

MCMC MTSFB TC G025-2:2020

TECHNICAL CODE

BASIC CIVIL WORKS - PART 2: OPEN TRENCH

Developed by



Registered by



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Committee representation

This technical code was developed by the Fixed Network Facilities Sub Working Group under the Network and Broadcast Infrastructure and Facilities Working Group of the Malaysian Technical Standards Forum Bhd (MTSFB) which consists of representatives from the following organisations:

Core MTX Sdn Bhd

Digi Telecommunications Sdn Bhd

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Malaysian Digital Economy Corporation

Maxis Broadband Sdn Bhd

Redsun Engineering Sdn Bhd

Telekom Malaysia Berhad

TIME dotCom Berhad

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Foreword

This technical code for Basic Civil Works - Part 2: Open Trench (‘this Technical Code’) was developed pursuant to section 95 and section 185 of the Act 588 by the Malaysian Technical Standards Forum Bhd (MTSFB) via its Fixed Network Facilities Sub Working Group under the Network and Broadcast Infrastructure and Facilities Working Group.

The *Basic Civil Works* documents consist of the following parts:

Part 1: General Requirements

Part 2: Open Trench

Part 3: Micro Trench

Part 4: Horizontal Directional Drilling

These series of Technical Codes shall replace SKMM/G/01/09, *Guideline on the Provision of Basic Civil Works for Communications Infrastructure in New Development Areas*.

This Technical Code (Part 2: Open Trench) specifies the requirements for open trench works for the installation and maintenance of communications network facilities. This Technical Code shall be read together with MCMC MTSFB TC G025-1:2020 for common requirements.

This Technical Code shall continue to be valid and effective from the date of its registration until it is replaced or revoked.

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BASIC CIVIL WORKS - PART 2: OPEN TRENCH

1. Scope

This Technical Code specifies the requirements for open trench works for the installation and maintenance of communications network facilities which cover the following:

- a) planning for open trench works;
- b) technical specifications; and
- c) installation procedures.

2. Normative references

The following normative references are indispensable for the application of this Technical Code. For dated references, only the edition cited applies. For undated references, the latest edition of the normative references (including any amendments) applies.

MCMC MTSFB TC G025-1:2020, *Basic Civil Works: Part 1 - General requirements*

3. Abbreviations

GI	Galvanised Iron
HDPE	High-density polyethylene
NFP	Network Facilities Provider
PVC	Poly Vinyl Chloride
RSJ	Rolled Steel Joist
uPVC	unplasticised Poly Vinyl Chloride

4. Terms and definitions

The terms and definitions are as specified in MCMC MTSFB TC G025-1:2020.

5. Planning for open trench works

Planning of open trench works shall be done as described in MCMC MTSFB TC G025-1:2020.

In general, there are two types of open trench either with concrete encasement or without concrete encasement. The construction of trench work with concrete encasement is to provide extra protection to the cable and shall be able to reduce the risk of cable cut. Concrete encasement is compulsory to all new construction trench work for 4 ways and above, regardless of the location, unless there are limitations in terms of safety, technical or engineering nature.

6. Technical specifications

The open trench works shall be done according to work and material specifications as follows.

6.1 Width of trench

The width of trench excavated should not be greater than necessary for satisfactory execution of the works. The line of the excavated trench shall be as straight as possible and any bends or curves shall be of the maximum radius not less than 10 times of duct parameter as shown in Figure 1.

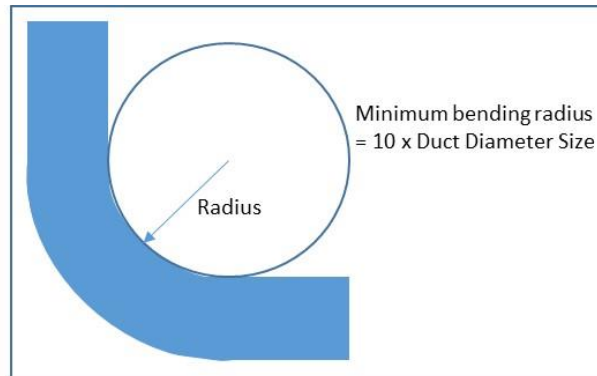


Figure 1. Duct bending radius

The line of trench shall be marked out. Line enclosing a suitable width of trench shall be marked by aid of a chalked cord. Where ducts are to be encased in concrete the width of trench is dependent upon the number of conduits to be laid in a horizontal direction. In unstable ground, timbering may be necessary to support the trench and to act as a former for the concrete. The width of the trench shall be no greater than is reasonably necessary for the satisfactory execution of the works and to avoid excessive use of concrete.

6.2 Depth of trench

The recommended minimum depth of the trench depends on the number of duct layer as shown in Table 1 below. Nonetheless, the minimum depth of trench shall comply with the requirements of the relevant authorities.

Table 1. Minimum depth of trench

Number of duct layer	Minimum depth of trench (mm)
1	1,070
2	1,200
3	1,400
4	1,600
5	1,800
6	1,950

For trench depth more than 1.5 m, a temporary shoring system shall be prepared along the trench.

6.3 Material

The material specification for open trench shall be as specified in MCMC MTSFB TC G025-1:2020.

7. Installation procedure

7.1 Pilot holes

Pilot holes shall be dug to ascertain the most suitable positions for the works. Normally, one pilot hole is dug per sectional length at positions selected by the project manager.

Pilot holes are done by excavating small holes along the identified route alignment to check any possibility of existing underground utilities or other obstacles such as hard rock or other material which may cause difficulty during excavation. Pilot holes shall be carried out manually using hand tools.

7.2 Road cutting

Asphalt cutting is carried out for the following purposes:

- a) to ensure a smooth excavation on the surface of carriageway; and
- b) to reduce the over break and keep the upper road pavement layers adjacent to the trench intact.

Asphalt cutting process shall follow the following procedures:

- a) mark 2 lines on the road with the average width of 750 mm between the lines; and
- b) cut along the lines by using road cutter to the full depth of the bituminous or concrete material.

Cutting of asphalt by using road cutting machine is as shown in Figure 2.



Figure 2. Cutting of asphalt by using road cutting machine

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7.3 Duct excavation

7.3.1 Excavation procedure

Once the route alignment has been confirmed, excavation of trench shall commence. The excavation procedures are as follows:

- a) Excavate the trench to the required depth as shown in Table 1.
- b) At every 20 m interval along the route alignment, depth of the trench shall be measured and recorded. A picture showing the trench depth shall be taken as evidence for documentation purposes as shown in Figure 3.
- c) The bed of the trench shall be levelled and clear from any obstacles which may hinder duct laying.



Figure 3. Sample depth of trench measurement

7.3.2 Protection of excavated material

During excavation, the contractor shall carefully segregate the surface and foundation materials from the lower sub-soil. Sub-soil shall be protected, whilst above ground, from weathering action which could affect the natural moisture content of the soil leading to the formation of voids and/or settlement after back-filling.

Damaged sub-soil shall be removed and replaced by undamaged sub-soil from a newly excavated length. The excavation shall include all necessary timbering and shoring as required.

7.3.3 Mechanical excavator

Any mechanical excavator shall be capable of allowing for, and should be used in a manner as to fulfil the requirements as in specified in 7.3.2 and 7.3.6 in respect of segregation of materials and width of trench obtainable by using manual excavation.

A timber base support or platform shall be placed under the feet of the excavator as a protection to prevent the carriageway surface being marked with scars and blemishes when the machine is in operation. Failure to comply with this requirement will result in the project manager being held liable for any road reinstatement and charges incurred.

7.3.4 Silencer

Where pneumatic drills or other power-driven road breaking appliances are used, they shall be fitted with efficient silencing devices and the compressor machine shall be maintained in an efficient condition so as to avoid exceeding permissible noise exposure limit.

7.3.5 Timbering of excavations

Timber supports for excavations shall be designed and placed as to permit wherever possible withdrawal of such timber and consolidation of the space it occupies.

7.3.6 Width of Trench

In no case shall the width of trench excavated be greater than is necessary for satisfactory execution of the work. The line of the excavated trench shall be as straight as possible and any bends or curves must be of the maximum radius possible. The line of trench shall be marked out. Line enclosing a suitable width of trench shall be marked by aid of a chalked cord. Where ducts are to be encased in concrete the width of trench is dependent upon the number of conduits to be laid in a horizontal direction. In unstable ground timbering may be necessary to support the trench and to act as a former for the concrete. To avoid excessive use of concrete the width of the trench shall be no greater than is reasonably necessary for the satisfactory execution of the work.

7.3.7 Depth of Trench

The depth of trenches shall be such that the average depth below the surface is according to the respective specification and as required by the authorised officer. The floor of the trench must be level and not follow surface irregularities. The bottom of every trench shall be normally levelled with 50 mm of sand and rammed.

7.3.8 Change of level

In passing from footway to carriageway and vice versa or where ducts enter jointing chambers below standard depth or in any other circumstances where it is necessary to change level, the bottom of the trench shall rise or fall gradually as the authorised officer may direct.

7.3.9 Dewatering

The water shall be disposed to prevent detrimental damage to ducts, cables and other materials. All pumps and appliances required shall be provided to carry out the necessary pumping and bailing.

7.4 Laying of underground duct

Underground duct ways are required to connect the manholes from 1 to another and to the nearest NFP infrastructure.

The number of duct ways is depending on the size and types of connection and number of potential users/customers in the development areas.

For new housing development area, developer shall consult the relevant NFP on the appropriate selection of the number of duct ways to be provided as to accommodate their requirements in the deployment of the communications facility in the development area.

The line of ducts shall be kept as straight as possible. The groupings to be adopted, and the size of trenches, shall be subject to best practices; the character of the duct to be laid may vary to suit special requirements.

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Any necessary cutting and bending of ducts shall be done according to the requirements of the work. Inside edges of cut ducts, etc. shall be thoroughly polished before being put into position that there can be no possibility of damage to cables from the edges.

The trench bottom shall be filled with a layer of sand 50 mm thick and holes shall be taken out of the bottom of the trench at all points where sockets occur so that the barrels of the ducts rest on solid ground.

In rocky soils, sand shall be spread over the trench bottom and compacted to afford a bedding 80 mm thick on which to lay the ducts.

Duct laying work shall not be undertaken without supervision by the project manager.

7.4.1 Protection of paving

All reasonable steps shall be taken to prevent damage to paving and to protect paving from contamination by fuel and/or oil from the equipment.

7.4.2 Duct arrangement

Project manager shall ensure that the duct arrangement are as follows:

- a) The line of the duct way shall be kept as straight as possible; and
- b) If the number of duct layers is more than two, the line shall have break joint by approximately half of the duct length in alternate lines, horizontally and vertically as shown in Figure 4.

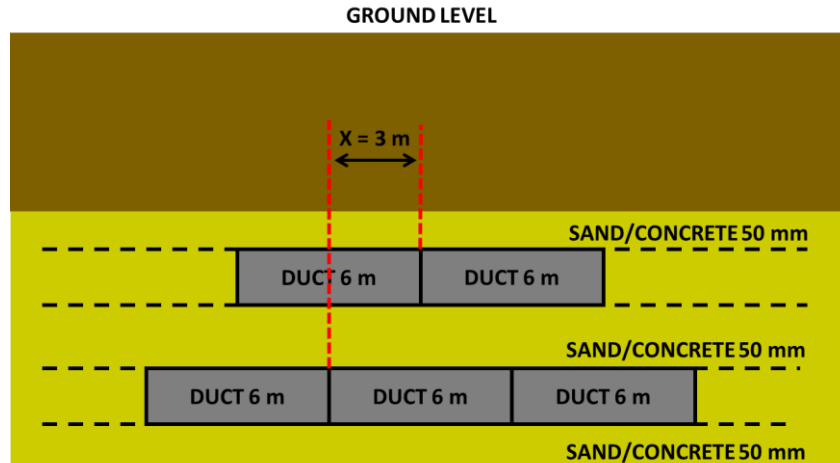


Figure 4. Break joint between duct

7.5 Laying of duct in concrete encasement

Duct encasing shall be carried out layer by layer where each duct is completely surrounded by concrete.

7.5.1 Installation around curves

Rigid PVC duct may be bent to avoid obstacles or to negotiate curves. The conduit may be cold bent around stakes for radius above 10.6 m. To provide favourable cable hauling conditions the bend radius should be as large as possible. Cold bending in situ to the curve required is achieved by provision of stakes to form the conduit to the required shape. The stake shall be spaced at intervals not greater in

length than 1/20 of the radius of curvature or alternatively as indicated in the Table 2. Concrete cover above the top duct of a completed tier is to be a minimum of 50 mm.

Table 2. Duct bending specification

Bend radius (m)	Support spacing (cm)
10.6 -12.2	53.3
12.2 - 15.2	61.0
15.2 - 18.2	76.2
18.2 - 21.3	91.5
21.3 - 24.3	106.7
24.3 - 27.4	122.0
27.4 - 30.4	137.2

After the initial set of the concrete has occurred and before it sets hard, withdraw all stakes by applying a lifting and turning action to the stakes. Where additional conduits are to be installed above the first nest, withdraw the stakes until approximately 305 mm remain embedded.

7.5.2 Installation in straight runs

The installation procedure for straight runs are as follows:

- a) Open trench to the required length. Minimum opening is approximately 1½ times length of conduits being used.
- b) Place a 50 mm thick bed of concrete on the bottom of trench.
- c) In unstable ground or locations where high security is required, place a wire mesh vertically on either side of nest of ducts. The concrete should fully cover the reinforcement which shall be 150 mm x 150 mm x 6 mm welded meshes.
- d) Install a layer of conduits along the trench keeping them evenly spaced by using wooden combs at intervals of 1.5 m.
- e) Place a layer of concrete over the conduits and compact in so as to fill the spaces between the conduits. Provide an approximate 50 mm covering above the conduits to form a bed for the second layer.
- f) Repeat the process for the next and subsequent layer of conduits, raising the spacing comb as each layer is completed.
- g) Remove spacing comb and wash in a suitable cleaning agent.
- h) Concurrently with the conduit laying in the first section of the trench, excavate the second section so that sufficient trench is opened to continue conduit laying on completion of the first section.
- i) Under no circumstances shall any batch of concrete be off-loaded from wheelbarrow, bucket, dumper, chute or similar equipment, directly onto the assembled duct nest. It should be first be off-

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loaded onto a suitable board prior to placing around the ducts. Spades or shovels used for placing shall not be pushed into the placed concrete.

- j) To assist in the placing of subsequent rows of spades and ducts, and concrete, a walk-way shall be used when access within the trench or from the surface is restricted. Under no circumstances shall the laid duct be used as a walk-way.

7.6 Laying of Galvanised Iron (GI) pipes

GI pipes shall be used to a depth less than 300 mm. All pipes shall be provided in nominal lengths of 6 m and provided with screwed socket at one end and shall comply with MCMC MTSFB TC G025-1:2020.

Where 1 line of ducts is laid over another in the same trench, sand shall be filled in over the lower line of ducts and carefully compacted to form a bedding of 50 mm in thickness for the top ducts. Sand shall also be compacted between the ducts laid side by side in the same trench.

The ducts shall break joint by approximately half the length in alternate lines, horizontally and vertically. Joints shall be made by positioning the threaded end of the pipes to the screwed socket of the other pipe end. Turn one of the pipes until it cannot turn anymore and ensure that the thread of the threaded end cannot be seen.

Pipes shall be cut when necessary at right angle to the bore only. The inside edges being filled afterwards so that there can be no possibility of damages to cables from the edges.

7.7 Laying of Poly Vinyl Chloride (PVC) duct

Generally, ducts are supplied in 6 m lengths. These ducts should be stored away from direct sunlight, as they tend to deteriorate and go out of shape. Solvent cement is used for the joint with minimum 1.2 m depth.

Where it is impossible to provide a clearance of less than 1.2 m depth, duct shall be encased in concrete with Quality C.

The trench shall be scooped out at all points where the spigot rest, so that the body of the duct lies on compacted sand.

Where 1 line of ducts is laid over another in the same trench, sand shall be filled in over the lower line of ducts and carefully compacted to form a bedding 50 mm in thickness for the top ducts. Sand shall also be compacted between the ducts laid side by side in the same trench. The ducts shall break joint by approximately half the duct length in alternate lines, horizontally and vertically.

If it is necessary to deflect from a straight line or to vary the depth, clearance may be given to the joints, but deflections shall not be greater than 12 mm per 610 mm run of the single ducts. Short ducts not less than 610 mm in length, shall be built into the track in order to secure the required deviation, but the deflection shall not be greater than 12 mm.

Ducts shall be cut when necessary, preferably with a saw in a simple cutting guide and trimmed to avoid any possibility of damages to the cables from the edges.

The spigot of the ducts shall be wiped clean. The solvent cement shall be applied to the spigot as well as the end of another conduit. The end of the conduit where the solvent cement was applied shall be positioned and pressure applied for the 2 conduits to be jointed. In no circumstances shall dirt or grit be allowed to enter the joints.

7.8 Dummy ducts method

Length of 1 PVC duct shall be positioned in a wall of the chamber or above the row of ducts terminated at a jointing chamber.

Later on, when it is necessary to increase the number of ways, the new ducts shall be jointed to the dummy ducts. The ducts can be made available by breaking the mortar seal that was set previously in position when the ducts and chamber were constructed.

7.9 Fixing ducts to bridges

Only GI and HDPE pipe shall be used for installation of ducts on exposed bridges subject to approval from the relevant authorities.

The following 2 methods shall be used:

- a) fixing to steel Rolled Steel Joist (RSJ) or fabricated beams; and
- b) fixing to reinforced concrete bridge beams and masonry walls.

It should be noted that the extra care shall be taken when it is necessary to make holes for fixing bolts in existing bridge beams. All bridge fittings shall be thoroughly cleared and painted with 1 coat of bituminous paint.

Where it is necessary for duct to pass through abutment walls, the masonry or brickwork shall be arched over the pipe. The diameter of the hole thus formed being at least 13 mm more than the external diameter of the duct. The space between the masonry or brickwork and the pipe shall then be filled with bitumen to provide a cushion of bitumen to the perimeter of the pipe at least 13 mm thick.

7.10 Cutting and bending of ducts

Any necessary cutting and bending of ducts shall be done according to the requirements of the work. Inside edges of cut ducts shall be thoroughly rounded off or so dressed before being put into position that there can be no possibility of damage to cables from the edges.

7.11 Trench bottom

The trench bottom shall be filled with a layer of sand 50 mm thick and holes shall be taken out of the bottom of the trench at all points where sockets occur so that the barrels of the ducts rest on solid ground.

7.12 Rocky soil

In rocky soils, sand shall be spread over the trench bottom and compacted to afford a bedding 80 mm thick on which to lay the ducts.

7.13 Slewing and/or lowering or raising of duct

7.13.1 Excavation

The size of the excavation for slewing and/or lowering or raising a duct line shall be as agreed to by the project manager.

Where lowering only is necessary the duct line shall be suspended, and the required excavation taken out down the side and under the duct line. When this method is not practical, the duct line shall be slewed and raised or lowered temporarily for a distance which is just sufficient to allow access for carrying out the excavation.

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With the exception of making slight adjustments to the duct line after slewing and lowering, the duct line shall not be moved in any way without adequate reinforcement in the form of a strongback being firmly lashed to it.

7.13.2 Strongback

In certain site conditions, the strongback shall be lashed to the duct line, with ends of each duct firmly held, using separate lashings or a continuous rope. The lashing shall be tightened, by driving wedges between the ducts and the strongback or otherwise.

Any forces which is necessary to apply to the duct line to move it in any way shall be applied not directly to the duct line but to the strongback lashed to it. Such forces shall be applied at points where spacing is sufficiently close to keep the bending of the duct line and strongback the points to a negligible amount.

7.13.3 Suspension

When the duct line is to be lowered, the complete length shall be suspended from suitable beams spanning the excavation. When the duct line is to be slewed whilst suspended in this way, the suspending ropes shall be fastened to sling poles resting on the supporting beams and running parallel to the duct line and strongback, and free to move across the beams. All suspending ropes shall be so arranged that the duct line can be raised or lowered as required, smoothly and continuously, and can be tied off firmly at any stage.

7.13.4 Slewing

When the duct line is to be slewed, it may be moved without suspending it, provided that:

- a) the surface across which the duct line is to be slid shall be reasonably level and regular, made so if necessary, by setting boards on the surface;
- b) grooves shall be cut across the surface in positions to allow the socket of each duct to remain in a groove throughout its movement;
- c) the strongback shall be firmly lashed to the side of the duct line;
- d) the moving force shall be applied to the strongback by rope, jack or other method to allow the duct line to be moved smoothly and without jerking; and
- e) in the final position of the duct line, the holes for the duct sockets shall be made large enough to allow access to the underside of each joint for the purpose of making the seal. Such holes shall be subsequently filled with soft cement mortar.

7.13.5 Movement

The slewing and/or lowering of the duct line shall be carried out by making a succession of very small movements of the duct line, each made progressively along the affected length. The curvature of the duct line at any intermediate stage between the initial and final positions shall not exceed the deviation limits laid down for laying new duct of the same type.

7.13.6 Trench bottom

Prior to final placing of the duct, the trench bottom shall be prepared in the same way as specified for duct laying.

7.13.7 Irregularities

After the duct line has been finally lowered into its required position and the strongback has been removed, any slight irregularities in the general line of the ducts shall be corrected.

7.13.8 Repairing PVC ducts

Damaged empty ducts shall be replaced by similar good ducts, or split ducts, and damaged occupied ducts shall be replaced with split ducts. Minor damage to ducts shall be repaired in situ with a mixture of cement. Split ducts shall be surrounded with 50 mm of cement mortar, carried over the joints and held in position by forms. The entry of mortar into the ducts shall be prevented by the use of building paper or similar effective means.

7.13.9 Pulled joints

Where, following slewing and/or lowering or raising operations, a duct joint or joints have pulled apart, short length or ordinary or split duct way is inserted in the duct line.

7.13.10 Inspection

After all operations are completed, the joints of all ducts shall be inspected to ensure that they are forming an effective seal, any defects shall be made good.

7.13.11 Testing

All spare bores of the duct line shall be cleaned and tested as specified for the particular duct concerned.

7.14 Manhole

The manhole installation procedure shall be as specified in MCMC MTSFB TC G025-1:2020.

7.15 Lead-in duct to manhole

The lead-in duct procedure shall be as specified in MCMC MTSFB TC G025-1:2020.

7.16 Backfilling

The ultimate performance of the restored trench will be greatly influenced by the manner in which this backfilling operation is carried out. It is important that the correct backfill materials are utilised. The compaction shall be done on layer-by-layer basis. When the standard depth of trench cannot be achieved, where the depth is equal to the minimum depth of trench, the uPVC slab/warning tape shall be laid at the depth of 450 mm from ground level.

Additional excavation is needed during the initial pilot hole process, where starting and receiving holes are excavated. It is important that the correct backfill materials is used. The compaction shall be done on layer-by-layer basis.

7.16.1 Backfilling of open trench in carriageway (for road crossing)

Backfilling of trench for open trench method in carriageway shall be done by using clean sand but subject to approval from the relevant authorities.

Pour a layer of 50 mm to 100 mm sand into the trench and compact the layer, and this should be repeated until the sand level reaches the road base level.

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Lay the uPVC slabs/warning tapes along the route alignment at the depth range of 440 mm to 600 mm from the ground level as shown in Figure 5. Take a picture that shows the depth of uPVC slab/warning tape for evidence and documentation.

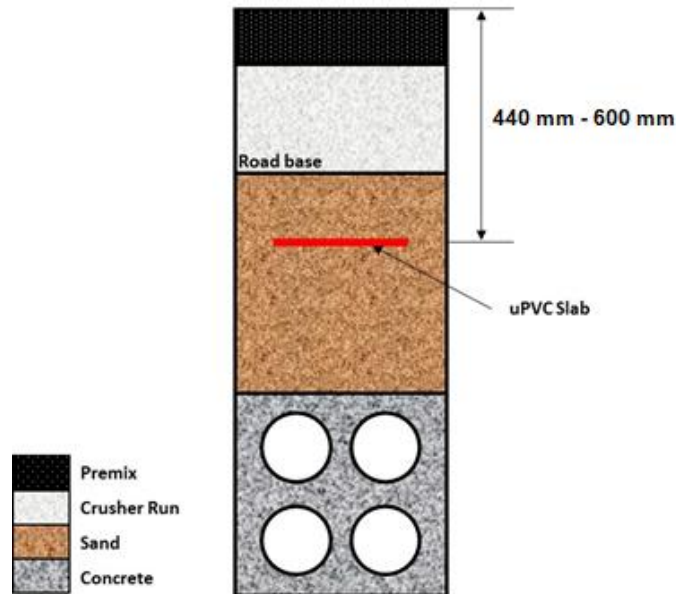


Figure 5. Backfilling of trench for 4-way duct with concrete encasement in carriageway

7.16.2 Backfilling of open trench in grass

Backfilling of trench in grass shall be done by using earth/soil. Backfill the trench by pouring a layer of 50 mm soil and compact the layer properly, and this should be repeated until the trench is fully covered with soil.

Lay the uPVC slabs or warning tapes along the route alignment at the depth range of 450 mm to 600 mm from the ground level.

8. Completion of works

The completion of works procedure shall be as specified in MCMC MTSFB TC G025-1:2020.

Acknowledgements

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