

 <b>UNSERE GRÜNE GLASFASER</b>	FTTF CONSTRUCTION GUIDELINES	TECHNICAL NORMATIVE	DECEMBER 2023 5 <sup>th</sup> Edition
		<b>TEF-NORM-00008</b>	Page 1/33

# FTTF CONSTRUCTION GUIDELINES

	<b>FTTF CONSTRUCTION GUIDELINES</b>	TECHNICAL NORMATIVE	DECEMBER 2023  5 <sup>th</sup> Edition
		<b>TEF-NORM-00008</b>	Page 2/33

## INDEX

<b>1.</b>	<b>INTRODUCTION .....</b>	<b>4</b>
1.1	REVISIONS.....	4
<b>2.</b>	<b>FIBER TO THE FENCE (FTTF).....</b>	<b>6</b>
<b>3.</b>	<b>PRELIMINARY WORKS.....</b>	<b>7</b>
<b>4.</b>	<b>GENERAL CRITERIA TO SELECT THE UBICATION OF THE FTTF POINT .....</b>	<b>8</b>
<b>5.</b>	<b>CONSTRUCTIVE TECHNIQUES FOR FTTF .....</b>	<b>11</b>
5.1	FLEXIBLE DRILLING.....	11
5.2	RIGID DRILLING .....	12
5.3	MINING.....	13
5.4	IMPACT ROCKET/MOLE.....	15
<b>6.</b>	<b>CONSTRUCTION RECOMMENDATIONS FOR FTTF .....</b>	<b>16</b>
6.1	FTTF - SAME SIDE – CLOSE TO TRENCH.....	16
6.2	FTTF - SAME SIDE – FAR FROM THE TRENCH (BETWEEN 1 AND 3 METERS).....	18
6.3	FTTF – OTHER SIDE.....	20
6.4	FTTF - CLOSE TO BUILDING FOUNDATION.....	23
<b>7.</b>	<b>FTTF POINTS (INVENTORY AND DETECTION).....</b>	<b>24</b>
7.1	USE OF ELECTROMAGNETIC MARKERS FOR THE FTTF LOCALIZATION .....	25
7.1.1	<i>INSTALLATION OF THE ELECTROMAGNETIC BALL MARKERS .....</i>	<i>26</i>
7.1.2	<i>INSTALLATION OF ELECTROMAGNETIC END-CAP MARKERS (KIT-VERSION).....</i>	<i>27</i>
<b>8.</b>	<b>CUSTOMER CONNECTION FROM THE FTTF POINT .....</b>	<b>29</b>
8.1	LOCATION OF THE DUCT .....	29
8.2	RECOVERING OF THE DUCT .....	29

	<p style="text-align: center;">FTTF CONSTRUCTION GUIDELINES</p>	<p style="text-align: center;">TECHNICAL NORMATIVE</p>	<p style="text-align: center;">DECEMBER 2023 5<sup>th</sup> Edition</p>
		<p style="text-align: center;"><b>TEF-NORM-00008</b></p>	<p style="text-align: center;">Page 3/33</p>

8.3 FTTF POINT IS NOT THE BEST TO COMPLETE THE DROP..... 30

8.4 FTTF POINT IS NOT VALID TO COMPLETE THE DROP ..... 31

**ANNEX 1: FTTF FOR MDU WITH BETWEEN 6 AND 12 HOMES..... 32**

**ANNEX 2: FTTF FOR MDU WITH MORE THAN 12 HOMES ..... 33**

	<b>FTTF CONSTRUCTION GUIDELINES</b>	TECHNICAL NORMATIVE	DECEMBER 2023  5 <sup>th</sup> Edition
		<b>TEF-NORM-00008</b>	Page 4/33

## 1. INTRODUCTION

This document describes in detail the technical specifications for the fiber to the fence (FTTF) construction of pipeline systems for the optical fiber deployment of Unsere Grüne Glasfaser (UGG) regarding the work to be performed.

The Contractor must comply with all the requirements that are written in this document.

The construction of the FTTF must be carried out in accordance with the executive project, the legislation and the recommendations included in this document regarding:

- The technique used for carrying out FTTF works,
- The method of laying the microduct,
- The inventory and detection of FTTF points

The following indications must be considered:

- All materials must conform to UGG specifications and approvals.
- Materials must be protected by suitable packaging both during transport and for the established storage period.

Before to start any civil work or excavation, the contractor should have all the necessary permits from the competent authority.

### 1.1 REVISIONS

EDITION	DATE	REVISED SECTIONS	CHANGES	OBSERVATIONS
1 <sup>st</sup>	FEBRUARY 2022			
2 <sup>nd</sup>	MARCH 2022	7.1 Use of electromagnetic markers for the FTTF localization	Added spike type marker  Added markers installation procedure	
3 <sup>rd</sup>	MARCH 2022	6.2 FTTF – Same side – Far from the trench (between 1 and 3 meters)	Flexible drilling from the trench is only possible when using end-cap markers.	
		7.1 Use of electromagnetic markers for the FTTF localization	Deleted spike type marker  Added kit version of the end-cap marker  Added possibility of using ball markers when drilling	

EDITION	DATE	REVISED SECTIONS	CHANGES	OBSERVATIONS
3 <sup>rd</sup>	MARCH 2022	7.1.1 Installation of the electromagnetic ball markers	Added possibility of using ball markers when drilling	
		7.1.2 Installation of electromagnetic end-cap markers (KIT-version)	Added kit version of end-cap marker. Added installation of end-cap marker when mining.	
		8.1 Location of the duct	Detailed explanation of marker detection and digging point.	
		8.2 Recovering of the duct	Added the recovering of the marker if it is possible	
4 <sup>th</sup>	AUGUST 2022	2 Annexes are added to cover the cases of FTTF in MDUs with big fiber counts: Annex 1 for MDU between 6 and 12 homes, Annex 2 for MDU with more than 12 homes.	Added the explanation of the procedure to follow for MDUs cases.	
5 <sup>th</sup>	DECEMBER 2023	All	New codification of the document	The document is codified with the document code: TEF-NORM-00008. The logo of UGG is updated in the page header. References to other documents are included.
		6.2 FTTF – Same side – far from the trench	Deleted the use of mining in this case	
		6.3 FTTF – Other side	Deleted the use of mining in this case	
		7.1 Use of electromagnetic markers for the FTTF localization	End-cap marker (Plug&Play) is included	

	FTTF CONSTRUCTION GUIDELINES	TECHNICAL NORMATIVE	DECEMBER 2023  5 <sup>th</sup> Edition
		<b>TEF-NORM-00008</b>	Page 6/33

## 2. FIBER TO THE FENCE (FTTF)

**The fiber to the fence (FTTF)** consists of making a **partial installation of the drop section** up to the fence for **houses without a signed contract**. The partial drop installation is made reaching the private soil with the network, avoiding in the future to open the public soil again when it is needed to connect the house.

The FTTF is based on leaving a microduct or microducts reserved and buried inside the private soil of the property (only a few centimeters inside the private area). All the microducts must be properly sealed in their ends by using a microduct end-cap or by an end-cap type electromagnetic marker (depending on the case). The land surface of the owner must not be damaged, so **only underground works must be done**.

The points where the microduct is finished must be localizable in the future, so an electromagnetic marker will be installed, and the point must be inventoried and register with GPS coordinates.

	<b>FTTF CONSTRUCTION GUIDELINES</b>	TECHNICAL NORMATIVE	DECEMBER 2023  5 <sup>th</sup> Edition
		<b>TEF-NORM-00008</b>	Page 7/33

### 3. PRELIMINARY WORKS

This section describes the construction procedures to be followed by the contractors in the execution of the FTTF points. In general, several important points will have to be taken into account for the correct implementation of the fiber optic deployment:

- All available data on buried services in the area of action should be consulted. If these are not available, both the local authority and the suppliers responsible for the previous installation of buried services should be consulted.
- Definition of the drop section position in each house, using affected services plans and visual inspection of each case.
- Before starting to carry out the work with the corresponding trenches, ditches, wells, etc. a tour of the planned installation area must be carried out using a GPS to locate and document the locations. Depending on the results obtained, the planned execution has to be adapted, either by layout or by the method to be used.
- Approximately one week before starting the civil works, the FTTF points must be marked in the soil (mark in public soil, not in private) with spray to make easy the execution for the civil works teams avoiding misunderstanding and taking decision on-sites.



**Figure 1. Spray marking FTTF points.**

**NOTE:** it is not needed to explain in advance the FTTF to the owners. Only if the sprays marks generate consults from the property owners, and they suggest other points after the explanation of its use, the FTTH point could be reconsidered according to their indications.

- The data obtained must be uploaded to the IT application provided by UGG.

**It is important to understand that the FTTF must allow UGG to connect each home in the future without opening the public soil.**

	FTTF CONSTRUCTION GUIDELINES	TECHNICAL NORMATIVE	DECEMBER 2023  5 <sup>th</sup> Edition
		<b>TEF-NORM-00008</b>	Page 8/33

#### 4. GENERAL CRITERIA TO SELECT THE UBICATION OF THE FTTF POINT

The ubication point for the FTTF must be selected carefully in such a way that it can be used successfully in the future once the house has to be connected. This point must be chosen by the contractor, following the next rules (in order of priority):

1. Detect the point of entry of the telephone/television line into the building. This point is very likely to be the one chosen by the user, because of the similarity of service criteria used in the installation. This information can be obtained from Deutsche Telekom or from the provider of the TV line, which can be obtained from the municipality. If it is not available that way, it will be necessary to look to the façade of the building.
2. Locate the garage of the building, considering that the access from this point should be the easiest to execute and would have been the one chosen in the past.
3. If a window or a half-buried door is located along the façade, this point will be easy to access and indicates the existence of an accessible zone. Therefore, the perpendicular point closest to the trunk should be chosen.
4. If no more information is available, choose the perpendicular point, i.e. the point with the shortest distance to the middle of the building front.

The above points stablish the first reference to select the FTTF point, but other circumstances must be considered to simplify the execution of the FTTF and the posterior use of it.

This other circumstances can have in some cases preference and prory to the first ones, and in other cases, only are applicable if the deviation is small.

1. **The surface of the soil where the future FTTF must be done:** the FTTF recovery process in the future will be more difficult or easy to do depending on the type of surface.

The prioritization should be:

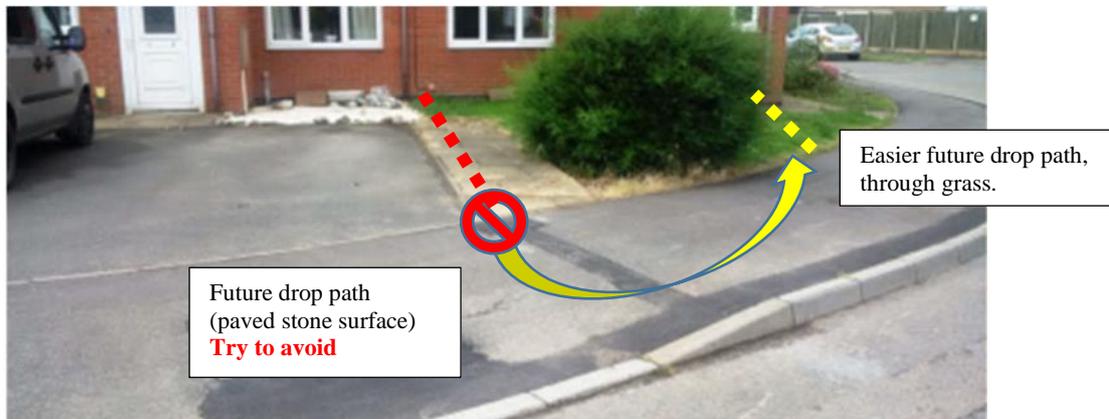
1<sup>st</sup> preference is to do on grass, or ground if it is possible.

2<sup>nd</sup> paved surface

3<sup>rd</sup> and the last option asphalt. The asphalt surface restorement should be avoided if it is possible.

Of course this criteria cannot prevail over the first list, because the most important thing is to have the possibility of using the FTTF point in the future.

	<b>FTTF CONSTRUCTION GUIDELINES</b>	TECHNICAL NORMATIVE	DECEMBER 2023 5 <sup>th</sup> Edition
		<b>TEF-NORM-00008</b>	Page 9/33

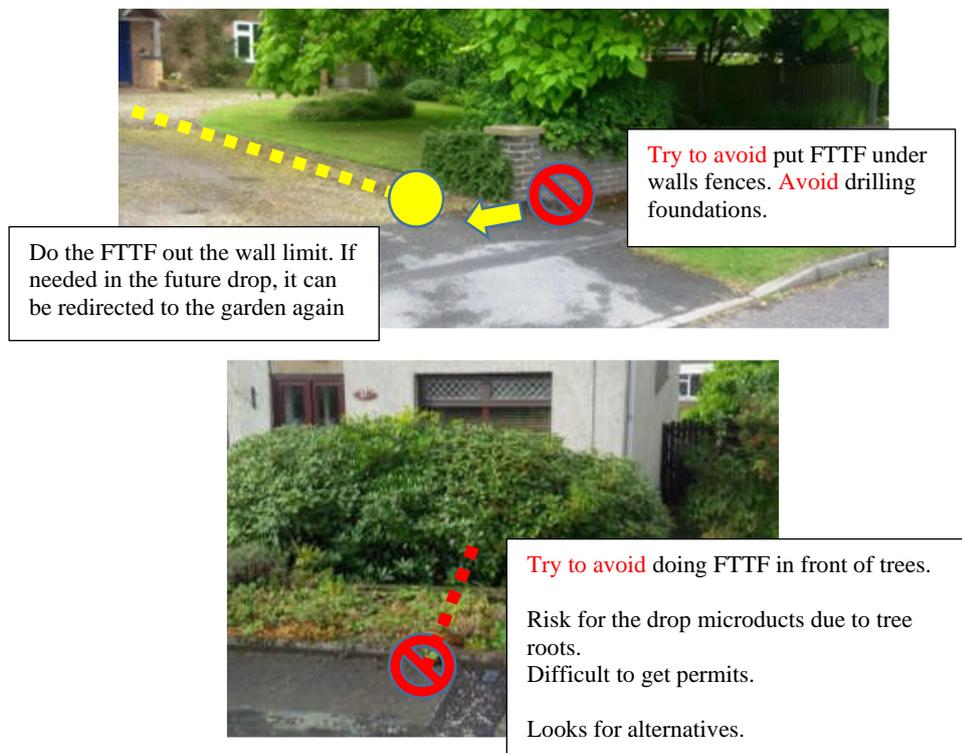


**Figure 2. FTTF example that the surface must be considered.**

**2. Obstacles in the future path between FTTF point and estimated house entry drilling point.**

The FTTF must not be done in front of obstacles that can affect the laid of the drop microduct in the future. Avoid trees (roots can affect), treated gardens (difficult that the owner accept to damage), large rocks that naturally come out of the ground or walls fences.

This case prevail over all the cases, because it is possible that it makes the FTTF point not usable in the future.



**Figure 3. FTTF examples to avoid path obstacles.**

	<p>FTTF CONSTRUCTION GUIDELINES</p>	<p>TECHNICAL NORMATIVE</p>	<p>DECEMBER 2023 5<sup>th</sup> Edition</p>
		<p><b>TEF-NORM-00008</b></p>	<p>Page 10/33</p>

3. If there is a possibility, the FTTF point must be done close to pedestrian paths or road entries to the garage. This could facilitate the the drop microduct laid, following a parallel path to reach the house.



**Figure 4. FTTF example to follow pedestrian paths.**

	FTTF CONSTRUCTION GUIDELINES	TECHNICAL NORMATIVE	DECEMBER 2023 5 <sup>th</sup> Edition
		TEF-NORM-00008	Page 11/33

## 5. CONSTRUCTIVE TECHNIQUES FOR FTTF

This section aims to outline the different methods to be used in the implementation of FTTF points.

### 5.1 FLEXIBLE DRILLING

The first method to use, whenever possible, is the flexible drill. Due to the flexible drill bit, the drill can be tilted so that the drilling point can be accessed in a confined space, e.g. a traditional trench without a starter shaft.

**NOTE:** for the application of the flexible drilling, the soil must be soft enough. Hard soils are not valid for this technique.

The main characteristics are set out below:

- Machinery to be used: Drilling machine with flexible and extendable drill bit. For the execution, it is only necessary to have a drilling machine, which for reasons of agility should preferably be battery powered.
- Space required for start-up: 30 cm.
- The limitations of the method are:
  - The first drill bit is used to drill a hole, then the next drill bit is attached and so on. It may not be rigid enough to drill through stones/rocks, so this is a limitation.
  - After drilling, the microduct (with the electromagnetic marker attached) is inserted by pushing it in by hand. To prevent the walls of the borehole from being collapsed, the microduct must be inserted immediately after the borehole itself has been completed.
  - Another point to note is the possibility of being able to control the distance of the drill by coupling many drill bits, although in the case of FTTF installation, this should not present any problems due to the short distances to be overcome (<50cm). Adding the initial distance, it will be possible to overcome a distance of several meters, in a way that is sufficient for the placement of the FTTF point.

An assembly of machinery with accessories of a Flexible-Drilling is shown in the following figure:



Figure 5. Flexible-Drill-Kit and battery drill.

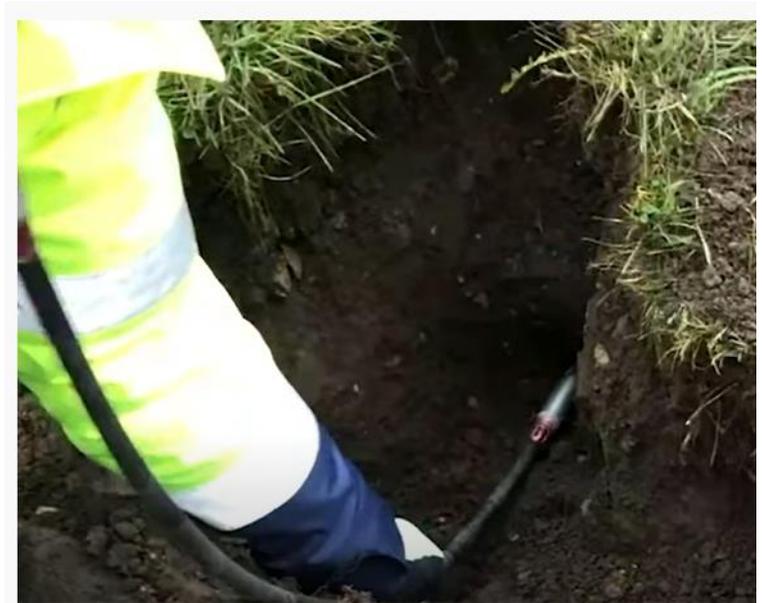


Figure 6. Flexible drill starting points examples.

## 5.2 RIGID DRILLING

Rigid drilling consists of drilling a borehole from a well or a trench duly enlarged on its sides. For the FTTF application, the borehole is drilled with a diameter of approximately 2.5 cm until a length of 50 cm is reached.

After drilling, the microduct (with the electromagnetic marker attached) is inserted into the borehole by pushing it in by hand. To prevent the collapse of the borehole, it must be installed immediately after the borehole itself has been completed.

For the execution, it is only necessary to have a drilling machine, which for reasons of agility should preferably be battery powered.

In the following image, a layout is shown schematically:

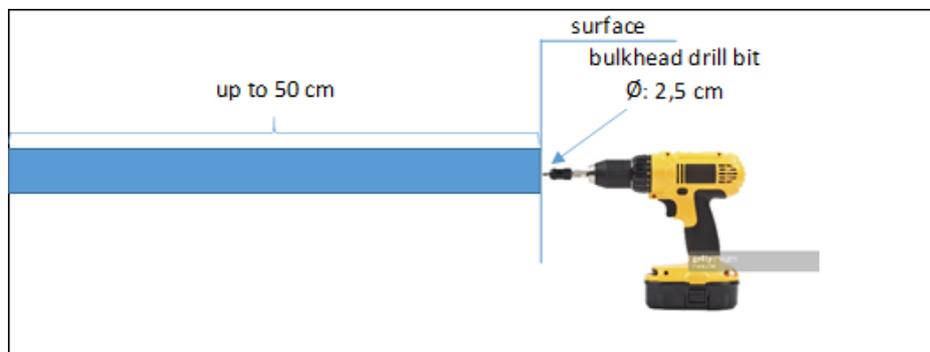


Figure 7. Geometric diagramm of rigid drilling.

	<p>FTTF CONSTRUCTION GUIDELINES</p>	<p>TECHNICAL NORMATIVE</p>	<p>DECEMBER 2023 5<sup>th</sup> Edition</p>
		<p><b>TEF-NORM-00008</b></p>	<p>Page 13/33</p>



**Figure 8. Real example of rigid drilling execution for FTTF point.**

### 5.3 MINING

Mining is a method that basically consists of opening a cavity perpendicular under-ground. If the trunk runs on the owner's side of the property, the FTTF point can be executed by hand-mined excavation.

To this end, the following points should be considered:

- The cavity must have sufficient volume to introduce store a 20 cm coil (and the ball marker in the center of the microduct coil), so a depth of 20 cm and a diameter of 20 cm should be planned.
- The method is easily applicable, whenever natural soil is found under the surface of the private domain. Therefore, it presents the quickest and most eco-efficient solution to apply in these conditions.
  - It is not needed special tools for this application. The tools necessary for its execution is part of the usual tools present on a construction site: hammer, mallet, trowel, buckets, pick, shovel, etc.
  - It is not needed additional space to execute the works if the FTTF is close to the trench.
- In cases where the garden is directly in soft soil, backfilling is carried out with sand and excavated material using shovels or trowels and a longer compaction is needed by using a compaction machine. The compaction machine can even been tilted to reach the greatest possible depth of the "mining". Generally, it is estimated that, given the short distances, manual compaction (inserting sand/excavation material with subsequent compaction with hammers, sledgehammers) will be sufficient. This procedure, well executed, is considered sufficient due to the small distance.



**Figure 9. Mining execution for FTTF (mining with pick and shovel).**

In the next images, it is possible to see a FTTF point executed by mining before the backfilling process.



**Figure 10. FTTF point realized by mining (close to the trench).**

In the backfilling process, **it is important to pay special attention to the compaction in this area** and make it at an angle that helps to fill correctly the generated cavity generated to minimize possible risks of subsidence.

	FTTF CONSTRUCTION GUIDELINES	TECHNICAL NORMATIVE	DECEMBER 2023 5 <sup>th</sup> Edition
		<b>TEF-NORM-00008</b>	Page 15/33

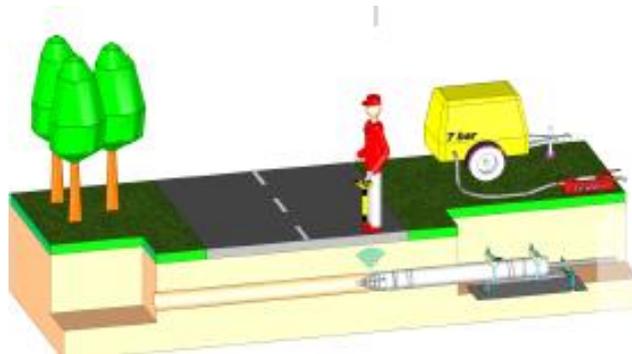
#### 5.4 IMPACT ROCKET/MOLE

Other method that could be used to perform the FTTF is the impact mole. This machinery can be applied also for street crossings when it is necessary.

The execution of the road crossings should preferably be carried out using the "Impact Rocket/Mole" method. In this case, it is necessary to execute two pits, a starting pit in which the machinery is introduced and a second pit at the destination.

The destination pit can be located in the area adjacent to the private domain of the future user (the FTTF point). As they are located very close to this private property, the FTTF can subsequently be completed using the same machinery. Also, it is possible to use one of the methods described above, depending on the circumstances encountered.

The following figure is a schematic diagram of how the method "Impact Rocket/Mole" works:



**Figure 11. Functional scheme of "Impact Rocket/Mole" drilling.**

Anyway, there are some conditions to cope with, to apply this method.

- As the method is of the type of steerable drilling, the soil characteristics must be suitable for the method.
- A second condition is the presence of other buried installations in the street to cross. Such as water supply, sewage, gas, etc. If it is not very clear where those services are located, it will be required to execute a crossing by traditional trench.

If it is not feasible to apply this method due to the characteristics of the terrain and/or the existence of other underground services, the traditional trench method must be used.

	<b>FTTF CONSTRUCTION GUIDELINES</b>	TECHNICAL NORMATIVE	DECEMBER 2023 5 <sup>th</sup> Edition
		<b>TEF-NORM-00008</b>	Page 16/33

## 6. CONSTRUCTION RECOMMENDATIONS FOR FTTF

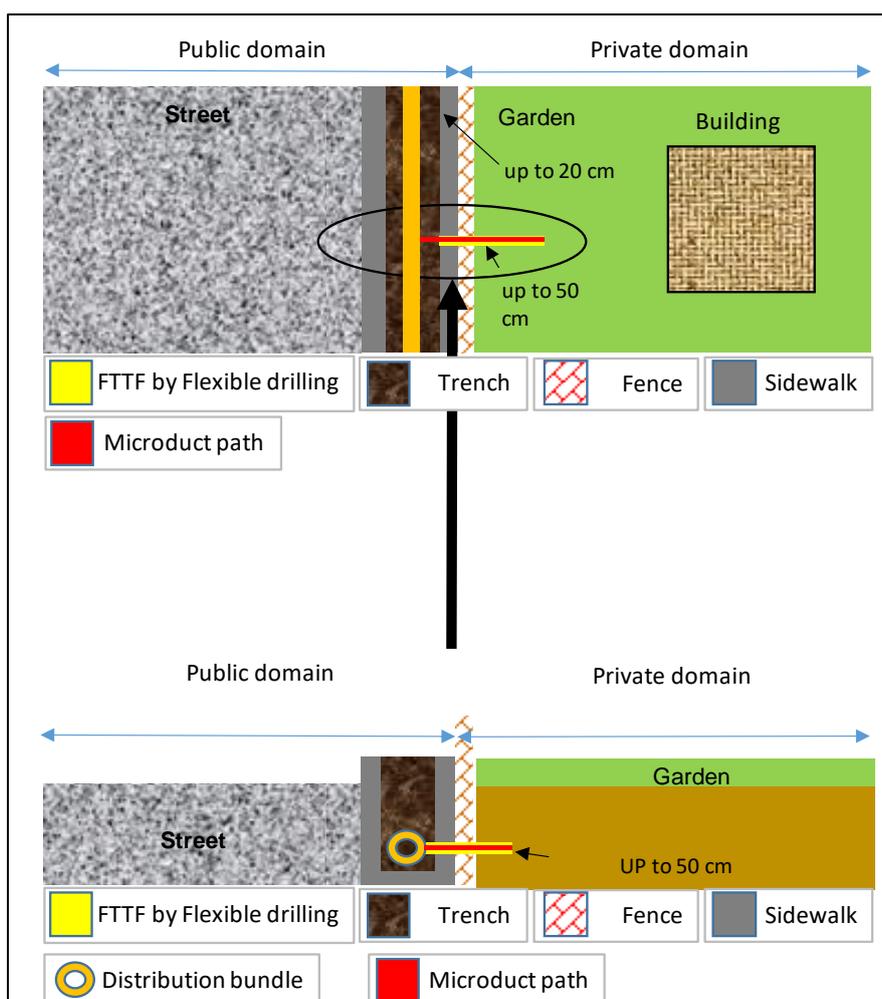
Depending on the situation, different cases must be distinguished to normalize the way in which the FTTF works must be done.

### 6.1 FTTF - SAME SIDE – CLOSE TO TRENCH

The connection point (virtual handhole) is very close to the private domain of the future user, the distribution line runs close to user's domain. In this situation, the installation priorities are the followings:

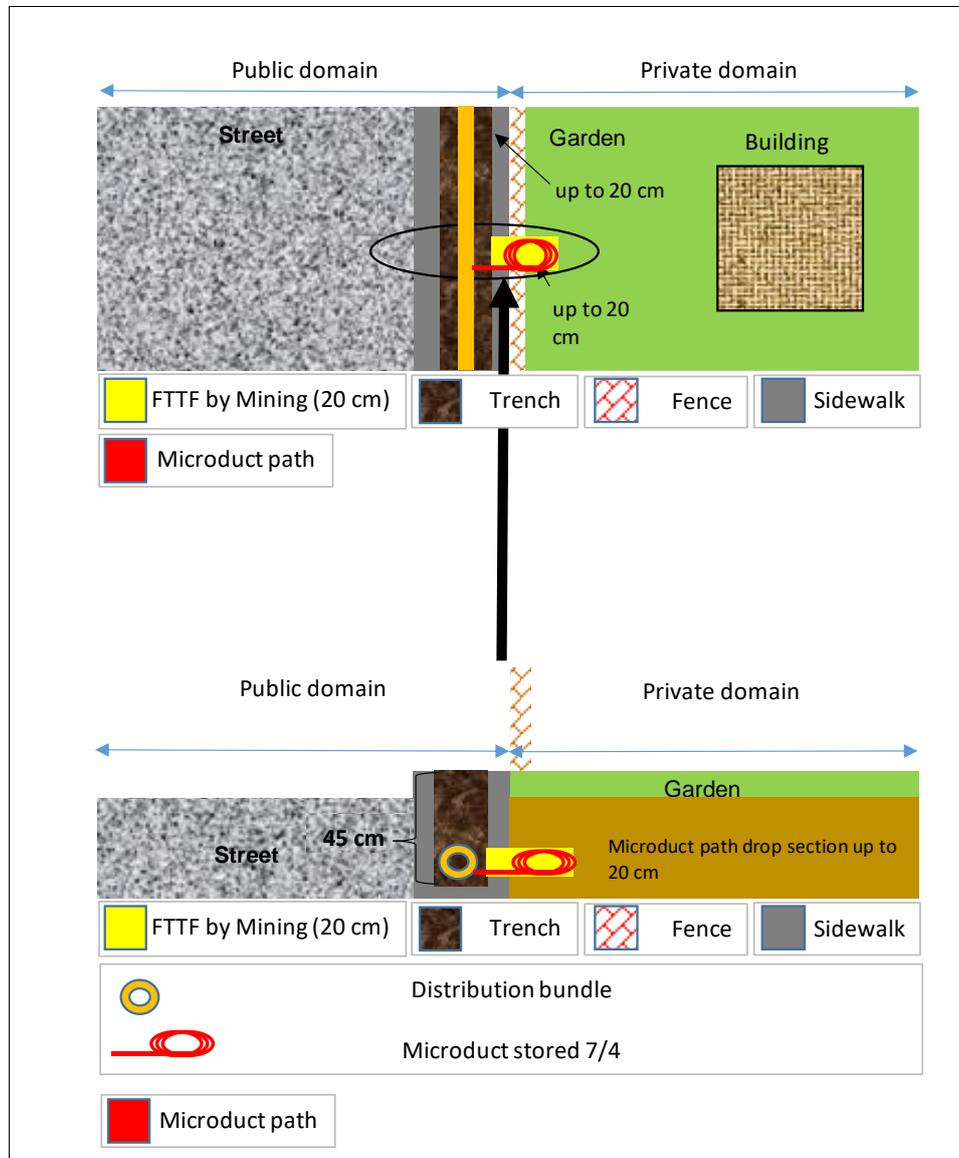
- 1) Flexible drilling (up to 50 cm)
- 2) Mining (20 cm). The microduct (1,5 m of length) is stored in a coil (20 cm diameter).

The next images show the scheme to do the FTTF by flexible drilling.



**Figure 12. Flexible drilling (same side and close to the trench) scheme.**

Below are some geometric diagrams to show this situation done by mining.



**Figure 13. Mining (same side and close to the trench) scheme.**

As can be seen from the figures above, applying flexible drilling would be the easiest and quickest solution possible and should therefore be applied whenever feasible, because there is no need for a big pit.

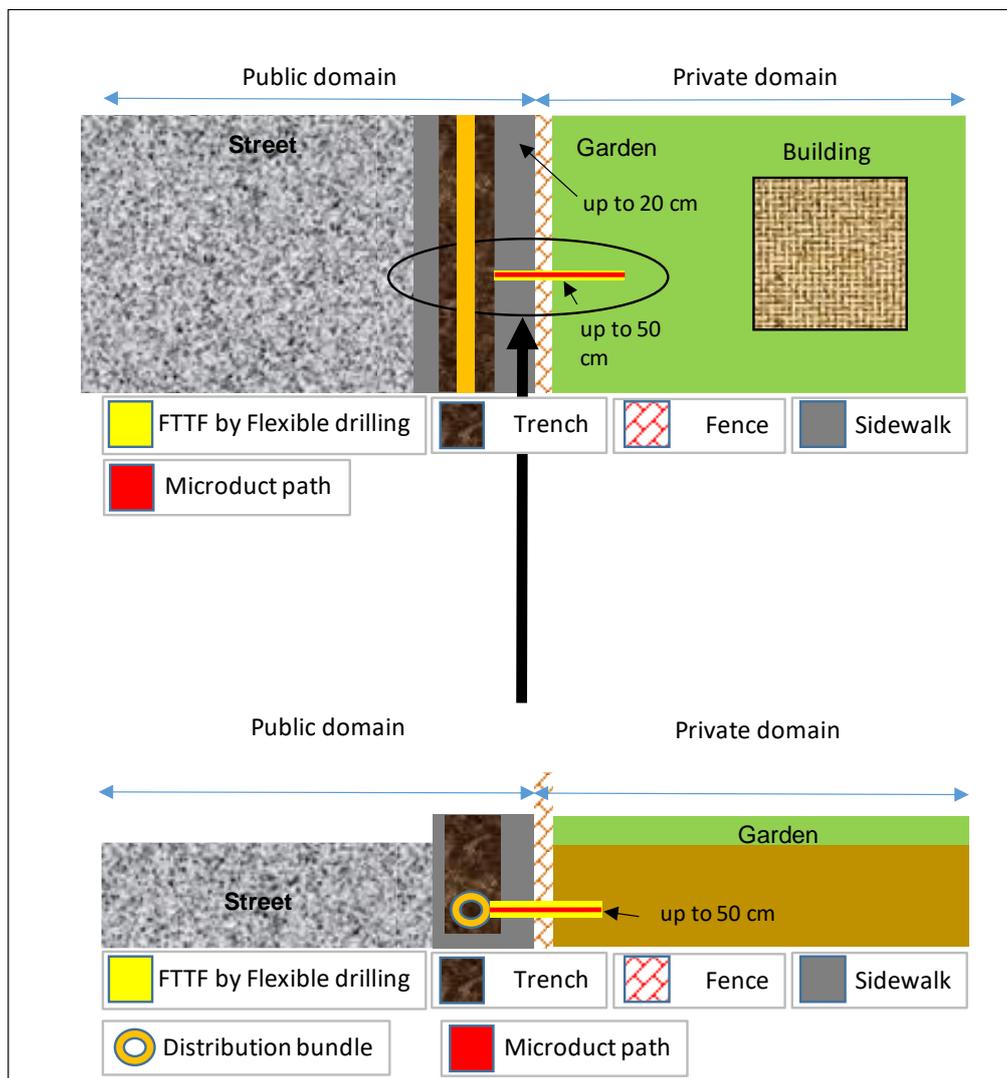
If it is not possible to use the flexible drilling method, manual mining must be carried out. The mine should be done to allow the storing 1,5 m duct of length rolled in a coil with a diameter of 20 cm.

	FTTF CONSTRUCTION GUIDELINES	TECHNICAL NORMATIVE	DECEMBER 2023 5 <sup>th</sup> Edition
		<b>TEF-NORM-00008</b>	Page 18/33

## 6.2 FTTF - SAME SIDE – FAR FROM THE TRENCH (BETWEEN 1 AND 3 METERS)

The connection point (virtual handhole) is further away from the edge of the private domain of the home. In this case, it is more difficult to reach the private domain, and could be needed to use a constructive technique to reach the public/private limit (Note: the perpendicular trench should be avoided, whenever is possible, an alternative technique as the flexible drilling from the distribution trench should be used).

### 1) Flexible drilling from the trench.



**Figure 14. Flexible drilling (same side and far from the trench) scheme.**

**Note:** This option is only possible when using end-cap markers.

If it is not possible to reach the private terrain with the flexible drilling system or end-cap markers are not available, a perpendicular trench should be done to reach the limit between the public soil and the private soil. In this situation, more space is available to make the FTTF, and the prioritization of alternatives to be applied is the following:

	<b>FTTF CONSTRUCTION GUIDELINES</b>	TECHNICAL NORMATIVE	DECEMBER 2023 5 <sup>th</sup> Edition
		<b>TEF-NORM-00008</b>	Page 19/33

- 2) **Trench (15x45 cm) + Rigid drilling (up to 50 cm).** The public/private limit is reached with the trench, and a small hole of 2,5 cm of diameter is made by rigid drilling with the appropriate length drill bit. After drilling the hole, the microduct is inserted into the hole until the FTTF point on the private side is reached. This technique avoid possible problems of subsidence of land that could have the mining technique.

The following figure shows schematically the rigid drilling method:

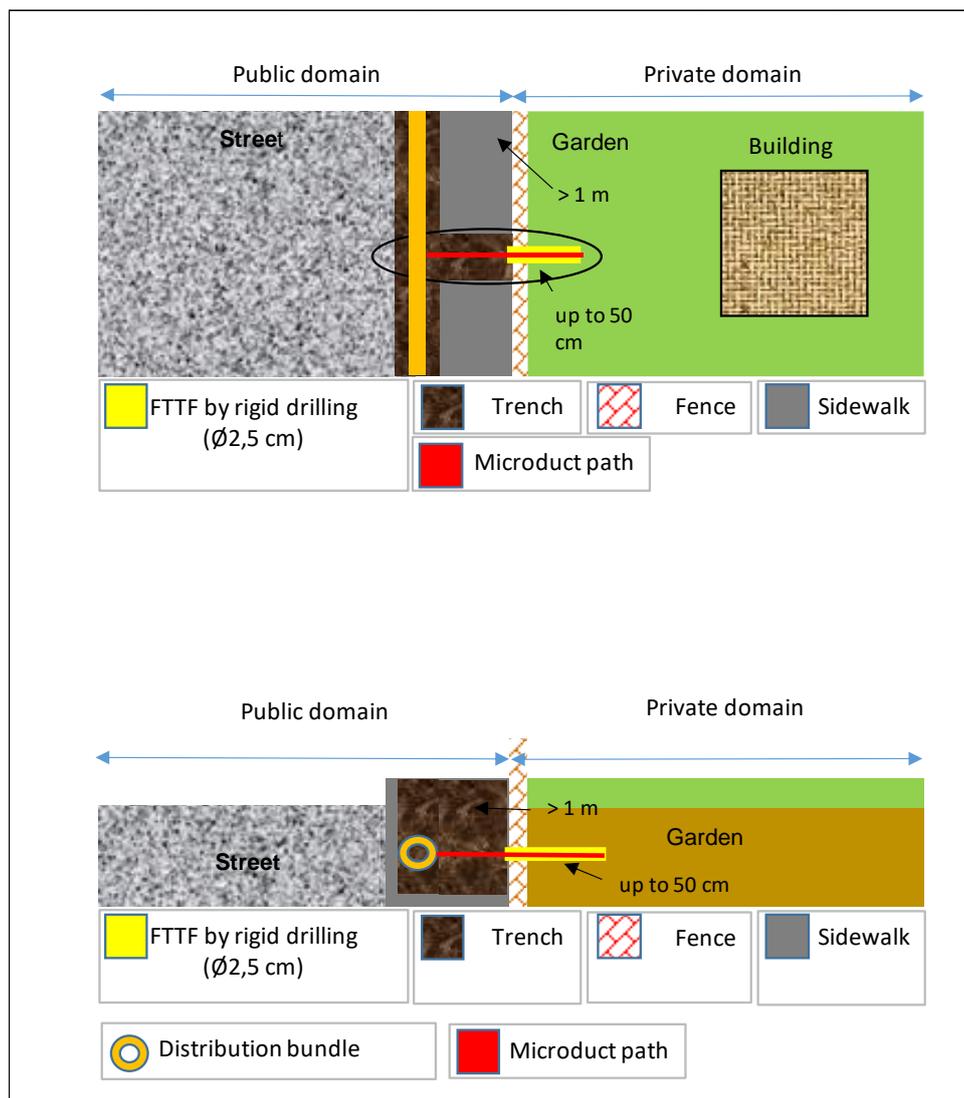


Figure 15. Rigid drilling (same side and far from the trench) scheme.

	FTTF CONSTRUCTION GUIDELINES	TECHNICAL NORMATIVE	DECEMBER 2023  5 <sup>th</sup> Edition
		<b>TEF-NORM-00008</b>	Page 20/33

### 6.3 FTTF – OTHER SIDE

In this case, a street crossing must be executed.

The preferred method to cross the street would be always the use of “Impact Rocket/Mole”. For its implementation, it is necessary to build a starting and an exit pit at both sides of the street.

**Only in cases where this method cannot be applied due to other buried services or unsuitable ground conditions, the alternative of a traditional trench should be considered.**

Once the road crossing has been completed, the instructions in the previous sections must be followed. Since an exit pit or a trench must be built during the construction of the road crossing, more space will be available to execute the civil works needed for the FTTF duct storage (so different techniques can be used). The order of priorities is altered, which is presented below:

If the street cross has been made by “Impact Rocket/Mole”:

- 1) **“Impact Rocket/Mole” (up to 50 cm).** The exit pit, should be executed reaching the public/private limit. In this situation the way in which the FTTF should be executed continuing with the impact mole making a few centimeters into the private domain of the home. Once the hole is made and the private domain is reached, the microduct is inserted into the hole until the end.
- 2) **Rigid drilling (up to 50 cm).** If after reaching the public/private domain a hard soil is found, rigid drilling should be used to make the FTTF. In this case, a hole of 2,5 cm of diameter should be done by a traditional drill. Once the hole is made and the private domain is reached, the microduct is inserted into the hole until the end.

Below is the geometrical scheme shown:

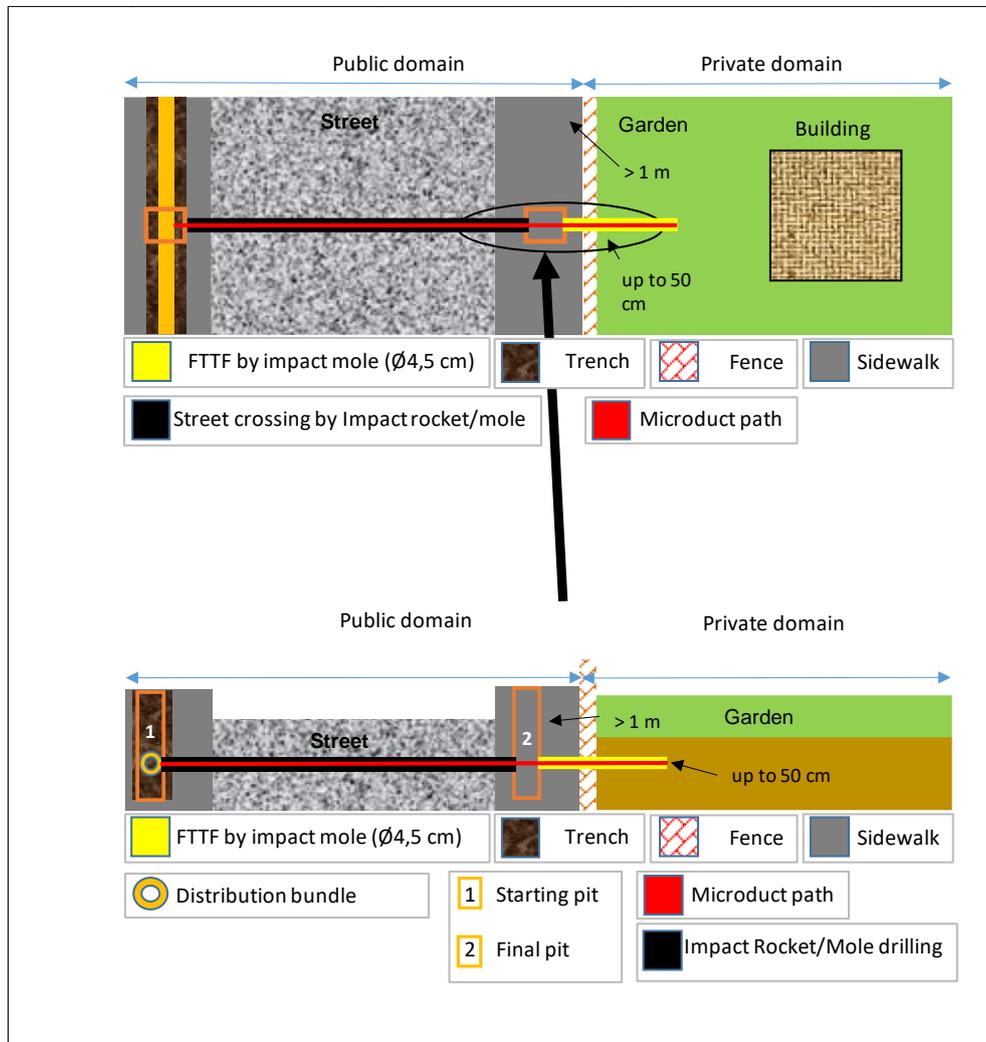


Figure 16. Street crossing by “Impact Rocket/Mole” + FTTF “Impact Rocket/Mole” scheme.

If the last part is not possible to be done by impact mole/rocket, the scheme should be the same as before, changing the last part from impact mole/rocket to rigid drilling.

In the case that it is not possible to execute a road crossing by the “Impact Rocket/Mole” method, it must be executed with a traditional trench.

If the street crossing has been made by traditional trench:

- 1) Rigid drilling (up to 50 cm).** Once the public/private limit is reached, the last part for the FTTF duct storage should be done by drilling.

**Note:** As the depth of the road surface section is greater than the depth of the pavement section, it is shown schematically in the following figure:

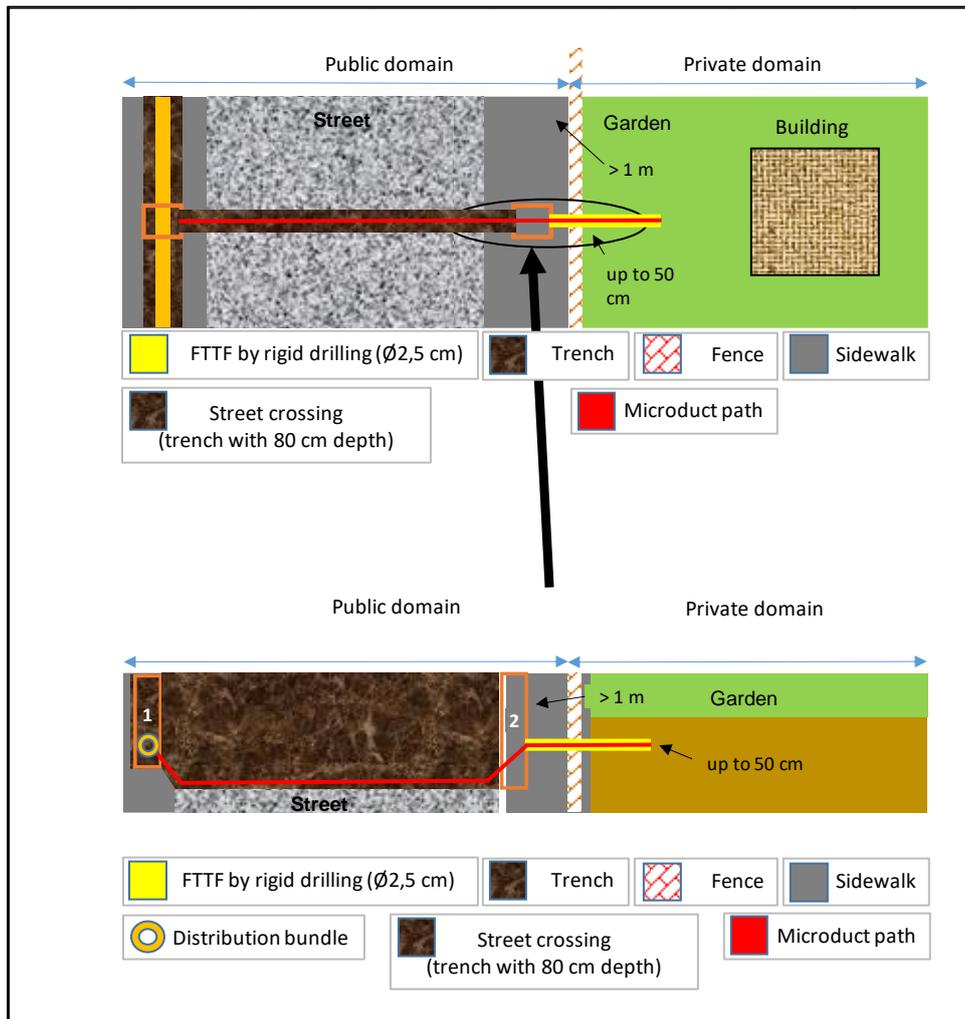


Figure 17. Street crossing by “traditional trenching” + FTTF “rigid drilling” scheme.

	FTTF CONSTRUCTION GUIDELINES	TECHNICAL NORMATIVE	DECEMBER 2023 5 <sup>th</sup> Edition
		<b>TEF-NORM-00008</b>	Page 23/33

#### 6.4 FTTF - CLOSE TO BUILDING FOUNDATION

In the cases in which the limit between the public and private soil is the building foundation (that is, there is not private soil surface available) **the FTTF procedure will NOT be executed.**

	FTTF CONSTRUCTION GUIDELINES	TECHNICAL NORMATIVE	DECEMBER 2023 5 <sup>th</sup> Edition
		<b>TEF-NORM-00008</b>	Page 24/33

## 7. FTTF POINTS (INVENTORY AND DETECTION)

All the FTTF points must be registered and inventoried with GPS coordinates (with an accuracy of 2cm). **The border between public and private soil should be taken as the point for GPS coordinates.**

Also, in every FTTF point, an electro-magnetic marker must be buried to make easy the future detection of the microducts.



**Figure 18. Example of GPS acquisition data of FTTF point.**

The GPS recording results will be delivered in digital form as defined by UGG.

In this procedure, both the FTTF point and the segregation/bifurcation point must be registered and inventoried with a referenced photo.

If possible, the data should be included in a CAD/GIS file, so that it can be printed out later and shown to the user at the time of the “Hausbegehung”. It is considered that, in this way, the user will be better informed and more convenient in case of doubts.

## 7.1 USE OF ELECTROMAGNETIC MARKERS FOR THE FTTF LOCALIZATION

To avoid future problems in locating FTTFs using only the GPS detector system, **passive markers must be always used at the location where the end of the FTTF microduct is placed.**

Depending on the situation, different markers can be used. There can be considered two types of markers: ball type (self-levelling) and end-cap type. Both types are waterproof (IP68).

All types of markers are passive, i.e. they do not require any power supply and they are detectable by a commercially available marker detector. The system used by the markers is electro-magnetic and they are detectable at the frequency of 101,4 kHz. The detector used must be suitably configured to emit and detect the signal at this frequency.

Two main cases for the use of markers should be considered:

1. If the FTTF has been made by drilling methods (either rigid, flexible or impact mole):

**End-cap markers must be used.** They are attached to the end of the microduct before the microduct is inserted into the pre-drilled borehole. As this type of markers adapts perfectly to the shape and dimensions of the microduct to be inserted, it does not require any additional space and it is therefore the perfect solution under these conditions.

**Note:** If end-cap markers are not available, it is possible to use ball markers except in the case of flexible drilling when the FTTF point is far from the trench.

2. If the FTTF has been made by mining:

**Any marker type could be used:** End-cap type or Ball type.

Images of the different markers are presented below:



**Figure 19. Electromagnetic markers.**

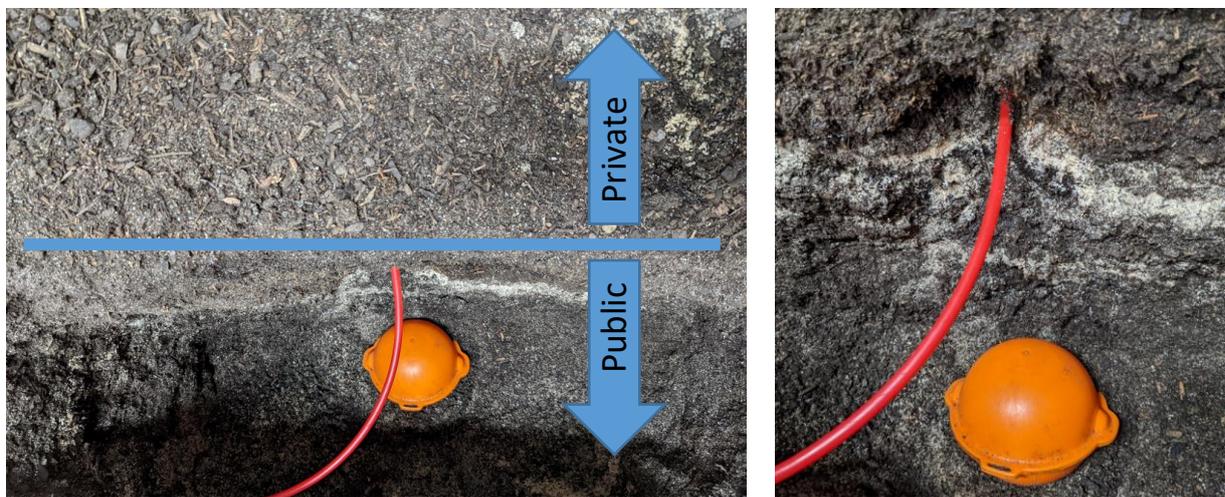
	FTTF CONSTRUCTION GUIDELINES	TECHNICAL NORMATIVE	DECEMBER 2023 5 <sup>th</sup> Edition
		<b>TEF-NORM-00008</b>	Page 26/33

### 7.1.1 INSTALLATION OF THE ELECTROMAGNETIC BALL MARKERS

This type of marker requires a bigger space to be placed so it will be preferably used when the FTTF point has been done by mining.

If the FTTF point has been done by drilling (rigid, flexible or impact mole): The procedure of installation consists in placing the ball marker inside the trench, where the microduct is inserted into the borehole in the border between the public and the private domain. The ball marker must be marking the point where the borehole was made. This type of marker is detected in any angle and position, so no specific orientation of the ball is needed.

**Note:** It is not possible to install the ball marker if the limit between the public and the private domain is not reached.



**Figure 20. Installation example of a ball marker (drilling technique).**

If the FTTF point has been done by mining: The procedure of installation consists in placing the ball marker in the center of the microduct coil. The ball marker is detected in any angle and position, so no specific orientation of the ball is needed.



**Figure 21. Installation example of a ball marker (mining technique).**

7.1.2 INSTALLATION OF ELECTROMAGNETIC END-CAP MARKERS

This type of markers can be used in any scenario:

If the FTTF point has been done by drilling (either rigid, flexible or impact mole): the end of the microduct must be finished with the end-cap marker. Then, the resultant end of the microduct must be inserted all the way into the borehole.

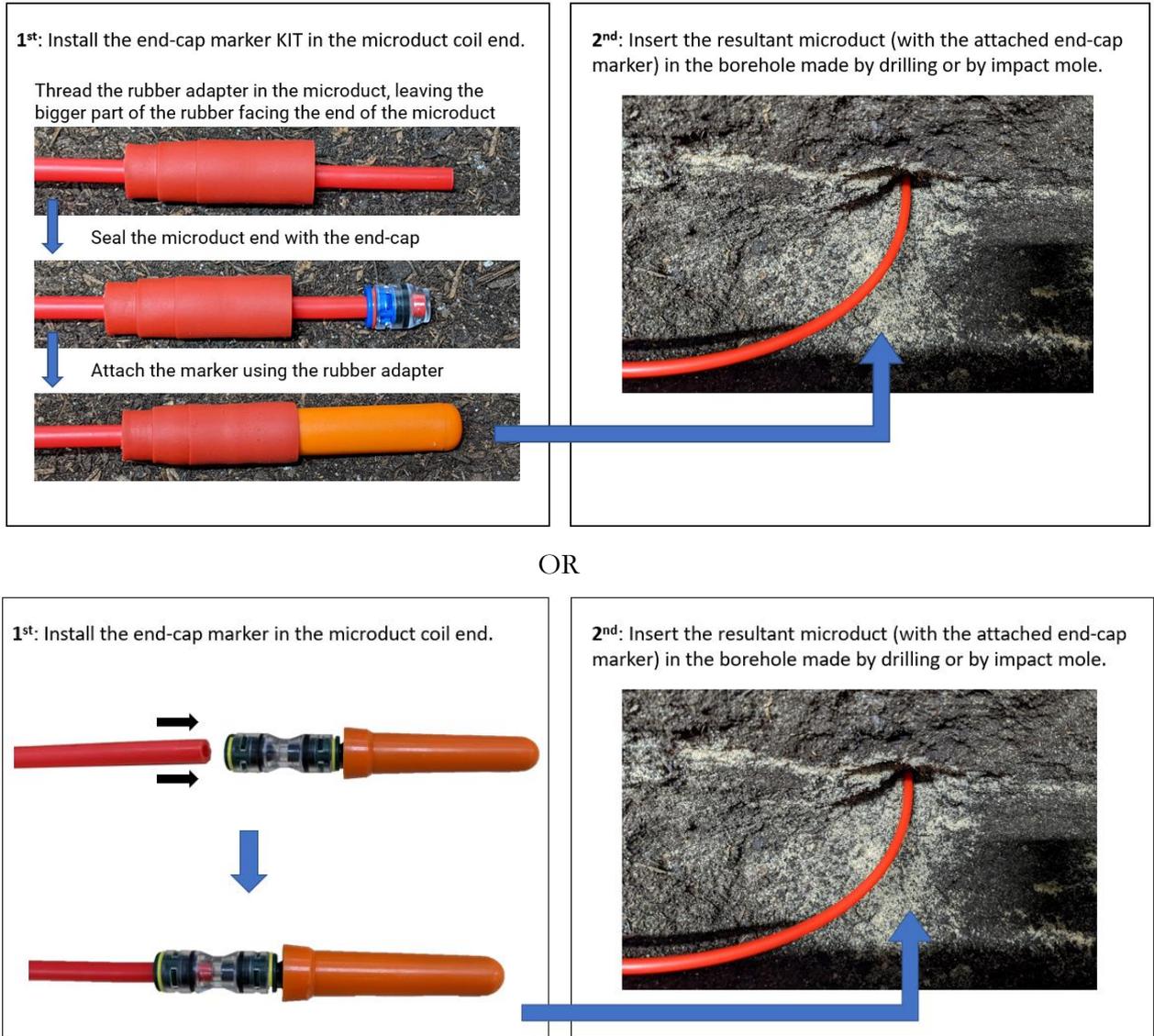


Figure 22. Installation example of an end-cap marker (drilling technique).

If the FTTF point has been done by mining: the end of the microduct must be finished with the end-cap marker and then, the microduct coil must be placed inside the mined hole as usual.

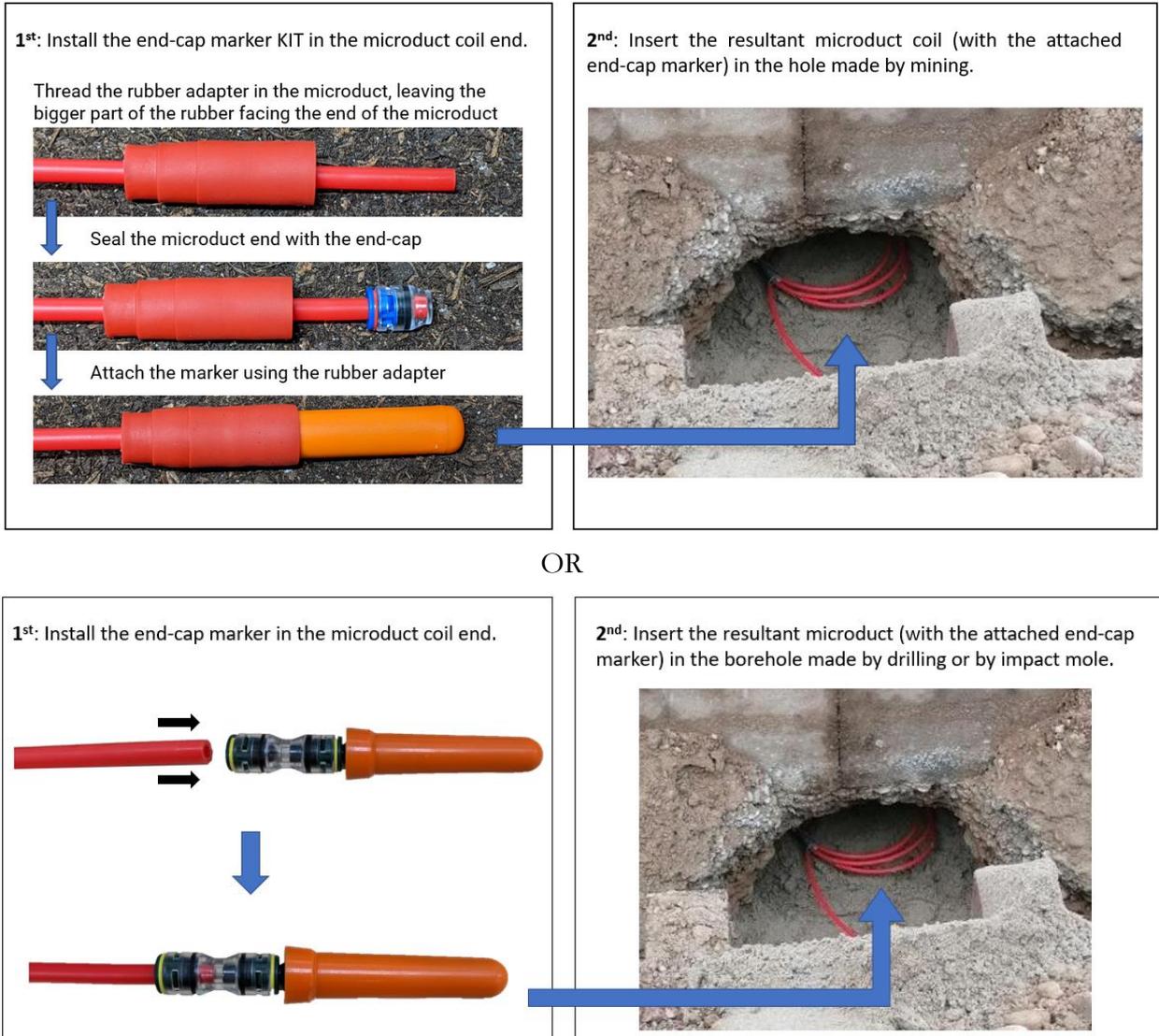


Figure 23. Installation example of an end-cap marker (mining technique).

	FTTF CONSTRUCTION GUIDELINES	TECHNICAL NORMATIVE	DECEMBER 2023 5 <sup>th</sup> Edition
		TEF-NORM-00008	Page 29/33

## 8. CUSTOMER CONNECTION FROM THE FTTF POINT

### 8.1 LOCATION OF THE DUCT

The FTTF is buried, so it is necessary to detect the point at the end of the microduct to complete the subsequent connection to the user.

All the FTTF points must be inventoried and registered in the UGG systems with the appropriate GPS coordinates, so these coordinates can be used to locate the microducts to complete the drop section until the customer home.

Also, all the FTTF points, include a buried electromagnetic marker so it is possible to find the point of the microducts termination before starting to dig to complete the drop section. For the detection, an electromagnetic marker detector configured to emit and detect the 101,4 kHz frequency must be used. If the electromagnetic marker is detected on public soil, the digging point must be the closest one **on private domain** in the direction to the building.

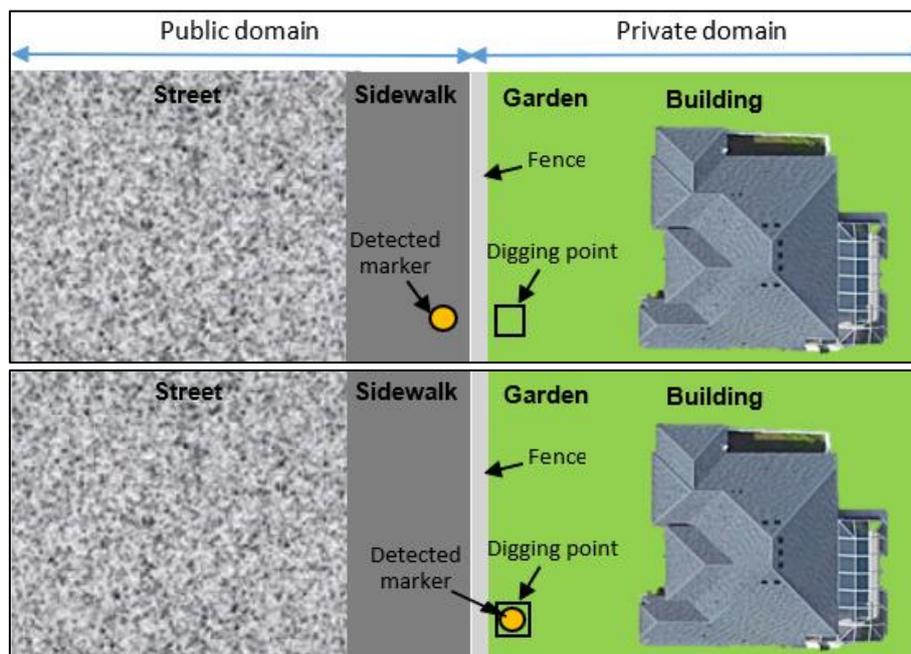


Figure 24. Marker detection and digging point schemes.

### 8.2 RECOVERING OF THE DUCT

Once the FTTF point is located by GPS or by an electromagnetic marker detector, it is needed to dig to find the microduct end. **The dig must be done only on the private domain**, the public soil can't be dug during the recovering of the duct. If it is possible to recover the electromagnetic marker, it must be saved to use it again in a new FTTF point in the future.

- If the mining method has been applied, a microduct coil will be found which facilitates the subsequent “microduct joint” with the drop for connection to the customer's property.
- If the drilling methods has been applied (either rigid, flexible or impact mole) the boreholes have been drilled in such a way that a sufficient length of microducts is available for the “microduct joint”.

	FTTF CONSTRUCTION GUIDELINES	TECHNICAL NORMATIVE	DECEMBER 2023 5 <sup>th</sup> Edition
		<b>TEF-NORM-00008</b>	Page 30/33

### 8.3 FTTF POINT IS NOT THE BEST TO COMPLETE THE DROP

Although the FTTF point has been selected following a logical criterion, several situations can appear in the future that make that the point selected doesn't match with the path that the customer prefers to get the optical network into his house.

In these cases, the first idea to follow is to recover the FTTF stored drop and execute a path **inside the private domain** (changing the direction, adding curves if needed, etc) that allows to redirect the drop microduct according to the customer's preferences.

**The main goal is to avoid touching the public soil again.**

The path inside the private domain is the preferred one and it must be executed even if it has a longer distance, more curves, etc, than the path reopening public soil.



Figure 25. Example of FTTF point that has been used, redirecting the path, without touching public soil.



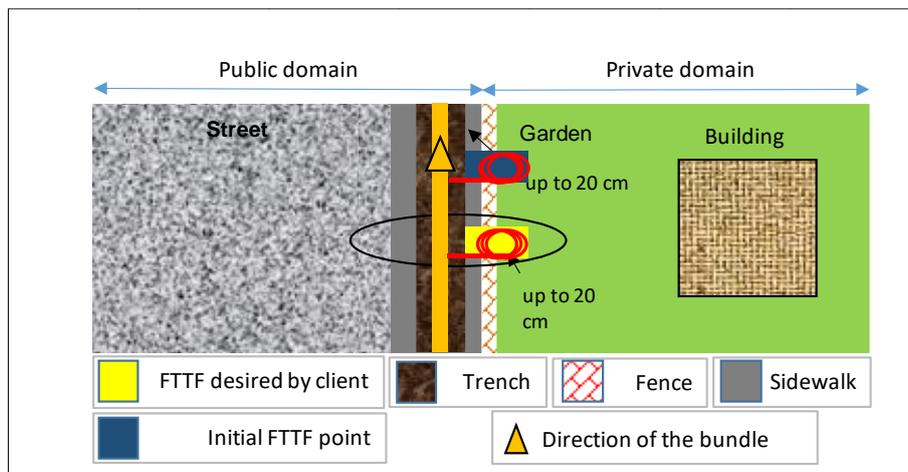
Figure 26. Examples of FTTF points executed in front of trees (to be avoided). The FTTF ducts could be recovered without touching the public soil.

#### 8.4 FTTF POINT IS NOT VALID TO COMPLETE THE DROP

If after analyzing all the possibilities to redirect the drop's final path through the private domain, there is no option to use the FTTF point (or it has no sense technically), a new segregation from the distribution network (new virtual handhole) must be done.

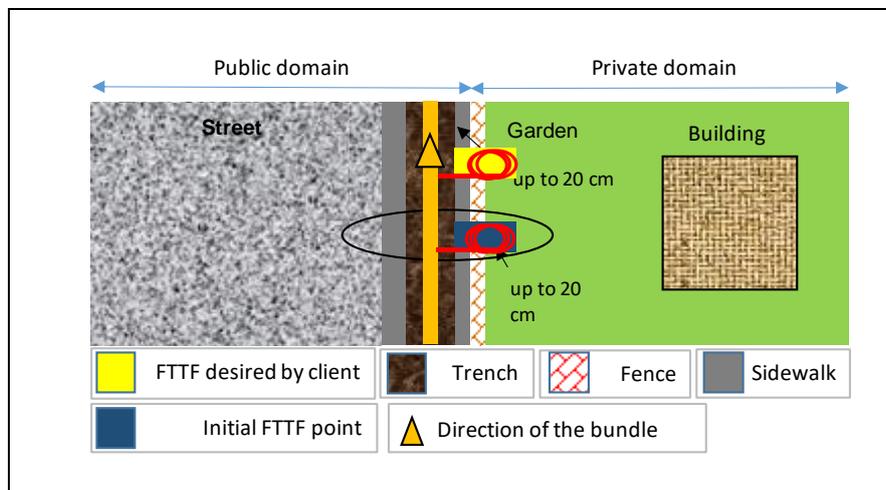
In this situation we can find two different cases:

1. The location of the new segregation point desired by the customer is before (always with reference to the Distribution Point) the FTTF point initially chosen. In this case, it will be sufficient to carry out a tasting pit at the definitive point to get access to the distribution microducts bundle and to make the subsequent microduct joint for the "drop".



**Figure 27. Desired point before initially chosen point (FTTF).**

2. The location of the new segregation point desired by the customer is after (always with reference to the Distribution Point) the FTTF point initially chosen. In this case, it will be necessary to carry out two pits in the public domain. The first, at the initially chosen point to restore the microduct of the distribution bundle and the second at the finally desired point by the customer to make the new segregation.



**Figure 28. Desired point after initially chosen point (FTTF).**

	FTTF CONSTRUCTION GUIDELINES	TECHNICAL NORMATIVE	DECEMBER 2023 5 <sup>th</sup> Edition
		<b>TEF-NORM-00008</b>	Page 32/33

### ANNEX 1: FTTF FOR MDUS REQUIRING 2 MICRODUCTS OF 7MM

In the case in which is needed to execute an FTTF installation for a MDU that requires 2 microducts of 7mm, all the instructions and recommendations given previously in the document must be followed.

**The only change is that 2 microducts must be reserved in the FTTF point for this case, both connected to the distribution bundle.**

In the case of doing the execution with drillings techniques, the operation must be done 2 times unless the diameter of the perforation is slightly increased so that the 2 microducts enter through the same borehole.

An electromagnetic marker should be included to signalize the FTTF point (only one).

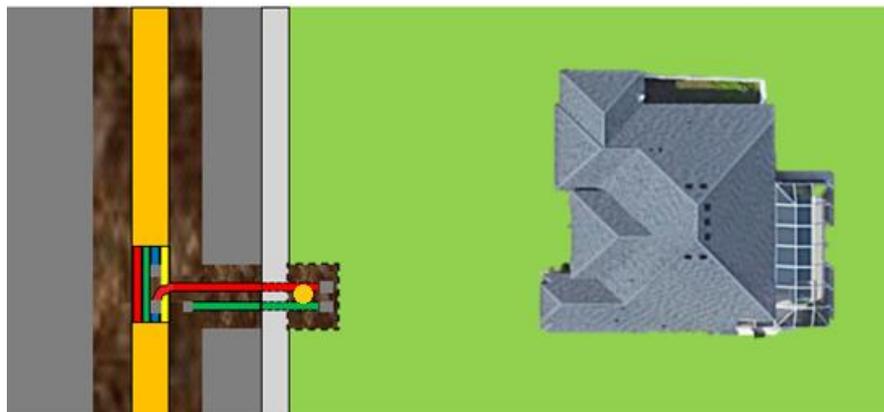
	<b>FTTF CONSTRUCTION GUIDELINES</b>	TECHNICAL NORMATIVE	DECEMBER 2023 5 <sup>th</sup> Edition
		<b>TEF-NORM-00008</b>	Page 33/33

## ANNEX 2: FTTF FOR MDUS REQUIRING 2 MICRODUCTS OF 14MM

In the case in which is needed to execute an FTTF installation for a MDU that requires 2 microducts of 14mm, all the instructions and recommendations given previously in the document must be followed with a few minor modifications.

**NOTE:** This case is only happening in the Centralized Splitting Architecture in MDUs with more than 12 homes.

In this situation, the microducts that serve the building form part of the feeder network and have a diameter of 14/10 mm (outer/inner diameter). Also, for this situation 2 microducts must be deployed from the bundle branch-off point until the FTTF point. Nevertheless, only one of the microducts need to have continuity to the POP (that means, that only one will be connected to a microduct of the feeder bundle, and the other one will be kept sealed with an end-cap as a reserve). In the next image, a scheme can be seen:



**Figure 29. FTTF scheme for a MDU with more than 12 homes (mining technique).**

Due to the size and rigidity of this kind of microducts, the microducts will reach the FTTF point straight (not in a coil reserve), entering to the private property at least 20 cm (preferable 50 cm if the used technique allows it).

The techniques used to execute the FTTF could be the same that are described along the document with little modifications to be useful for the size of these microducts.

In the case of doing the execution with drillings techniques, the diameter of the borings should be at least 35 mm (2 borings are needed) to make possible the pass of the end-cap through the borehole.

An electromagnetic marker (ball type) should be included to signalize the FTTF point (only one).

In the future, when it is necessary to carry out the complete drop, the 2 ducts will be extended as seen in the following scheme:



**Figure 30. Final drop section from the FTTF point to the building.**