines to be laid. For example, not all roads will require to accommodate all types of utility lines. Further, the space required for each utility line will depend on its size, but generally the utility lines follow the hierarchical system of the road. That is, service lines laid along major roads will be the main ones requiring larger space than those along minor roads. This means, major roads will require to provide for larger space for services than minor roads. Generally, a width of 5 m for services on either side of the road will be adequate in most cases. In case where earmarked space for services is not available or land cannot be acquired, the service lines should be accommodated in common utility ducts at extreme ends of right of way.

Hazardous utilities like HT cables, gas lines etc in the buried condition shall be marked on the ground by concrete/steel/HDPVC, indicators for their ease of identification during widening road or while adding further utilities, **Photo-2**

**Photo-2 Sample Photo of Buried Gas Line Marked on the Ground**

3.4.2 Other considerations needing attention in the location of utility services are given below:

- i) Utility lines should be located as to minimise the need for their subsequent adjustment to accommodate future road improvements, at the same time the location should be such that it permits maintenance of the lines with minimum interference to road traffic.
- ii) The utility lines should be laid on uniform alignment parallel to the road centre line;
- iii) Service lines requiring frequent access shall be located in a separate duct or in common utility duct.
- iv) Some of the utility lines will require provision of manholes, controllers/regulators, etc. within the right-of-way. The manhole covers should not protrude over the road surface and should be fixed in level with the existing road. In the course of subsequent renewals of road, level of manhole covers should also be raised to the level of road. The manhole covers should be so maintained as not to endanger the safety and environment. The manhole covers shall be strengthened by providing M40 grade interlocking paving blocks or M40 grade concrete surrounding manhole to serve as dampener due to impact of vehicular loads, **Photo-3 and Fig 2.**



Photo-3 A Sample Photo of Damaged Manhole Cover

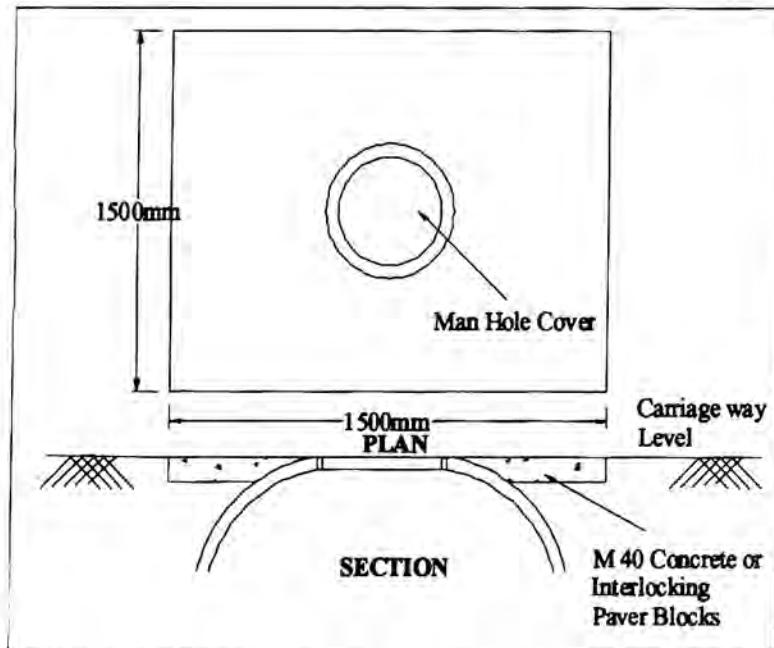


Fig. 2 Concrete Cover to Prevent Damage

- v) Water valve chambers similar to manhole are provided to water supply lines which runs underneath the carriageway. These chambers are normally covered with BS slabs/RCC slabs and due to repeated impact of vehicles the slab gives way and replacement involves time and expenditure. Alternatively the chamber shall be filled with sand to serve as cushion, top cover shall be a suitably designed RCC slab. The valve could be reached for operation through a PVC pipe. **Fig.3** indicate's the same.

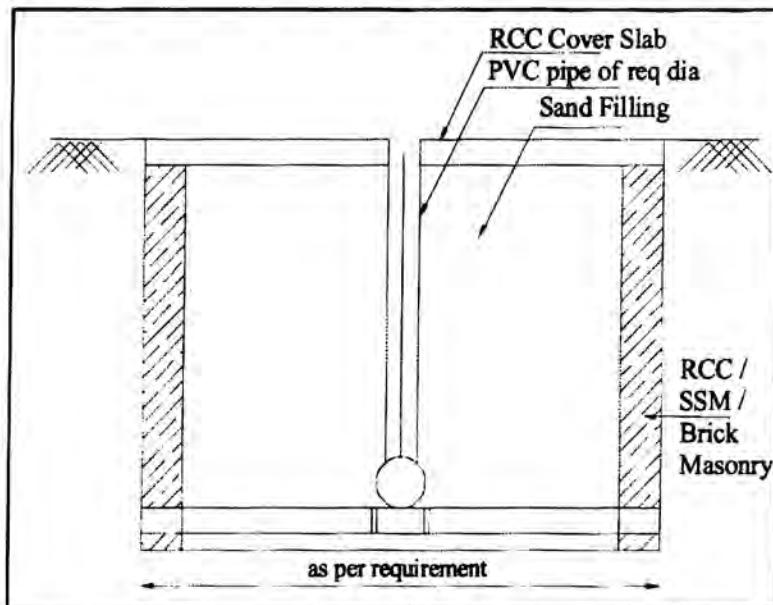
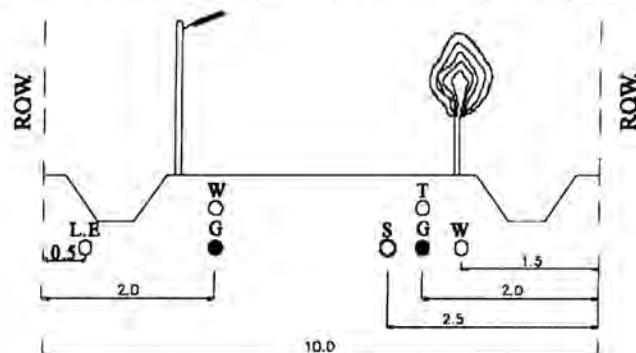


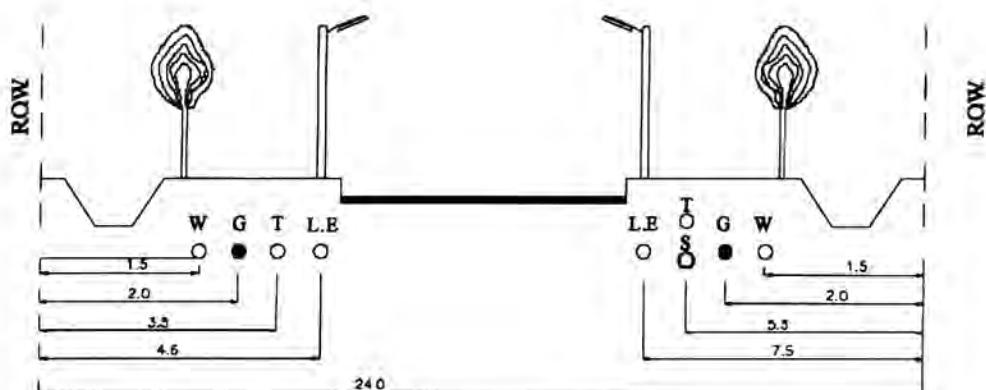
Fig. 3 Design of Water Valve Chamber

3.4.3 Suggested locations for the various utility lines are indicated on the typical cross-sections of Local Street in urban roads in **Fig. 4**. The cross-sections are based on the recommendations given in IRC:69. Avenue trees, roadside drains and street light posts are also shown on the cross-sections to ensure that these do not interfere with the utility lines.

When concrete roads are laid, a edge strip of 1.00 m to 1.50 m of interlocking paver block or flexible pavement shall be provisioned for utilities.



(a) LOCAL STREET (CUL-DE-SAC)



(b) LOCAL STREET (DOUBLE LANE)

Note:

1. All dimensions are in meters
2. The locations of the services are suggestive only and will depend on number, size and type of services to be accommodated, space available for services, etc.
3. Open drains shown for storm water drainage may be replaced by closed drains/pipes as per situation
4. Depth would be in accordance with para 3.3.3.

Legend:

L-Lighting cable
E-Electricity cable
W-Water supply line
T-Telecom cable
S-Sewer
G-Gas line

Fig.4 Suggested Locations for Utility Services Along Local Streets

3.5 Design Of Utility Lines and Common Utility Ducts

3.5.1 Design of utility lines to be accommodated within the road land is the responsibility of the concerned utility agency, but this should be reviewed and approved by the road authority in respect of location, method of installation, effect on structural integrity of the roadway and road structures, ease of maintenance, and permitting free and safe flow of traffic.

3.5.2 Where the common utility ducts are to be provided beneath the roadway along or across the road, the road authority shall be satisfied about their structural adequacy. Materials used should be durable of adequate strength and conform to the currently applicable specifications of the Bureau of Indian Standards so that subsequent disturbance to the road is minimised.

3.5.3 The design of duct shall be adequate enough for future needs of expansion, the duct structure shall be designed for durability, strength and other structural considerations confirming to Bureau of Indian Standards. The duct shall be treated as any other normal structure for all design purposes. In case of cost sharing between utility agencies and urban road authority, same shall to be decided by the urban road authority who shall construct the duct.

General Common Utility Duct configurations are illustrated below in **Fig. 5 to 11 and Photo-4**

(a) Brick/Size Stone Masonry

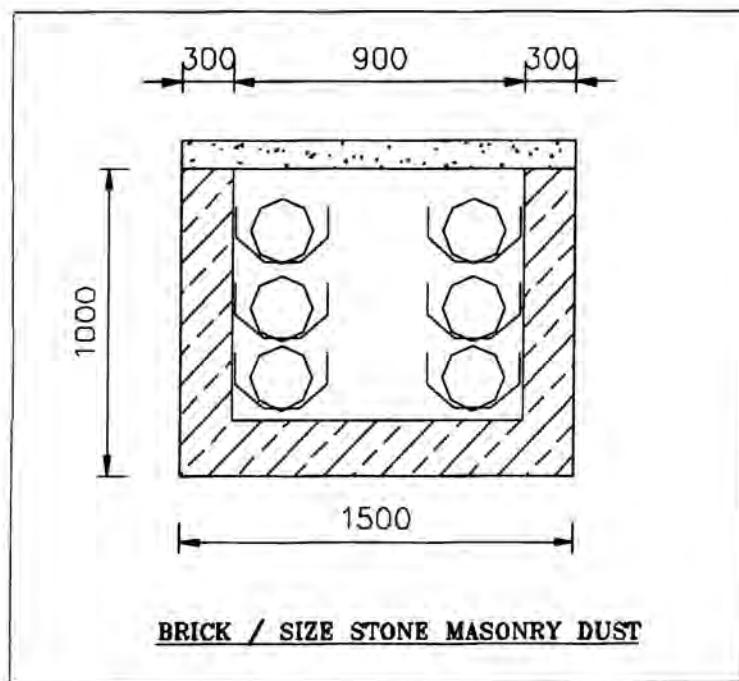


Fig. 5 Duct Using Brick/Stone Masonry

(b) Pre Cast/Cast-In-Situ RCC Ducts

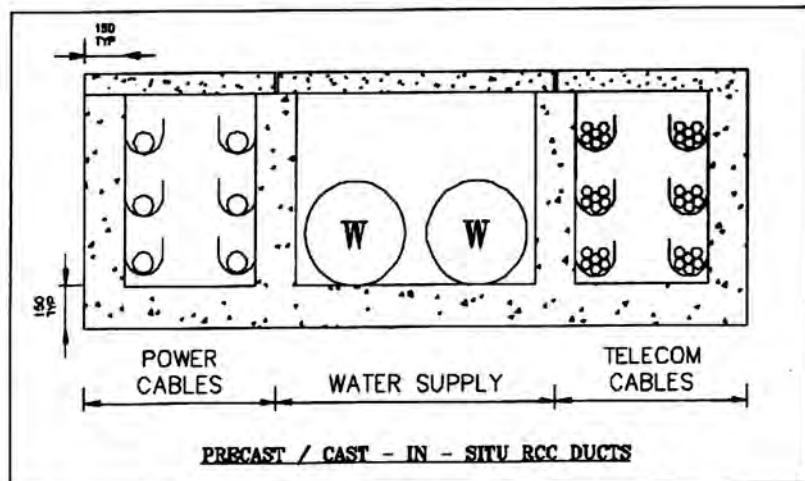


Fig. 6 Duct Using Pre Cast/Cast-In-Situ RCC

(c) Ducts Using RCC Spacers

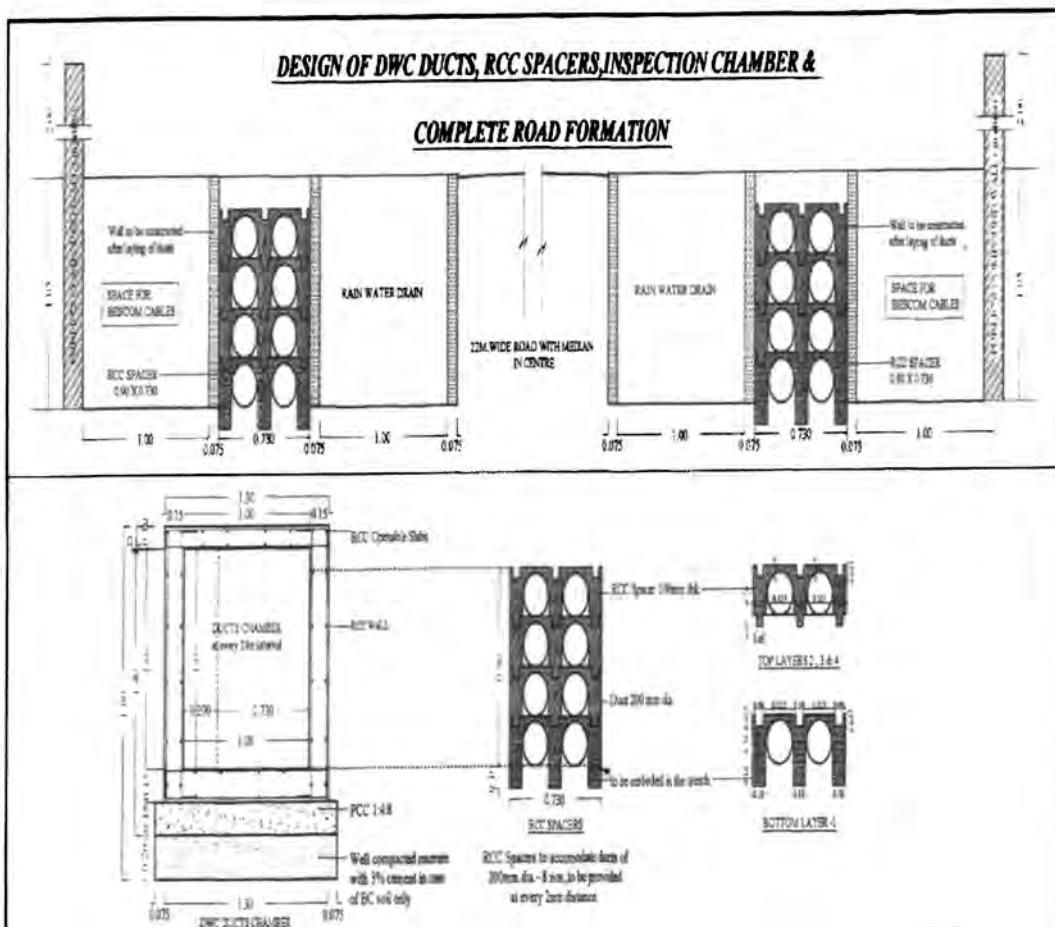


Fig. 7 Ducts Using RCC Spacers

(d) Duct Bank Combinedly for OFC, Telecom & Power Cables

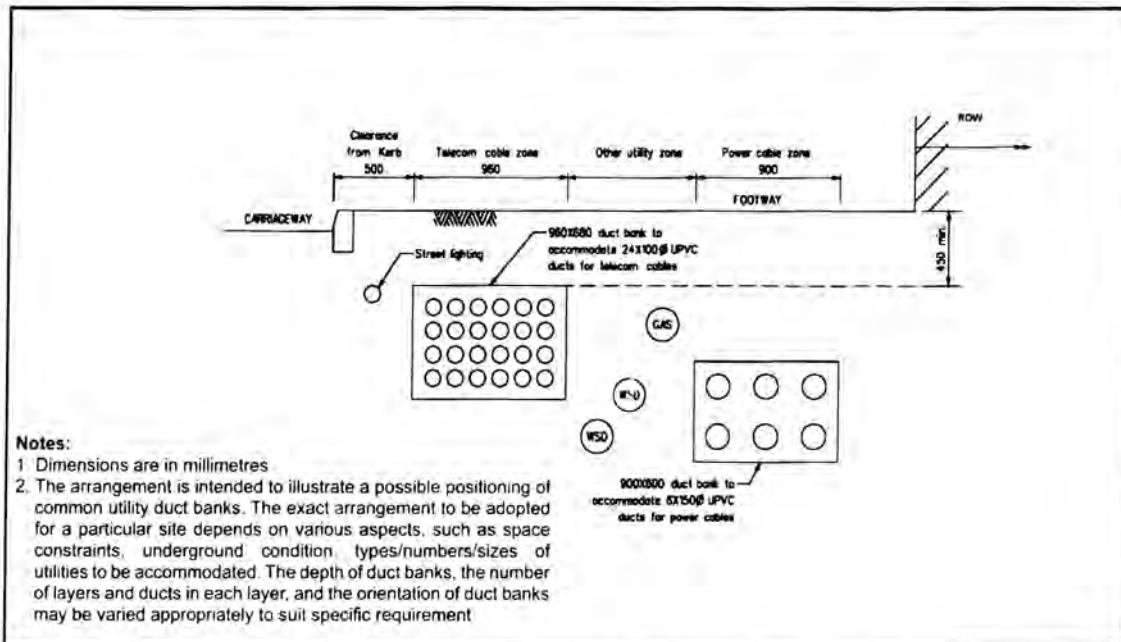


Fig. 8 Duct Bank Combinedly for OFC, Telecom & Power Cables

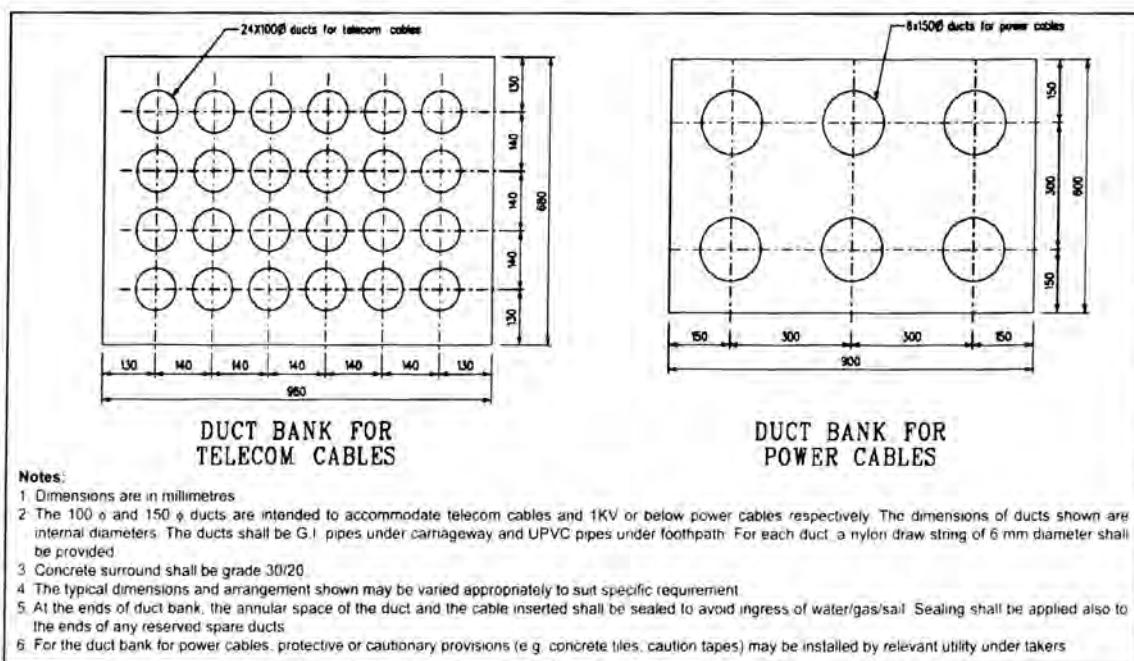


Fig. 9 Duct Bank Combinedly for Telecom & Power Cables

(e) Duct Bank for Heavier Power Cables

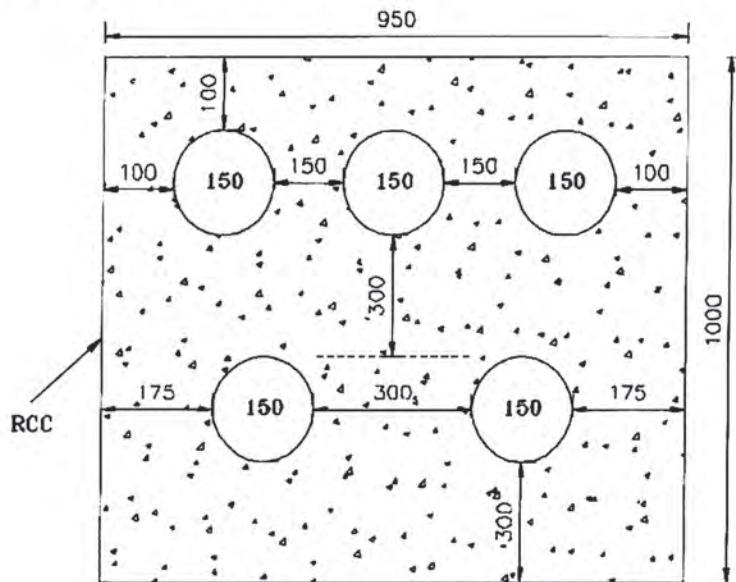


Fig. 10 Duct Bank for Heavier Power Cables

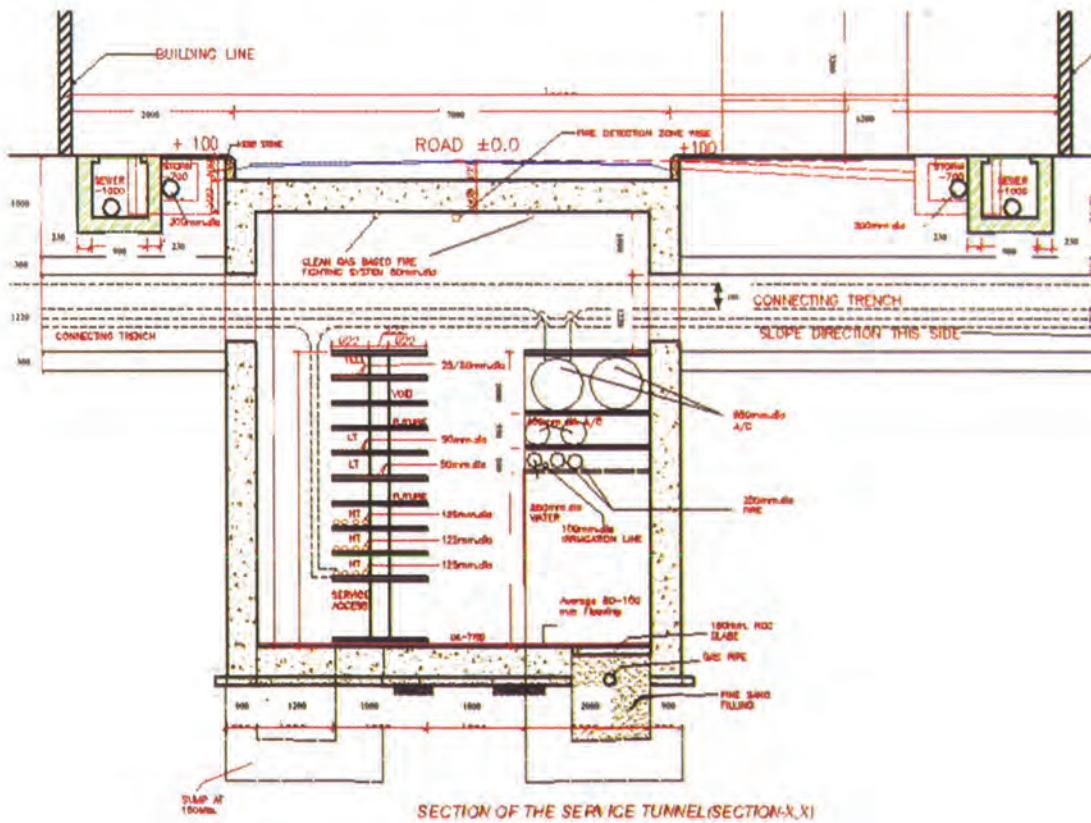


Fig. 11 A Typical Multi Utility Service Tunnel



Photo-4 A Typical Multi Utility Service Tunnel under Construction – at Connaught Place, New Delhi

3.6 Accommodation of Utility Lines Across Roads

3.6.1 Need for accommodating utility services across a road will arise in situations such as road intersections where the lines along one road will have to cross the intersecting road, and for spur connections from a service line to reach the other side of the road. Several methods are available for effecting the crossing depending on the situation, but in all cases, the following principles should be kept in view:

- i) The service line should cross beneath the road along a line normal to the road alignment.
- ii) In case of new roads, arterial/sub arterial, collector streets, the service lines shall be taken through ducts of sufficient size in consultation with utility agencies in order to facilitate future repairs/addition of lines, etc. without resorting to cutting open of the road.
- iii) The installation should be strong enough to stand the superimposed traffic loads & earth pressure

- iv) NP4 pipes in triple rows shall be provided across the road way for full width for crossing of lines in major roads. The longitudinal utility corridor as appropriate shall be provided by integrating with the cross road utilities.
- v) The installation should be such that it is possible to maintain the service lines without undue interference to traffic movement or damage/disturbance to the road pavement/structures, and
- vi) The utility lines should be laid at such depths as to provide adequate cover beneath the pavements. The cover shall be minimum of 600 mm in case of trenching.

The different methods of crossings of roads by service lines are discussed in paragraphs below:

3.6.2 Simple uncased crossing

In certain situations such as crossing of a minor road, service lines may be installed without encasement. The minimum cover over the top of the service line should be 1.2 m. Where the service line is a pipeline, it should be embeded on a layer of granular material free of stone fragments, and should be backfilled carefully in two stages, one upto the top of the pipe and the other upto the top of subgrade. The pipeline should be strong enough to support the superimposed loads when the pipe is operated under all ranges of pressure, i.e. zero to maximum internal pressure. As this method will involve cutting of the road for any maintenance or replacement, it should be restricted only to minor roads. However, to protect the utility and to identify it during subsequent excavations, the utility line should be preferably be provided with a sand cushion and covered with brick lining. A typical service line cross section across and along are shown in **Photos-5 and 6**.

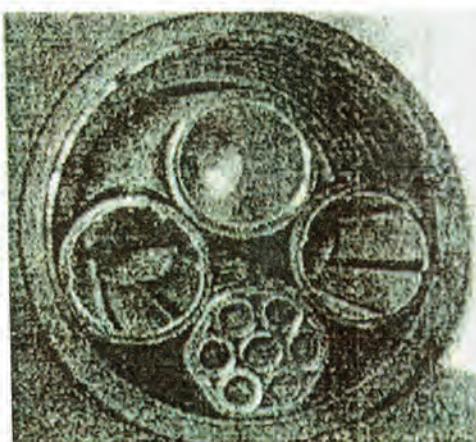


Photo-5 Typical Service Line Across Cross-Section

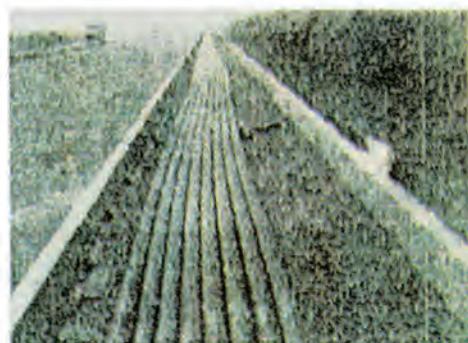


Photo-6 Typical Service Line Along Cross-Section

3.6.3 Crossing through casing pipe

The casing pipe (or conduit pipe in the case of electric cables) carrying the utility lines should be of steel, cast-iron or reinforced cement concrete (NP4) and be large enough to permit easy withdrawal of the carrier pipe/cable.

3.6.3.1 The strength of casing should at least be equal to that of a normal cross-drainage structure on the road taking into account the overfill. The casing pipes should be NP-4 or equivalent, leak proof and without joints in the case of steel casing anticorrosive paints be provided over its surface. If necessary, pipes could be welded to cover the full width of the road. Ends of the casing should be sealed from outside so that the annular space between the carrier line and the casing does not act as a drainage path.

3.6.3.2 The casing pipe should, as a minimum, extend from drain to drain in cuts and toe of slope to toe of slope in fills. The top of the casing should be atleast 1.2 m below the road level subject to it being atleast 0.3 m below the drain inverts.

3.6.3.3 The casing pipe should be installed preferably by boring through the road embankment. Where trenching method is adopted in exceptional cases the casing should be bedded on a 0.15 – 0.30 m thick layer of granular material free of rock pieces and carefully back filled in two stages, one upto the top of the pipe and the second upto the top of subgrade. In general, the installation of the casing pipe should follow the same procedure and observe the same precautions as are required for pipe culvert construction. A typical cross-section of crossing a road through casing pipe is shown in **Fig. 3.10**.

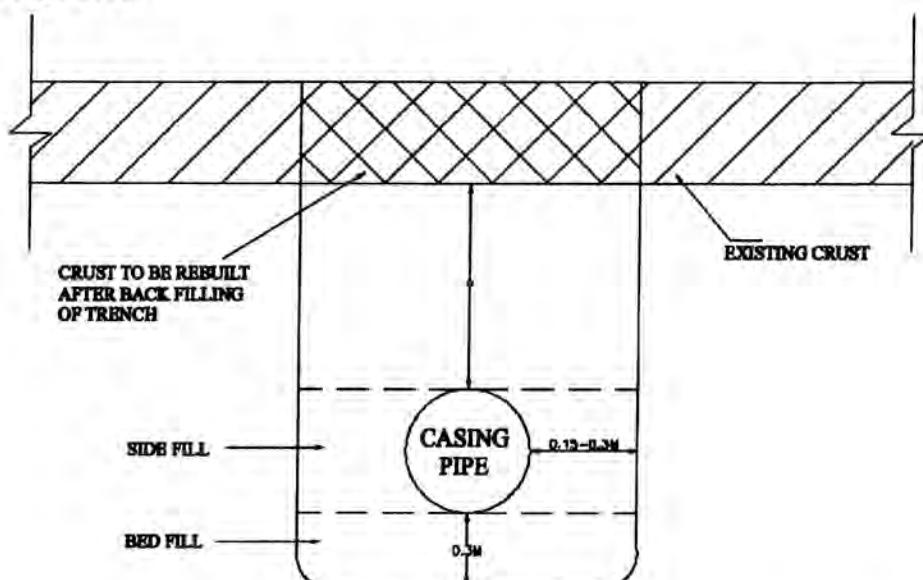


Fig. 12 Typical Cross-Section of Crossing a Road Through Casing Pipe

3.6.3.4 Installation of service lines through casing pipes facilitates easy withdrawal of the carrier line in case of maintenance or replacement without need for cutting the road. Interference to traffic and disturbance to pavement structure are avoided. This method should be adopted for all important roads where separate ducts/subways exclusively for service lines are not available.

3.6.4 Horizontal directional drilling

The horizontal directional drilling also called as trench-less technology permits drawing of cables underneath ground for a straight stretch upto 200 m with only two end openings. These end openings can be restored with same materials used for different layers of pavement. This method eliminates pavement excavation for laying all types of cables well below pavement surface.

3.6.5 Direct Buried Cable is adopted for customer connectivity. The cables shall be laid at a depth of atleast 100 mm below pavement surface. Whenever pavement is cut/grooved to burry this type of cable a suitable geomembrane/geogrid shall be placed over the cable and to equal width on either side of cable and asphalt surface replaced. Bonding between cable top surface, geogrid and bottom surface of asphalt layer shall be effectively carried out by application of asphalt based epoxy coatings. A sample of poorly restored road surface opened for laying cable is shown in **Photo-7**.



**Photo-7 Sample of Poor Restoration of Surface
Opened for Laying Cable**

Reinstatement of trenches cut for accommodating utility services: The excavated material shall be removed and carted out. After laying the utility lines the trench shall be filled with sand/robo sand/quarry dust upto the sub base level and profusely watered and compacted to achieve required modified proctor density. Subsequently laid with WMM proceeded by bituminous layers compacted/rolled to the same thickness as that of the adjoining undisturbed surface crust. Proper care and attention are required during planning and implementation of installation of utility services, so that the work of reinstatement of trenches is carried out in specified manner right in time. Any neglect

in adhering to a proper schedule can lead to serious traffic hazards besides recurring problem in road maintenance



Photo-8



Photo-9

Sample of Poorly Restored Surface

Below guidelines shall be followed for reinstating the trenches cut across the road for accommodating utility service lines.

- i) As a measure of abundant precaution against future settlement and other allied problems, use of only grade-2 or grade-3 sand and saturating the same in filling for reinstatement of trenches is recommended.

As an alternate, controlled low strength, self compacting cementations materials shall be used for reinstatement of trenches. Specification for the material is giving in **Appendix-3**

Where the depth of fill is more than 450 mm below the crust (refer **Fig. 12**) the entire depth and cutting below the level of 450 mm may be filled either with coarse sand (with fineness modulus not less than 2) or the excavated trench material of it is also of similar quality and compacted in layers not exceeding 75 mm when compacted by ordinary power roller/plate compactor.

For the depth upto 450 mm (refer **Fig. 12**) the construction of the entire formation width along the trench may be done with granular material.

Depending upon its location and level, each layer shall be compacted as per the requirement of compaction of embankment and sub-grade (IRC:36) and that of the relevant material constituting the road crust laid down in the appropriate code of practice of the IRC.

Since most utility services may need to be laid in deep and narrow trenches use of special compaction equipment like plate compactor, frog-hammer etc. may be essential.

- ii) After filling the trench upto the sub-grade level, road crust in the trenches should be provided same as that of existing road crust in the adjoining reaches.
- iii) With continuous traffic/rains, it is possible that certain amount of settlements may occur in the reinstated area (**Photos-8 and 9**). Necessary correction/replenishment shall be carried out on such area preferably after a wet season, using compatible material after dressing up the edge of the trench to vertical, for proper "Keying in" of the material. In the case of bituminous surfaces, a tack coat shall be applied to ensure proper cohesion and bond between old and replenished surface.
- iv) Before start of trenching, arrangement shall be made for barricading the area with indicative boards, retro reflective sign boards, necessary lighting at night, in order to caution the road users and same shall be maintained till the road is restored, **Fig. 18** and **Photo-12 and 13** for barricading under **Appendix-I**.
- v) It is important to keep the duration between trenching and its reinstatement to the barest minimum, as trenching leaves the road structure in its weakest condition especially when the road is left open to traffic simultaneously. For effective implementation, the road authority may stipulate a specific duration for reinstatement as a special condition while permitting the concerned agencies for installation of utility services.
- vi) All works of reinstatement shall be the responsibility of respective utility agencies and shall be got done from approved list of Contracting Agencies and supervised by a third party agency from road authority, for which the cost of such work shall be met by the agency owning the utility services. In case reinstatement is not done by utility agencies, the same shall be done by Urban Road Authority at the risk and cost of utility agency with additional penalty and future permission shall be refused.

3.6.7 Crossing through subways

Major crossing of roads by service lines takes place at road intersections where the lines along one road have to cross those along the intersecting road. Further, intersections are crucial areas of traffic movement, where any obstruction to the road for trenching, etc. will lead to chaotic condition. For avoiding such situations both during the initial laying of the services and their subsequent maintenance, it will be advantageous to construct subway across each intersecting arm exclusively for accommodating the service lines. The scheme is depicted in **Fig. 13**. Levels of subways for the intersecting roads should be adjusted in such a way that there is no conflict between the intersecting service lines.

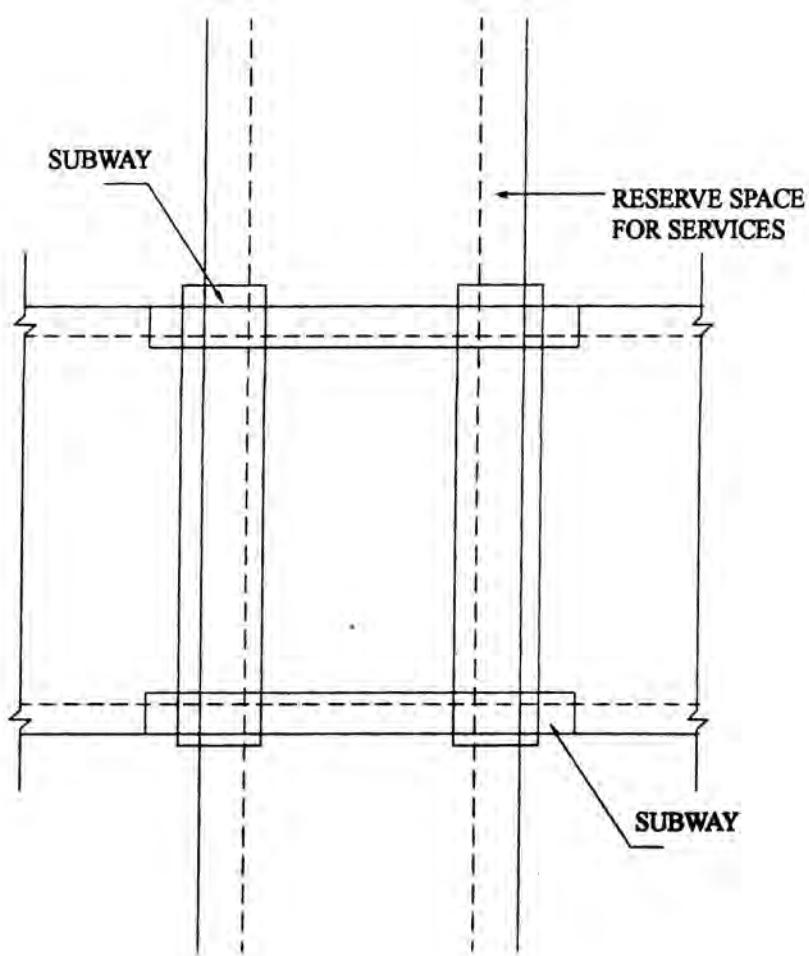


Fig. 13 Subways at Road Intersections for Accommodating Service Lines

For long road stretches without intersections in-between, conduit pipes/subways might be constructed at periodic intervals for facilitating crossing of the road by the service lines. This scheme is shown in **Fig. 14**.

The conduit pipes/subways should be sufficient size to accommodate the service lines expected to be laid and facilitate their easy maintenance. These should be designed as a normal highway culvert. Cross-section of a subway showing typical arrangement of service lines is shown in **Fig. 15**.

There are several advantages of accommodating the service lines in subways shown in **Figs. 13 to 15**. One is, frequent cutting of the roads for maintenance/replacement of the service lines is obviated and consequently the traffic is not disturbed. Second is that since the positions are earmarked for each service line, maintenance of any line can be carried out independently without affecting other lines. This system, no doubt, will be expensive in initial cost, but will be economically viable in the long run if maintenance cost is also considered. As such, this system is recommended for major roads and major road intersections.

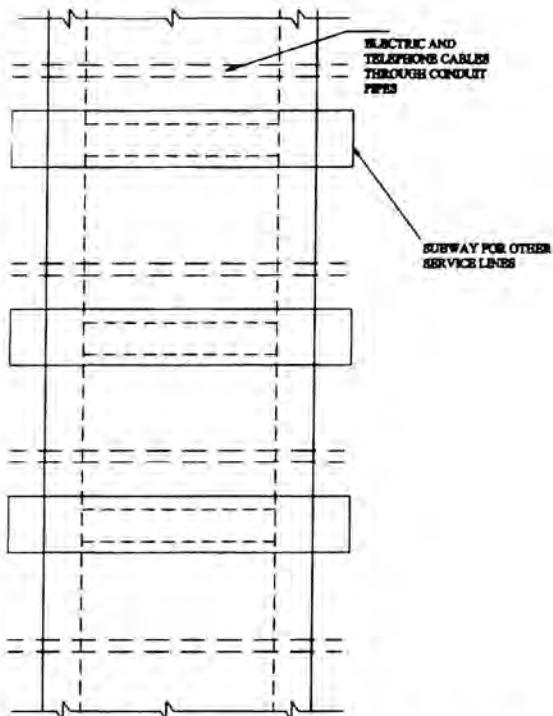


Fig. 14 Subways and Conduit Pipes for Accommodating Service Lines Across Long Stretches

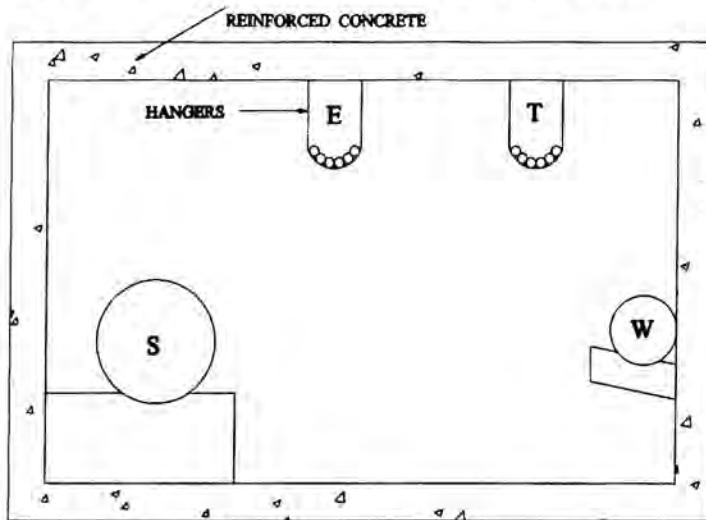


Fig. 15 Cross-Section of Typical Subway Accommodating Utility Services

Note:

- 1) For legend, refer **Fig. 4**
- 2) The minimum height clearance of subway should be 1.5 m for facilitating inspection and maintenance.
- 3) Suitable arrangements for drainage should be made.
- 4) The locations of the services are suggestive only and will depend on number, size and type of services to be accommodated, space available for services, etc.

3.7 Accommodation of Utility Lines Across Bridge Structure

3.7.1 Provision of utility services such as water mains, gas pipes and sewage pipes on the main bridge structures of important bridges should be avoided as far as possible.

3.7.2 In cases where the carrying of water mains or sewage pipes on any important bridge becomes inescapable, the following precautions may be taken so as to avoid possibility of any damage to the bridge and its approaches.

3.7.2.1 The pipelines shall be supported on the substructure of the bridge only. In no case it should be laid on the superstructure.

3.7.2.2 Only seamless pipes with welded joints should be permitted. C.I. pipes with S&B joints should not be allowed.

3.7.2.3 Location of pipeline on the substructure should be so fixed that it is easily accessible for carrying out its inspection, maintenance and repairs and it shall not in any way hinder the inspection, maintenance and repairs of the super structure, bearings and sub-structure of the Bridge.

3.7.2.4 The pipeline should be so aligned that it is taken out of the approach embankment as quickly as possible with minimum embedment into it. The thrust block at the bends in the pipeline required for taking it out of the embankment must be placed inside a culvert so as to facilitate easy maintenance and ensure its functioning independent of that of the embankment.

3.7.2.5 Where there is any change in the elevation of the pipeline while traversing the bridge length, air valves shall be provided.

3.7.2.6 In order to take care of the effect of surge force, pressure relief valves on the pipelines shall be provided near the two ends of the bridge, as a measure of abundant caution, even though a surge arrester may have been provided at the pumping station.

3.7.3 Gas mains and lines carrying combustible material should be carried on independent supports on the river bed from considerations of safety/pollution. Electricity cables and telecom lines carried on the bridge should be suitably insulated, grounded and carried in protective conduits or pipes. See **Fig. 16** for accommodation of utility services on bridges.

3.7.4 Service lines carried on a bridge cause additional load to the structure and the road authority shall be satisfied about the structural adequacy of the structure before giving permission for laying the lines. In case of service pipelines running under pressure, consideration should be given to forces generated on the bridge structure due to bends and surge effects on account of bursting of pipelines or sudden closure of the valves.

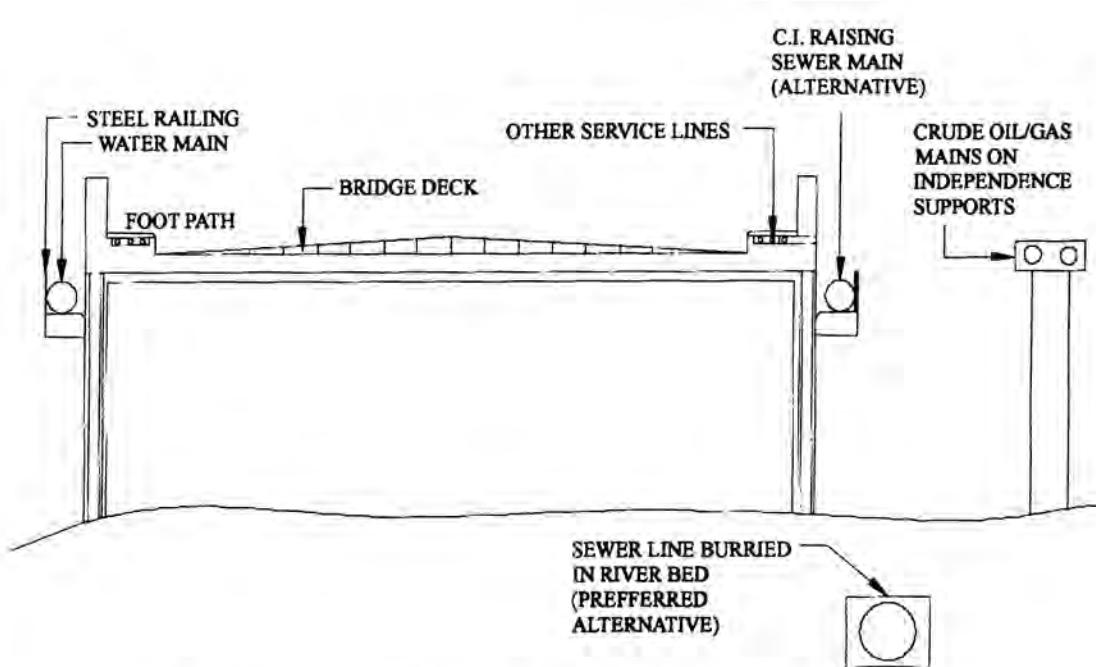


Fig. 16 Accommodation of Utility Services on Bridges

Note:

The locations of services are suggestive only and will depend on number, size and type of services to be accommodated, space available for services, etc.,

3.7.5 Adequate care shall be taken to ensure that the service lines are hidden or camouflaged from the view of the motoring public to avoid distraction and that the environment is not degraded.

3.7.6 For all new bridge structures, the road authority should consult all public utility authorities to ascertain their needs so that appropriate provision in the design could be made for the services that can be permitted to be carried on the bridge.

3.7.7 Under Bridge/Culverts: In urban areas many storm water drains, cross roads at culvert locations, the utility lines invariably cross the culvert and are located at different levels, which during monsoon create/obstruct the flow due to clogging/wrapping around the floating material like plastic, waste cloth, other debris resulting in blocking and over flowing of water on to the pavement and also flooding in the upstream. The present scenario is depicted in **Photo-10**. Different utility lines crossing the culverts shall be at the same level to overcome such situation, as indicated in **Fig. 17**.

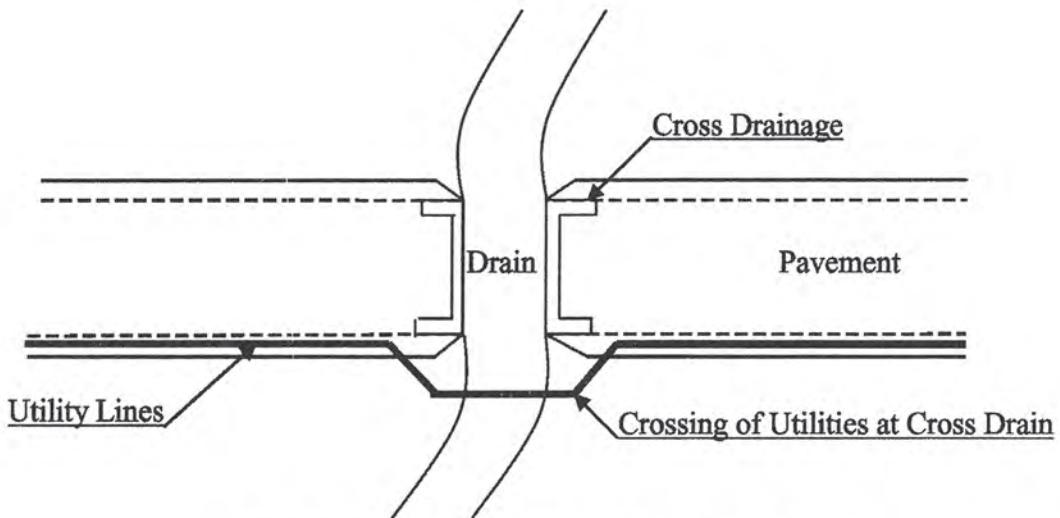


Fig. 17 Re Alignment of Utilities at Cross Drain Location



Photo-10 A Sample of Debris Clogged Due to Passing of Utility Lines in

3.8 Drawings of Utility Lines

3.8.1 Underground utility lines once laid along/across a road may require to be relocated at a future date when the road is taken up for widening or other improvements. To assess the need for such relocation or for laying new service lines, bank of reference plans, road or area wise, showing all the existing utility lines with their location and depth. Such drawings should be maintained by the road authority who should update these as and when a new line is laid.

3.8.2 Drawing of utility lines: All service providers using the road network for laying their lines below the ground shall submit their full and complete network drawings in hard copy and soft copy formats to the road authority.

3.8.3 The road authority shall maintain inventory of network of various lines/cables of all service providers using road network for upgrading the road or for expansion of services or for allowing for new services.

3.9 Co-ordination

The utility services are under the jurisdiction of different service providers. Cutting of the road is resorted to when a service provider wants to lay, repair or replace its service lines. Not infrequently, this is followed by similar action by other service providers. All this results in disturbance to the pavement, inconvenience to traffic and infructuous expenditure not to mention the complete lack of consideration to traveling public. Lack of coordination leads to opening of newly laid surfaces, **Photo-11**.



Photo-11 A Sample Photo of Recently Laid Surface Opened Due to Lack of Coordination

3.9.2 The number of road cuttings can be minimized by preparing a list of works to be carried out by each service provider once in six months through co-ordination meetings and then executing these simultaneously at particular locations. For this purpose, a permanent Co-ordination Committee should be set up, chaired by the road authority.

3.9.3 Meeting of concerned utility agencies or service provider may be convened before planning new roads grade separators, elevated roads, mono/metro for

relocation of utilities and also before resurfacing / strengthening of carriage way or for upgradation/repair of existing lines. Programme of Road Authority and service provider may be exchanged at the beginning of the year to prevent opening of completed surfaces.

3.9.4 Where the main utility lines like high tension lines, larger dia water lines/ sanitary lines, with direct linking communication lines between exchanges or for similar purpose which are not proposed for tapping, these lines shall be laid under roads of lower classification other than arterial/sub arterial roads to prevent opening and restoration during laying and for future repairs/up-gradation.

3.9.5 Road authority shall have powers to penalize utility agency for unauthorized trenching of road and improper reinstatement of trenches and shall have the powers to refuse future permissions till proper restoration is effected and certified by third party agency.

4 ROAD OPENING PROTOCOL

4.1 The road authority shall invariably prescribe road opening protocol depicting the methods to be followed by the utility agencies and application for permitting laying of utilities in existing roads. The utility agencies shall also submit GIS of existing utilities and the proposed utility, so as not to disturb/damage the existing ones.

4.2 Once the Road Authority has brought out, Road Opening Protocol for providing utility lines in the city in respect of all category of roads, the protocol is limited to OFC and Electrical cables (by Horizontal Direct Drilling).

4.3 The authority has to finalize after discussions with all the utility agencies the road opening requisition as per application as in **Appendix-I**. The protocol to shall define:

- 1) All OFC Agencies viz, MTNL/BSNL & Private operators will submit Application with a fee and in addition they restore the opened trenches as per IRC Specifications.
- 2) They will be permitted to take up HDD during nights and would restore within 48 hours.
- 3) HDD application made by one Agency will be mailed/faxed to all other agencies so that such of those agencies, who require opening on any future date will also lay in the same opening before restoration.
- 4) Agencies will give their plans for coming one year so that once opening is made on road will not be opened within one year.
- 5) Typical drawing of barricading are shown in **Fig. 18, Photos-12 and 13**. In addition, contact numbers are to be displayed with name of agency.

BARRICADE DETAILS

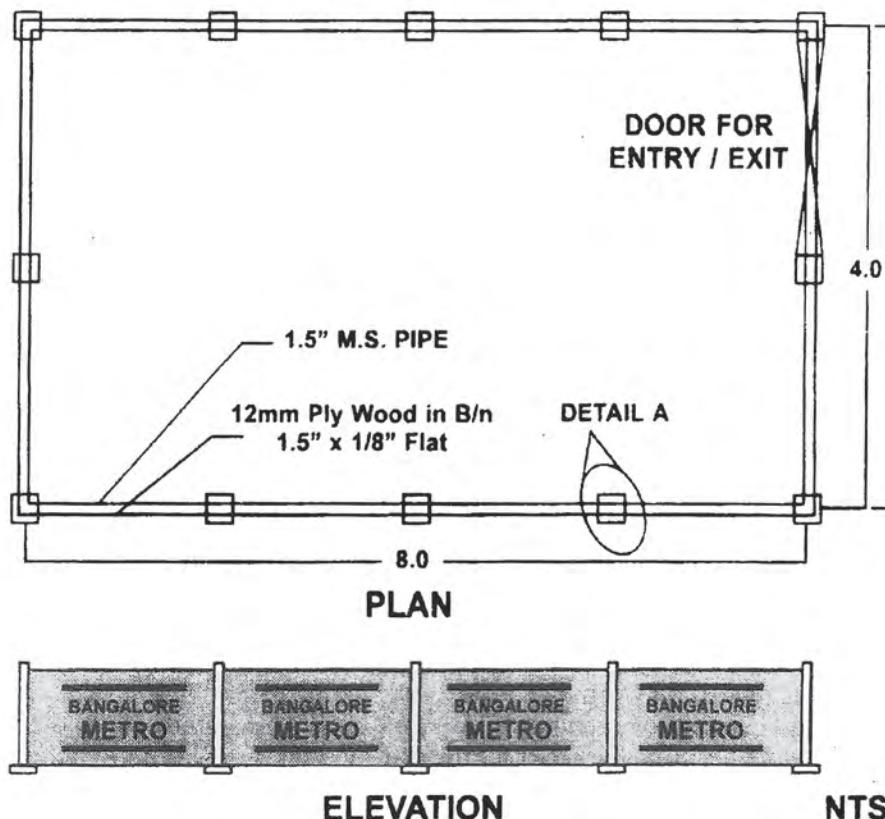


Fig. 18 Sample Barricading



Photo-12 Photo of a Sample of Barricading



Photo-13. Photo of a sample of Barricading

- 6) For individual houses small pits will be considered in footpath & thereby MTNL/BSNL will remove poles.
- 7) The formats of Application for seeking "Road Opening" is in **Appendix-I**.
- 8) Permission during monsoon shall not be considered except for repairs and emergent works.
- 9) Care to be taken to prevent slippage of earth, to neighboring structure to prevent accidents.
- 10) Application for utility permit to contain
 - i) Applying agency details with contact person and number
 - ii) Location including name of road with chainage, type of surface proposed with plan/GIS/size of opening.
 - iii) The fee for permitting opening (per pit in case of HDD)
 - iv) Permit endorsement indicating opening and closing date of the surface.

In addition Guidelines and Specifications are appended along with application form that may be suitably modified by the concerned road authority.

4.4 One more format for Permit/Road Opening Permit is given in **Appendix-II**.

5 PRECAUTIONS WHILE OPENING/TRENCHING

When laying of utilities are undertaken in long lengths, apart from barricading, precaution like shuttering is to be taken to prevent soil slipping in loose strata. Wherever opening is done in depths, more than 1 meter proper shuttering to be provided to prevent slippage of earth. In localities adjacent to buildings/compound utmost care is to be taken to prevent collapsing of structural parts in to the pits, where workers are engaged in trenching. The length of opening shall be limited to days work followed by restoration, within next 6 days.

APPENDIX-I
(Refer Clause 4.3)
URBAN LOCAL BODY

**APPLICATION FOR OPENING OF URBAN ROADS, FOOT PATHS BY
TRENCHING/HDD**

Name of Agency Applying _____

Address of Agency _____

Contact Person _____

Telephone No: _____

Location of Proposed

Opening (with plan) Road from _____ to _____

Trenching/HDD Opening (tick as required) Carriageway Sidewalk Shoulders

Other Area

Purpose: _____

Confirm that I have read the following

1) Notes for Applicant

2) Guidelines

3) Specifications

And I am fully acquainted with the requirements contained therein.

I undertake, if granted a Trenching/HDD opening License, to indemnify Road Authority against all claims for damages which may arise as a result of the works, from the date of issue of the License to the end of the maintenance period of one year.

Signature of Authorized Representative: _____ Date: _____

Seal _____

Trenching/HDD

Type of Carriageway	Pavement Layer Composition	Fee ₹ Per Sqmts
CARRIAGEWAY		
UNSURFACED AREA		
ROADSIDE MARGIN		

Notes:

- 1) Fee to be decided by Road Authority.
- 2) Fee applicable shall be based on sq. meter of opening to be reinstated by applicant/ agency.
- 3) If the Trenching/HDD is through a footpath which is 1.4 m or less in width, then the entire width of the footpath shall be restored.

ROAD OPENING BY Trenching/HDD

APPLICATION NUMBER

DATE OF RECEIPT, DD No. AND DATE

HDD IN	CARRIAGeway	SIDEWALK	OTHER AREAS
Surface Type			

Opening Date : _____

Closing Date : _____

SIGNATURE : _____

Officer Designated by Road Authority

**OPENINGS TO PUBLIC ROADS, FOOT PATHS AND OTHER AREAS
APPLICATION FORM**

NOTES FOR APPLICANTS

1. Before completing the Road Opening Application Form, the applicant should read the attached "General Conditions" together with the "Specifications and Drawings"

In particular, the Applicant should acquaint responsibilities with reference to:

 - a) Insurance and Indemnify
 - b) Opening Fees
 - c) Consultation with relevant authorities in relation to underground services
 - d) Road works
 - e) Maintenance period
2. Before submitting the Trenching/HDD opening Application Form to the Road Authority. The applicant shall proceed for a joint site visit, to enable the exchange of information and requirements.

INSTRUCTIONS TO APPLICANTS

- 1) HDD permission will be given on all days. Permission is valid for the particular dates & period only. No Blanket permission is available. In case of expiry of the permission, new permissions shall be applied for.
- 2) No manual cutting/open trenching is allowed.
- 3) Cutting only in the presence of engineer of the concerned agency specified in the permission letter. Cutting should only be in the square, rectangular or trapezoidal shape.
- 4) Trenching/HDD Pit on Cutting shall be Refilled / Re-made within 48 hours.
- 5) Any over burden debris/earth should be removed and conveyed beyond Urban limits.
- 6) Follow the procedure as laid down in Road Opening Restoration Protocol. Barricading, caution boards and other precautionary signages and name of the agency contact numbers shall be displayed during the execution of work. Sample board enclosed.
- 7) Laying of utility cables should not damage any of the Urban Road drains and has to be taken below the shoulder drain and it shall be ensured that no damage is done to trees or their roots. Ground Penetrating Radar or such device shall be used to identify existing utilities.
- 8) Applications for HDD/DBC shall be submitted within 15days in respect of roads proposed to be rehabilitated and no applications will be considered once the works are taken up.
- 9) In case of emergent openings for restoration of power in case of Power Utility Service provider and in case of Water & UGD, optical telephone cables of MTNL/BSNL & other Agencies, the concerned shall fax to the road authority, before opening and they shall collect the required materials for restoration before opening and restore within 24 hours.

SPECIFICATIONS

- 1) All openings in Roads, Foot paths and Other Areas for HDD are to be restored in accordance with IRC:98 (*Second Revision*)
- 2) A road-cutting saw shall be used for cutting straight edges prior to excavating through roads and/or footpaths
- 3) No excavated material may be used as filler material.

- 4) Refilling the cut portion shall be either by self compacting material and the depth of filling shall be with quarry dust or coarse sand filled in layers of 15 cm. thick and well watered/compacted
- 5) Use well graded/premix emulsion or hot mix. Compaction to be done with rollers either had operated/power roller and no manual compaction will be allowed. After compaction, surface should be in flush with the existing surface.
- 6) Joints in asphalt and macadam roads and footpaths are to be sealed vertically and horizontally with hot bitumen.
- 7) Vehicular traffic shall be prohibited from concrete reinstatement for a period of 7 (seven) days after completion of work.
- 8) Where an opening is made through concrete kerbs, replacement of kerbs shall be laid to Specification (in the case of pre-cast kerbs)
- 9) Where an opening is made through a paved area like cobble stones, the pavers shall be carefully removed by hand prior to excavation work, and shall be re-laid in a proper manner. Any pavers damaged in the course of the works shall be replaced by pavers of identical size and colour, and not by any other paver.
- 10) Any pre-cast concrete flags damaged in the course of the works shall be replaced by flags of similar size and colour.
- 11) Where an opening in a concrete footpath crosses a vehicular access of driveway, the depth of concrete shall be 150 mm and not 100 mm as applied elsewhere on concrete footpaths, and shall be reinforced with weld mesh.
- 12) It shall be the responsibility of every Utility Agency to ascertain the existence of other underground services, and to take all reasonable care in the protection of the said services, as specified by the relevant Authority. The applicant shall be held responsible for any damage caused to other utilities during such works.
- 13) Where the Public Utility proposes to carry out an opening through what is considers to be a sub-standard road or footpath, the condition of the said road or footpath shall be brought to the attention of Road Authority prior to any works.
- 14) If an opening is made in a footpath which is 1.4 m or less, in width, then the full width of the path shall be restored.

- 15) Temporary reinstatements, if applicable, are to be of hot or cold macadam only. No surface reinstatement of stone, sand grit or other "loose" material shall be permitted.
- 16) Width of HDD pit shall be of size 1200 mm by 1500 mm.
- 17) If, during the maintenance period of one year, the Applicant fails to rectify any defect which may arise reserves the right to carry out such works as deemed necessary to remedy such defect, and to Charge the Applicant for the costs of such work.
- 18) Barricading shall be done with proper display of name of Organization, Contract numbers. (A sample barricade Road Authority is appended). In **Fig. 18, Photo-11 and 12**

APPENDIX-II
(Refer Clause 4.4)

URBAN AUTHORITY ENGINEERING DEPARTMENT OF ROADS
APPLICATION FOR UTILITY PERMIT ON URBAN ROAD
RIGHT OF WAY

Application is hereby made for permission to place, construct and thereafter maintain a _____ along or across Urban Road Arterial/Sub Arterial/Local/Feeder Road from _____ to _____

meter from center line on the _____ (east, west, north or south) side of the road in accordance with the sketch shown on the inside hereof, or attached thereto.

1) UNDERGROUND CONSTRUCTION

CONDUIT

- | | |
|--|---|
| <input type="checkbox"/> Multiple tile | <input type="checkbox"/> Sectional concrete |
| <input type="checkbox"/> Transit | <input type="checkbox"/> Steel pipe |
| <input type="checkbox"/> Clay Tile | <input type="checkbox"/> Other _____ |

CASING

- | |
|---|
| <input type="checkbox"/> Steel pipe |
| <input type="checkbox"/> Sectional concrete |
| <input type="checkbox"/> Other _____ |

VOLTAGE	NUMBER OF CONDUCTORS	SIZE	DEPTH
		SIZE OF CONDUCTOR	

METHOD OF INSTALLING UNDER ROADBEDS (if open trench, explain why necessary)

- | |
|--|
| <input type="checkbox"/> Open trench _____ |
| <input type="checkbox"/> HDD |
| <input type="checkbox"/> DBC |

EXTENT & LOCATION OF TREE CLEARING

Work to start on or after _____ and to be completed on or before _____

The applicant in carrying on any and all of the work herein above mentioned or referred to in its application and in Permit issued herefore, shall strictly conform to the terms of such Permit, and the regulations of Road Authority, as set forth herein together with the Special Provision, all of which are made a part hereof. The application specifically agrees to be bound hereby. The application shall also comply with the regulations of all other governmental agencies for the protection of the public. The work shall be accomplished in a manner that will not be detrimental to the highway and that will safeguard the public.

Date this ____ day of _____ 20_____

Name of Utility Agency Making Application

Signature _____ By _____

Title

Address _____ (submit in
duplicate)

DEFINITIONS

- i) Urban Road: Urban Road shall mean all roads in the Urban limits designated as expressway, arterial streets, subarterial streets, collector streets and local streets.
- ii) Urban authority: Urban authority shall mean Urban Local Bodies/PWD which are vested with all Urban Roads in the Urban limits
- iii) Utility. Under this order "Utility" shall mean and include all privately, publicly or co-operatively owned communication lines and facilities, any system, lines and facilities for the distribution and transmission of electrical energy, oil, gas, water, sewer, steam and other pipe lines, railways, ditches, flumes or other structures which under the laws the ordinance of any city may be constructed, placed or maintained across, along or on Urban right of way. Dependent upon the meaning intended in the context, "Utility" shall also mean the utility company, inclusive of any wholly owned subsidiary.
- iv) Designated Authority: Designated Authority shall mean designated officer/ engineer who is authorized to issued Utility Permit, on behalf of Urban Authority.

GENERAL

- I) Except as otherwise permitted, utility construction and relocation on urban road right of way shall not be commenced until an application for a Permit has been made and such Permit granted. The Permit sketch shall show the location of the proposed utility with reference to Urban Road center line. A copy of the sketch shall be provided for each copy of such Permit.
- II) All waterways and lines of drainage shall remain operative
- III) Wherever topsoil and sod are disturbed they shall be replaced and maintained satisfactory until the turf is established
- IV) The utility facility and installation shall not interfere with any existing utility facilities on the urban road right of way.
- V) Barricades, warning devices and flagmen shall be provided by the Utility during all phases of their construction and maintenance operations on Urban Road right of way.
- VI) At the time of construction of the utility and at the times of subsequent maintenance, prior approval shall be obtained from the Designated Authority/Authorities for the cutting and trimming of trees within the urban road right of way. Wherever trees are cut the resulting stumps shall be removed unless otherwise provided in the Special Provisions of the Permit. Any holes caused by stump removal shall be backfilled, the area leveled and all materials associated therewith disposed of outside the urban area. The utility shall advise the Road Authority at least 48 hours in advance on its intent to start clearing and grubbing operations so that proper supervision can be provided.
- VII) The Utility provider shall notify the Road Authority of its intent of perform service and maintenance operations, which will interfere with the flow of traffic on urban road, and shall obtain his approval prior to performing such operations. However, the Company may perform service and maintenance operations on urban road including opening and disturbing the surface of the right of way after sending fax to Designated Authority in those instances where an emergency exists that is dangerous to the life or safety of the public and which required immediate repair. The utility shall take all necessary and reasonable safety measures to protect the traveling public and shall notify the Designated Authority at the earliest possible moment.
- VIII) The Utility provider shall assume all liability for, and save the Urban Body, its employees, harmless from, any and all claims for damages, actions or causes

of action arising out of the work to be done herein and the continuing uses by the Utility, including but not limited to placing, constructing, reconstruction, maintaining and using of said utility under this application and Permit.

- IX) The Road Authority may require the Utility provider, or its constructor, to furnish a deposit in the form of a Demand Draft in favour of the Urban Body, for any expense incurred by the Urban Body in the repairing of damage to any portion on the Urban road right of way caused by work performed under a permit, including any out of the ordinary engineering supervision and inspection expense provided by the Road Authority. In those instances wherein a deposit is required, the amount of the deposit shall be specified in the Special Provisions of the Permit. If a Demand Draft is furnished, any monies remaining over and above such expense shall be returned to the applicant.
- X) The Permit as issued does not in any way imply an easement on private property.
- XI) The installations shall be made in conformity with all applicable laws, regulations and codes covering said installations. All installations shall be made in conformity with regulations of governmental agencies for the protection of the public.
- XII) Upon completion of an installation, the Utility shall restore the Urban Road right of way to its original condition. The Utility shall then notify the office of the Urban Bodies of the completion of work so that inspection can be made to determine its acceptability.
- XIII) Any further permits will be considered only after satisfactory restoration of surface earlier permitted for laying of utility
- XIV) When one utility is permitted for open trenching others will be informed. So that they can also lay their utility in the same trench avoiding frequent opening
- XV) Road opening permit will not be issued during monsoon, except in case of emergent repairs.

Location Sketch

Show location of proposed facility in relation to the center line of the Urban road and other pertinent features such as right of way line, shoulder line, curb line and edge of surfacing. The facility should also be referenced to adjacent landlines.

**URBAN AUTHORITY
DEPARTMENT OF ENGINEERING**

UTILITY PERMIT

Reference: Project _____

In accordance with the application herein, a Utility Permit is granted to _____
to place, construct and thereafter maintain _____ Urban
Road _____ in location shown on the sketch which is a part of said
application, or in such location as may be specified by the Engineering Department of
Roads in the Special Provisions hereof.

SPECIAL PROVISIONS:

Approved _____

(date)

Engineering Department of Roads

By _____

Officer Designated by Road Authority

Permit No. _____

Certified No. _____

Surety Bond No. _____

Date of Surety Bond No./ _____

Check No. _____

Bank or Bonding Co. _____

Deposit Made by _____

APPENDIX-III

(Refer Clause 3.6.5)

SPECIFICATION FOR CONTROLLED LOW STRENGTH MATERIAL

1. Introduction

CLSM – Controlled Low Strength Material is self compacting, cementitious material. The properties of CLSM are between Soil and Concrete. CLSM is manufactured from materials similar to those used to produce Concrete and is placed for equipment in a fashion similar to that of concrete.

2. Applications

2.1 General

The primary application of CLSM is as a structural fill or as base of pavement. Since CLSM is in fluid form it is self leveling and needs no compaction. It is ideal for use in restricted access areas where placing and compacting fill is difficult e.g., refilling trenches, space behind walls, around manholes etc. The strength of CLSM is between M2 to M8.

3. Materials

3.1 CLSM is a mixture of water, Portland cement, sand, fly ash (or GGBS) and aggregate. Selection of material should be based on required characteristics of the mixture including flow – ability and strength. Trial mixes can be done to arrive at proper quality of CLSM giving strength of M2 to M8.

3.2 Cement

The cement used shall be any of the following types selected for the intended use.

- 1) Portland Pozzolana Cement (Fly ash based conforming to IS 1489 (Part I))
- 2) 33 Grade ordinary Portland Cement conforming to IS 1269
- 3) 43 Grade ordinary Portland Cement conforming to IS 1269

The cement content varies from 60 to 90 kg/m³.

3.3 Fly Ash

Coal combustion fly ash or GGBFS—(Ground Granulated Blast Furnace Slag) can be used. The quantity used is from 150 to 750 kg/m³.

3.4 Aggregates

Aggregates are the major constituent of CLSM mixtures. The type, grading and shape of aggregate can effect the physical properties such as flow ability and comprehensive

strength. Generally crushed aggregates of size 10 mm down are utilized. Quarry waste of this size could be utilized. The sand shall be river sand of required gradation. Silty sand could be used. However, sand with clayey fines should not be used. The quantity of total aggregates used is from 1500 to 1700 kg/m³.

3.5 Admixtures

Air entraining admixtures and foaming agents can be a useful constituent for the CLSM. The inclusion of air in CLSM can help to provide improved workability and reduced shrinkage, less bleeding, minimum segregation and lower unit weights.

The CLSM mixture are pumpable but require higher pump pressures. To prevent extended setting times, extra cement or an early setting admixture may be added if required. In such cases pre-testing should be performed to determine acceptability by providing trial stretches. This can give opportunity to effect minor modifications in the design.

3.6 Water

Water that is acceptable for normal concrete mixtures is acceptable for CLSM mixtures. (Potable water is generally considered satisfactory for mixing of CLSM). Water used is from 150 to 400 kg/m³.

4. Properties

CLSM can be successfully delivered by conventional concrete pumping equipment or by locally preparing in concrete mixers. Proportioning of the mixture is critical. Voids must be adequately filled with particles to provide adequate cohesiveness for transport through the pump line under pressure without segregation. Hardening time is mainly dependent in the type and quantity of cementations material used in CLSM.

Wet density of normal CLSM in place is in the range of 1840 kg/m³ to 2300 kg/m³. A CLSM mixture with only fly ash, cement and water should have a density between 1440 to 1600 kg/m³.

The ability to excavate CLSM if required in future is an important consideration for road shoulder work. In general CLSM can be excavated by pickaxes or with light excavating equipment. However, the limits for excavability are some what arbitrary, depending upon the CLSM mixtures.

CLSM is compatible with Polyethylene materials which are mainly used as protection for the underground utilities or as the conduits themselves. As with any back fill care must be taken to avoid damaging the protective coating of under ground utility lines.

4.1.1 Flow ability

Flow ability is the property that distinguishes CLSM from other fill materials. It enables the materials to be self leveling to flow into small size excavated portion and

readily fill a void and is a self compacting without the need for conventional placing and compacting equipment. This property represents a major advantage of CLSM compared with conventional fill materials that need mechanical placement and need compaction.

4.1.2 Hardening time

Hardening time is the approximate period of time required for CLSM to go from fluid state to a hardened state with sufficient working strength. Generally it takes 24 hours under normal conditions without admixtures. With admixtures this time is required to brought between 2 to 4 hours. Broadly speaking, a person should be able to walk over the laid CLSM within about 2 to 4 hours.

Following are the factors affecting the hardening time:

- 1) Type and quantity of cementations material
- 2) Moisture content of CLSM
- 3) Permeability and Degree of saturation of surrounding materials that is in contact with CLSM
- 4) Proportioning of CLSM
- 5) Mixture and surrounding temperature
- 6) Humidity
- 7) Method of filling

5. Mixture Proportioning and Procedure

Different proportions of mixes for CLSM have been prescribed in ACI. But trial mixes and stretches can be prepared with different proportion to achieve the CLSM, which hardens sufficiently in 2 to 4 hours. To achieve required strength of M2 i.e., 20 kg/cm^2 mixes with 1 cement and 60 parts of sand/grit/fly ash combination is usually required. Trials are, however, necessary to fix actual proportions.

Following is the procedure that can be adopted for mixing:

- 1) Add 70 to 80 percent of water required
- 2) Add 50 percent of the aggregate filler
- 3) Add all cement and fly ash required
- 4) Add balance of aggregates
- 5) Add balance water.

6. Mixing Transporting and Placing

6.1 Mixing

CLSM can be mixed by several methods including ready mix through batching plant conveyed by RMC Trucks. It can be also done by concrete mixers etc.

6.2 Placing

The placing of CLSM can be done by chutes, conveyor, buckets or pumps depending upon the application and its accessibility. As mentioned internal vibration or compaction is not required since the CLSM gets consolidated due to its own weight. Usual curing methods as adopted for concrete are not considered essential for CLSM.

7. Quality Control

7.1 The extent of a quality control of CLSM can vary as per experience, application and basic materials utilized and level of quality desired. Quality control of CLSM can be as simple as a visual check of the completed work, where standard pretested mixtures are being used. Mould cubes should be taken and tested as for normal concrete.
