Frogfoot

Just connect

Frogfoot FTTH Aerial Line Cable Specifications

Procedure Number (CMT-AER-P02-Rev 2)

Document number	CMT-AER-P02
Document category	Procedure
Author	FF
Approver (owner)	HOD Planning
Status	Approved
Issue date	17 February 2021
Revision number	2

Document Information	
Issue Number:	1.0
Revision:	2
Effective Date:	17 February 2021
Print Date:	

Document History

Rev	Date	Sections Amended
2	17 February 2021	As per table

The signatures below certify that this Document has been reviewed and approved and demonstrates that the signatories are aware of all the requirements contained herein and are committed to ensuring their provision.				
Document Owner				
Name:	Sheldon Mackridge			
Position:	HOD Planning			
Company:	Frogfoot Networks		Signature:	Date:
Sign-Off.:				
Name:				
Position:				
Company:			Signature:	Date:
Name:				
Position:				
Company:			Signature:	Date:
Authorized By:				
Name:				
Position:				
Company:			Signature:	Date:

Revision Table

Date:	Revision	Author	Changes
4/09/2020	0	Johan	First Draft
03/12/2020	1	Brian	Add in photos, pole installation, fibre work, EHS
17/02/2021	2	Johan	Comment and updates on revisions

Table of Contents

1. Purpose

1.1 The purpose of this document is to provide a guideline for the deployment and connection of FTTH Aerial Line Cable projects on the Frogfoot network. It should be noted that this document is to serve as a guideline and not purport to address all best practices and techniques.

1.2 It is advised that this document be read in its entirety before commencement of any works to gain a clear and complete understanding of the requirements.

1.3 Whilst every step has been taken to ensure the accuracy and completeness of this information, it should be noted that recommended prescribed installation specifications should not be overlooked whilst using this document.

2. Scope

2.1 All elements and the proposed configurations for FTTH ALC are enclosed in this document.

2.2 This document will address the deployment of FTTH OSP, ACB installations and best practices as far as possible.

3. Reference documents

3.1 Frogfoot FTTH Civil Specifications
3.2 Frogfoot Micro Trenching Specification
3.3 Frogfoot Labelling Specification Guideline - Underground Networks
3.4 Frogfoot Traffic Management Plan rev 1
3.5 Frogfoot HSE Plan 12 April 2016 rev 0
3.6 Frogfoot Waste Management Plan rev 0
3.7 Frogfoot DIT Results
3.8 Frogfoot OTDR Results
3.9 OHS Act 85 of 1993
3.10 COID ACT 130 of 1993
3.11 NEMA Act 107 of 1998
3.12 Construction Regulations 2014
3.13 South African National Road Traffic Act.
3.14 South African Roads Traffic Signs Manual, Volume 2, Chapter 13.
3.15 Construction Regulations 2014.
3.16 Occupational Health and Safety Act 85 of 1993.

Definition	Definition Precise Meaning
Contractor	Company appointed to conduct construction work
Wall Termination Box	In building termination box connecting multiple fibre cores to the main feeder.

4. Definitions and Acronyms

4.1 Definitions

4.2 Acronyms

Acronym	Acronym in Full
e.g.	exempli gratia "for example"
mm	Millimetre
GPON	Gigabit Passive Optical Network
ONT	Optical Network Terminal
OLT	Optical Line Terminal
SDU	Single Dwelling Unit
MH	Manhole
HH	Hand Hole
ACB	Access Build
FTTH	Fibre to the Home
OSP	Outside Plant
BB	Boundary Box
MDU	Multi Dwelling Unit
DIT	Duct Integrity Test
DCP	Dynamic Cone Penetrometer
ID	Inside Diameter
OD	Outside Diameter
PON	Passive Optical Networks
ODF	Optical Distribution Frame
HDD	Horizontal Directional Drilling
ALC	Aerial Line Construction
FJ	Feeder Joint
DJ	Distribution Joint
AFC	Aerial Feeder Cable
ADC	Aerial Distribution cable
ALC	Aerial Line Cable

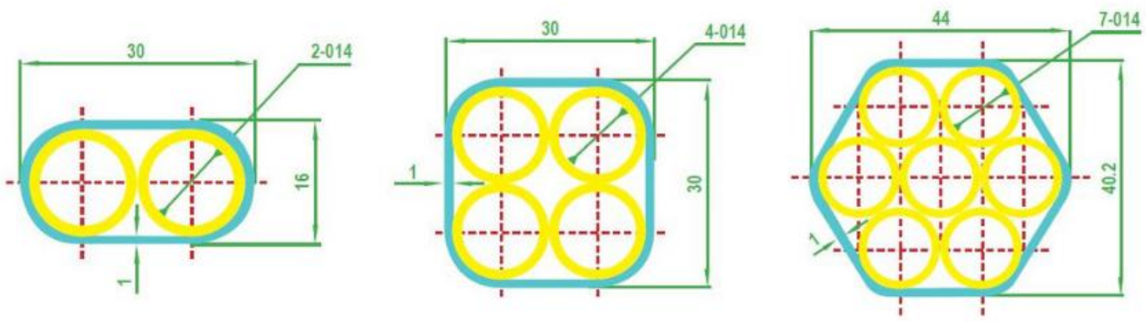
5. Introduction to Frogfoot FTTH

5.1 Introduction to Frogfoot FTTX

- A node will be hosted at a designated location as central to the project area as possible.
- This node will host the respective active and passive equipment. This will include but not be limited to:
- OLT
- EDFA's
- ODF/'s
- Patch Panels
- 1:4 Splitter Cards
- Slack Trays
- Cable Guides
- 42U Cabinet
- Power and Backup Power Equipment
- Active Monitoring and Security Equipment.
- The Network is designed with a cascading splitter configuration. 1:4 splitters in the node and 1:16 way splitters in the field. Refer to MDU specifications for variations of the above.
- For the successful deployment of an aerial network, there will be a requirement for conventional trenching particularly when there are more than two aerial cables used for the Core, Feeder or Distribution (only for multiple feeder cables) fibre. In this instance, direct buried ducts and micro cables are to be used.
- The suburb will be broken down into multiple sectors or projects with separate Core cables running to each. Should the design call for a conventional deployment of these routes, this will comprise of a 2 way 14/10mm, 4 way 14/10mm or a 7 14/10mm duct. Specification may differ based on the requirements. Refer to Figure 1.1 – Duct Sizes & FTTX Specification.
- Wherever possible, under the constraint of at most two core or feeder or a combination thereof, the routes will be run aerially.
- Road crossing are to be done overhead wherever possible and based on the wayleave conditions.
- The fibre will route from the aggregation node to a series of fibre splice closures situated on poles or within HHs along the various core, feeder and distribution routes.

- The deployment of an FTTX ACB installation will connect the residence to an OFDC- A4 Splice/Patch Closure which will be located on a pole in the road reserve and in line with the boundary between two properties. Refer to Figure 1.2 – OFDC-A4 Splice/Patch Closure Box
- Each OFDC-A4 Splice/Patch closure will serve four households, unless otherwise indicated on the drawings.
- The distribution aerial cable will loop through each OFDC-A4 Splice/Patch closure, and only the number of required fibres will be expressed and spliced onto pigtails.
- Whilst only 1 core per ACB will be spliced, the remaining cores will be reserved for future implementation.
- When standing at a pole that houses an OFDC-A4 Splice/Patch closure, facing the two properties, the residences on the left will be known as ACB1 and ACB2 and the ones on the right will be referred to as ACB3 and ACB4.
- In the case of an MDU, a distribution cable will be brought downwards along the pole by means of a PVC or galvanised pipe, floated in a 2 way 8/5mm duct, and expressed in an EBB by the entrance gate of the estate. In this scenario the ACB will be done from the EBB to the lead point within the estate. Refer to Figure 1.3 – Boundary Box
- The design for the routing of the cables may differ with each premises. A design will need to be made based on the notes, photographs and sketches made during the site survey.

Figure 1.1 – Duct Sizes & FTTX Specification



Tube Colours (TIA/EIA Standards)					
BLUE	ORANGE	GREEN	BROWN	GREY	WHITE
BLACK	YELLOW	VIOLET	PINK	TURQUISE	RED

- *Figure 1.2 – OFDC-A4 Splice/Patch Closure*

- *Figure 1.3 – 320T Boundary Box*

-

  - An ODF will be hosted at the nearest designated node feeding the GPON within the suburb.
  - The suburb will be broken down into multiple parts with separate feeder fibres running to each. The main feeder routes, with multiple feeder cables going in the same direction, will be done employing standard underground practices. Typically, this will comprise of 1 x 7-way (14/10) duct. Specification may differ based on the requirements. Also called the feeder duct bank
  - The fibre will route from the aggregation node to a series of distribution HH's

Suite 302, Building 20
The Waverley Business Park
Kotzee Road, Mowbray
Cape Town, South Africa

PO Box 12930
Mowbray
Cape Town
7705

Tel: +27 21 448 7225
Sales/Enquiries: ftth@frogfoot.com
Support: support@frogfoot.com

frogfoot.co.za

Frogfoot Networks (Pty) Ltd, Reg No. 2006/011693/07

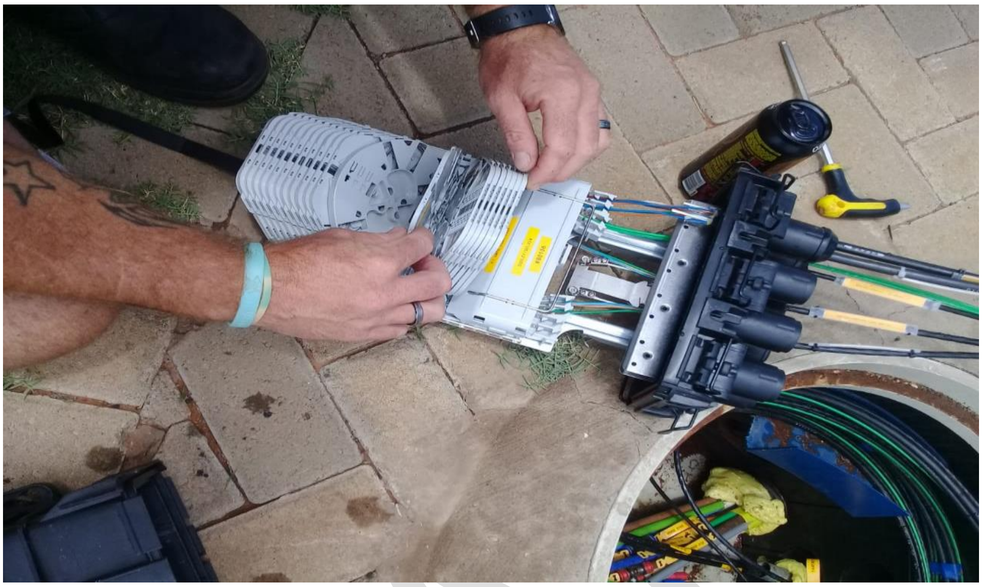
situated along the various core and feeder routes. This will in turn feed fibre cores to the FJ's situated in HH's along the route and the FJ's on the terminal poles at the transition from underground to overhead deployment.

- The FJ's will house the splitters and serve as origin for the distribution cables feeding the DJ's.
- Each DJ will serve up to four households, unless otherwise indicated on the drawings.
- The deployment of an FTTH ACB installation will connect the residence to an DJ which will be located in the road reserve, in line with the boundary between two of the properties.
- The DJ will house a total of 6 cores (1 per residence with 2 spare cores).
- Whilst only 1 core per ACB will be spliced, the remaining cores will be reserved for future implementation.
- When standing at a DJ, facing the properties, the residence on the left - of a cluster of up to 4 residences, will be known as ACB1 and the one on the right will be referred to as ACB4.
- The design for the routing of the cables may differ with each premises. A design will need to be made based on the notes, photographs and sketches made during the site survey.

Demarcation of Work Area

- Should any person be working on or have equipment on the sidewalk, the work area must be demarcated when excavation or planting of poles are in progress

- If any person will be entering the road, the correct demarcations need to be established according to the Frogfoot Traffic Management Plan rev 1.

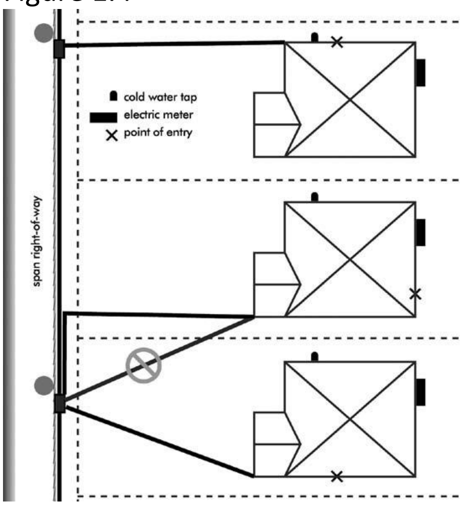


ACB – Fibre to the X

6.1 ACB Planning

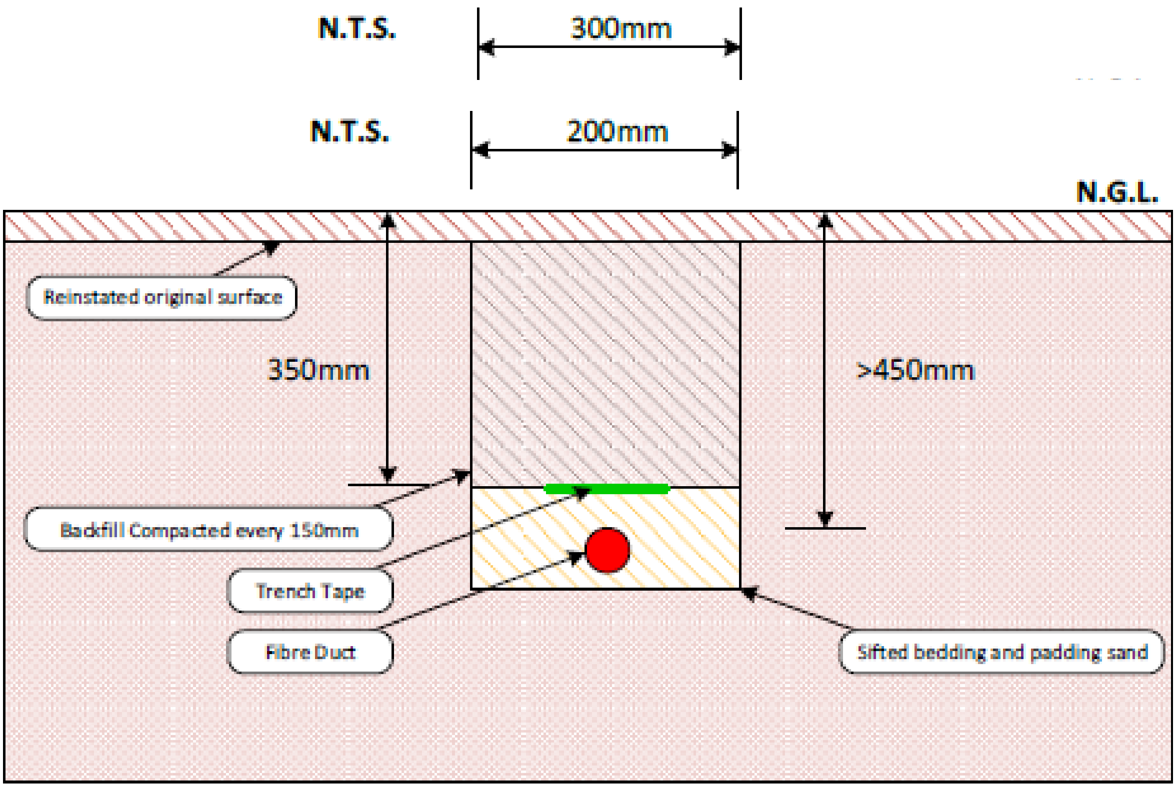
- Listed below are the requirements which must be determined, planned and authorized by the relevant parties.
- The build requirements will be determined and noted during a site survey, paying particular attention to obstacles and existing third-party services along the way.
- Photos will be taken for future reference.
- The nearest OFDC-A4 Splice/Patch closure located on a distribution pole will be used with reference to the plan.
- The access route and an entry into the home through home ducting / cable routing to the termination point.
- Termination equipment to be used and the location thereof.
- Acquiring permission and an entry time into the home for deployment.
- An agreement between the contractor and the resident must be made to cover any additional cost that may occur.
- In the case where a pole cannot be planted at the boundary of two erfs, the access build drop fibre may not cross the erf of the neighbour and installation should be done as per figure 1.4.

Figure 1.4



6. Civil Works

A. Feeder Core Network | 600mm Duct coverage
B. Distribution Network | 450mm Duct coverage
C. Access Network | 450mm Duct coverage



6.1 Pilot Holes

6.1.1 Pilot holes needs to be excavated before any trenching work starts

6.1.2 The pilot holes should be excavated 30m apart to determine a trench line

6.1.3 Pilot holes also need to be excavated where there are other visible services that need to be crossed.

6.1.4 The size of the Pilot Holes needs to be 200mm deeper than the required trench depth

6.1.5 The Pilot Hole must be opened diagonally from the route, starting on the Boundary Wall up towards 1m from the Boundary wall.

6.1.6 If there is no space within the 1m to install the Frogfoot infrastructure the Pilot hole may be widened to a max width up to 300mm to the curb.

6.1.7 Great care needs to be taken when exposing other services not to damage them.

6.2 Scanning & Cable Locator

6.2.1 Ground penetrating scanning must be done on the section to be trenched before any trenching may commence

6.2.2 The scanning results need to be saved so that it can be verified later in the event of an incident.

6.2.3 Cable locators to be used on the day of the trenching, the electrical cables need to be marked so that the trenching team is aware where the service is.

6.3 Trenching

6.3.1 Trenching shall be done by hand excavation only.

6.3.2 The trench line must be inside the 1m from the Boundary wall and follow as straight as possible a route.

6.3.3 All grass and general plantation requiring to be uprooted shall be removed and placed along the trench for easy reinstatement.

6.3.4 Any tree roots encountered during excavation will not be cut unless absolutely unavoidable.

6.3.5 The minimum depth to the bottom of the trench must be 650mm in areas where bedding isn't required. according to Wayleave conditions

6.3.6 Where services are encountered inside the trench line and not avoidable, the trench must be sloped so that the Frogfoot Infrastructure can be installed underneath the service being crossed. Clearance of 300mm

6.3.7 Crossing of services: refer to Service Wayleaves on the crossing method(s)/distances

6.3.8 Trenching within the residential area will be done to a depth of 300mm and no deeper than 500mm. See Figures 2.1 and 2.2 below.

6.3.9 Trenching shall be done by hand excavation.

6.3.10 Any uprooting of trees, brush or shrubs will require consent in writing from the property owner.

6.3.11 No trench shall be left open overnight unless suitably demarcated, signage displayed, and arrangements are made with the client and residents.

6.3.12 When trenching across driveways/ pathways/ guttering or kerbs, will require proper support, and must be in place until the trenching is complete.

6.3.13 Where tunnelling beneath kerb is not possible, a cut using an angle grinder will be used to create a smooth uniform finish.

6.3.14 All backfill of the trench will be of the same compaction level or of a better standard than that prior to the excavation.

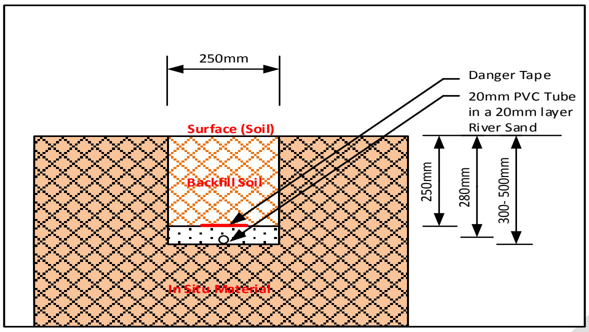
6.3.15 Caution will be exercised to ensure no large rocks are placed on top of the 20mm PVC conduit which may cause damage.

6.3.16 Where conduit is to be laid beneath pavers, the pavers are to be carefully removed for reuse. Upon reinstatement of the pavers, a bedding of river sand ~20mm deep is to be placed beneath the pavers.

6.3.17 The standard of reinstatement expected will be of the same or better quality prior to

Figure 2.1 – Residential Trenching

excavation and must meet the client's expectations.



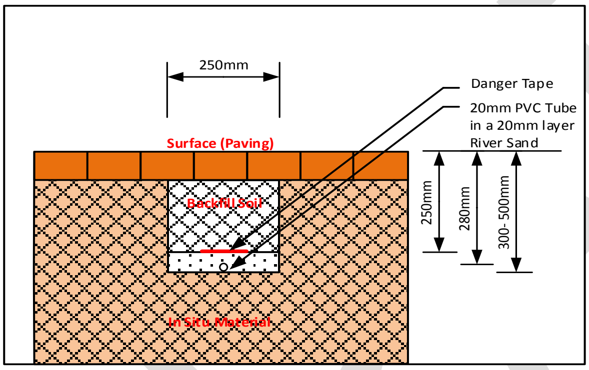


Figure 2.2 – Residential Trenching under pavement

Definitions

- Core: cables linking the FF node to the backhaul supplier's network entry point, and cables interconnecting different FF nodes.
- Feeder: cables feeding from the FF node - into the feeder area – to the feeder joints, housing the splitters.
- Distribution: cables feeding from the feeder joints into the blocks, feeding the distribution joints (aerial or in BB's), where the drops to the houses are terminated.

a. Core Route Trenching:
   i. Refer to *Figure 6.1 – Core Trench Diagram* below as reference.
   ii. The fibre core route trench will be dug to a depth of no less than 900mm and typical house a 110mm, a 4way 14/10mm and a 12 way 12/10mm ducts. Any variations hereof will be indicated on the drawing.

iii. Typically, this will be done by hand excavation unless otherwise stipulated by

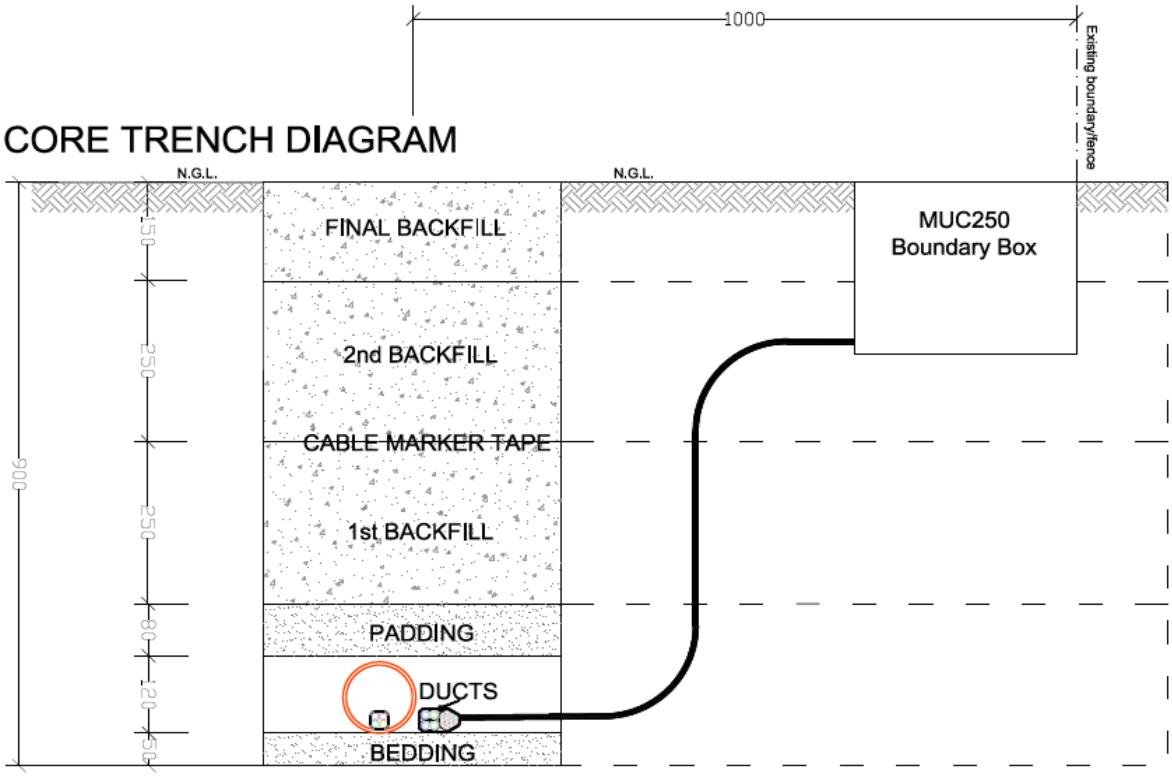


Figure 6.1 – Core Trench Diagram

the client.

b. Feeder Trenching

i. Refer to *Figure 6.2 – Feeder Trenching Diagram* below as reference.

ii. The fibre feeder route trench will be dug to a depth of no less than 600mm and typical house a 4way 14/10mm and/or a 12 way 12/10mm duct. Any variations hereof will be indicated on the drawing.

iii. Typically, this will be done by hand excavation unless otherwise stipulated by

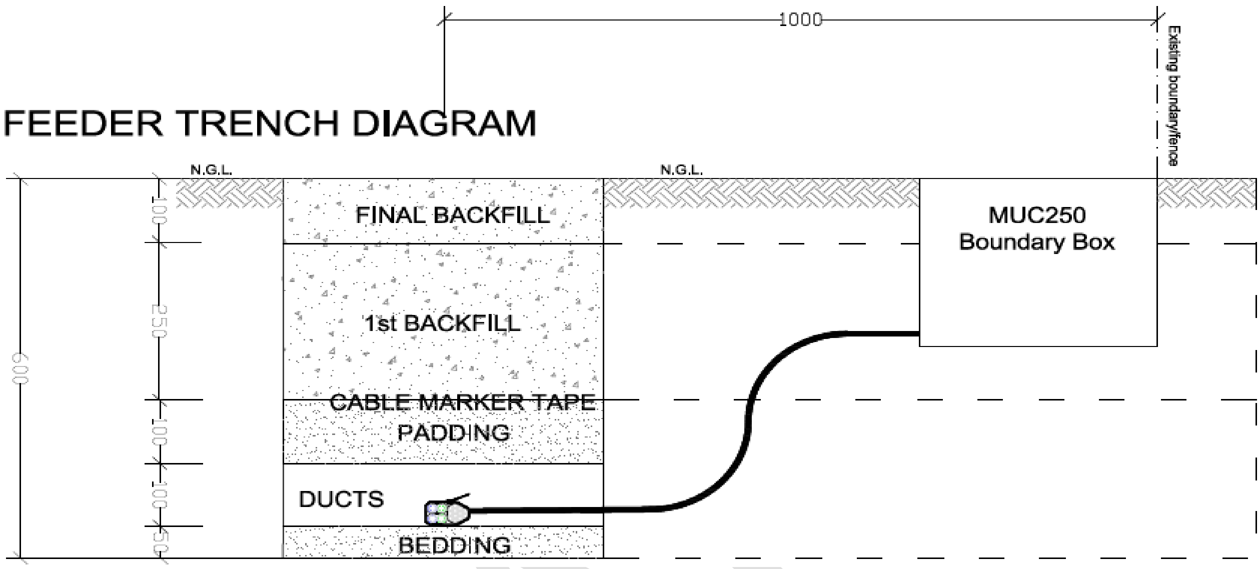


Figure 6.2 – Feeder Trenching Diagram

the client.

c. Distribution Route Trenching
   i. Use *Figure 6.3 – Feeder Trenching Diagram* below as reference.
   ii. The fibre distribution route trench will be dug to a depth of no less than 450mm and typical house a 12 way 8/5mm duct. Any variations hereof will be indicated on the drawing.
   iii. Typically, this will be done by hand excavation unless otherwise stipulated by the client.
   iv. Micro-trenching may very well be used at the discretion of the client. This will be stipulated ahead of the commencement of the work.

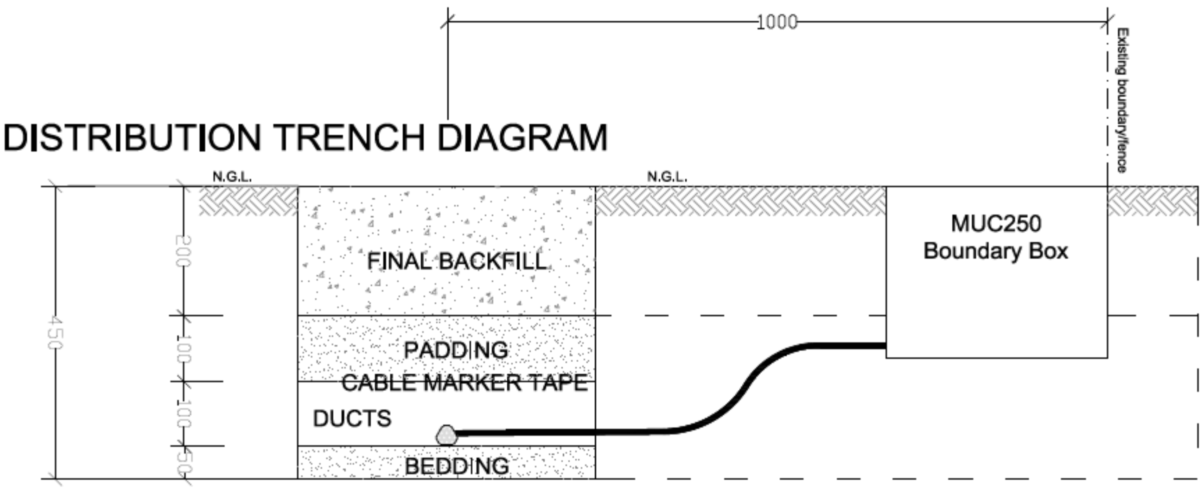
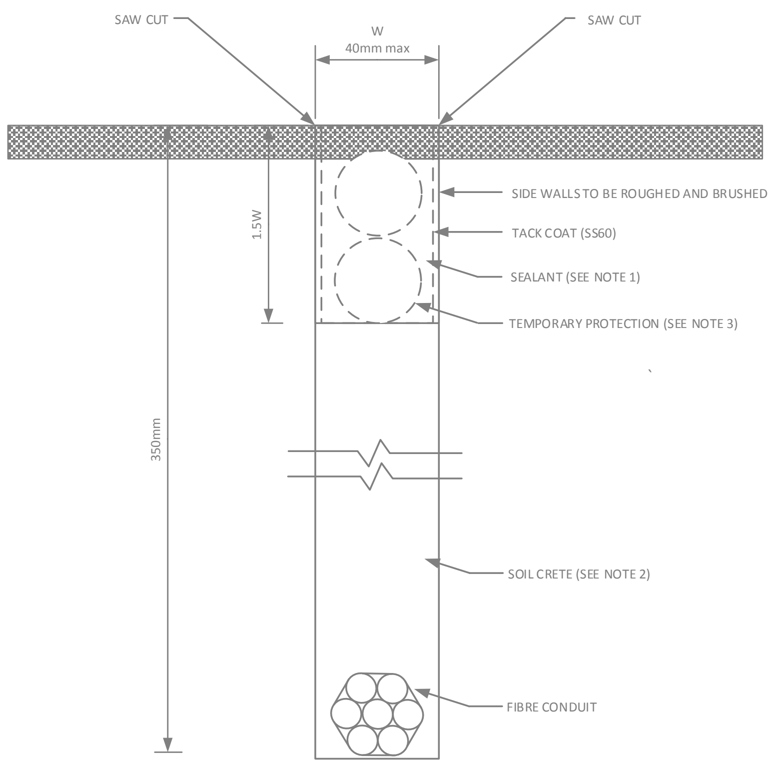


Figure 6.3 – Feeder Trenching Diagram

co.za

d. Micro-Trenching
   i. Refer to *Figure 6.4 – Micro-Trenching Reinstatement Solution* below.
   ii. The use of micro-trenching will make use of Frogfoot's machinery unless otherwise stipulated by the client.
   iii. Every effort should be made to cut along existing road joints wherever possible.
   iv. Cut lines will have to be marked out on the roads surface before the commencement of work.
   v. When a bend is required, the cut radius should be no smaller than 3m.
   vi. A typical cut thickness of 35-40mm will be made to a depth of 350mm.



NOTES:
1. SEALANT
   1.1 WARM APPLIED BITUMEN RUBBER OR POLYMER MODIFIED BITUMEN. (ELASTIC RECOVERY AT 15 DEGREES C MORE 80%; BITUMEN SOFTENING POINT MORE THAN 80%).
   1.2 MORE THAN ONE APPLICATION MAY BE
   1.3 BIND WITH 7mm or 4.75mm PRE-COATED STONE AGGREGATE ON FINAL APPLICATION.
2. SOIL CRETE
   2.1 3% MINIMUM CEM 1 42.5R
   2.2 APPLIED WET USING POKER VIBRATOR REQUIRED
3. TEMPORARY PROTECTION
   3.1 PLACE 30MM SISAL ROPES ON TOP OF SOILCRETE
   3.2 REQUIRED FOR SAFETY REASONS AND TO ALLOW SOILCRETE TO SET.
   3.3 REMOVE SISAL ROPE PRIOR TO TACK AND AND SEALANT APPLICATION.

Figure 6.4 – Micro-Trenching Reinstatement Solution

6.4 Bedding & Padding

6.4.1 Bedding material is only required where the trench bottom is not suitable to lay the duct(s) on directly.

6.4.2 Bedding material must consist of fine aggregate that can pass a 13mm Diamond mesh sieve.

6.4.3 Bedding must be 30-50mm thick dependant on the bottom of the trench, the bedding is done to protect the duct from being damaged by sharp obstacles.

6.5 Duct Laying

6.5.1 All ducts must be de-coiled using a de-coiler.

6.5.2 Ducts must be de-coiled continuously from Hand Hole to Hand Hole

6.5.3 If there is any 8/5mm configuration in the same trench, the 8/5mm configuration must be installed nearest to the boundary wall.

6.5.4 Bending radius entering any sleeve/MH/HH/BB must be considered that the bend radius doesn’t exceed the manufactures specification.

6.6 Backfilling

6.6.1 Backfilling must be done in layers of 150mm using a Rammer, the first compaction must be done at 250mm above the Duct bank.

6.6.2 The soil conditions must be suitable to be compacted, the test if it is compactable is to press a test sample in your hand and if it stays in the shape pressed it is suitable. If water peels out between your fingers it is too wet and if it collapses/crumbles it is too dry, add water during compaction.

6.6.3 Rocks greater than a fist size must be removed from the backfill material, only material containing some rocks may be used above layer 2.

6.6.4 Trench/Warning tape must be installed after the first layer of compaction

Suite 302, Building 20
The Waverley Business Park
Kotzee Road, Mowbray
Cape Town, South Africa
PO Box 12930
Mowbray
Cape Town
7705
Tel: +27 21 448 7225
Sales/Enquiries: ftth@frogfoot.com
Support: support@frogfoot.com
frogfoot.co.za
Frogfoot Networks (Pty) Ltd, Reg No. 2006/011693/07

6.6.5 Compaction must be done up to the NGL.
6.6.6 The backfilling must be able to pass a DCP test.

6.7 Reinstatement

6.7.1 The standard of reinstatement expected will be of the same or better quality prior to excavation and must meet the client's expectations
6.7.2 Upon reinstatement of pavers, a bedding of river sand ~20mm deep is to be placed beneath the pavers
6.7.3 Asphalt reinstatement must be done to meet the Wayleave condition.
6.7.4 Only Hot Asphalt is allowed, Cold Asphalt may be used as a temporary Solution if it impacts the HSE of the site.
6.7.5 Factors to be kept in mind during the reinstatement process of all excavations.
6.7.6
6.7.7 All backfill of the trench will be of the same compaction level or of a better standard than that prior to the excavation.
6.7.8 Caution will be exercised to ensure no large rocks are placed on top of any ducting which may cause damage.
6.7.9 The standard of reinstatement expected will be of the same or better quality prior to excavation and must meet the client's expectations.

6.7.10 Reinstatement of conventional trenching.

After every layer of material between 200-300mm a suitable compaction effort will be applied.

A DCP test will need to be conducted every 125m or 8 times per km after all the filling has been done. A record must be kept of the results obtained.

Reinstatement of a bitumen layer must be placed and suitably compacted.

Reinstatement of concrete must be neatly smoothed over.

Upon reinstatement of pavers, a bedding of river sand ~20mm deep is to be placed beneath the pavers.

6.7.11 Reinstatement of micro-trenching

Where micro-trenching is used, the reinstatement applied will match that of the surrounding paving.

Reinstatement of bitumen layers

A bedding of porous concrete of thickness 50mm will be instituted before the conduit is laid within the trench.

Thereafter a mixture of 4Mpa concrete will be applied wet, using a vibratory

poker up to a level 50mm below the final road paving.
The sides of the cut are to be cleaned using either a wire brush or compressed air.
Place a 30mm Sisal rope on top of the soilcrete to aid with the curing process and for safety reason.
A tack coat is to be applied by hand to the sides of the cut.
After heating the polymer modified bitumen crack sealant to 100°-160° Celsius, apply to the cut until it is just above the final road level.
Allow it to stand for 15min or until the ambient temperature is reached before allowing any vehicle to pass over it.

6.7.12 Reinstatement of Concrete
6.7.13 The concrete will be levelled to the existing level and neatly smoothed over.
6.7.14 Reinstatement of Pavers
6.7.15 The cement colour will be matched to the surrounding pavers.
6.7.16 The cement fill should be neatly matched to the surrounding pavers.

6.8 Manholes 900R

6.8.1 Manhole(s) need to be assembled before installation.
6.8.2 Determine an Area to be excavated in line with the route that the new duct bank won't be crossed by any other service provider to pass the Manhole.
6.8.3 Excavate a pit 300mm wider than the Manhole's Diameter and deep enough to install the Manhole flush with NG.
6.8.4 A drainage pit needs to be excavated in the MH pit, directly underneath the drainage hole, 300mm x 300mm x 200mm, this needs to be filled with 19mm Stone Chip.
6.8.5 Bottom entries need to be used.
6.8.6 The entry nearest to the Boundary Wall is reserved for the Distribution route (Breakout Routes, 8/5mm Duct), Access and Feeder (Backhaul) needs to be installed in the entry closest to the roadway.
6.8.7 Manholes need to be compacted in Layers of 150mm.

Ducting should be skinned back that 100mm is left, from the Manhole wall. The exposed duct should be left at a length of 100mm.

6.8.8 The entry holes that have been used must be sealed with expanding Foam.
6.8.9 Manholes must be left cleaned.

6.9 Hand Hole 600R

6.9.1 Hand hole(s) need to be assembled before installation.

6.9.2 Determine an Area to be excavated in line with the route so that the new duct bank won't be crossed by any other service provider to pass the Manhole.

6.9.3 Excavate a pit 300mm wider than the Hand Hole's Diameter and deep enough to install the Hand Hole flush with NGL.

6.9.4 A drainage pit needs to be dug in the excavated pit, underneath the drainage hole, 300 x 300 x 200, this needs to be filled with 19mm Stone Chip.

6.9.5 Bottom entries needs to be utilized the one nearest to the Boundary Wall is reserved for the Distribution (Breakout routes) (8/5mm Duct), Access and Feeder (Backhaul) needs to be installed in the entry closest to the roadway.

6.9.6 Ducting should be skinned back so that 100mm is left, from the Hand Hole wall. The exposed duct should be left at a length of 100mm.

6.9.7 Hand Holes need to be compacted in Layers of 150mm.

6.9.8 The entry holes that have been used must be sealed with expanding Foam.

6.9.9 Manholes must be left cleaned.

6.10 Boundary Box

6.10.1 The BB needs to be installed close as possible to the boundary wall.

6.10.2 A drainage pit needs to be dug in the excavated pit, underneath the drainage hole, 100 x 100 x 100, this needs to be filled with 19mm Stone Chip.
6.10.3 The entry duct needs to be left at a length of 100mm inside the Boundary Box
6.10.4 The BB needs to be installed at the point where the two Boundaries meet.
6.10.5 Two 8/5mm single ducts need to be installed to the Boundary wall where the logical entry point to the ERF's will be.
6.10.6 The ducts should be installed at least 300mm in depth from the boundary box to the property boundary so that the HDC will be able to avoid trenching into the municipal servitude
6.10.7 Boundary box must be left cleaned and locked.

6.11 Horizontal Directional Drilling

6.11.1 Drill Plans need to be submitted and approved before drilling may start.
6.11.2 The correct Bentonite ratio must be used while drilling.
6.11.3 Drill pits should be excavated to expose services but may not be closer than 300mm from the roadway. No tunnelling is allowed underneath the 300mm toward the Roadway.
6.11.4 Permission to use any Municipal water outside of the Drilling Company premises must be granted and written permission to be available on request.
6.11.5 110mm or 160mm Sleeves of Class 8 or higher must be used.

6.11.6 Only Butt Welding is allowed to join two lengths of 160mm sleeves
6.11.7 All newly installed sleeves need to be taped at both ends to ensure the sleeve is free from debris.

6.12 Impact Moling

6.12.1 Impact Moling is the preferred method to cross Driveways so that the least amount of disruption is done to the resident.
6.12.2 Launch pits should be excavated next to the driveway but should be done in a manner that the Surface of the Driveway won't sink in after the Launch Pit has been reinstated.
6.12.3 The sleeve size to be used must be decided beforehand from the planning document so that the duct(s) can be hauled freely.
6.12.4 Only soil conditions where it is possible to achieve a straight line from Launch Pit to Exit Pit are allowed to attempt by Moling.

6.13 Hauling of Ducts

6.13.1 Hauling of ducts through HDD Sleeves and Road Cut Sleeves needs to be foamed after installing the Ducting.
6.13.2 Care should be taken when hauling the ducts through sleeves so that the ducts do not kink.
6.13.3 Ducts should not be hauled in a manner that damages the outer sheath, shaving will occur, but this should be controlled to a minimum.

6.14 Pulling the fibre SDU/MDU

a. Using a suction hand pump fitted to the EBB end of the 20mm PVC Conduit, and 20mm sponge attached to a draw string/wire will need to be sucked the length of the tube.
b. By attaching the draw string to the Kevlar strength members of the pre-terminated 4 core fibre, it can be pulled from the PVC terminal box to the EBB.
c. At this point the fibre cores will need to be rolled up and neatly packed away before closing up the boundary box.

6.15 DIT

DIT test to be conducted as per 8(a)

6.16 Blowing of Fibre

a. Blowing of Fibre will commence once there are an adequate number of sub sections where the ducts are completely installed, and reinstatement is completed.

b. This is done to allow the floating and splicing to run without interruptions or hold ups.
c. These teams can be moved between sub sections at the client's discretion.
d. Clear instruction will be given by Frogfoot in the form of detailed drawings for floating and splicing of cables.
e. The contractor will be liable to ensure that cables are neatly packed away and adequately labelled.

6.17 Splicing

a. Referring to *Figure 5 – Illustration of Splicing (HH-ACB)* below.
b. Core 1 of ACB1 will be spliced to core 1 of the 8F cable which will be connected to point 1 on the splitter
c. Core 1 of ACB2 will be spliced to core 5 of the 8F cable which will be connected to point 2 on the splitter
d. Cores 2, 3 and 4 of the 8F cable will be reserved for ACB1 when additional splitters are later to be installed in the EBB.
e. As stated in point d, cores 6, 7 and 8 of the 8F cable will be reserved for ACB2.

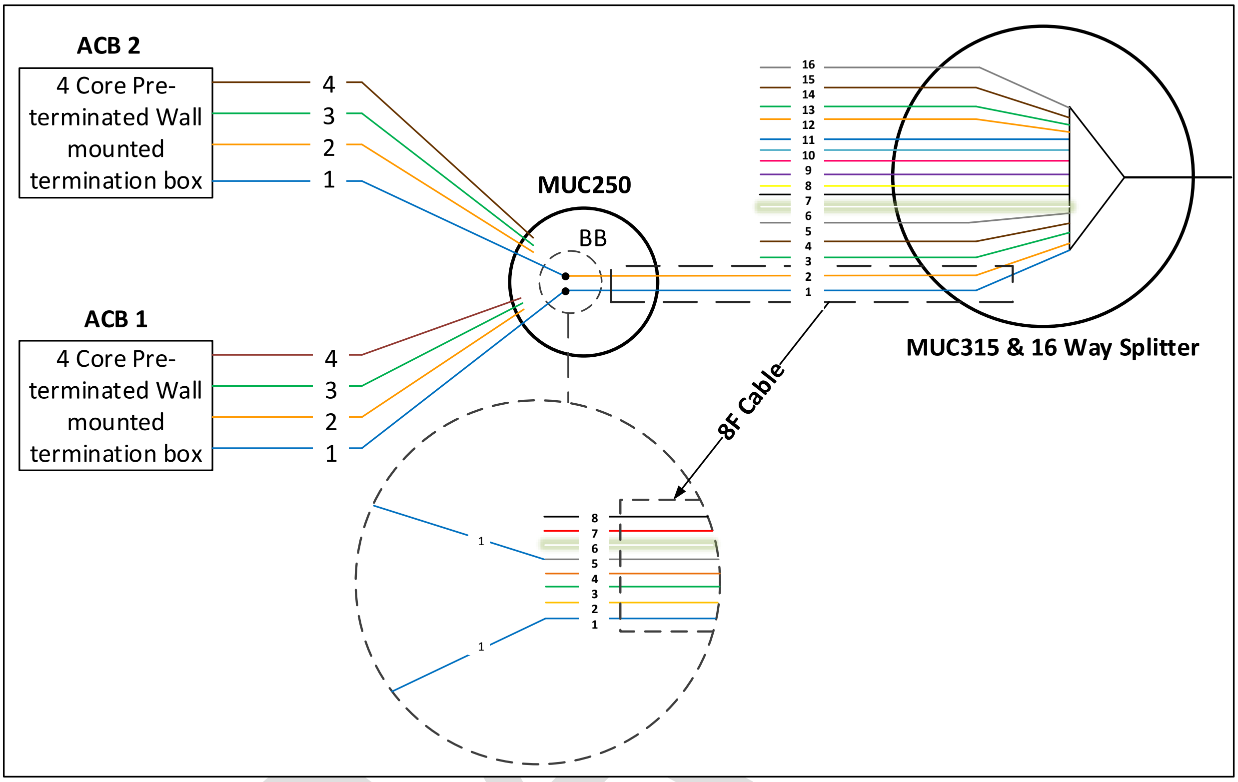


Figure 5 – Illustration of Splicing (HH-ACB)

7. OSP - Fibre to the Home (FTTX)

a. The section below describes the project requirements in terms of planning and the design solution for OSP for Frogfoot FTTX network expansion.

7.1 OSP Planning

a. Listed below are the requirements which must be determined, planned and authorized by all the relevant parties.
   i. After a designated area and node placement is selected, the proposed routes are to be designed and drawn by the relevant planners.
   ii. The closest connection to a back-haul fibre must be used.
   iii. The proposals are to be scrutinized during a site survey. Paying particular attention to obstacles and existing services along the way.
   iv. Photos are to be taken for future reference.

v. All existing services should be noted. Existing services should be used as far as possible, granted that they fall within regulation to do so
vi. Any complications or alterations are to be amended on the proposed drawings until an all-inclusive final drawing is attained.
vii. Termination, aggregation and distribution equipment to be used and location thereof.
viii. Once all relevant information is gathered, scoping of a node room can begin.
ix. Establishment of a schedule in order to notify residents of potential traffic related obstructions at least 7 days before they occur.
x. Future maintenance of all links, special requirements and network upgrades should be kept in mind throughout the planning process.
i. Any implications encountered during installation will be forwarded to the client, who shall then advise on the required solution.

7.2 Labelling

7.2.1 All newly installed infrastructure needs to be labelled correctly. Refer to the FTTH Labelling Specification.

8. Testing Methods

Tests

a. DIT testing should be conducted before and after reinstatement is completed. Mentioned below are the steps which constitute the full test. Please refer to the Frogfoot DIT Procedure.
   i. Foam Sponge Test (Repeat if dirt is still coming out. Sponge to be 2x ID)
   ii. Air Tightness Test (Blowing compressed air for 1 min to remove dirt and debris)
   iii. Dart/Mandrill Test (OD to be 85% of Duct ID)
   iv. Pressure Test (Pressurize to 10Bar. Losing 1Bar over 5min is acceptable)
      i. DIT testing should be conducted before reinstatement is completed, this will ensure that the reinstated area doesn't need to be opened up again if there is a fault. Mentioned below are the steps which constitute the full test.
      ii. Foam Sponge Test (Repeat if dirt is still coming out. Sponge to be 2x ID)
      iii. Air Tightness Test (Blowing compressed air for 1 min to remove dirt

and debris)

iv. Dart 3m long (Dart OD to be 80% of Duct ID)
v. Pressure Test (Pressurize to 10Bar. Losing 1Bar over 5min is acceptable)
vi. Total time to be tested per Duct is 5min
vii. Pressure tests on 14/10mm Duct to be tested for 5min
viii. Pressure tests on 8/5mm Duct to be tested for 1min

v.

b. DCP Testing should be conducted once the trenches are filled and compacted with their respective graded material.
   i. A DCP test should be done ever 100m – 125m or 8 times for every 1km.
   ii. The DCP test results and the exact coordinates will be recorded.
   iii. The DCP test will be done to the distance 0.5m below that of the trench depth but no less than 1m from the surface.
   iv. 4 DCP test should be done around every EBB, MH and HH.
      i. DCP Testing should be conducted once the trenches are filled and compacted with their respective graded material.
      ii. The DCP test results and the exact coordinates will be recorded in WGS84 standard
      iii. The DCP test will be done to a maximum depth of 200mm above the uppermost duct, e.g. Trench depth 600mm, duct bank uppermost 500mm test will be done up to a maximum depth of 300mm.
      iv. First compare trench vs virgin. If it fails:
      v. Then check average of 14mm/blow, or 70mm per 5 blows.
      vi. Measurement per blow must be equal or smaller than 14mm per blow.

c. Before cable installation begins, the cable reels should be carefully inspected for any imperfections such as nails, broken flanges, cable crossovers, or anything else that might cause damage to the cable as it is played out. Precautions should be taken to protect stored reels from possible damage by vandals or other sources while left unattended. The thermal protective covering that is provided on each reel of fibre optic cable should always remain in place when storing reels.

Pre-construction Fibre Measurements

The cable on all reels need to be inspected for damage as they are received. As a precaution and to avoid costly extra cable removal operations, all fibres should be measured on the reel using an OTDR. Measurements on single-mode fibre cables should be made at user-specified wavelengths or both 1550 nm and 1300 nm.

1. Optical continuity in all fibres.
2. Length of each fibre.
3. The optical attenuation coefficient of each fibre at user-specified wavelengths.

d. **Post-construction measurements** provide assurance that cable placing, splicing, and link construction activities have been completed that will enable the intended transmission system to function properly and to provide support for any future maintenance activities on the link.

The most common post-construction measurements include the following:

- Length of the fibre link
- Attenuation for fibre link
- Splice losses
- Optical return loss
- Reflectance or high loss in link

e. OTDR testing must be done from the point of termination back to node. A few key properties which need to be tested and recorded are below. Please refer to the Frogfoot OTDR Results document.
    i. Project Name.
    ii. Phase, sector and sub-sector reference.
    iii. Link reference.
    iv. Termination box number.
    v. Fibre cable used.
    vi. Measured Optical Length.
    vii. Attenuation at:
        i. 1310nm (db.).
        ii. 1550nm (db.).
        iii. 1625nm (db.).
    viii. Attach a copy of the test results.
    ix. Person conducting the test, the date, and relevant signatures.
    x. Serial number of the machine used.

8.1 Troxler Testing

8.1.1 Troxler to be done as per the Wayleave conditions.

9. Aerial Line Construction.

Survey - Gather Route Information

- The information on this route must accurately indicate distances.
- Take photos of all obstacles on the route (existing services, bridge crossings, rocky areas, buildings, built-up areas, paved/tarred areas, wetlands, overhead obstacles, etc.).
- Identify all obvious landmarks where the route changes direction (take photos).
- Note down any road repair work necessary - record distances and GPS coordinates.
- Provide for a series of DCP test readings along the route and document the exact positions.
- Description of the topography along the route (sloping, edge of cliff, adjacent to lake, forest surroundings, rivers, swampy areas, etc.) - record distances and GPS coordinates.
- Description of the ground condition along the route and distances (rocky, sandy, grassy, clay, etc.) - record distances and GPS coordinates.
- Contractor is responsible to locate possible warehouse/camp sites where material can safely be stored.
- Indicate the availability of hospitals / clinics / police stations along the route - in case required during operational activities.
- Plan the route to allow for projected road or rail deviations.
- Double-check recorded details on the return journey.

Pre-Install Meeting

A pre-install meeting or meetings must be held to discuss the survey results, the optimum pulling sites, span lengths, installation equipment and hardware requirements, logistics, splice locations, terrain, and other vital installation topics.

Checks to be undertaken prior to commencing with the planned aerial work

- Does the contractor have approved aerial route drawings, signed by the client?
- Do the drawings show the alignment of the aerial route within the wayleave specification?
- Are the wayleaves in place? (must always be kept on site).
- Contractor must scan for the locations of existing services.

- Are the aerial route drawings being marked indicated on which side of existing road/pathway to stay?
- Has the accessibility of poles to splicing vehicles been considered?
- Does the cable have a UV resistant cable jacket?

9.1 Tree/Bush Cutting

9.1.1 Public Streets and Thoroughfare.

9.1.1.1 The local authority should perform the cutting or trimming of trees in public streets and thoroughfares whenever satisfactory arrangements can be made.

9.1.1.2 Standing written agreements should be arranged whenever possible.

9.1.1.3 Traffic regulations and road signs must be strictly adhered to.

9.2 Pole Planting

9.2.1 It is desirable to maintain a uniform length of span and depart from it only when this is rendered necessary by such conditions as uneven ground or sharp bends, or to avoid dangerous positions for poles or stays. Preferred span length of 50m must be adhered to.

9.2.2 Selection of pole and stay positions

Survey

- Survey rods must be planted in line at selected pole positions so that, when erected, the poles will be in a straight line.
- A spirit level must be used to verify that there is no lean to the rods.
- As the survey advances, the rear rods used for lining up - will be withdrawn and survey pegs driven into the ground in the exact position previously occupied by the survey rod.
- The location of the poles to be erected along roads shall be in accordance with the way leave drawings and conditions stipulated by the authorities concerned.
- Square wooden pegs shall be used to mark the position of every pole, stay or strut.
- The numbering (or other details) and marking of the wooden pegs shall be done as agreed upon by both the client and contractor.
- The tops of pegs that show the positions of angle poles must be marked with blue lumber crayon crosses.
- A survey peg for a strut position must show the approximate spread of the strut.

In selecting the positions for poles, stays, and struts, the planner should comply with the following requirements:

Obtain the necessary ground clearance at the least cost.

9.2.2.1 Avoid dongas, culverts, drains and other water channels.

9.2.2.2 Avoid obstructing private roads and entrances.

9.2.2.3 Reduce road crossings to a minimum and avoid long oblique crossings.

9.2.2.4 Avoid trees. Where this is impossible, select a position that will result in minimum interference from trees and the minimum of tree cutting even if construction costs are increased slightly by the action taken.

9.2.2.5 Plan the route to allow for projected road deviations.

9.2.2.6 Keep the route as far away as practical from power lines. To add general requirement

9.2.2.7 Select stay positions that will result in the most efficient spread/height ratio (due regard being paid to clearance between wires or projected wires and the stay wire and the least exposure to danger from traffic

9.2.2.8 The principle to be followed in all cases is that neither stays nor poles are to be planted where they are likely to cause obstruction or to be dangerous to users of the road or pedestrians.

Suite 302, Building 20
The Waverley Business Park
Kotzee Road, Mowbray
Cape Town, South Africa

PO Box 12930
Mowbray
Cape Town
7705

Tel: +27 21 448 7225
Sales/Enquiries: ftth@frogfoot.com
Support: support@frogfoot.com

frogfoot.co.za

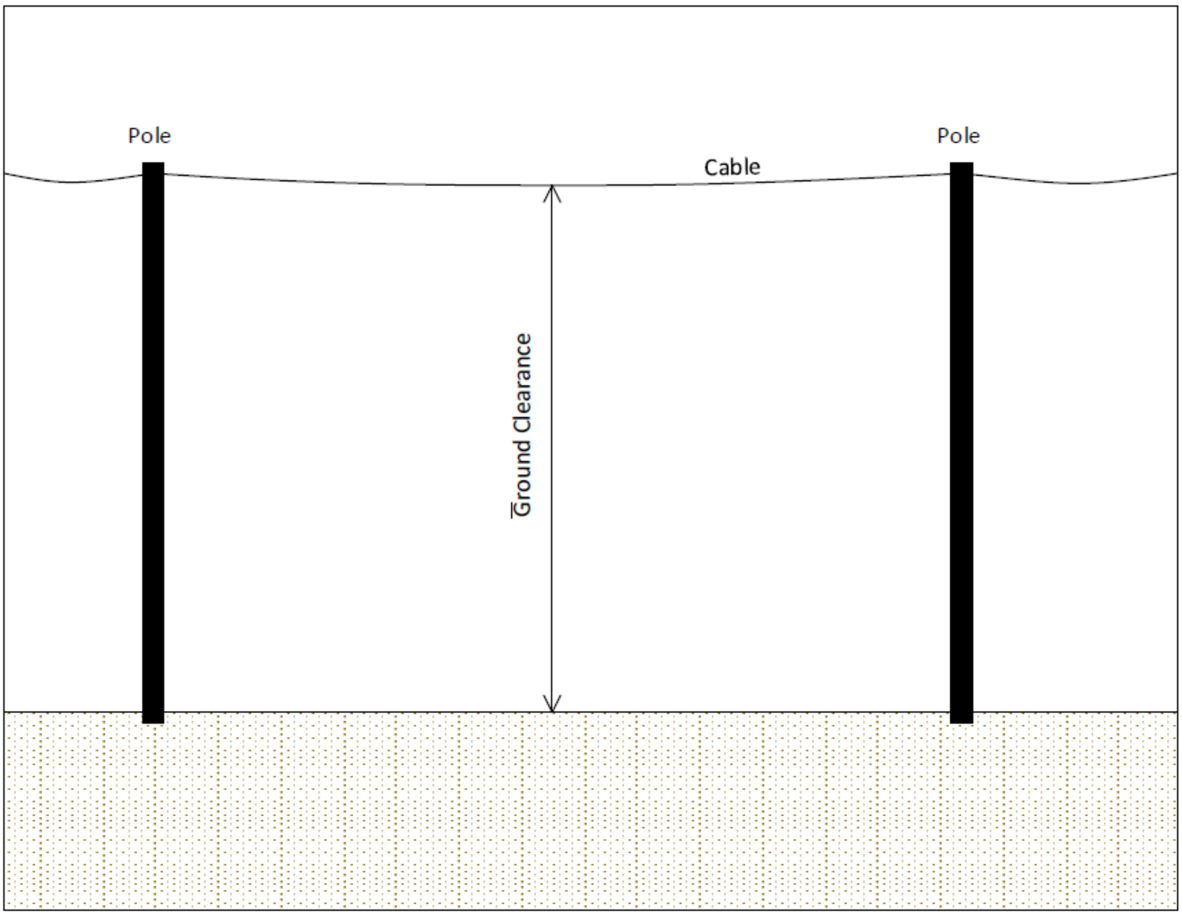
Frogfoot Networks (Pty) Ltd, Reg No. 2006/011693/07

Vertical Clearance

9.2.3 Routes should be so designed that when they are loaded to their maximum capacity and at a conductor temperature of 50 C, the lowest cables (whether open or covered) will have the minimum vertical clearance at the point of least clearance.

9.2.4 Ground clearance of routes

Ground Clearance: The distance between the cable and ground level, measured at any point between 2 poles in a span.



Location of route	Clearance (m)
1. Across any national road	6.5
2. Across abnormal provincial roads	7.0
3. Across other provincial roads.	6.1
4. Across other public roads.	6.1
5. Across street roads other than (2) (3) or (4) above.	5.0
6. Along streets (including midblock), roads or privately-owned railway lines or near towns.	3.7

9.2.5 Cables round a curve

Care must be taken to prevent cables round a curve from hanging over a road. Where this is unavoidable, clearance must be provided as stated in the table.

9.2.6 Double termination.

Cables must be double terminated at the following points.
9.2.6.1 At all angles in the route where the angle in the line exceeds 15°.
9.2.6.2 At all changes in gradient where the vertical angles exceed 8°.
9.2.6.3 At all road crossings (excluding minor roads)
9.2.7 Stays and struts
Stays are of great importance to the stability of a route and their positions should be selected with care. They should generally be provided as follows:
9.2.7.1 On all poles where cables terminate (terminal stays).
9.2.7.2 At all changes in direction of a route (angle stays)
9.2.7.3 Struts should only be used where any kind of stay or unstayed poles set in concrete cannot be provided.

9.3 Excavation of pole holes and the erection of poles

9.3.1 Tools to be used

9.3.1.1 The tools provided for hole-digging include picks, shovels, earth augers, earth scoops and crowbars, and particularly where blasting is required, compressors, drills, and sledgehammers. The tools to be used for any particular work are determined largely by soil conditions but are also influenced by other considerations.
9.3.1.2 On large works, wherever ground conditions permit, full use could be made

of boring machines. (Earth auger) In residential areas only hand digging is permitted.

9.3.2 Excavations

9.3.2.1 Where the ground is very rocky, holes may need to be prepared with the aid of compressors, drills, and sledgehammers.

9.3.2.2 Where the ground is soft, earth augers or earth scoops and crowbars are suitable for digging. These are more economical than picks and shovels and have the advantage of disturbing the ground less. Picks and shovels must be used if baseplates are to be fitted to poles.

9.3.2.3 Pole holes excavated by pick and shovel should normally be oblong in shape with the longer sides in the direction of the route, except at terminal poles, where the longer sides should be at right angles to the route. The holes should not be made wider or longer than is convenient for digging. If the holes are too large, the ground will be unnecessarily disturbed and the stresses on the poles will not be withstood by solid earth.

9.3.2.4 When augers or earth scoops are used, care must be taken to ensure that the holes are dug in their correct positions. Greater accuracy is necessary than with the pick and shovel method, as the size of the hole is smaller and there is less scope for the adjustment of pole positions during alignment.

9.3.3 Planting Depth

The depths to which poles must be planted are as follows:

TYPE OF POLE	DEPTH
6 m pole	0.9 m
7m/ 8m pole	1.2 m
9m and more	1.5 m

9.3.3.1 When a pole is to be planted in sloping ground, the depth of the hole should be measured from the lowest point on the ground surface.

Measuring of hole depth

9.3.3.2 Where the ground is very soft, poles may be planted 300mm deeper than shown above, but only if the necessary vertical clearance will still be within limits.

9.3.3.3 Where poles are planted in soil that is difficult to compact, such as sand, the pole should be cast in concrete. The concrete should be cast so that it has a minimum radius of 400mm around the centre of the pole and to a depth of 800mm

9.3.3.4 In all other cases, and where clearances will be inadequate, additional wind stays should be fitted and the pole planted to the normal depth.

9.3.3.5 Care must be exercised after excavation to prevent loose earth from falling into a hole before the pole is erected in position. Before backfilling a hole, a final check must be made to ensure that the planting depth of the pole is correct. In case of wooden poles, a ready check is provided by the metal discs, which are affixed by the suppliers. These discs are located 3.5 meter from the butt end in respect of poles up to 9.15 meters in length.

9.3.3.6 Ramming of poles - To stabilize pole in loose soil, the filling must be done in three stages and for every stage the soil must be rammed with a pole rammer from the bottom to the top. Backfilling and ramming should take place in 300 mm, 600mm and 300mm intervals respectively.

9.3.4 Erection of poles

Wooden pole inspection (prior to installation)

- Correct type of pole supplied? (length and thickness)
- Excessively bent or cracked poles should never be used. Horizontal cracks perpendicular to the grain of the wood may weaken the pole. One large knot

or several smaller ones at the same height on the pole may be evidence of a weak point on the pole.

- Inspect the pole for evidence of termites or ants.
- Ensure that all poles are fitted with 'end plates' and strapping at both ends.
- The poles should never be off loaded and stacked on the ground for long periods as this could cause damage to the poles as well as the environment.
- Hammer Test (existing poles): Rap the pole sharply with a hammer weighing about 1kg, starting near the ground line – then continue upwards around the pole to a height of approximately 1.5m. The hammer will produce a clear sound and rebound sharply when striking sound wood. Decayed areas will be indicated by a dull sound or a less pronounced hammer rebound.

9.3.4.1 A wooden pole should be erected by laying it on the ground in such a position that by raising the top section, the base should slide into the hole.

9.3.4.2 The side of the hole away from the pole should be protected by a crowbar or steel plate placed vertically so that the pole base bears against it during erection.

9.3.4.3 Lightly loaded wooden poles should have all fittings attached before they are erected.

9.4 Pole Holes

Poles must be buried sufficiently deep for stability. The depth depends on the height of the pole. Check with local authorities to confirm these dimensions.

Length of pole	Plant depth
< 6 m (20 feet)	0.9 m (3 feet)
7 – 8 m (23 – 26 feet)	1.2 m (4 feet)
>9 m (30 feet)	1.5 m (5 feet)

All excavations for pole holes will be such that the survey peg indicates the centre of the hole. If the holes are too large, the soil will be unnecessarily disturbed, and the poles will not be supported by solid earth. (A diameter of approximately 400mm (16 inches) is recommended). Where a hole is dug on sloping ground, the depth of the hole shall be measured from the lowest point on the ground surface. In extreme rocky conditions where holes cannot be excavated to the specified depth, an arrangement between contractor and client can be reached for poles to be set in concrete.

9.5 Pole Spacing

It is advisable to maintain a uniform span length and depart from this only when it is rendered necessary by conditions such as: (1) uneven ground (2) sharp bends (3) or to avoid dangerous positions. This may necessitate the planting of additional poles or omitting of poles. Steel measuring wires for standard span lengths should be made up locally. When the length of span has been chosen the appropriate wire should be used to determine the distance between successive poles. A steel tape measure should be used for checking the length of the measuring wire daily during the survey.

9.5.1.1 Poles must be set to a plumb line, a spirit level being used for the purpose, and they must be aligned correctly. As wooden poles may not be quite straight, extra care should be taken when setting and aligning them. If necessary, a survey rod and spirit level should be used to ensure that there is no leaning in any direction.

9.5.1.2 Angle poles which are not stayed or strutted should be set back slightly against the angle so that they assume a vertical position when the cables are strained. If necessary, a hole must be packed with stones on that side of the pole where the ground must withstand the pull of the cables.

Pole in hole – before backfilling.

9.5.1.3 For ALL poles erected in normal conditions: The backfill material must be mixed with 5kg of cement per pole and well compacted as a dry mix in layers as follows:

9.5.1.4 Mix half of the soil that has been dug out with 5kg of dry cement.


Preparation of Dry mix

9.5.1.4.1 Divide the mixture into two equal portions.
9.5.1.4.2 Use one part of the mixture for a (300 mm) first backfill layer. Compact with a pole rammer.
9.5.1.4.3 Use ordinary soil for (600 mm) backfill. Compact with a pole rammer. (Can be compacted every 300mm).
9.5.1.4.4 Use the remaining mixture as the (300 mm) final layer. Compact with a pole rammer.


Compacting of soil and dry mix completed

9.5.1.5 In very dry & sandy areas - where the soil moisture is very low to zero, some water may be added to moisten the soil before mixing with the cement. Using a dry mixture ensures that 'a permeable crust' is eventually formed around the pole that allows moisture to dissipate and prevent the pole from rotting.

9.5.1.6 'Abnormal conditions' where special procedures apply is with soil in:

9.5.1.6.1 Very sandy conditions (where poles are e.g. cemented in).

9.5.1.6.2 Rocky conditions.

9.5.1.6.3 Very wet or clay conditions.

9.5.1.7 The placing of cement in a dry mix for backfill MUST be adhered to in order to ensure that Safety, Stability and Longevity of the infrastructure is not compromised and may result in future claims against the company and/or installer.

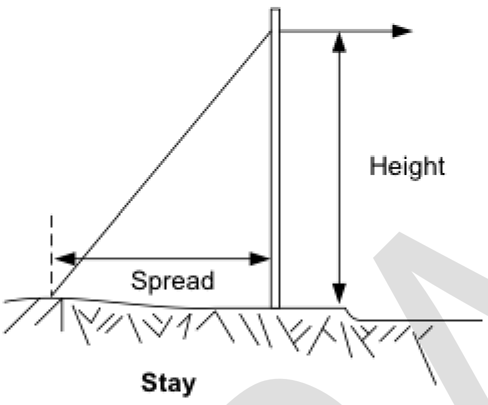
9.6 Suggested Pole Planting Work Practices

- Avoid dongas, culverts, drains or water channels.
- Avoid obstructing private roads and entrances.
- Restrict road crossings to a bare minimum, and if possible, stick to the same side of the road throughout.
- Avoid trees and where not possible, select a position which will minimise interference from trees – even at the expense of construction costs being increased slightly by this action.
- Along national and other proclaimed roads the poles and stays should be located in the position agreed to by the Road Authority and as indicated on the wayleave.
- Keep the route as far away as practically possible from power lines.
- Where the ground is very soft, poles may be planted 300 mm (12 in) deeper than specified, but only if the necessary vertical clearance is maintained.
- Ensure that all holes necessary for pole dressing are drilled prior to erection.
- Maintain a distance of at least 1m from trig beacons and stations.
- The principle to be followed in all cases is that neither stays nor poles are to be planted where they are likely to cause obstruction or to be dangerous to users of the road, or where they are likely to interfere with ordinary road maintenance such as the clearing and trimming of the edges of the road or the cutting of drains, gutters, etc.
- In railway reserves, the poles should be located as close as possible to the

boundary fence.

9.7 Spread/Height Ratio

The spread is the distance from the foot of the pole to the point to where the stay enters the ground.



The height is the distance from the ground to the pole attachment.
Wind stays shall have a spread/height ratio of 0.6:1
Terminal and line stays has a spread/height ratio of 1:1

9.8 The fitting of stays and struts

A stay wire should be terminated on a pole in the positions shown below – 4.2m above ground level

<u>End pole with a stay wire</u>

Pole configuration:

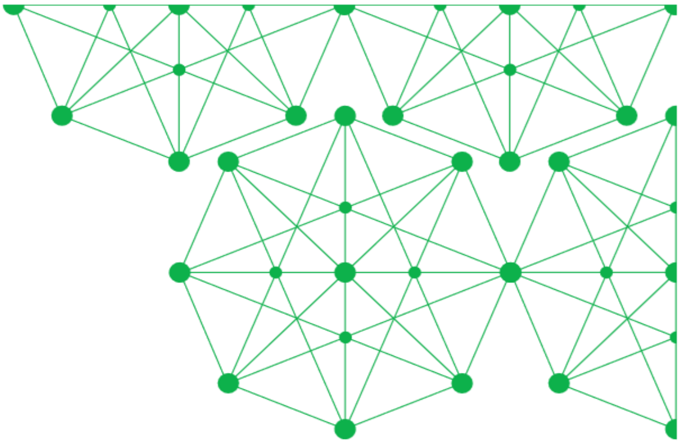
- 6m wooden pole (8m wooden pole at road crossings)
- Stay wire set:

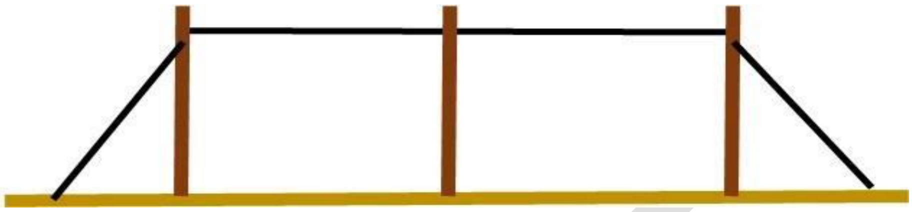
- Double wrap guy grip (top make-off),
    - 5 x 38mm staples (to secure top make-off to pole),
    - Stay wire (same length as pole),
    - Guy marker (to ensure visibility of stay wire)
    - Thimble grip (bottom make-off)
    - Adjustable stay rod
    - Base plate.
    - Stay guard
- Cable hanger with bandit strap clamps
- Cable anchoring clamp – AC10 260
- 5m UV resistant conduit or bosal pipe (25mm for 1 cable, 50mm for 2 cables), secured to pole with 3 x bandit straps (bottom, middle and top)
- PVC sleeve to route cable/s from pole to hand hole

9.9 Types of Stays

8.9.1 Terminal stays

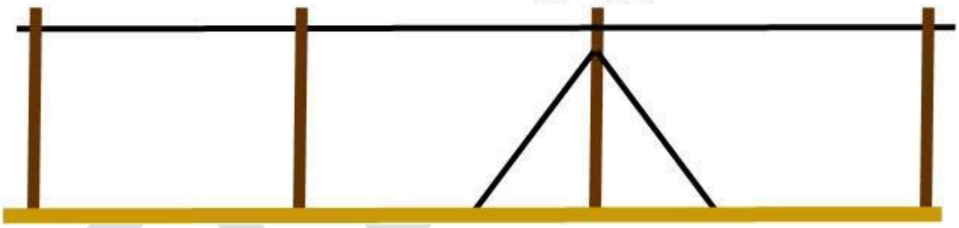
Provided where the route starts and ends. This stay must be on the side of the pole opposite to the direction of the cable route.





8.9.2 Line stays

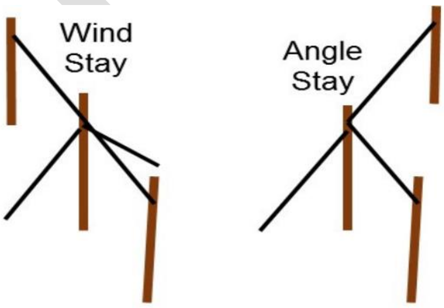
Installed at every 13th pole along the route or spaced alternatively as per specification. Line stays must be installed on poles either side of rivers and road crossings where normal span lengths are exceeded.

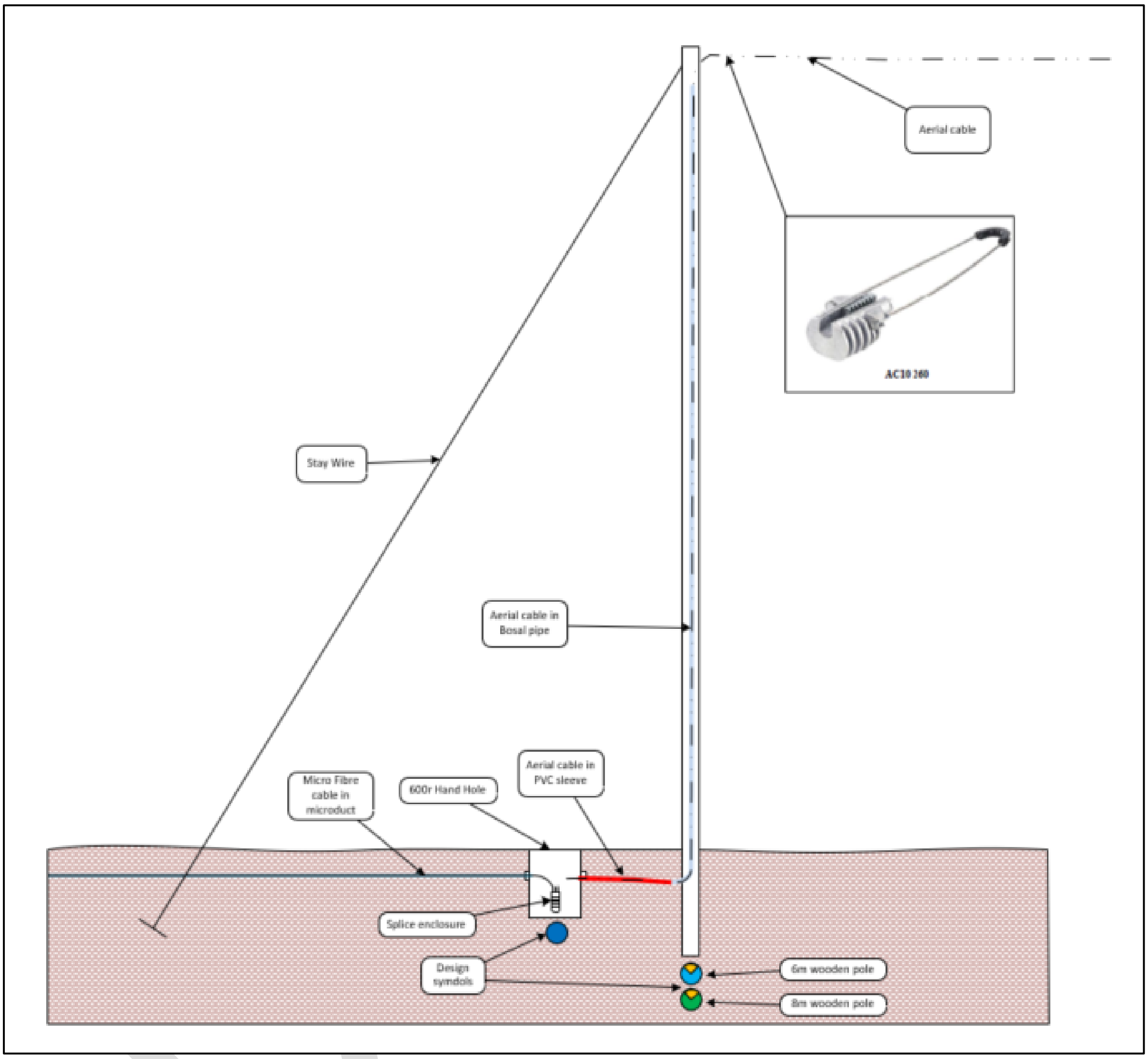


8.9.3 Wind stays & Angle stays

Wind stays are used to stabilize a cable route against wind. Fitted at 90˚ against the direction of the cable route and on either side of a pole.

Angle stays are used to counter-act a change in direction of the cable route by more than 15˚or as per client specs.




Aerial cable
AC10 260
Stay Wire
Aerial cable in Bosal pipe
Micro Fibre cable in microduct
600r Hand Hole
Aerial cable in PVC sleeve
Splice enclosure
Design symbols
6m wooden pole
8m wooden pole

9.9.1 On wooden poles, five 8mm G.S. staple should be used to secure the stay wire.

9.9.2 Stay holes

9.9.2.1 The stay hole should be marked out behind the pole and the hole dug so that the plate bears against undisturbed earth as far as possible. The cross-section of the hole should be confined to the smallest size necessary for ease of excavation and the depth should be such that the unthreaded portion of the rod protrudes 100 mm from ground level (various stay rod lengths)

9.9.2.2 A slot must be cut for the stay rod, which should protrude from the ground and be in line with the pole route in the case of a line stay. It should bisect the angle in the case of an angle stay. The stay should be buried to within 100mm of its threaded end unless ground conditions are exceptionally difficult. The rod must not be bent.

Suite 302, Building 20
The Waverley Business Park
Kotzee Road, Mowbray
Cape Town, South Africa

PO Box 12930
Mowbray
Cape Town
7705

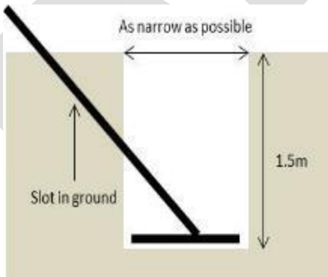
Tel: +27 21 448 7225
Sales/Enquiries: ftth@frogfoot.com
Support: support@frogfoot.com

frogfoot.co.za

Frogfoot Networks (Pty) Ltd, Reg No. 2006/011693/07

9.9.2.3 The ground with a dry mix must be well rammed as it is returned in layers of 300mm into the hole. Where difficulty in consolidating the ground is anticipated, stones should be included with the initial replacements of earth. In exceptional cases may the stays be concreted.

The cross-section of the hole shall be confined to the smallest size necessary to accommodate a stay plate.



The depth of stay holes shall be 1.5 (5 feet) meters or at such a depth where the unthreaded portion of the stay rod protrudes by no more than 25mm (1 in) above ground level. Stay rods without plates may be used where solid rock is encountered. The stay rod is now inserted in a hole drilled into the rock and secured with a chemical anchor. In difficult to dig ground conditions shallower holes are allowed subject to approval and shall then be backfilled using concrete.

9.10 Support pole with a boundary box

Pole configuration:

- 6m wooden pole
- A UV-resistant drop tube will be used to route the 8f drop cable
- The drop tube will be routed in a UV resistant PVC conduit or a bosal pipe – strapped to the pole – for additional protection.

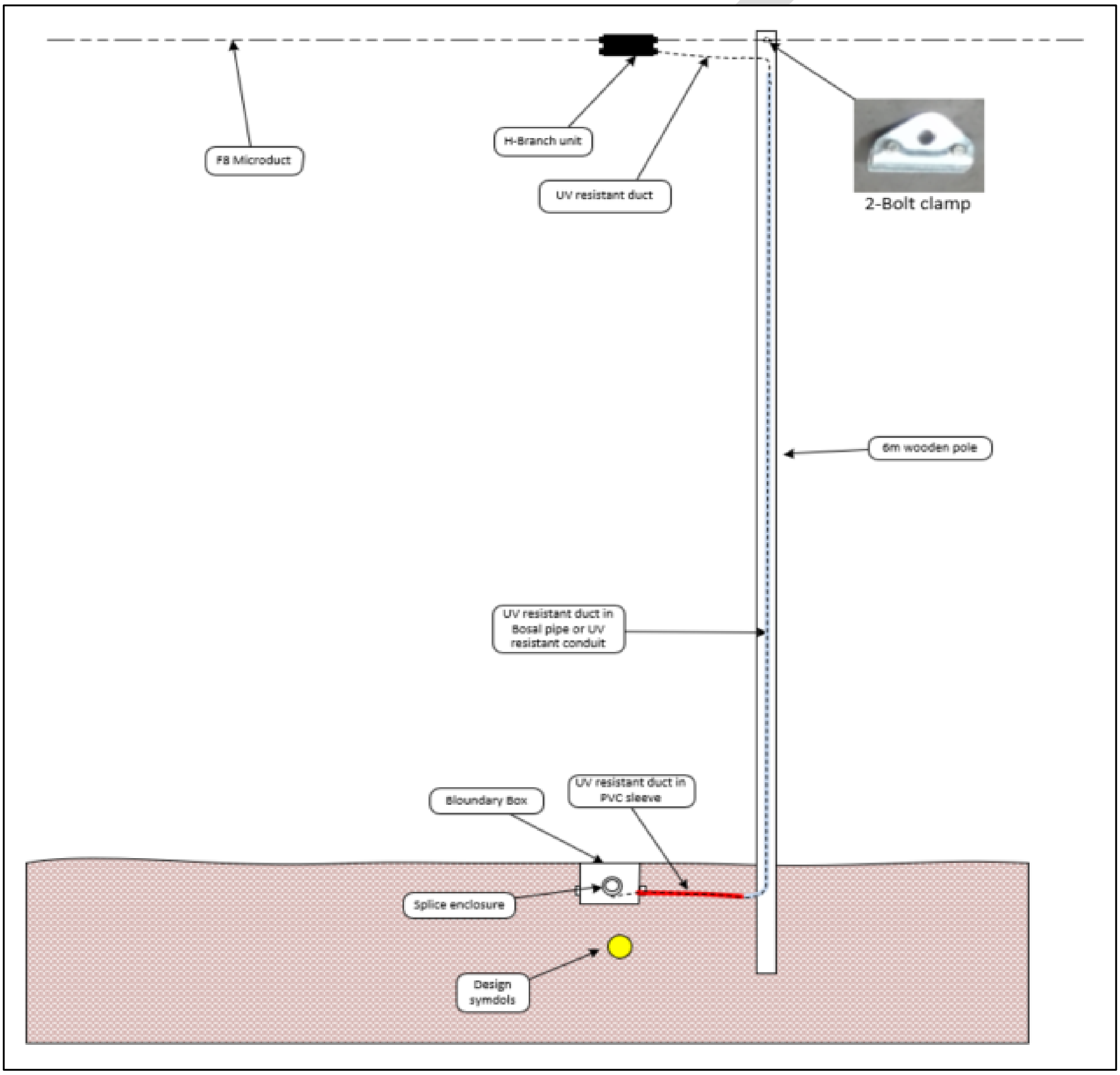


Figure 7: Support pole with boundary box

9.10.1.1 Stay rods without plates may be used where solid rock is encountered. The stay rod should be inserted in a hole drilled into the rock in the line of the stay and secured by chemical anchor. When filling in the hole it is important that the mixture be tamped thoroughly.

9.10.2 Stay guards

9.10.2.1 Stay guards must be fitted on all stays, which are exposed to vehicular or pedestrian traffic.

9.10.2.2 The stay guard must be fitted just above the crosshead to ensure greatest visibility, especially at night.

9.10.3 Termination of stay wire.

9.10.3.1 Top and bottom end make-off must always be used.

9.10.3.2 Use top preformed make off and staple it around the pole with ends meeting together.

9.10.3.3 Twist top preformed make-off around suspension wire, cut a length of suspension wire same as the length of the pole.

9.10.3.4 Place bottom preformed make-off's around the crosshead.

9.10.3.5 Pull tight and cut the suspension wire in line with the crosshead and twist the bottom preformed make- off.

9.10.4 Tightening stay after terminating

9.10.4.1 After the stay wire has been terminated, it should be tightened by means of a stay key – The top end of the stay rod must be flush with the stay rod nut. In order that scope may be left for further tightening of the stay, it is desirable to put tension on the stay wire by means of a draw vice before terminating at the crosshead

Suite 302, Building 20
The Waverley Business Park
Kotzee Road, Mowbray
Cape Town, South Africa

PO Box 12930
Mowbray
Cape Town
7705

Tel: +27 21 448 7225
Sales/Enquiries: ftth@frogfoot.com
Support: support@frogfoot.com

frogfoot.co.za

Frogfoot Networks (Pty) Ltd, Reg No. 2006/011693/07

9.10.5 Struts

9.10.5.1 The length of a strut pole should be such that a terminal should have a spread of 1:1 and that, the butt is buried to a vertical depth of at least, 900mm. Some 1m to 1,1m of strut will then be buried in the ground.

9.10.5.2 For a wooden pole, a strut bracket must be used to attach the top end of the strut pole to the pole.

End pole with a strut

9.11 Strut Accessories configuration:

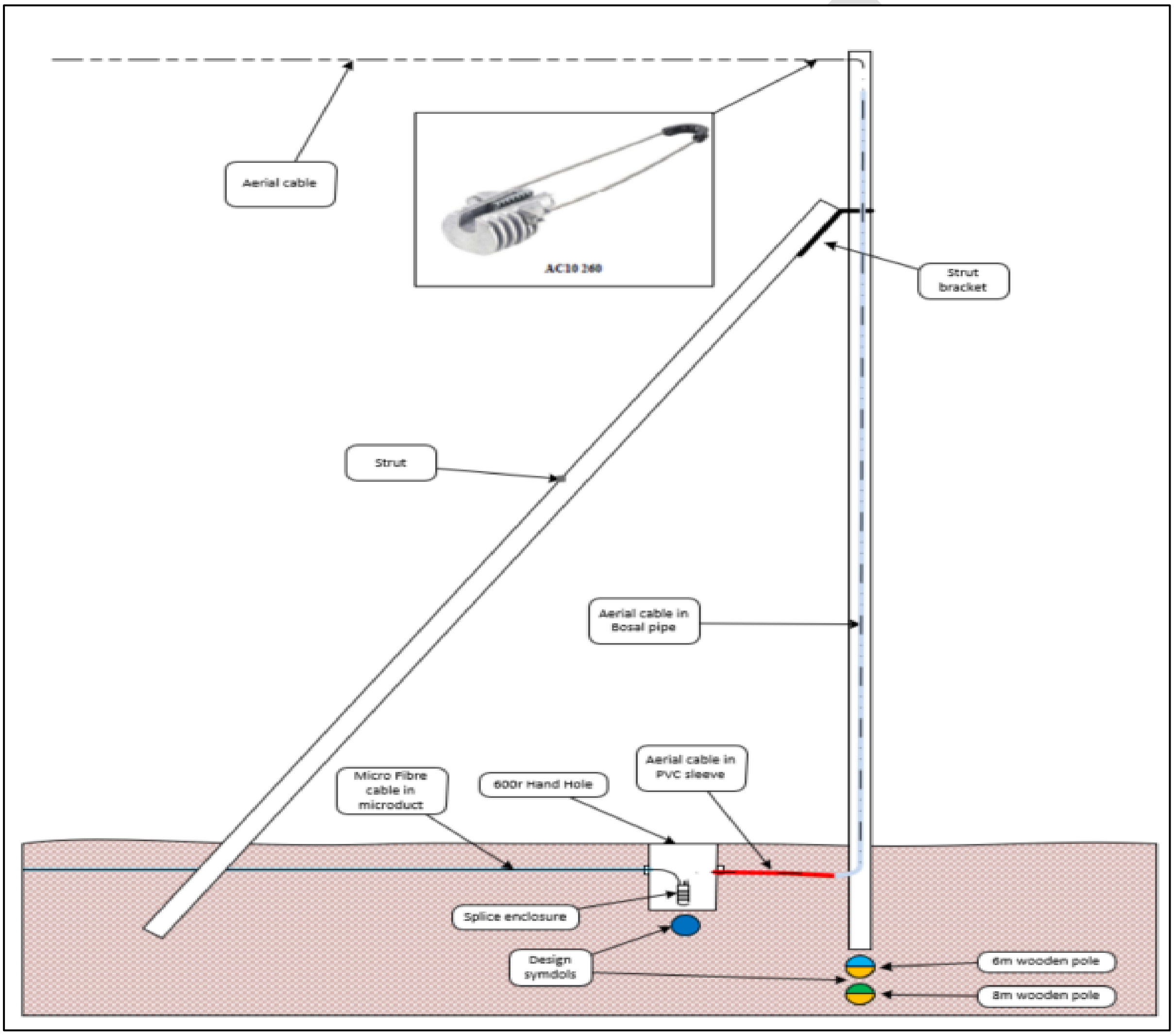
9.11.1 Poles

6m wooden pole (8m wooden pole at road crossings)

9.11.2 Accessories

- Stay wire set
- Double wrap guy grip (top make-off),
- x 38mm staples (to secure top make-off to pole),
- stay wire (same length as pole),
- guy marker (to ensure visibility of stay wire)
- Thimble grip (bottom make-off)
- Adjustable stay rod

- Base plate.
- Cable hanger with 180mm bolt
- Cable anchoring clamp – AC10 260
- 5m UV resistant conduit or bosal pipe (25mm for 1 cable, 50mm for 2 cables), secured to pole with 3 x bandit straps (bottom, middle and top)
- PVC sleeve to route cable/s from pole to hand hole




STO

9.12 Construction of overhead routes with wooden poles

9.12.1 Safety

Aerial cable installation can be hazardous as personnel may be working at a considerable height above the ground on ladders, bucket trucks or even climbing poles and near electrical transmission wires. All workers should have proper training and personal protective equipment before being allowed to work on aerial installations.

9.12.2 Pole Handling Personal Protection Equipment (PPE)

- Safety boots with steel caps.
- Protective clothing with long sleeves.
- Shoulder pads.
- Gloves.
- Hardhat.

9.12.3 Climbing Ladders

- Keep hands free of tools or materials when climbing or descending a pole or ladder.
- Workers climbing up or down ladders must always face the ladder and maintain a 3-point contact. This effectively means that 2-hands and 1-foot or 2-feet and 1-hand must always be on the ladder.
- Ladder must be positioned correctly (1-4 ratio).
- Ladder must be properly secured (lashed and held).
- Ladder must be in a good condition.
- Pole ladder must be used.
- A worker must be correctly positioned on the ladder.
- A safety harness must be worn and secured to the pole once the working position is reached.
- Never climb any pole if the span they support is being placed under tension.

9.12.4 Transportation of Poles

Poles must never exceed the 0.5m vehicle overhang and must have a red flag secured on the overhanging end. Poles that are loaded onto a truck must be purpose built for carrying poles, poles must be secured to ensure that the cargo does not move while it is in transit.

9.12.5 Pole Off-Loading Procedure

Ensure that the removal of any one pole will not cause shifting or rolling of any of the remaining poles.
Step 1: Unfasten the poles.
Step 2: Slide one pole at a time towards the rear end of the vehicle.
Step 3: When the pole reaches its equilibrium point, the persons on the vehicle must raise their end slowly.
Step 4: The persons on the ground slowly pull the pole until 1m of it is left on the back of the vehicle bed.
Step 5: The persons on the ground receive the pole and gently place it on the ground.
A pole must never be dropped on the ground, as this could damage the pole and/or cause injury to team members.

9.13 Pole Handling Ratios

Smaller poles may be handled manually with sufficient personnel available but larger poles require proper mechanical aids.
7m pole =4 people
8m pole =6 people
9m pole = 8 people or a mechanical aid
10m pole = mechanical aid.
11m + pole = mechanical aid

9.13.1 Lengths of Poles

Wooden poles are available in – 6, 7, 8, 9, 10 and 11m lengths and are classified as light duty and heavy duty.

9.13.2 Erecting poles

9.13.2.1 Poles should be erected as described. The S-hooks should be fitted before erection wherever possible. As wooden poles might not be quite straight, care should be taken when setting and aligning them. To aid in checking the depth of planting, wooden poles are supplied with discs affixed 3.5m from the butt end in respect of poles up to 9.1m in length and 3.5m from the butt end for special longer poles.

9.13.2.2 The heavier poles available in a consignment should be used at angle positions, particularly where stays will be attached below resultant positions on the poles. Poles which appear too light for the job should be put aside for use where suitable, e.g. for drop wire support.

9.13.2.3 Wooden angle poles which are not stayed, should be set back slightly so that they assume a vertical position when the line wires are strained. When filling in a pole hole in such cases, the backfill must be firmly rammed with a pole rammer and if necessary, the hole packed with stones on that side of the pole where the ground will have to withstand the pull of the wires.

9.13.2.4 Where angle poles are not stayed and are not set in concrete, their positions should be selected so that staying will be possible later if rendered necessary by the erection of additional wires.

9.13.2.5 Wherever it is necessary to drill or cut wooden poles for the attachment of fittings, the exposed wood must be treated liberally with creosote to protect it from rotting. The butt end of a wooden pole must never be cut.

9.13.3 Clearance

At points where there will be inadequate ground clearance with the normal poles, longer poles must be used.

9.13.4 The use of wooden poles set in concrete

Wooden poles (up to and including 8.0 meters) set in concrete should only be used in the following cases.

- On routes where the planting of stays at small angles, may be difficult or give rise to objections from property owners.
- For distribution purposes in blocks, where the nature of the soil is such

Suite 302, Building 20
The Waverley Business Park
Kotzee Road, Mowbray
Cape Town, South Africa

PO Box 12930
Mowbray
Cape Town
7705

Tel: +27 21 448 7225
Sales/Enquiries: ftth@frogfoot.com
Support: support@frogfoot.com

frogfoot.co.za

Frogfoot Networks (Pty) Ltd, Reg No. 2006/011693/07

that an unstayed pole would lean when two or more drop wires are erected.

- In extreme rocky conditions where the minimum required planting depth cannot be achieved

9.13.4.1 The following table indicates the minimum depth required casting a pole in concrete.

Length of pole	Minimum depth
7m	600mm
8m	800mm

9.13.4.2 Only new wooden poles may be set in concrete. Recovered or existing wooden poles must not be concreted, as much of the preservative will have leached away.

9.13.5 The use of unstayed concreted wooden poles at angles is limited by the following factors:

- Pole size.
- Size of angle.
- Methods of planting poles in concrete

9.13.5.1 Pole Holes

The hole for a pole, which is to be concreted, should be circular in shape. The diameter should be kept to a minimum but must be sufficient to ensure that there will be a radius of 400mm of concrete between the sides of the pole and the undisturbed ground. The hole for an angle pole must be dug so that the pole when planted will be on the correct position.

9.13.5.2 Concrete Mixture

The concrete to be used must be made from a mixture of 1-part cement, two parts sand and five parts crushed stone.

9.13.5.3 Pole Setting

The pole complete with fittings is been put in position and lined-up in the normal manner.

9.13.5.4 Angle Pole

9.13.5.4.1 An angle pole must then be tilted, with a rake of 1 in 26, towards the position where the angle stay would normally be planned.

9.13.5.4.2 The various lengths of poles, planted to correct depth with a rake of 1 in 26, will be set out of the vertical at the top by the following approximate amounts: -

LENGTH OF POLE	SET AT TOP
7,9 meters	250mm
7,3 meters	225mm
6,0 meters	175mm
5,4 meters	150mm

9.13.5.5 Filling of Hole

When the pole has been set correctly, it must be firmly held. Concrete is then poured into the hole to fill it to ground level. The concrete must not be rammed but should be worked around the pole with a light stick.

9.13.5.6 Props

Props, as required, are then placed against the pole to maintain its correct setting. The pole must then be left undisturbed for at least 24 hours, to allow the concrete to set.

9.13.6 To clamp a pipe/U channel to a pole.

9.13.6.1 For new installations, galvanised steel pipe must be used to protect the cables

9.13.6.2 The pipe must extend to 350mm below ground level to protect the cable.

9.13.6.3 Unroll a length of tape enough to fit round the pipe and the pole, slip a buckle over the one side of the tape.

9.13.6.4 Pass the tape around the pipe and pole and pass the loose end of the tape through the buckle on the pole side of the long part of the tape.

9.13.6.5 Bend the end of the tape back and move the buckle along the tape so as to engage with the bent end.

9.13.6.6 Pull the tape tight by hand, place it in the groove in the nose of the tool and grip it between the jaws of the sliding grip.

9.13.6.7 Protect the bare cable on the top of the pole with pieces of cable sheathing to prevent damage to the cable by the steel tape.

9.13.6.8 Tension the tape further by turning the tensioning handle, taking care not to over-tension the tape.

9.13.6.9 Bend the tool back over the buckle to bend the tape at the joint. Release the tension on the handle while bending the tool back to prevent the tape from breaking.

9.13.6.10 Cut the tape by using the build-in cutter on the clamping tool.

9.13.6.11 Remove the tool and hammer the end of the tape and securing clamps on the buckle down to secure the tape end.

9.13.6.12 There must be 3 straps per pole.

9.13.6.13 The buckle must be positioned directly away from the natural position where the ladder will rest against the pole.

9.14 Hauling of overhead optical fibre cable

9.14.1 Preparation of route

Route preparation – planting of poles, with the correct S-hooks fitted and bush cutting – should be completed before starting with the hauling activities.

9.14.2 Installation process - Conventional Method

9.14.2.1 Fit specially designed pulleys for the erection of Optical Fibre Aerial Cable to every pole on the route for the length of cable to be erected.

9.14.2.2 Feed the hauling rope through the pulleys.

9.14.2.3 Make a hauling eye at the end of the cable by removing a piece of the cable sheath (250-300mm), after which the Kevlar of the cable is then wound around the cable and attached to the cable with a 300mm 25/8 heat shrink sleeve.

9.14.2.4 Place the drum with cable at least one span length or 50 metres away from the pole where the cable will go through the first pulley. This would prevent the cable from bending too much while being hauled. Ensure Cable is decoiled in correct direction, indicated on the cable drum. Under no circumstances should the cable be bent.

9.14.2.5 Hook the mechanical fuse to the end of the hauling rope and to the hauling eye of the cable. Hauling can now begin.

9.14.2.6 Cable lengths of up to 5000 m can be erected with one haul if the terrain allows it (flat, straight terrain).

9.14.2.7 Radio Communication between persons at the drum, alongside the cable-end and the hauling gang must be maintained.

9.14.2.8 If a short hauling rope is used, haul the rope through the next lot of pulleys as the rope becomes available during the hauling process.

9.14.2.9 The hauling gang must haul the cable evenly to prevent jerking. The person(s) at the cable drum must "feed" the cable off the drum according to the speed with which the cable is hauled. There must be no strain on the cable between the drum and the first pulley.

9.14.2.10 When hauling the cable, a person with a two-way radio must walk alongside the cable-end to ensure that the cable is not twisting with the rope, especially at angle-poles where the possibility of twisting is greater.

9.14.2.11 Sticking of the mechanical fuse and swivels must be avoided. When the cable starts twisting, hauling must be stopped immediately. The cause of the problem must be pinpointed and rectified before hauling can continue.

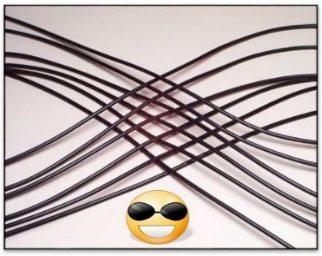
9.14.3 Installation process – Figure 8 Method

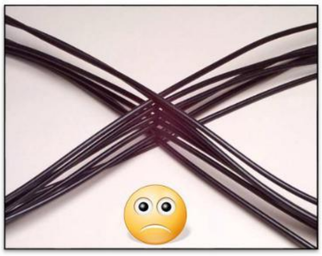
9.14.3.1 Place the drum approximately halfway along a long hauling section to reduce the strain on the cable.

9.14.3.2 Follow steps (1) to (5) as in paragraph 8.7.2.

9.14.3.3 The one half of the cable length is hauled in the one direction.

9.14.3.4 The balance of the cable is then completely run off the drum into a figure 8 on a tarpaulin after which it is then hauled in the opposite direction.





9.15.1.1 Radio Communication between persons at the drum, alongside the cable-end and the hauling gang must be maintained.

9.15.1.2 This method should be used when the terrain is such that the conventional method cannot be used.

9.15.1.3 The figure 8 method should not be used for cables longer than 2500 metres as it becomes risky to manage a bigger coil than 1250 meters of optic fibre cable without damaging the cable.

9.15.1.4 It is recommended that an additional splice should rather be introduced at every 2500 meters if the conventional method cannot be used.

9.15.2 Securing of cable to poles

9.15.2.1 Termination

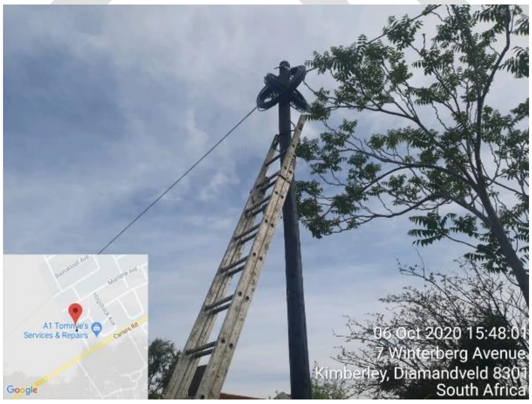
9.15.2.1.1 A DYNAMOMETER or sag gauge, (tension meter), 0- 1000 KG (0- 10KN), must be used to obtain the correct tension (sag) on the cable.

9.15.2.1.2 To terminate the cable at a terminal pole (beginning or end of route), a preformed, galvanised steel thimble type dead-end, is wrapped around the cable and hooked onto a suspension hook.

9.15.2.1.3 Terminate cable with correct size dead-end at 1st terminating pole, leaves 20-meter slack for jointing purpose.

9.15.2.1.4 The jointing slack is then coiled in a 500 mm coil and secured to the pole as high as possible from the ground. Starts coiling by rolling the slack cable like a wheel. This will ensure that no twists are put in the slack, which will result in the fibres being damaged.

9.15.2.1.5 When a route deviates with an angle greater than 10°, the cable must be



terminated as follows:

9.15.2.1.5.1 Fit a triple S-hook on the angle-pole
9.15.2.1.5.2 Wrap a temporary dead-end around the cable beyond the angle-pole.
9.15.2.1.5.3 Hook the one end of the Dynamometer into the thimble of the dead-end and a rope to the other end.
9.15.2.1.5.4 A number of workers must then pull on the rope until the desired tension is obtained.
9.15.2.1.5.5 While the tension is held steady, a person on top of the pole then wraps a dead-end around the cable and hooks it onto the termination hook.

9.15.2.1.5.6 After the cable is terminated, wait for a while plus/minus 10 minutes to allow the cable to stabilise before clamping the cable in the support clamp for intermediate support.
9.15.2.1.5.7 Remove the temporary dead-end from cable.
9.15.2.1.5.8 A dead-end is then wrapped around the cable in the opposite direction and hooked onto the termination hook. See point (8.7.4.1.7) for the loop of the piece of cable between the two dead-ends.
9.15.2.1.6 The same procedure is used where the drum is placed halfway along a hauling section.
9.15.2.1.7 Where a cable is terminated without the termination point being a joint, the loop of the piece of cable between the two dead- ends shall be at least 50mm away

Suite 302, Building 20
The Waverley Business Park
Kotzee Road, Mowbray
Cape Town, South Africa

PO Box 12930
Mowbray
Cape Town
7705

Tel: +27 21 448 7225
Sales/Enquiries: ftth@frogfoot.com
Support: support@frogfoot.com

frogfoot.co.za

Frogfoot Networks (Pty) Ltd, Reg No. 2006/011693/07

from any structure but not more than 70mm.

9.15.2.1.8 To terminate the cable at the far end, follow the same process as described in 8.7.4.1.5.1 to 8.7.4.1.5.5.

9.15.3 Supporting of cable

9.15.3.1 To support the cable at intermediate poles, suspension hooks or triple suspension hooks are fitted to the poles. A tangent support is then wrapped around the cable and hooked onto the suspension hooks.

10 Related Documents

Document Ref.	Document Title

11 Forms

Form No.	Form Title	Rev No.

12 Notes and Attachments

DIT, link results,

13 Safety, Health and Environmental Management (SHE)

9.1 Relevant Documentation

a. Before commencement of any works, the contractor will make themselves familiar with the health and safety requirements of the client (Refer to Frogfoot HSE Plan 12 April 2016 rev 0).

b. All health and safety specifications set out by the client will be read in conjunction with the relevant acts and regulations of occupational safety and environmental compliance, in order of the statutory and regulatory compliance of the contractor during execution of the works. These include, but are not limited:

   i. OHS Act 85 of 1993
   ii. COID ACT 130 of 1993
   iii. NEMA Act 107 of 1998
   iv. Construction Regulations 2014
   v. Frogfoot Waste Management Plan rev0

10.5Frogfoot DIT Results

Project:		**Contractor:**	
Region:		**Date:**	

All testing should be done in accordance the Frogfoot DIT Procedure.

Street Name If Applicable:									
Starting Point (HH/MH Nr):			**End Point (HH/MH Nr):**					**Distance:**	
Duct Size (mm):	**14/10**		**12/10**		**8/5**				
Test Type	**Test Performed**			**Number of ducts tested:**		**Notes:**			
Confirmation: Are the MH/HH and Ducts clearly labelled and neatly packed? Was this duct cleaned using a sponge and lubricant?	Yes	No	N/A						
Air Pressure: The duct will need to pass 10Bar worth of pressure. Did the successfully pass the 10min mark losing no more than 1Bar of pressure per 5min?	Yes	No	N/A						
Obstruction & Blockages: The duct will need to be pressurized to 5 Bar. For a 14/10 or a 12/10mm duct, the 5m dart should be used. For an 8/5mm duct, a	Yes	No	N/A						

4.2mm ball bearing will need to be used. Did the dart/ bearing make it the other end free of obstructions?					

Street Name If Applicable:					
Starting Point (HH/MH Nr):			**End Point (HH/MH Nr):**		**Distance:**
Duct Size (mm):	**14/10**		**12/10**	**8/5**	
Test Type	**Test Performed**			**Number of ducts tested:**	**Notes:**
Confirmation: Are the MH/HH and Ducts clearly labelled and neatly packed? Was this duct cleaned using a sponge and lubricant?	Yes	No	N/A		
Air Pressure: The duct will need to pass 10Bar worth of pressure. Did the successfully pass the 10min mark losing no more than 1Bar of pressure per 5min?	Yes	No	N/A		
Obstruction & Blockages: The duct will need to be pressurized to 5 Bar. For a 14/10 or a 12/10mm duct, the 5m dart should be used. For an 8/5mm duct, a	Yes	No	N/A		

4.2mm ball bearing will need to be used. Did the dart/ bearing make it the other end free of obstructions?					

Date:		**Signature:**	
Contractor Representative:			

Date:		**Signature:**	
Frogfoot Representative:			

10.6Frogfoot Fibre Handover

FROGFOOT LINK HANDOVER			
Client & Access Site Particulars		**Source Particulars**	
Project Number:		**Access Circuit:**	
Client / Company Name:		**Source Name:**	
Office Park & Building Number:		**Office Park & Building Number:**	
Floor (if Applicable):		**Floor (if Applicable):**	
Street Address:		**Street Address:**	
Region:		**Region:**	
Link Termination (e.g. Server Room):		**Location of POP (e.g. Basement):**	
Number of Fibres:		**Ports:**	
Ports:		**Row:**	
Termination Box		**Tray:**	

Frogfoot
Just connect

Number:				
Mid-Couplers Type (e.g. PC/APC):		**ODU Number:**		
Landlord Approval:		**Mid-Couplers Type (e.g. PC/APC):**		
Backhaul Ordered:		**Type of Node (e.g. Passive, AE, GPON):**		
Materials Ordered:		**Wayleaves:**	**Yes/No**	**Expiration Date**
		Electrical department:		
		Roads and storm water:		
		DFA:		
		Eskom:		
		Telkom:		
		Neotel:		
		Citi Telecoms:		
		Bulk water:		
		Water Sanitation:		
		High Voltage:		
PMO ACCEPTANCE				
Frogfoot Representative:		**Date:**		
Designation:		**Signature:**		
Contact Number:				
OTDR TEST RESULTS				
Fibre 1		**Fibre 2**		
Measured Optical Length (km):		**Measured Optical Length (km):**		
Attenuation at 1310nm (db):		**Attenuation at 1310nm (db):**		
Attenuation at 1550nm (db):		**Attenuation at 1550nm (db):**		
Attenuation at		**Attenuation at**		

1625nm (db):		1625nm (db):	
Fibre 3		**Fibre 4**	
Measured Optical Length (km):		Measured Optical Length (km):	
Attenuation at 1310nm (db):		Attenuation at 1310nm (db):	
Attenuation at 1550nm (db):		Attenuation at 1550nm (db):	
Attenuation at 1625nm (db):		Attenuation at 1625nm (db):	
Person Conducting Test:		Date of Test:	
Serial Number of OTDR:		Results Attached (YES/NO)	
PROVISIONING MANAGER ACCEPTANCE			
Frogfoot Representative:		Date:	
Designation:		Signature:	
Contact Number:			