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Design standard for communication conduit and passage engineering

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Foreword

According to the requirements of Document Jian Biao [2024]NO. 41 issued by Ministry of Housing and Urban-Rural Development of the People's Republic of China - “Notice on Printing the Development and Revision Plan of National Engineering Construction Standards in 2024” developed this standard, which is revised and completed by China Information and Telecommunications Consultancy and Design Institute Co., Ltd. and with the relevant units.

This standard is divided into 12 chapters. The main technical content includes general provisions, terminology, principles of communication conduit and passage planning , determination of the routing and location of communication conduit and passage, determination of communication conduits’ capacity, Pipe material selection, burial depth of communication conduit, bending and section length of communication conduit, laying of communication conduit, manhole or handhole settings, optical (electric) cable passgae, optical (electric) cable into the room design.

During the revision process, the preparation group in reference to the current domestic standards and collection of relevant projects of communication conduits and materials used, and widely consult the views of all parties to develop. The main technical contents of this standard revision include: 1. increase the explanation of terminology chapter; 2. increase the network composition diagram of communication conduits; 3. supplement the minimum clear distance requirement between communication conduits and oil pipelines; 4. increase the method of calculating the capacity of pipe holes; 5. increase the specification requirements for plastic pipes and general selection requirements; 6. increase the horizontal directional drilling communication conduit design requirements; 7. reference to the “Residential Area and Residential Reference to the “residential and residential fiber to the home communication facilities in the building engineering design specifications” GB 50846 revised the relevant content; 8. Increased manhole (hand) hole type general selection requirements.

The standard printed in bold type are compulsory ones and must be enforced strictly.

Ministry of Housing and Urban-Rural Development is in charge of the administration of the standard and the explanation of the compulsory provisions while CITC is responsible for the explanation of specific technical contents. During the implementation process of the code, suggestions and recommendations are welcome and can be mailed to CITC. (Address: Building #3, ZhuYu Business Center, No. 9, South Shouti Road, Haidian District, Beijing. P.R.China Postal Code:100048).

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Contents

1	General provisions	1
2	Terms	2
3	Basic requirements	3
4	Routing and location determination of communication conduit and passage	4
5	Capacity determination of communication conduit	6
6	Pipe selection	7
7	Buried depth of communication conduit	8
8	Bending and segment length of communication conduit	9
9	Laying of communication conduit	10
10	Manhole or handhole setting	12
11	Optical(electric) cable	14
12	Inlet chamber of optical(electric) cable	15
	Explanation of Wording in this standard	17
	Index of quoted standards	18
	Explanation of provisions	19

1 General provisions

1.0.1 This Standards is formulated with a view to modern urban construction and information development, to coordinate the location of communication conduit and passage in the underground space of the city, to coordinate the relationship with other engineering pipelines in the city, and to provide a basis for the planning and management of communication conduit and passage.

1.0.2 This standard is applicable to the design of urban underground communication conduit and passage projects.

1.0.3 Communication conduit shall be constructed ahead of time, and the construction of communication conduit and passage shall be consistent with the principle of co-construction and sharing.

1.0.4 Communication conduit and passage engineering design shall be selected in line with the current relevant standard of the nation's stereotyped products. Qualified pipes shall be used in the project.

1.0.5 Construction of communication conduit and passage not only the requirements stipulated in this standard, but also those in the current relevant ones of the nation shall be complied with.

2 Terms

2.0.1 Trunk Pipeline

Generally covers urban arterial roads, mainly connecting core/aggregation nodes or connecting communication conduits between core/aggregation nodes and access points, including outbound and to trunk roads.

2.0.2 Branch Pipeline

Generally covers urban feeder roads and mainly connects communication conduits between trunk pipeline and customer premises network pipeline.

2.0.3 Customer Premises Network (CPN)

Pipelines outside the red line of the municipal plan, mainly including communication conduits in buildings, residences and other areas within the red line of the building plan, as well as internal pipe ducts in buildings.

2.0.4 Integratedcommunication Building

Integrated communication buildings, core rooms of the communication network, and machine rooms where various types of core business equipment are located.

2.0.5 Telecommunication Station

Relay station, local network service convergence node, generally refers to the node where all types of service convergence/convergence equipment within the local network are located.

3 Basic requirements

3.0.1 Planning for communication conduits and passages shall be based on urban development plans and master plans for telecommunication construction. Planning for the construction of communication conduits shall be incorporated into urban construction planning.

3.0.2 Communication conduits shall be constructed ahead of time, and the construction of communication ducts and passages shall be consistent with the principle of co-construction and sharing.

3.0.3 The master plan for communication conduits shall include planning and construction programs for trunk pipeline, branch pipeline, customer premises network pipeline, etc, which shall form a network of pipelines and take into account the feasibility and economy of implementation.

3.0.4 For newly constructed or remodeled buildings, pre-buried communication conduits outside the building shall be synchronized with the construction of the building and shall be connected to the public communication conduits.

3.0.5 Bridges, tunnels, high-grade highways and other buildings in the city shall synchronize the construction of communication conduits or reserve the location of communication conduits.

3.0.6 On wide roads with large terminal pipe capacity, communication conduits or passages shall be constructed on both sides of the road when the distance between the red lines of the planned roads is equal to or greater than 40 m. When it is less than 40 m, communication conduits shall be constructed on the side where there are more users and street-crossing ducts shall be constructed or constructed in accordance with the specific conditions.

3.0.7 Alteration and expansion of pipeline projects, shall first consider the top of the original pipe plus expansion holes, should not be added on both sides of the original pipe expansion holes.

3.0.8 The construction of communication conduits and passages should be synchronized with the construction of relevant underground pipelines in the city.

4 Determination of the routing and location of communication conduit and passage

4.0.1 The determination of communication conduit and passage routing shall be in accordance with the following requirements:

- 1 Communication conduits and passages should cover the main roads and buildings of the city and residential neighborhoods, and communication conduits shall also be constructed on the main highways in the suburbs of the city.
- 2 Routing of communication conduits and passages shall be based on pipeline planning to fully study the feasibility of split construction.
- 3 Communication conduits and passage routes shall be routed away from hazardous materials and chemically corrosive zones.
- 4 Routing of communication conduits and passages shall be prioritized to roads with fewer underground and aboveground obstructions.
- 5 Communication conduits and passages shall not be constructed on roads that have been planned but not yet formed, or that have been formed but the soil has not been compacted, and in areas of quicksand and overburden.

4.0.2 When selecting the building location of communication conduits and passages, the following provisions shall be in accordance with the following requirements:

- 1 It is advisable to build it under the sidewalk. When it is not possible to build under sidewalks, it may be built under non-motorized paths or greenbelts and should not be built under motorized paths.
- 2 The location of communication conduits on high-grade highways shall be selected in accordance with the following sequence: under the central median, on the shoulder and side slopes, and within the roadside barriers.
- 3 The location of communication conduits and passages should be on the same side as the telecommunication poles.
- 4 The centerline of communication conduits and passages shall be parallel to the centerline of the roadway or the red line of the building.
- 5 The location of communication conduits and passages should not be selected near other pipelines that are buried deeper.

4.0.3 Communication conduits and passages shall be avoided to be built on the same side of the road as gas pipelines, heat pipelines, oil pipelines, and high voltage power cables.

4.0.4 When communication conduits and passages are constructed on the same side as other underground pipelines and buildings, the minimum clear distance between communication

conduits and passages and other underground pipelines and buildings shall comply with the provisions of Table 4.0.4.

Table 4.0.4 Table of minimum clearances between communication conduits, passages and other underground pipelines and buildings

other underground pipelines and building names		parallel clearance (m)	cross clearance (m)
existing building		2	-
planned building red line		1.5	-
water supply pipe	$d \leq 300\text{mm}$	0.5	0.15
	$300\text{mm} < d \leq 500\text{mm}$	1	
	$d > 500\text{mm}$	1.5	
drain pipe		1.0 ^{Notice '1'}	0.15 ^{Notice '2'}
thermal pipe		1	0.25
oil pipeline		10	0.5
gas pipe	Pressure $\leq 0.4\text{MPa}$	1	0.3 ^{Notice '3'}
	$0.4\text{MPa} < \text{Pressure} \leq 1.6\text{MPa}$	2	
electric power cable	Below 35kv	0.5	0.5 ^{Notice '4'}
	35kv and above	2	
high voltage tower foundation edge	35kv and above	2.5	-
telecommunication cable (or communication conduit)		0.5	0.25
telecommunication pole, light pole		0.5	-
greening	tree	1.5	-
	shrub	1	-
curb edge		1	-
rail steel rail (railway rail)		2	-
bottom of the ditch foundation		-	0.5
base of the culvert foundation		-	0.25
base of the tram rail		-	1
base of the railway rail		-	1.5

- Note:
1. When laying after the trunk pipeline, the parallel clear distance between the edge of the drain construction trench and the existing communication conduit shall not be less than 1.5m.
 2. When the pipeline crosses underneath the drainage pipe, the clear distance must not be less than 0.4 meters, and the communication pipeline should be enclosed.
 3. Within the 2-meter range at the crossing, when the gas pipe has a joint device and accessories, the communication pipeline should be enclosed.
 4. When the power cable is provided with a protective pipe, the clear distance could be reduced to 0.25 meters.

4.0.4 No other pipelines shall cross in the manhole or handhole.

4.0.5 The crossing angle between communication conduits and railroad tracks and tramways should not be less than 60°. When crossing, the distance from the turnout and the return line shall not be less than 3 m. When steel pipes are used at the crossing with tramway or electric railway, safety protection measures shall be taken.

5 Determination of communication conduits' capacity

5.0.1 Pipe bore capacity shall be calculated on the basis of operational forecasts and specific conditions, and the number of pipe bores in each section may be estimated in accordance with Table 5.0.1.

Table 5.0.1 Pipe capacity table

Usage Type	Long-Term Pipe Capacity
Subscriber ^{Notice (1)} optical(electric) ^{Notice (2)} Cable Pipe	Based on the number of planned fiber optic (electric) cables ^{Notice (2)}
Wireless network base station ^{Notice (3)} optical cable pipe hole	Based on the number of planned optical fiber cable
Relay optical cable pipe	Based on the number of planned fiber optic (electric) cables
Access bureaus (stations) Optic Cable Pipes	Calculated as required
Rental of pipes and others	2 to 3 holes
Redundant Pipes	20% of total pipe capacity

Notes: 1.Users include the general public and dedicated line users, among others.
 2.Currently some special and important private networks still need to build cables.
 3.Wireless network base station including macro base station, distribution system base station and fiber optic remote station and other station building mode site.

5.0.2 Pipe capacity shall be taken according to the long-term needs and reasonable pipe group combination type, and shall be left with spare holes.

5.0.3 Along a single route, the pipes shall be laid out in a single operation according to the long-term capacity.

5.0.4 The pipeline into the bureau (station) shall be constructed at once according to the needs of the final bureau (station). Pipe larger than 48 holes may be made into passages, which shall be connected from the basement.

6 Pipe material selection

6.0.1 The main materials available for communication conduits shall include plastic pipes, cement blocks, and steel pipes.

6.0.2 The specifications and scope of application of plastic pipes for telecommunication shall be in accordance with those specified in Table 6.0.2.

Table 6.0.2 Commonly used plastic pipe specifications and scope of application

Serial number	type	material	specification (mm)	scope of application
1	solid-walled tube	PVC-U	Φ110/100	Trunk pipelines, branch pipelines, customer premises network pipelines
			Φ100/90	
		PE	Φ110/100	
			Φ100/90	
2	double-wall bellow	PVC-U	Φ100/90	
		PE	Φ110/90	
3	silicone core tube	HDPE	Φ40/33	
			Φ46/38	
4	plum tube	PE	7 holes (inside diameter 32)	Trunk pipelines, branch pipelines
5	raster tube	PVC-U	4 holes (inside diameter 50)	
			6 holes (inside diameter 33)	
			9 holes (inside diameter 33)	
6	honeycomb tube	PVC-U	7 holes (inside diameter 33)	

6.0.3 The specifications and range of application of cement pipe blocks shall be in accordance with those specified in Table 6.0.3.

Table 6.0.3 Common Cement Pipe Block Specifications and Scope of Application

Number of holes X Hole diameter (mm)	nominal	Overall Dimension (L×W×H, mm)	Scope of application
3×90	3-hole pipe block	600×360×140	Urban trunk pipelines, branch pipelines
4×90	4-hole pipe block	600×250×250	
6×90	6-hole pipe block	600×360×250	

6.0.4 Steel pipes should be used when crossing roads or bridges.

6.0.5 Urban roads with a variety of comprehensive pipelines, complex terrain shall be selected plastic pipe; suburban and wild long-distance optical cable pipe shall be selected silicone core pipe.

7 Buried depth of communication conduit

7.0.1 The burial depth of communication conduits shall be in accordance with those specified in Table 7.0.1. When the requirements are not met, it shall be protected by concrete encasement or steel pipe.

Table 7.0.1 Table of minimum depths from road surface to top of pipe (m)

Type	Sidewalk/Green belt	Motorway	Crossing with tram tracks (counting from the bottom of the tracks)	Crossing with railroad tracks (counting from the bottom of the tracks)
Plastic pipe, cement pipe	0.7	0.8	1.0	1.5
steel pipe	0.5	0.6	0.8	1.2

7.0.2 The top of the pipe foundation at the entry to the manhole or handhole shall not be less than 0.40m from the top of the manhole foundation, and the top of the pipe shall not be less than 0.30m from the bottom of the manhole or handhole overlay.

7.0.3 The burial of communication conduits shall be adjusted accordingly or specially designed when the following conditions are encountered:

- 1 When there are changes in the road surface elevation due to urban planning for future road expansion or reconstruction.
- 2 When the distance between the communication pipeline crossing with other underground pipelines does not comply with the provisions of Table 4.0.3.
- 3 When the height of the groundwater table and the layer of frozen ground affect the pipeline.

7.0.4 The pipeline shall be laid with a gradient. The gradient of the pipeline should be between 3‰ and 4‰, and it should not be less than 2.5‰.

7.0.5 On the longitudinal section, when the pipeline cannot be built in a straight line to avoid obstacles, the pipeline may be smoothly bent downwards towards the two manhole or handhole, and should not be bent upwards (i.e., a "U" shape bend).

8 Bending and segment length of communication conduits

8.0.1 The length of the pipeline segments shall be determined based on the positions of the manhole or handhole. On straight routes, the segment length of plastic pipelines should not exceed 200m, and the segment length of concrete pipelines should not exceed 150 meters. For communication conduit on high-grade highways, the segment length shall not exceed 1000 meters, depending on the type of pipe material used and the method of cable laying.

8.0.2 Each section of the pipeline should be laid in a straight line. When there is a bend in the road or it is necessary to detour around above-ground or underground obstacles, and a manhole is set at the bend where the pipeline segment is too short, curved pipelines may be constructed. The length of the curved pipeline sections should be less than the maximum allowable segment length of straight pipelines.

8.0.3 The radius of curvature for curved concrete pipelines shall not be less than 36 meters; for plastic pipelines, it shall not be less than 10 meters. The central angle of the curved pipelines shall be maximized. The same section of pipeline shall not have reverse bends ("S" shape bends) or bends where the central angle of the curved part is less than 90 degrees ("U" shape bends).

8.0.4 Horizontal directional drilling pipeline laying, the radius of curvature of the drilling trajectory shall meet the radius of curvature of the drill pipe at the same time, the axial maximum drag force and the minimum radius of curvature shall be determined to meet the requirements of the mechanical properties of the pipe.

9 Laying of communication conduit

9.0.1 Communication conduits shall be laid in accordance with the following:

- 1 The load and strength of the pipeline, and its design standards, shall conform to the relevant national standards and regulations.
- 2 The pipeline shall be constructed on a good foundation, and different pipeline foundations shall be used for different soil types, with the pipeline trench foundation meeting the required load-bearing capacity.
- 3 During the pipeline laying process and after construction is completed, the pipe entries into the manhole or handhole shall be sealed tightly.
- 4 Special design shall be carried out for areas with high groundwater levels and the layer of frozen ground.
- 5 The grouping and combination methods of the pipelines shall conform to the relevant provisions of the "Transect Drawing Gallery of Communication Conduit" YD5162.

9.0.2 The laying of plastic pipelines shall comply with the following regulations:

- 1 In areas with good soil quality, after excavating the trench, the bottom of the trench shall be compacted, and 50mm of fine sand or fine soil shall be backfilled at the bottom.
- 2 In areas with slightly poor soil quality, a concrete foundation shall be made after excavating the trench, and 50mm of fine sand or fine soil shall be backfilled on the foundation.
- 3 In areas with poor soil quality, a reinforced concrete foundation shall be made after excavating the trench, and 50mm of fine sand or fine soil shall be backfilled on the foundation, and the pipeline shall be concrete-encased.
- 4 In areas with rocky, gravelly, or frozen ground, 200mm of fine sand or fine soil shall be backfilled after excavating the trench.
- 5 The trench bottom must be level, free of protruding hard objects, and the pipeline shall be in close contact with the trench bottom.
- 6 When the pipeline enters a manhole or handhole or building, a reinforced concrete foundation and enclosure of not less than 2m in length shall be made on the side close to the manhole or handhole or building.
- 7 Pipes with large internal diameters of pipe bores shall be placed at the lower and outer edges of the pipe group, and pipes with small internal diameters of pipe bores shall be placed at the upper and inner edges of the pipe group.
- 8 When multiple porous plastic pipes form a pipe group, grid, honeycomb, or plum tubes shall be selected.
- 9 For the same pipe group combination, one type of porous pipe should be used, but may be combined with solid-wall, corrugated plastic single porous pipe or cement pipe.

10 Into the manhole or handhole before the 2m range, between the multi-hole pipe should be left 40mm ~ 50mm gap, single-hole solid-wall pipe, corrugated pipe should be left between 15mm ~ 20mm gap, all gaps shall be filled in layers.

11 The pipe position between two adjacent manhole or handhole shall be the same and the pipe group section shall conform to the design requirements.

12 The remaining length of the silica core pipe port inside the The pipe position between two adjacent manhole or handhole shall be the same and the pipe group section shall conform to the design requirements. should not be less than 400mm.

13 The jointing of plastic pipelines shall comply with the following regulations:

1) Connections between plastic pipes should preferably use sleeve-type connections, socket-type connections, socket-type elastic sealing ring connections, and mechanical tightening pipe fittings.

2) The socket and inside of the spigot of multi-hole plastic pipes shall be evenly coated with a special-purpose neutral adhesive, with a minimum viscosity of not less than 500 MPa·s. The plastic pipe shall be inserted to the bottom and fixed by compression.

3) Interfaces of each plastic pipe should be staggered.

4) The marked side of the plastic pipe shall be on top.

5) Grid plastic pipe groups shall be bundled once at intervals of about 3m with special bands, and other pipes such as honeycomb pipes should be fixed with special bracket arrangements.

6) Vertical joints between two rows of plastic pipes shall be filled with M10 cement mortar, the degree of fullness should not be less than 90%.

14 The jointing of steel pipes shall use sleeve-type connections.

15 A warning mark should be added 300mm above the pipe group.

16 When plastic pipes are laid above ground, protective measures against aging and mechanical damage shall be taken.

9.0.3 The laying of concrete pipelines shall be in compliance with the following requirements:

1 In areas with good soil quality, after excavating the trench, the trench bottom shall be compacted and a concrete foundation shall be made.

2 In areas with poor soil quality, a reinforced concrete foundation shall be made after excavating the trench.

3 In areas with rocky soil, the bottom of the pipeline trench shall be ensured to be level.

4 The combination of pipe groups should preferably be in units of 6-hole pipe blocks.

5 Cement pipe block joints should be made with slurry flush joints.

9.0.4 Horizontal directional drilling or other non-excavation methods should be used for sections not suitable for excavation. Paving over bridges should be fixed by trenching or bridge.

10 Manhole or handhole setting

10.0.1 The specifications and patterns of manhole or handhole shall comply with the provisions of the "Drawing Gallery of Manhole and Handhole for Communication Conduit Engineering" YD/T5178. For non-standard manhole or handhole, the design standards for load and strength shall conform to the relevant national standards and regulations.

10.0.2 The location of the manhole or handhole shall be in compliance with the following requirements:

1 manhole or handhole positions shall be set at the branching points of optical(electric) cables, the connection points of the raised optical(electric) cables, the bends of pipelines with steep slopes, road intersections, or next to buildings where underground cable lines are planned to be introduced.

2 The location of manhole or handhole at intersections should be at the sidewalk or in a green area.

3 The location of manhole or handhole shall be at a distance from other adjacent pipelines and pipe wells and shall be staggered from each other.

4 manhole or handhole positions should not be set at the entrances and exits of buildings, goods yards, low-lying areas prone to water accumulation, or areas with unstable foundations.

5 When communication conduits cross railroad tracks and wider roads, manholes or handholes shall be installed on both sides.

10.0.3 The manhole or handhole type shall be based on the size of the final pipe hole capacity. The manhole or handhole type may be selected in accordance with Table 10.0.3.

Table 10.0.3 Comparison table of commonly used pipe capacity and standard manhole or handhole model selection

Type of Manhole or handhole		Pipe Capacity (single direction, standard hole size 90mm)	note
manhole	550mm×550mm	Less than 3 holes	1.Located next to the riser pipe on the non-motorized lane. 2.Multi-hole pipe with a hole diameter of 28mm or 32mm, with 9 holes or fewer.
	700mm×900mm		In front of the building
	900mm×1200mm	More than 3 holes	1.Bidirectional or the angle between the centerlines of the pipes is less than or equal to 30 degrees. 2.Multi-hole pipe with a hole diameter of 28mm or 32mm, with more than 9 holes.
	1000mm×1500mm	Less than 6 holes	1.Multi-directional or the angle between the pipeline centerlines is greater than 30°. 2.Multi-hole pipe with a hole diameter of 28mm or 32mm, with fewer than 18 holes.
	1200mm×1700mm		
handhole	small size	More than 6 holes Less than 12 holes	Multi-hole pipe with a hole diameter of 28mm or 32mm, with more than 18 holes and up to 36 holes.
	medium sized	More than 12 holes Less than 24 holes	Multi-hole pipe with a hole diameter of 28mm or 32mm, with more than 36 holes and up to 72 holes.
	large size	More than 24 holes Less than 48 holes	Multi-hole pipe with a hole diameter of 28mm or 32mm, with more than 72 holes and up to 144 holes.

Note: The term "below" includes the base number itself, while "above" does not include the base number itself.

10.0.4 The type of manhole or handhole may be in accordance with those specified in Table 10.0.4.

Table 10.0.4 Table of manhole or handhole types

Type		Pipe centerline intersection angle	Note
Straight-Through		<7.5°	Suitable for manholes or handholes set in the middle of the straight communication conduits.
Tilt-Through	15°	7.5°~22.5°	Suitable for manholes set on non-linear folding points
	30°	22.5°~37.5°	
	45°	37.5°~52.5°	
	60°	52.5°~67.5°	
	75°	67.5°~82.5°	
3-way type		>82.5°	It is applicable to the manhole or the manhole in front of the bureau set up at the point of divergence on the straight communication conduits with diverging communication conduits in the other direction.
4-way type			Suitable for manholes set up at the intersection of vertical and horizontal communication conduits, or manholes in front of the bureau.
foreground manhole			Suitable for manholes in front of the bureau
manhole			Suitable for optical fiber cable line small capacity plastic pipe, branch lead-in pipe, etc.

10.0.5 For areas with a high groundwater level, the construction of manhole or handhole should be treated for waterproofing.

10.0.6 manhole or handhole shall be built on a concrete foundation. When encountering soft soil or a high water table, an additional layer of crushed stone should be added beneath the foundation, and reinforced concrete shall be used for the foundation.

10.0.7 Depending on the conditions of the groundwater level, the construction specifications for manhole or handhole may be determined according to the provisions of Table 10.0.7.

Table 10.0.7 Man (hand) hole construction program table

Groundwater situation	building program
manhole or handhole is located above the water table	Brick manhole or handhole, etc.
Located below the water table and below the soil freezing layer	Brick manhole or handhole, etc. (plus waterproofing)
Located below the water table and within the soil freezing layer	Reinforced concrete manhole or handhole, etc. (plus waterproofing)

10.0.8 manhole or handhole covers shall have measures for anti-theft, anti-slip, fall prevention, displacement prevention, and noise reduction. The cover shall have clear markings indicating its purpose and ownership.

11 Optical(electric) cable

11.0.1 optical(electric) cable passages may be considered for construction in the following situations:

- 1 For the outgoing (station) sections of newly built large-capacity communication bureaus (stations).
- 2 Where communication conduits cross through major urban streets, highways, railways, and other areas that will not be easily expanded in the future, and where the pipeline capacity is large.
- 3 Other road sections where the construction of optical(electric) cable passages is necessary.

11.0.2 The size and burial depth of the optical(electric) cable passages shall be in accordance with the following requirements:

- 1 The width should be between 1.4m and 1.6m, and the clear height should not be less than 1.8m.
- 2 The burial depth (from the top of the passages to the road surface) should not be less than 0.3m.

11.0.3 The optical(electric) cable passages may be built on a good foundation, and concrete or reinforced concrete foundations may be used according to soil conditions.

11.0.4 The construction of optical(electric) cable passages shall include effective measures for drainage, lighting, ventilation, and prevention of water seepage.

12 Inlet chamber of optical(electric) cable

12.0.1 A dedicated optical(electric) cable entry room shall be set up in the communication bureau.

12.0.2 The design of the optical(electric) cable entry room shall conform to the following principles:

- 1 The location of the entry room within the building shall facilitate the entry of optical(electric) cables into the bureau (station), with at least two cable entries from different directions.
- 2 The size of the entry room shall be designed according to the capacity of ultimate bureau (station), and the size of the entry pipeline capacity or passage shall also be designed according to the ultimate capacity of the bureau (station).
- 3 The architectural style of the entry room within the building shall preferably adopt a semi-underground construction method.
- 4 The entry room should be arranged close to the external wall.
- 5 The clear height and area of the entry room shall meet the requirements of capacity and process.
- 6 The layout of the entry room shall facilitate construction and maintenance, with convenient cable entries from all directions, and meet the technical requirements for the bending radius of optical(electric) cables.

12.0.3 The construction of the optical(electric) cable entry room shall be in accordance with the following requirements:

- 1 The entry room should not have protruding beams and columns.
- 2 When gas pipeline is prohibited from passing within the feeder room, no other pipelines should pass through. When there is a heating pipe passing through the entry room, protective measures should be taken to ensure that it does not affect the layout and deployment of optical(electric) cables. The entry room shall not be used as a passage to other basements.
- 3 When the entry pipeline penetrates the load-bearing wall of the building, it must be separated from the building structure, and the pipeline shall not bear the pressure of the load-bearing wall.
- 4 The structural design of the entry room shall be waterproof and should not leak. Effective blocking measures shall be taken for all idle pipe holes and pipe holes where optical(electric) cables have been put through at the entrance of the pipeline into the bureau (station). A flood barrier wall or sump shall be set up near the entry pipeline opening inside the entry room, and the entry room shall be equipped with facilities for pumping and draining water.

5 The entry room shall have fire-resistant properties. Fire-resistant steel doors shall be used, with the door opening outward, and the width should not be less than 1000mm.

6 The entry room shall be equipped with cable trays or cable holes (slots).

7 The positions of the reserved holes and slots in the entry room shall be accurate. The walls and ceiling shall be smoothly plastered, and the floor surface shall be leveled.

8 The entry room shall be equipped with ventilation facilities to prevent harmful gases, with an exhaust volume calculated at not less than five times the volume per hour.

12.0.4 There shall be lighting in the entry room. In addition to the general AC lighting and emergency lighting system, explosion-proof and moisture-proof measures shall be taken for the lamps. The two types of AC lighting lamps shall be arranged alternately. Moisture-proof power sockets shall be installed, with the sockets more than 1400mm above the ground. All lamp wires, switches, and sockets shall be wired internally. All lighting switches shall be located at the entrance of the entry room.

12.0.5 A grounding wire shall be installed in the entry room.

Explanation of Wording in this standard

1. Words used for different degrees of strictness are explained as follows in order to mark the differences in executing the requirements in this code.

1) Words denoting a very strict or mandatory requirement:

“Must” is used for affirmation; “must not” for negation.

2) Words denoting a strict requirement under normal conditions:

“Shall” is used for affirmation; “shall not” for negation.

3) Words denoting a permission of a slight choice or an indication of the most suitable choice when conditions permit:

“Should” is used for affirmation; “should not” for negation.

4) “May” is used to express the option available, sometimes with the conditional permit.

2. “Shall comply with...” or “Shall meet the requirements of...” is used in this code to indicate that it is necessary to comply with the requirements stipulated in other relative standards and codes.

Index of quoted standards

1. "Transect Drawing Gallery of Communication Conduit"YD 5162
2. "Drawing Gallery of Manhole and Handhole for Communication Conduit Engineering"YD/T5178

National Standard of the People's Republic of China

Design standard for communication conduit and passage engineering

GB 50373 – 2019

Explanation of provisions

Contents

1	General provisions	1
3	Basic requirements	2
4	Routing and location determination of communication conduit and passage	3
5	Capacity determination of communication conduit	4
6	Pipe selection	9
7	Buried depth of communication conduit	19
8	Bending and segment length of communication conduit	21
9	Laying of communication conduit	24
10	Manhole or handhole setting	26
11	Optical(electric) cable	27
12	Inlet chamber of Optical(electric) cable	28

1 General provisions

1.0.1 The communication conduit and passage referred to in this specification include main trunk pipeline, branch pipeline, customer premises network pipeline, and high-grade highway communication conduit and passage among others. They are part of the urban integrated pipeline network. During planning and construction, they should be consistent with the urban planning and coordinate well with other urban engineering pipelines.

1.0.3 Under normal circumstances, due to the longer construction period of pipelines and the multitude of factors that could affect construction, considering the needs of various telecommunication business operators, the capacity of pipes for communication conduits is usually considered for 5 to 10 years of construction needs.

3 Basic requirements

3.0.1 The construction of communication conduit and passage requires the excavation of tunnels. Planning and incorporating the overall plan of communication conduit and passage into the urban construction plan in advance, based on the urban development plan, could prevent damage to established roads, reduce construction difficulty, and save construction costs. This is beneficial for safe production, energy saving, emission reduction, and environmental protection.

3.0.3 The overall planning of communication conduit and passage should be proposed by the telecommunication business operators according to their development needs. This includes the planning and construction plan for the main trunk pipeline, branch pipeline, customer premises network pipeline and high-grade highway pipeline. The reference model for the communication pipeline network is shown in Figure 1

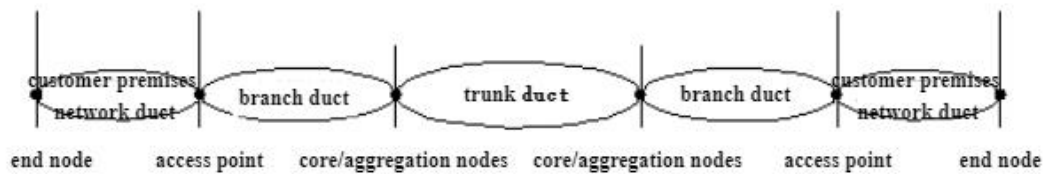


Figure 1 Reference model of the communication conduit network

3.0.4 Constructing communication conduit and passage in synchronization with building construction could prevent damage to the buildings, their foundations, and the surrounding road surfaces. It could reduce the difficulty of constructing communication conduit and passage save on construction costs, and is beneficial for safe production, energy saving, emission reduction, and environmental protection.

3.0.5 Synchronizing the construction of communication conduit or reserving the location for communication conduit with the construction of urban bridges, tunnels, and high-grade highways could prevent damage to the structural and foundational integrity of the buildings during later stages of communication conduit construction. It could reduce the difficulty of constructing communication conduit, save on construction costs, and is beneficial for safe production, energy saving, emission reduction, and environmental protection.

3.0.8 To save on investment and avoid repeated excavation, it is advisable to implement the construction of communication conduit and passage in conjunction with municipal construction.

4 Routing and location determination of communication conduit and passage

4.0.1 To protect the safety of individuals and the security of communication property, and to ensure safe production, the routing of communication conduit and passage must be kept away from areas with harmful substances and zones of chemical corrosion.

When planning and selecting the route and position for plastic communication conduit, the following characteristics should also be considered:

- 1 Plastic pipes have good waterproof and corrosion-resistant properties, and a low coefficient of friction.
- 2 Plastic pipes have relatively poor resistance to high temperatures.
- 3 Compared to concrete pipes, plastic pipelines occupy a smaller cross-sectional area of the road.
- 4 Plastic pipes are flexible and easy to install, especially in areas with many road obstructions.

4.0.4 The minimum distance between communication conduit and passage among other underground pipelines and structures is essential to protect personal safety, property safety, and to ensure safe production.

5 Determination of communication conduits' capacity

5.0.1 Due to the different nature of business of each user unit, the size of pipe holes used is also different. This article is in accordance with the operational needs, put forward in various cases of pipe hole requirements, the body of the table 5.0.1 pipe capacity is based on the standard hole diameter of 90mm considerations, in the construction or use, according to the use of the unit to make appropriate adjustments. Pipe holes should be used reasonably to avoid laying a large number of small-core optical fiber cable and small-pair cables occupying a standard pipe, resulting in a lower utilization rate of the pipe. Pipe capacity is calculated according to the algorithm in Table 2.

Table 2 Pipe Capacity Calculation Table

1,Calculation of Fixed Network Capacity								
(1) Calculation of Pipe Capacity for Public Users	Premises End Users (Households)	Total Number of optical cable in the Exiting Cable (Strands)	Average optical fiber cable Capacity per Hole (Strands)		Pipe Capacity (Holes)	Number of Exit Pipe Locations (Locations)	Average Capacity per Exit Pipe Location (Holes)	Note
			Less than 30,000 households	More than 30,000 households				
	A	B	C	C	D1	E	F	In the table, B=A×1.2, where 1.2 represents the optical fiber cable redundancy;D1=B÷C÷ (32 or 64) ÷80%×2, where the numbers in parentheses, 32 or 64, represent the splitting ratio (currently, optical splitters are generally used in ratios such as 1:16, 1:32, 1:64, etc., depending on the coverage radius of the office, and the proportion occupied by each type of splitter is also different. For calculation convenience, it is recommended to use a 1:32 splitting ratio for the calculation), 80% represents the utilization rate, and 2 represents the optical cable ring structure (for small offices, a 1 for a chain structure may also be considered), it is suggested to consider each to account for half when calculating. E: The number of exit locations is calculated based on the office capacity as either 2 or 4 locations.
	B=A×1.2	36--72	144—288	D1=B÷C÷ (32 or 64) ÷80%×2	F=D/E			
Note: Determination of the capacity for each exit pipe hole: Once the capacity for each pipe hole is essentially determined, for premises with fewer than 30,000 households, the capacity should be rounded up to the next multiple of six; for premises with more than 30,000 households, the capacity should be rounded up to the next multiple of twelve. The pipe holes are calculated based on standard hole sizes.								
(2) Dedicated Line Customers' Demand for Backbone Fiber Optics and Pipe Calculation	Dedicated Line Customers	area covered	Physical Address	Number of optical cable per Physical Address	Pipe Capacity (Holes)			
	Calculated at 10%-15% of Public Users	S=πr ²	M	C=S×M	D2=C/72			1.For commercial buildings over 30,000 square meters, 144-strand optical fiber cable are required; for those between 10,000 and 30,000 square meters, 72-strand optical fiber cable are required; and for those under 10,000 square meters, 48-strand optical fiber cable are required. Considering all factors, a 72-strand cable is used for calculation. 2.r represents the coverage radius, and M represents the number of dedicated line customers per square kilometer.
2,Calculation of Wireless Network Capacity	Number of Base Stations per Square Kilometer	area covered	Number of optical fiber cable Cores per Base Station	Number of optical fiber cable	Pipe Capacity (Holes)			
	N	S=πr ²	24	B2=S×N×24/72	D3=B2/3			The layout of base stations should be calculated according to the specific situations of urban and rural distributions in various provinces and cities. Optical cable rings are typically capable of connecting to 6-8 base stations. For developed areas

								with a concentrated density of base stations, it is suggested to consider a figure of 6, while in general, 3 is taken into account.
3,Calculation of Repeater Cable Pipe Capacity	Number of core or aggregation nodes	Enlarge ment factor	The direction of connection between core nodes and aggregation nodes, or between end offices and end offices (M)	Number of repeater optical fiber cable	Pipe Capacity (Holes)			
	n	1.2	M=3	$Bn=[n*(n-1)/2+(M)]*1.2$	$D4=Bn/3$			
4,Rented Pipe	Number of Rented Pipe				Pipe Capacity (Holes)			
	CZ=2-3holes				$D5=CZ$			
5,Regulations on Pipe Redundancy	Pipeline redundancy				Pipe Capacity (Holes)			
	20%				$D6=D1+D2+D3+D4+D5)*20\%$			
5,Total Capacity of Exit Pipe					$D=D1+D2+D3+D4+D5+D6$			

1 The following basic conditions must be met when calculating the capacity of pipes:

1) The positioning of the communication bureau (station) within the communication network has been clearly defined, that is, whether it is a core layer, aggregation layer, or access layer in the network.

2) The ultimate equipment capacity of the communication bureau (station) has been established, including public users and major customers, etc.

3) The coverage radius or area of the communication bureau (station) has been determined.

4) The geographical location of the communication bureau (station) within the city has been identified, whether it is a bustling commercial area or a general area.

5) The calculation is based on the main telecommunication business operators in the local area.

2 The capacity of the outgoing pipe of the communication bureau (station) is calculated according to the following algorithm:

1) According to the requirements of communication security, the public user's exit must be in at least 2 different directions.

2) The demand for backbone optical fiber for private line customers and others is considered in terms of the coexistence of optical fiber direct drive and transmission system bearer, and is calculated on the basis of half for each of the two. Business buildings should be calculated according to the actual situation in different areas.

3) The wireless network mainly considers the demand for backbone optical fiber from base stations and room division and WLAN. Base station demand for backbone optical fiber according to the base station in each city distribution of the specific situation, dense urban areas per square kilometer calculated according to 7.0 base stations, general urban areas and developed areas of the county per square kilometer calculated according to 3 base stations, the county general areas per square kilometer calculated according to 2 base stations; according to the coverage area of the telecommunication bureau (station) to calculate the number of base stations and optical cable fiber core demand. Room division, WLAN demand for backbone optical fiber in the large customer point-to-point dedicated line, PON dedicated line, etc. 72-core optical cable has been included, no longer calculated separately.

4) After the capacity of the outgoing pipes has been determined, they should be comprehensively arranged according to the road conditions in the area where the communication bureau (station) is located, taking into account the situation of the optical fiber cable across different regions. The number of pipes should be increased, but it should not exceed more than 6 pipes.

5) The calculation should be based on the positioning of the communication bureau (station) within the network (including all or part of the above 6 pipes).

3 The capacity of pipe holes for municipal roads is calculated as follows:

1) According to the nature of municipal roads, to determine whether it is a trunk road or secondary roads, the general trunk road is also a telecommunication trunk pipeline road by.

2) Consider the geographical location of the municipal road in relation to the adjacent communication bureau (station) based on the outgoing pipeline hole capacity.

3) Based on the requirements of co-construction and sharing, each telecommunication service operator reports and summarizes the information according to their respective needs.

6 Pipe material selection

6.0.1 Currently, the common materials used for communication conduit mainly include:

polyethylene pipes, Unplasticized Polyvinyl Chloride pipes, and concrete pipe blocks. In some road crossing areas and special sections, steel pipes are used.

6.0.2 The technology for plastic pipes has matured, and with reasonable pricing, plastic pipelines have been widely used in the construction of communication conduit. There are two main types of plastic pipes used for communication: Unplasticized Polyvinyl Chloride and Polyethylene. In cold regions and other special environments, High-Density Polyethylene pipes are recommended.

1 Unplasticized PolyVinyl Chloride pipes (PVC—U)

Polyvinyl chloride resin as the main raw material, adding the necessary additives, made by extrusion molding process of the inside and outside walls of the smooth, flat plastic pipe.

2 Unplasticized PolyVinyl chlorides (PVC-U) double wall corrugated pipe

Polyvinyl chloride resin as the main raw material, add the necessary additives, the two-layer composite co-extrusion molding process made of pipe wall cross-section for the double-layer structure, the inner wall is smooth and flat, the outer wall is the same distance from the arrangement of trapezoidal or curved corrugated hollow structural ribs of the plastic pipe.

3 PolyEthylene double wall corrugated pipes (PE)

Polyethylene resin as the main raw material, add the necessary additives, the two-layer composite co-extrusion molding process made of pipe wall cross-section for the double-layer structure, the inner wall is smooth and flat, the outer wall is the same distance from the arrangement of the trapezoidal or curved corrugated hollow structural ribs of the plastic pipe.

4 PolyEhylene pipes (PE)

Polyethylene resin as the main raw material, add the necessary additives, made by extrusion molding process of the inner and outer walls of the smooth, flat plastic pipe.

5 High Density PolyEthylene silicon core pipes (HDPE)

High-density polyethylene resin as the main raw material, adding the necessary additives, by three plastic extruders synchronized extrusion molding process made of smooth inner and outer walls, flat plastic pipe, the core layer for the lowest coefficient of friction of the solid lubricant silicone gel.

Regarding plastic pipelines, the most used and standardized plastic pipes in the current project are divided into single-hole pipes and porous pipes, single-hole pipes have solid-wall pipes, corrugated pipes and silicone core pipes; porous pipes have plum blossom pipes, grid pipes (which could be produced according to the number of holes demanded by the users) and honeycomb pipes. Plastic pipes for communication are as follows.

1 Solid-wall pipe: Typical solid-wall pipe sizes are shown in Table 3 and Table 4.

Table 3 Typical Polyvinyl Chloride (PVC-U) Solid Wall Pipe Pipe Structural Size and Length (mm)

Nominal Outside Diameter DN/OD	mean outside diameter d_{em}		Wall thickness e_0			Length L	
	Nominal value	Allowable error	Ring stiffness		Allowabl e error	Nominal value	Allowable error
			SN6.3	SN8			
			Nominal value				
90	90	$+x^1$ 0	1.6	1.6	$+y^2$ 0	The length of hard straight pipe is generally 6000mm, could also be agreed by the supply and demand sides, the middle is not allowed to have a broken head	$+0.4\%$ 0
100	100		2.2	2.5			
110	110		2.6	3			

Note 1: Polyvinyl Chloride (PVC) pipes are only available as rigid straight pipes.

Note 2: Upon the user's request and after consultation with the manufacturer, products with specifications and dimensions other than those specified in this table could be produced.

Note a: The value of x should be less than or equal to the greater of the following two values:

1,0.3mm

2,0.003 d_e , with the calculated result rounded to the nearest 0.1mm, and if the second digit after the decimal point is greater than zero, one should be carried over.

Note b: The value of y is equal to 0.1 e_0 +0.2, with the calculated result rounded to the nearest 0.1mm, and if the second digit after the decimal point is greater than zero, one should be carried over.

Table 4 Typical Polyethylene (PE) Solid Wall Pipe Size and Length (mm)

Nominal Outside Diameter DN/OD	mean outside diameter d_{em}		Wall thickness e_0		Length L		
	nominal value	Allowable error	ring stiffness		Allowable error	nominal value	Allowable error
			SN6.3	SN8			
			nominal value				
90	90	$+x^1$ 0	2.8	3.5	$+y^2$ 0	The length of hard straight pipe is generally 6000mm; the length of flexible pipe is generally 500m, 300m, 200m, which could also be agreed upon above the supply and demand, and the middle part is not allowed to have a break.	$+0.4\%$ 0
100	100		3.8	4.2			
110	110		4.2	4.8			

Note 1: Normally, when the nominal outer diameter is less than or equal to 63mm, the pipe material could be used in a flexible manner.

Note 2: Upon the user's request and after consultation with the manufacturer, products with specifications and dimensions other than those specified in this table could be produced.

Note a: The value of x should be less than or equal to the greater of the following two values:

1,0.3mm

2,0.009 d_e , with the calculated result rounded to the nearest 0.1mm, and if the second digit after the decimal point is greater than zero, one should be carried over.

Note b: The value of y is equal to 0.1 e_0 +0.2, with the calculated result rounded to the nearest 0.1mm, and if the second digit after the decimal point is greater than zero, one should be carried over.

2 Corrugated pipes: The typical specifications and dimensions of double-wall corrugated pipes are provided in Table 5, and the minimum average inner diameter of the spigot should not be less than the maximum average outer diameter of the pipe material. The specifications and dimensions for single-wall corrugated pipes are not currently prescribed.

Table 5 Typical Double-Wall Bellows OD Series Pipe Size (mm)

Nominal Outside Diameter DN/OD	mean outside diameter d_{em}		Minimum average inner diameter $d_{im,min}$	Minimum laminated wall thickness e_{min}	Minimum inner wall thickness e_{imin}	Minimum joint length A_{min}
	nominal value	Allowable error				
100	100	+0.4 —0.6	86	1.0	0.8	30
110	110		90	1.0	0.8	32
125	125		105	1.1	1.0	35
Note: Upon the user's request and after consultation with the manufacturer, products with specifications and dimensions other than those specified in this table could be produced.						

3 Silicon core pipe: Silicon core pipe specifications and dimensional tolerances shall be in accordance with Table 6.

Table 6 Silicon Core Pipe Specifications and Dimensional Tolerances

Norm (DN)	Average Outer Diameter d_{em}/mm		Wall Thickness and Tolerance/mm		out-of-roundness/%	
	nominal value	Allowable error	nominal value	Allowable error	before winding	after winding
34/28	34	+0.3 0	3	+0.30 0	≤ 2	≤ 3
40/33	40	+0.4 0	3.5	+0.35 0	≤ 2.5	≤ 3.5
46/38	46	+0.4 0	4	+0.35 0	≤ 3	≤ 5
Note: The specification size and tolerance of the ribbed pipe are agreed by the supply and demand sides.						

Silicon-core plastic pipes, which have a silicon core layer on the inner wall to serve as a lubricant, feature a low coefficient of friction and are widely used as protective tubes for optical fiber cable. The outer diameter of silicon-core pipes ranges from 32mm to 60mm, and each pipe could be as long as 2000 meters.

4 Plummer Tube: Typical Plummer Tube specifications and dimensions are shown in Table 7.

Table 7 Typical Plummer Tube Size Dimensions (mm)

Effective number of holes	Bore size (B)	Allowable error	Minimum inner wall thickness	Minimum outer wall thickness	Lengths (L)
			($e_{i,min}$)	($e_{e,min}$)	
five-hole	24 (26)	± 0.5	1.6	1.8	6000
Four-hole, five-hole	28	± 0.5	1.8	2	6000

Four-hole, five-hole, seven-hole	32	±0.5	2	2.2	6000
Note 1: The deviation of inner and outer wall thickness is 0~+0.4mm; Note 2: The allowable deviation of length is 0~+0.3mm, and the delivery length could also be agreed between the manufacturer and the user; Note 3: The size outside the parentheses in the inner hole size is the recommended size, and the size inside the parentheses is the optional size; Note 4: When requested by the user and negotiated with the manufacturer, products with specifications and sizes other than those specified in this table could be produced;					

5 Grid Pipe: Typical Grid Pipe (PVC-U) See Table 8 for models and sizes.

Table 8 Grate Pipe (PVC-U) Model and Size (mm)

Model	Hole Size d	Inner wall thickness C ₂	Outer wall thickness C ₁	heightL 1	high degree L ₂
SVSY32×4	32	≥2.2	≥2.8	≤110	≤110
SVSY50（48）×4	50（48）	≥2.6	≥3.2		
SVSY28×6	28	≥1.6	≥2.2		
SVSY33（32）×6	33（32）	≥1.8	≥2.2		
SVSY28×9	28	≥1.6	≥2.2		
SVSY33（32）×9	33（32）	≥1.8	≥2.2		
Note: The bore size of the grid pipe is the diameter of the inner tangent circle of the square.					

6 Cellular Pipe: Typical cellular pipe (PVC-U) models and sizes are shown in Table 9

Table 9 Cellular Tube Types and Dimensions (mm)

Model	Minimum Inner Diameter d	Inner wall thickness C ₂	Outer wall thickness C ₁	Height L ₁	high degree L ₂
SVSY28×5	28	≥1.8	≥2.3	≤110	≤110
SVSY33（32） ×5	33（32）				
SVSY28×7	27.5				
SVSY33（32） ×7	33（32）				
Note: The bore size of the honeycomb tube is the diameter of the internal tangent circle of the square hexagon.					

In addition to the plastic pipes mentioned above, there are also types such as bundled tubes currently used in engineering. Since there are no national product standards for this type of plastic pipe at present, they are not included in this specification for the time being. However, they could be tried out in engineering projects.

7 The typical shapes of solid wall pipes, corrugated pipes, silicon-core pipes, plum blossom pipes, grid pipes, and honeycomb pipes are illustrated in Figures 2 to 8.

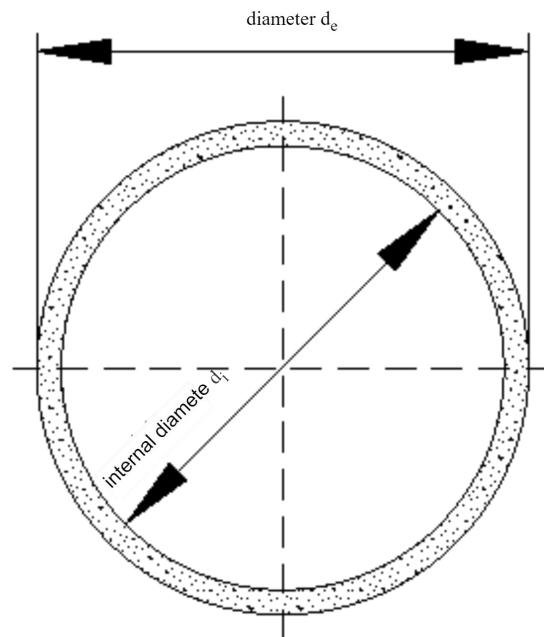


Figure 2: Schematic Diagram of a Typical Solid Wall Pipe Cross-Sectional Structure

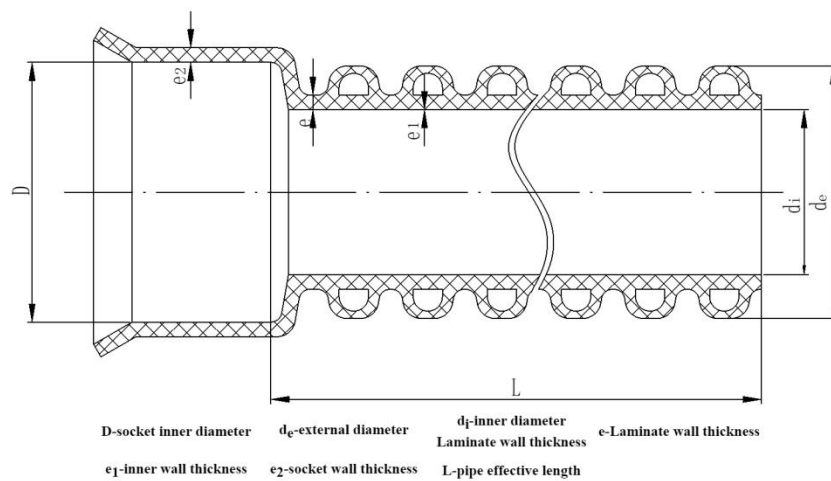


Figure 3: Schematic Diagram of the Shape of a Double-Wall Corrugated Pipe (with Bell Mouth)

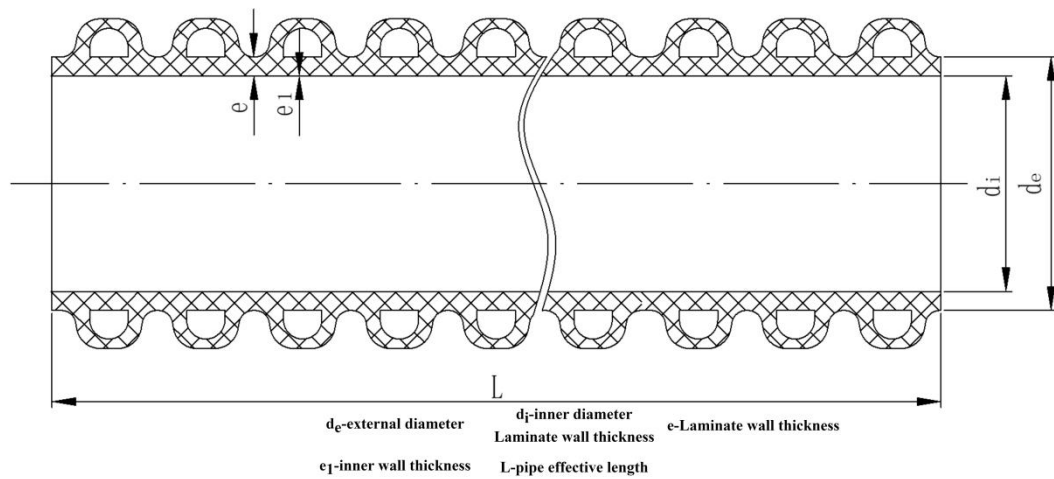


Figure 4: Schematic Diagram of the Shape of a Double-Wall Corrugated Pipe (without Bell Mouth)

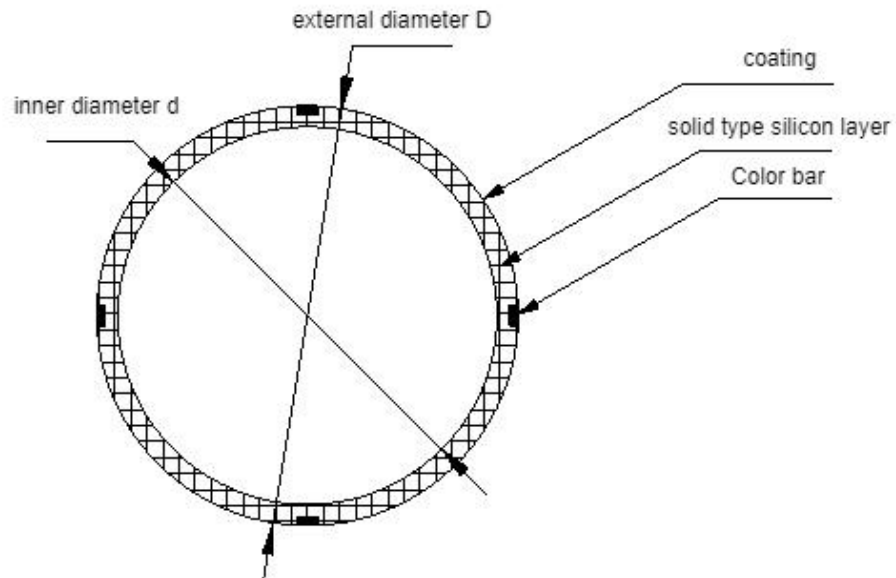


Figure 5: Schematic Diagram of the Cross-Sectional Structure of a Silica Core Pipe

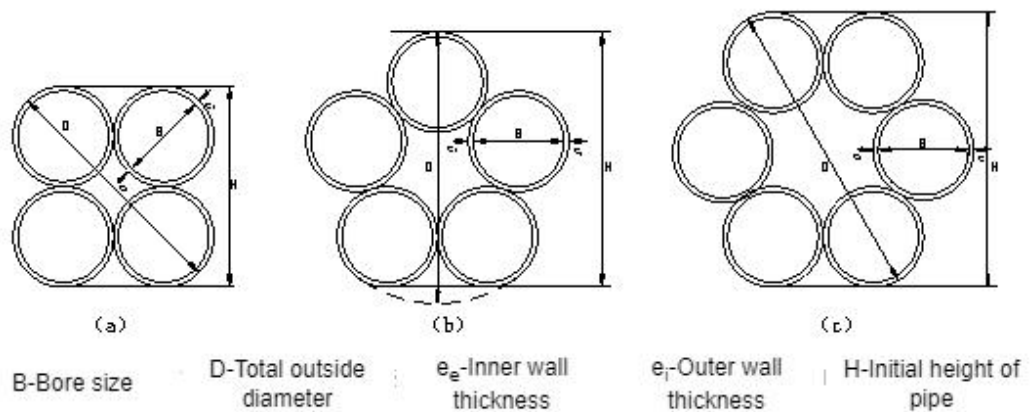


Figure 6: Schematic Diagram of the Cross-Sectional Structure of a Typical Plenum Pipe

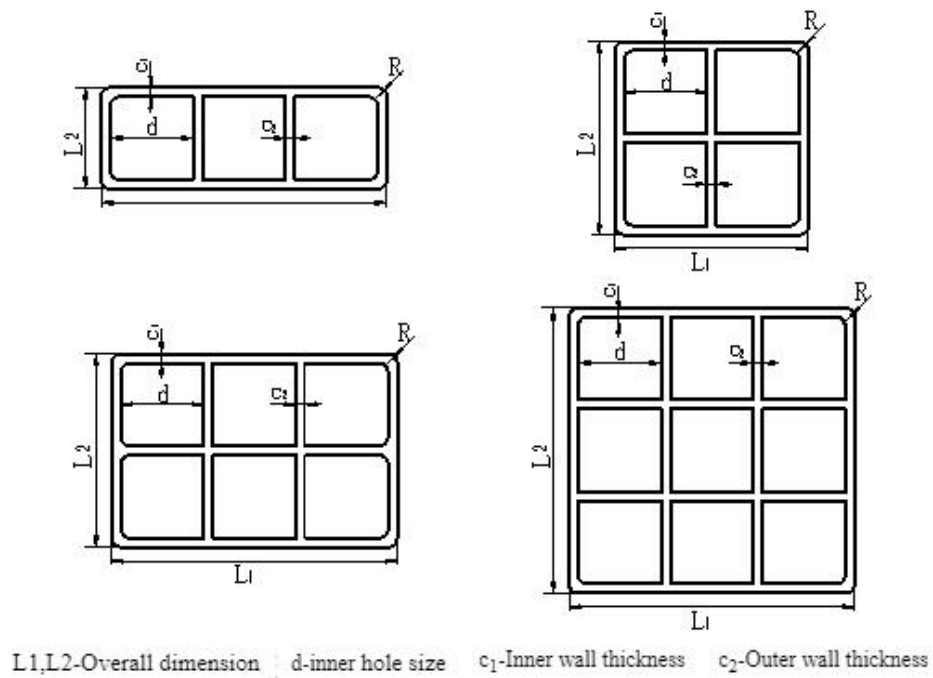


Figure 7: Cross-Sectional View of a Lattice-Pattern Plastic Pipe

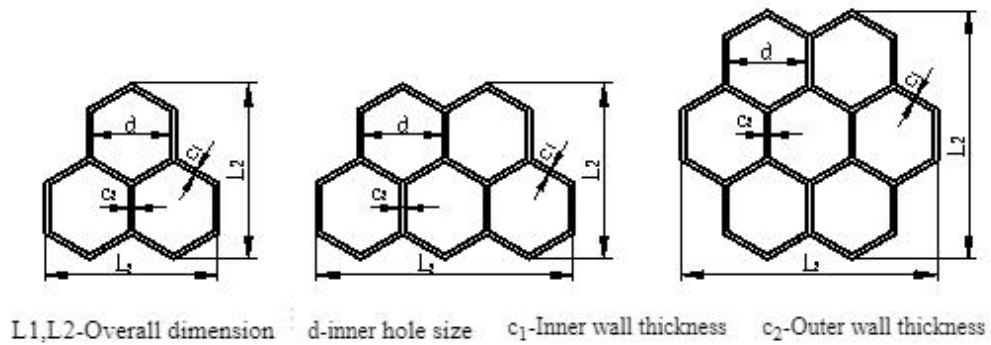


Figure 8 Cross-Sectional View of a Lattice-Pattern Plastic Pipe

6.0.3 Cement pipe blocks come in 3-hole, 4-hole, and 6-hole configurations. In actual pipeline construction projects, it is recommended to use a group of 6-hole unit cement pipe blocks. The form of the cement pipe blocks is shown in Figure 9.

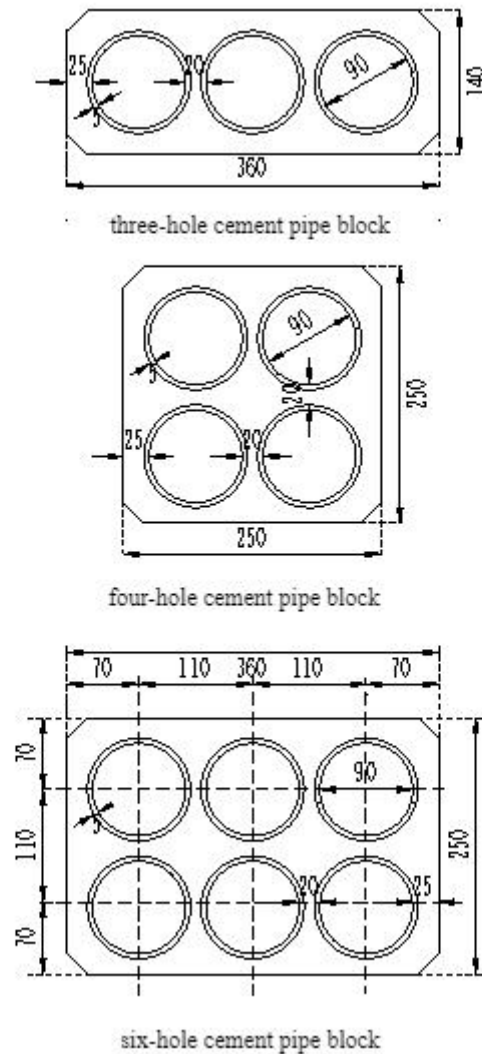


Figure 9: Form of Cement Pipe Blocks (Unit: mm)

6.0.5 Horizontal directional drilling method of construction of the pipe is usually selected plastic pipe. For the horizontal directional drilling construction using mud reaming pullback method of pipe, its wall thickness according to the depth of burial, pullback length and soil conditions, etc. to determine.

When installing polyethylene pipes (PE, HDPE) using the horizontal directional drilling (HDD) method, the main design criteria should meet the flow requirements under a given pressure condition and the total stress caused by the loads (friction, bending stress, buoyancy, hydrodynamic force, tensile stress, etc.) during the laying process, as well as the requirements for the pullback force. It is recommended that the D/T (diameter-to-thickness) ratio of the pipe be less than or equal to 11.

Regarding the selection of pipe materials, it is suggested to preferentially choose plastic pipes.

7 Buried depth of communication conduit

7.0.1 The minimum depth requirements for communication conduit burial as shown in Table 7.0.1 are determined considering the load on the pipeline and economic factors. To enhance the safety and reliability of the pipeline and to prevent damage to communication conduit from mechanized operations during urban road and related professional construction, the burial depth should be increased based on the combination of the pipe group in actual pipeline design.

7.0.2 When there is a conflict between the burial depths of communication conduit and other pipelines, and it is difficult to relocate, it is possible to consider reducing the height of the pipeline section (such as changing from vertical to horizontal placement), or changing the burial depth of the pipeline. If necessary, the burial depth requirements could be increased or decreased, but corresponding protective measures must be taken (such as concrete encapsulation, adding concrete cover plates, etc.), and the distance from the top of the pipeline to the road surface must not be less than 0.5 meters.

7.0.3 Special design considerations for insufficient pipeline burial depth:

- 1 The pipeline design may take into account the possibility of changes in road surface elevation due to road reconstruction, without affecting the minimum burial depth requirements of the pipeline. In addition, the manhole depth of burial is adjusted, generally by adding padded brick masonry to the lower portion of the manhole orifice to accommodate changes in pavement elevation.

- 2 Pipelines should, as much as possible, avoid being laid in the frozen ground layer and soil layers where heave may occur. In areas with high groundwater levels, it is advisable to bury them shallower.

7.0.4 There are two general methods of setting pipeline slopes in order to provide a reasonable depth of burial: a single slope and inverted V slope.

The method of a single slope, as illustrated in Figure 10, involves laying the pipeline between adjacent manhole or handhole at a certain gradient in a straight line. This method is relatively simple to construct and results in less wear on the optical(electric) cables. However, it requires a

deeper burial at one end, which leads to a larger volume of earthwork. When the length of the section is short and the impact of obstacles is minimal, the single slope method could be used for the convenience of construction.

The method of an inverted V slope, as shown in Figure 11, involves laying the pipeline with a certain gradient from the midpoint, which serves as the apex, towards both ends. This method results in a more shallow average burial depth, but it is prone to causing damage to the optical(electric) cables at the bend points. The gap at the joint of the concrete pipeline at the bend point should not exceed 5mm to prevent such damage. The inverted V slope method could be used when there are difficulties in the pipeline crossing obstacles or when the pipeline entering a manhole or handhole is too close to the covering layer.

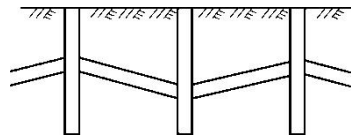


Figure 10: Pipeline of the single slope

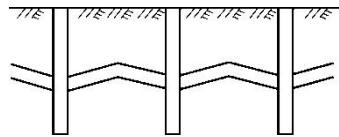


Figure 11: Pipeline of the inverted V slope

8 Bending and segment length of communication conduit

8.0.1 The maximum section length of a straight line pipeline may be calculated by the following formula:

$$L = \frac{T}{Wf} \quad (1)$$

Where: L—maximum segment length (m)

T—Maximum tension that a fiber optical(electric) cable could withstand when dragged into a straight pipeline (N)

W—Self-weight per unit of fiber optical(electric) cable (N/m)

f—Friction coefficient of the fiber optical(electric) cable against the wall of the pipeline.

f values vary from pipeline to pipeline, as shown in Table 10.

Table 10 Table of friction coefficient numbers of various pipe materials for communication conduit

Pipe Type	coefficient of friction f	
	Without lubricant	With lubricant
plastic pipe	0.29-0.33	-
steel pipe	0.6-0.7	0.5
cement pipe	0.8	0.6

The maximum section length of the cement pipeline does not exceed 150m , which is considered according to the laying of HYA1200-0.4.

8.0.2 to 8.0.3 Bend Pipe Section Length and Radius of Curvature.

1 Bend pipeline Section Length.

The length of the bend pipeline section should be less than the maximum allowable length of the straight pipeline to ensure that the tension experienced by the optical(electric) cable within the bend pipeline does not exceed the tension it would experience within the maximum allowable length of the straight pipeline. Plastic bending pipelines form a natural curvature under external force, non-heated bending.

The tension experienced by the optical(electric) cable when laid in the bend pipeline could be calculated using the following formula.

The situation shown in Figure 8.0.2-1, where the optical(electric) cable is pulled from the left end to the right end, is as follows:

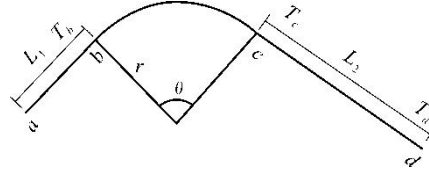


Figure 8.0.2-1: Tension Conditions of optical(electric) cables

$$T_b = w f L_1 \quad (2)$$

$$T_c = W \cdot r \{ \sinh[f\theta + \operatorname{arcsinh} T_b / (W \cdot r)] \} \quad (3)$$

$$T_d = T_c + w f L_2 \quad (4)$$

In the formula: T_b, T_c, T_d represent the laying tension (in Newtons, N) of the cable at points b, c, and d, respectively

θ is the central angle of the bend pipeline (in radians);

r is the radius of curvature of the bend pipeline (in meters).

When L_1 and L_2 do not match, due to the different directions in which the optical(electric) cable is pulled, the tension experienced by the cable will also differ. The larger of the two should be selected as the basis for calculation.

2 Bend Pipe Radius of Curvature.

The minimum radius of curvature for a bend pipelines made of concrete is primarily determined by the allowable conditions for pipe jointing, and the allowable radius of curvature varies for concrete pipelines with different bottom widths. Practical construction experience has shown that a minimum radius of curvature of not less than 36 meters for bend pipes made of concrete could accommodate different bottom widths of pipes. The coefficient of friction for plastic pipelines is smaller than that for concrete pipelines, and each section of the pipeline is much longer than that of a concrete pipeline, making jointing easier. Therefore, the radius of curvature for bend pipelines made of plastic could be smaller than that for bend pipelines made of concrete.

Based on the experience of constructing plastic pipelines in China, a minimum radius of curvature of not less than 10 meters for bend pipes made of plastic could meet the construction requirements for plastic bend pipes.

8.0.4 The curvature radius of the drill rod should be determined by the bending strength value of the drill rod. According to practical engineering experience, under normal circumstances, the bending radius of the drill rod should be more than 1200 times the diameter (D) of the drill rod's outer diameter.

9 Laying of communication conduit

9.0.1 Pipeline Foundation and Subgrade

1 Pipeline foundations are divided into two types: natural foundations and artificial foundations. Natural foundations without artificial reinforcement of the foundation, artificial foundations in the unstable soil after artificial reinforcement. Artificial foundations are generally reinforced in the following ways.

- 1) Surface Compaction: Suitable for subgrades of clay, sandy soil, large-pore soil, and backfilled soil.
- 2) Gravel Reinforcement: When the soil quality is poor or the foundation is below the water table.
- 3) Soil Replacement Method: When the soil bearing capacity is poor, it is advisable to excavate the original soil and replace it with lime soil or good soil.
- 4) Pile Reinforcement: In areas with soft backfilled soil, quicksand, silt, or level II large-pore soil, pile foundation reinforcement is used to enhance the load-bearing capacity of the subgrade.

2 The foundation of the pipeline: The foundation is the intermediary structure between the pipeline and the subgrade, which supports the pipeline and evenly distributes the load of the pipeline to the subgrade. There are concrete foundations and reinforced concrete foundations. Generally, concrete foundations could be used for ordinary soil, but the following areas should use reinforced concrete foundations:

- 1) When the foundation is below the water table and within the frost line.
- 2) Very soft backfilled soil.
- 3) Silt and quicksand.
- 4) Level II large-pore soil.

9.0.2 When laying plastic pipes, the combination of plastic pipe is arranged in the same way and cross-section as that of cement pipes. In order to ensure that the pipe are neatly arranged and evenly spaced, the plastic pipes are fixed every 3m or so with frames or spacing racks. For the safety of communication conduits, warning signs are added 300mm above the pipelines in the general zone. Warning signs are usually in the form of bands, bricks, cover plates and so on. Plastic pipe non-underground laying, generally refers to laying on bridges or pipe racks, etc.

9.0.4 Horizontal directional drilling construction directional drilling guide hole trajectory usually consists of oblique straight line section, curve section, horizontal straight line section and so on. Its design is based on the technical requirements of the production pipeline, construction site conditions, construction machinery and other comprehensive combination of trajectories.

10 Manhole or handhole setting

10.0.1 The size of manhole or handhole should be selected based on the final capacity of the pipe group. The selection of manhole or handhole could refer to "Drawing Gallery of Manhole and Handhole for Communication Conduit Engineering" YD/T5178, "Telecommunication Cable Tunnel Atlas" YD5063, and "Distributing Conduit Atlas for Telecommunication Cables" YD5062.

10.0.6 There are types of manholes such as brick masonry manholes and reinforced concrete manholes. Brick masonry manholes are simple to construct and could generally be used in most cases. Reinforced concrete manholes require the use of rebar and formwork, which leads to a longer construction period, but they have a higher strength than brick masonry manholes. In areas with high groundwater levels and severe soil freeze-thaw cycles, reinforced concrete manholes should be used.

10.0.8 The loss and damage of manhole or handhole covers are common issues in communication conduit. Various improvements and protective measures have been proposed to prevent the loss and damage of manhole or handhole covers, such as adding locks and using composite material covers as anti-theft measures. To facilitate gradual standardization, this specification suggests that manhole or handhole covers should have anti-theft, anti-slip, anti-fall, anti-displacement, and noise prevention facilities, and the cover should have clear markings indicating its use and ownership.

Regarding the materials for manhole or handhole covers, cast iron has traditionally been used. With the development of technology, new types of covers such as ductile iron and composite materials have emerged, and they have received positive evaluations in various regions where they are used.

11 Optical(electric) cable

11.0.1 optical(electric) cable passages could be applied to areas where the pipeline capacity is large and it is not easy to expand the pipeline in the future, such as the outgoing (station) section of a newly built large-capacity communication bureau (station).

11.0.2 This regulation is determined considering the correspondence to the current manhole size and the height requirements for human operation within the passage.

11.0.3 The optical(electric) cables in the passgae are centrally placed on the brackets on both sides, and the loads borne by the passage are mainly on both sides of the passage. In addition, because of the optical(electric) cable passage is long, the passage on both sides of the side to withstand the lateral pressure of the soil, so the foundation of the passage is not only high requirements, on both sides also have strict requirements. Optical(electric) cable passage foundation, side wall and overlay selection of material ingredients and dimensions need to be calculated according to the location of the passage soil, load bearing and other specific circumstances to determine.

11.0.4 The construction of the optical(electric) cable passage should have expansion joints to prevent uneven settlement of the foundation, which could cause cracks and lead to water leakage; there should be a sloped concrete wall in the shape of the Chinese character "eight" between the bottom slab and the side wall. The construction joint should be located at a position not less than 300mm above the bottom slab to prevent leakage.

12 Inlet chamber of Optical(electric) cable

12.0.2 Design considerations for optical(electric) cable entry rooms.

1 Determine the length, width and height of the optical(electric) cable feeder room according to the capacity of the final office (station) of the communication bureau (station), the arrangement of the final office (station) cables, the structure of the house and the requirements of the plane arrangement.

2 Determine the size of the incoming office (station) pipelines or passages required for the introduction of optical(electric) cables into the incoming room according to the capacity of the end office (station).