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NeuConnect

BIJLAGE 5_GENERIC CROSSING DESIGN ALGEMEEN ONTWERP KRUISINGEN

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NeuConnect

NeuConnect Interconnector
Generic Crossing Design

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1.0 Introduction

This document shows a high-level outline of possible crossing designs for the NeuConnect Power Cable with third-party assets. The sole purpose for these designs is serve as a discussion document, to start negotiations with the owners of the third-party assets.

In total, five different potential solutions will be shown. Three of these are for crossings where the existing asset is buried into the seabed, two are for crossings with the existing asset on top of the seabed.

The solution types for buried third-party assets:

- Type A: passing NeuConnect over the crossed asset at seabed, final protection with rock;
- Type B: installation of a pre-lay rock berm, passing NeuConnect over this pre-lay berm, final protection with rock;
- Type C: fit the NeuConnect cable with a spacer, pass NeuConnect with spacer over the third-party asset at seabed;

The solution types for third-party assets on top of the seabed:

- Type D: installation of a pre-lay rock berm, passing NeuConnect over this pre-lay berm, final protection with rock;
- Type E: fit the NeuConnect cable with a spacer, pass NeuConnect with spacer over the third-party asset at seabed;

Solution type A only applies to third-party assets buried deep enough to ensure sufficient separation, else B or C shall be used. Solution types B and C are in principle the same as respectively solution types D and E, but whether the crossed assets are in or on the seabed makes a substantial difference to the lay-out. Hence these solution types will be assessed separately.

Only solutions using rock and/or spacers will be considered. Solutions using e.g. sand bags, or concrete mattresses, as well as solutions requiring handling of third-party assets (e.g. retrenching) will not be considered.

All drawings that follow in the remainder of this document are not to scale and have been optimised to demonstrate the most important parameters.

The dimensions that will be discussed are proposed minimum dimensions. However, circumstances may dictate different dimensions. For example, governing hydrodynamic conditions may require a leaner side slope and/or thicker rock layers than shown. Such details shall be subject to a later detailed design; the purpose of this document is only to define the minimal requirements.

Not shown in the drawings are:

- Cable protection systems (e.g. uraduct), which the NeuConnect cable may optionally be fitted with at crossings;
- Sprinkle layers of rock (mandatory in the Dutch sector of the North Sea only);
- Exact diameters of the NeuConnect cable, the crossed third-party assets, as well as the exact shape of the spacers, including their dimensions.

In the next section, a top view shall be shown first, the principle of which applies to all solution types. Thereafter, the solution types A-E will be specified in longitudinal and cross-sectional drawings.

Note that this report only addresses possible solutions, which can be used for further assessment. It does not address any specific crossings or recommend a particular solution. As such, it does not contain a conclusion.

2.0 All solutions: Top View

The top view defines the crossing angle, valid for all solutions A-E. The crossing angle is always defined as the smallest angle in the crossing, i.e. always 90° or less. This is shown in Figure 1 below.

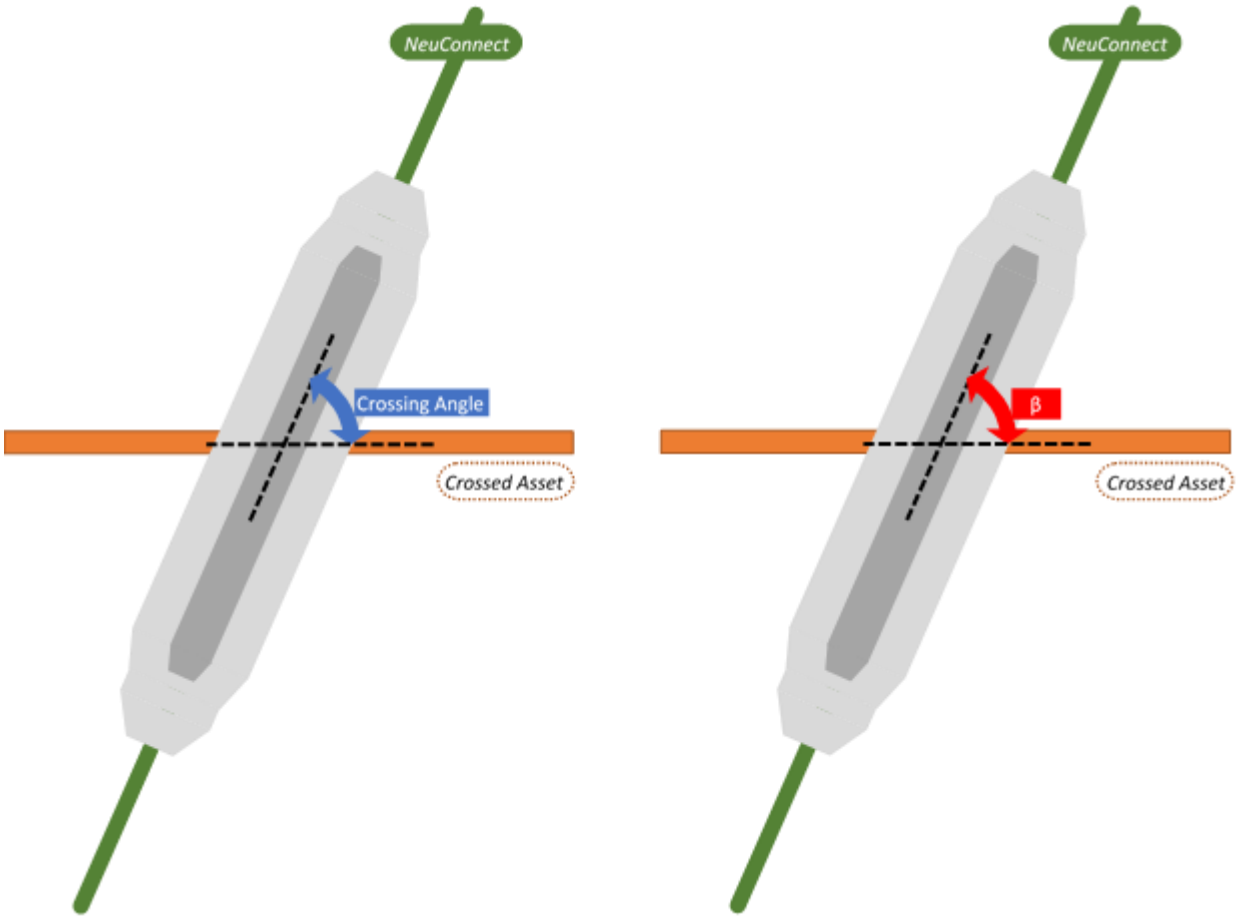

Figure 1 - Generic Top View

β Crossing Angle 60-90°

For the following sections, a longitudinal section is defined as being along the NeuConnect Cable, a cross-section as being along the crossed asset.

3.0 Solution Type A

In solution A, the NeuConnect cable passes the crossed asset at seabed. This solution assumes the crossed asset buried deep enough into the seabed to ensure sufficient vertical separation. Figure 2 below shows a typical longitudinal section and cross-section.

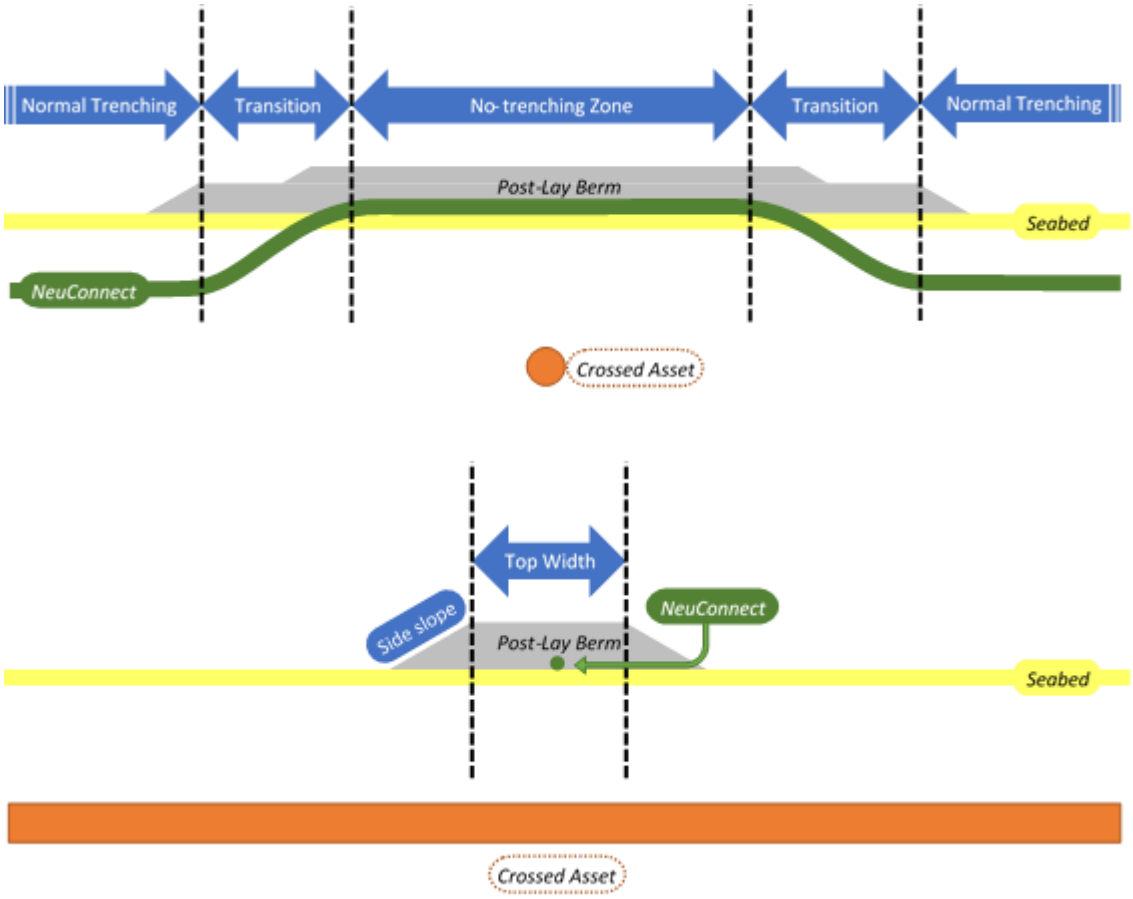

Figure 2 - Longitudinal section and cross-section of Type A crossing

Trenching will stop at a certain distance before the crossing, leading to a transition zone. On both sides of the crossed asset, there will be a no-trenching zone. After passing the no-trenching area, trenching will be resumed (with another transition). After completion of the crossing, including the transition zone, will be covered with rock.

This solution type is only recommended for crossed third-party assets that are buried relatively deep and of which the location can be accurately determined.

Figure 3 on the next page shows the definition of the proposed dimensions.

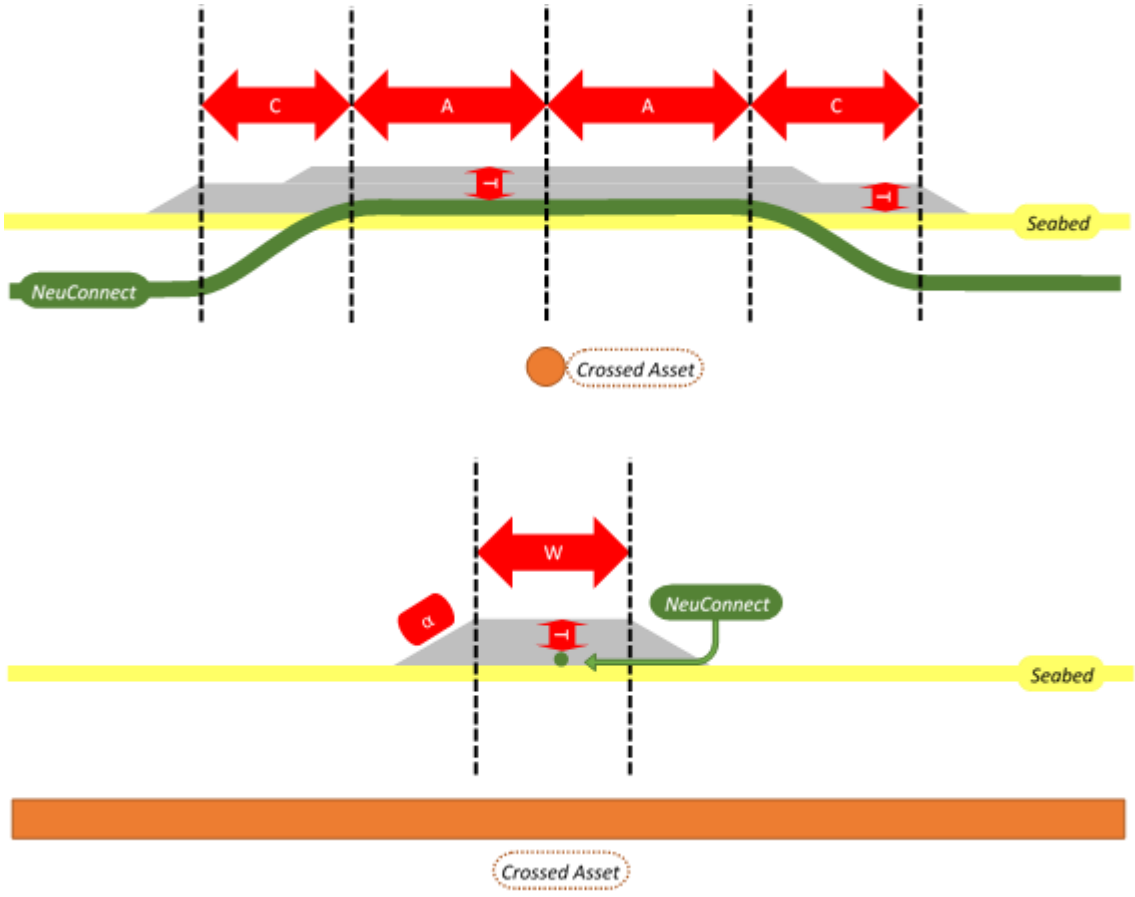

Figure 3 - Definition of Proposed Dimensions Type A Crossing

Proposed values for type A-crossings are:

A	No-trenching zone/Crossing	25 m
C	Transition zone	5 m
T	Layer Thickness	0.5 m on Top of Cable/Seabed
W	Top Width	1 m
α	Side Slope	1:3

4.0 Solution Type B

In solution type B, a pre-lay rock berm will be applied on the seabed, to ensure sufficient separation of the NeuConnect cable with the third-party asset. Figure 4 below shows a typical longitudinal section and cross-section.

Such pre-lay berms are typically much wider that post-lay-only berms, in order to allow for cable-lay tolerances. The actual required/possible tolerance shall be discussed with cable-lay contractors, hence the value shown here is to be considered as an initial proposal.

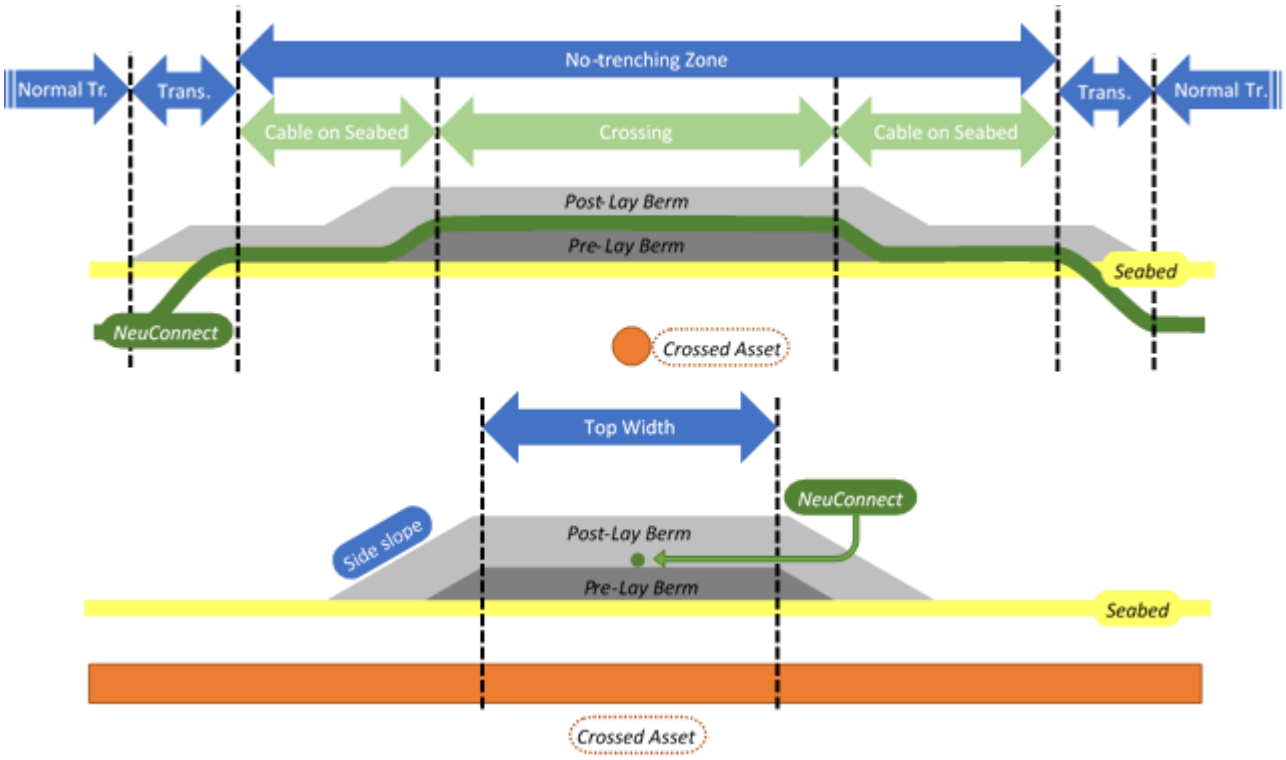

Figure 4 - Longitudinal section and cross-section of Type B crossing

When trenching, the trencher will have to get out of the seabed at some distance before the pre-lay berm. Therefore, there is an additional distance of cable on the seabed, when compared to type A. This distance is also considered as part of the no-trenching zone.

This solution can be applied for assets that are shallowly buried, up to top-of-pipe flush with seabed.

Figure 5 on the next page shows the definition of the proposed dimensions.

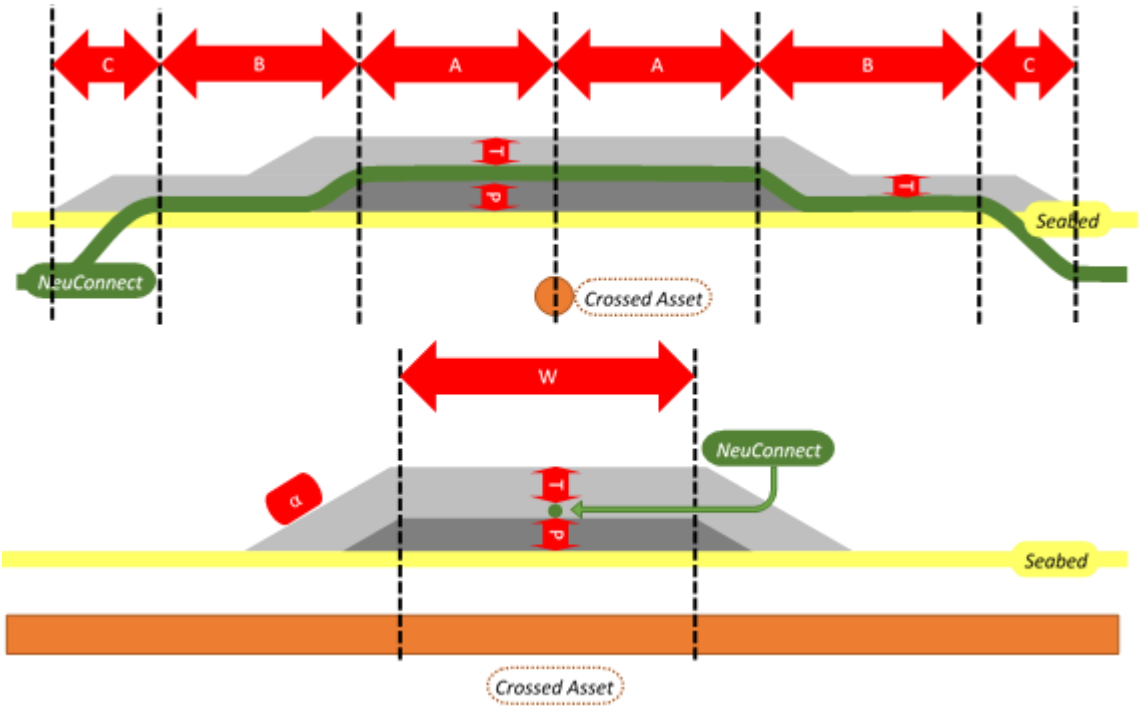

Figure 5 - Definition of Proposed Dimensions Type B Crossing

Proposed values for type B-crossings are as shown below. The no-trenching zone consist of zones A+B, on both sides of the crossed asset.

A	Crossing	25 m
B	Cable on Seabed	10 m
C	Transition zone	5 m
P	Pre-lay Berm Thickness	0.3 m on Top of Seabed
T	Layer Thickness	0.5 m on Top of Cable/Seabed
W	Top Width	3 m
α	Side Slope	1:3

5.0 Solution Type C

In solution type C, a spacer will be fitted on the NeuConnect cable, to ensure sufficient separation of the NeuConnect cable with the third-party asset. This eliminates the need for a pre-lay rock berm. Figure 6 below shows a typical longitudinal section and cross-section.

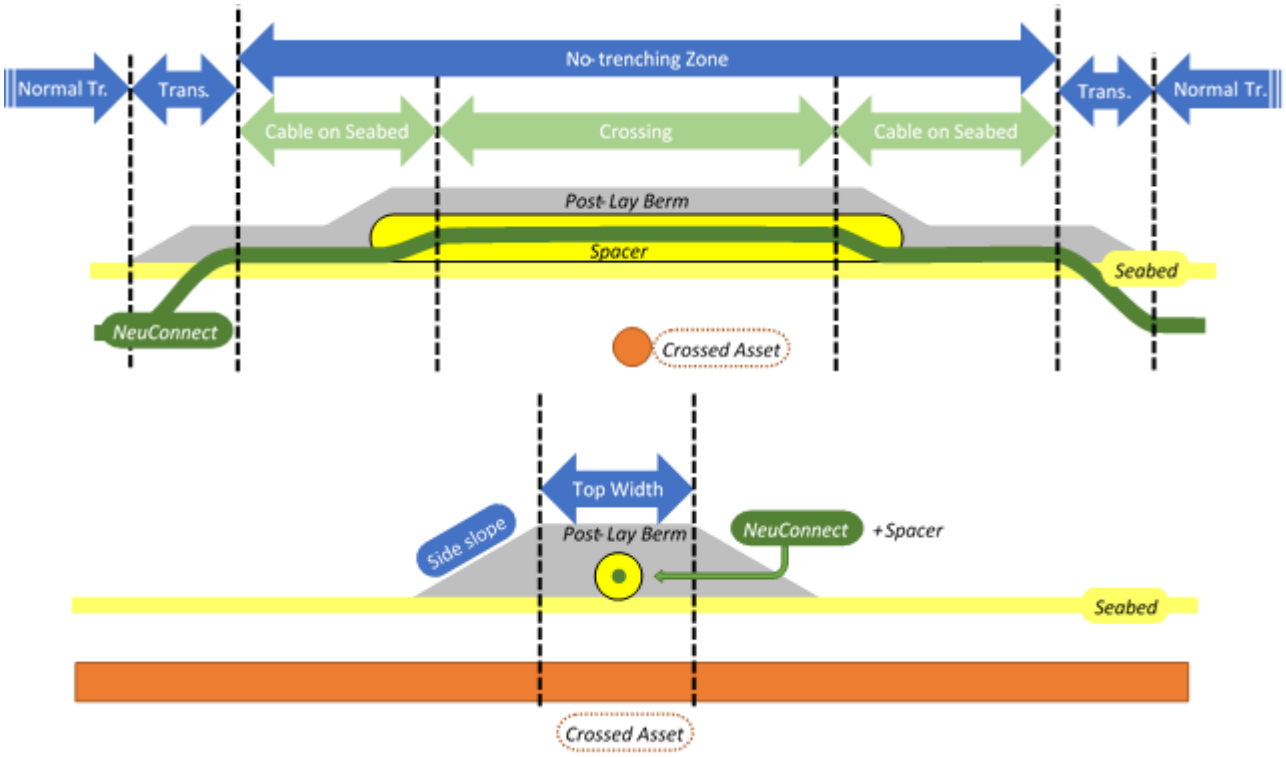

Figure 6 - Longitudinal section and cross-section of Type C crossing

When trenching, the trencher will have to get out of the seabed at some distance before the spacer is encountered. Therefore, there is an additional distance of cable on the seabed, when compared to type A. This distance is also considered as part of the no-trenching zone.

This solution can be applied for assets that are shallowly buried, up to top-of-pipe flush with seabed.

Figure 7 on the next page shows the definition of the proposed dimensions.

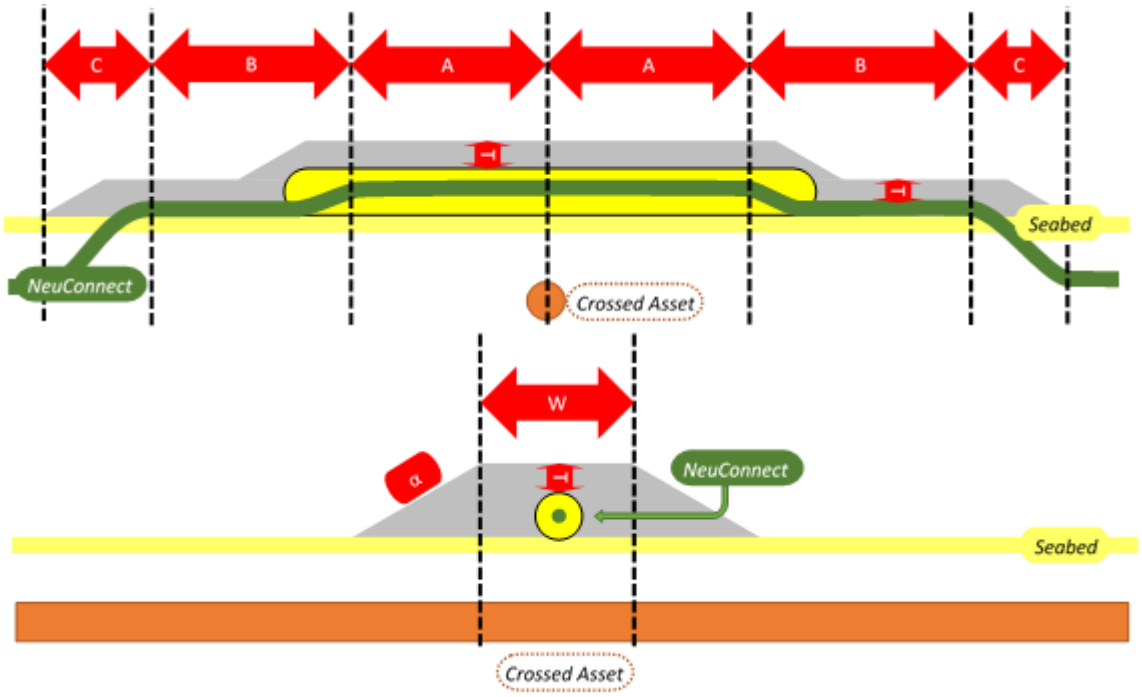

Figure 7 - Definition of Proposed Dimensions Type C Crossing

Proposed values for type C-crossings are as shown below. The no-trenching zone consist of zones A+B, on both sides of the crossed asset.

A	Crossing	25 m
B	Cable on Seabed	10 m
C	Transition zone	5 m
W	Top Width	1 m
T	Layer Thickness	0.5 m on Top of Cable (incl. Spacer)/Seabed
α	Side Slope	1:3

6.0 Solution Type D

In solution type D, a pre-lay rock berm will be applied over the crossed asset, to ensure sufficient separation of the NeuConnect cable with the third-party asset. Figure 8 below shows a typical longitudinal section and cross-section.

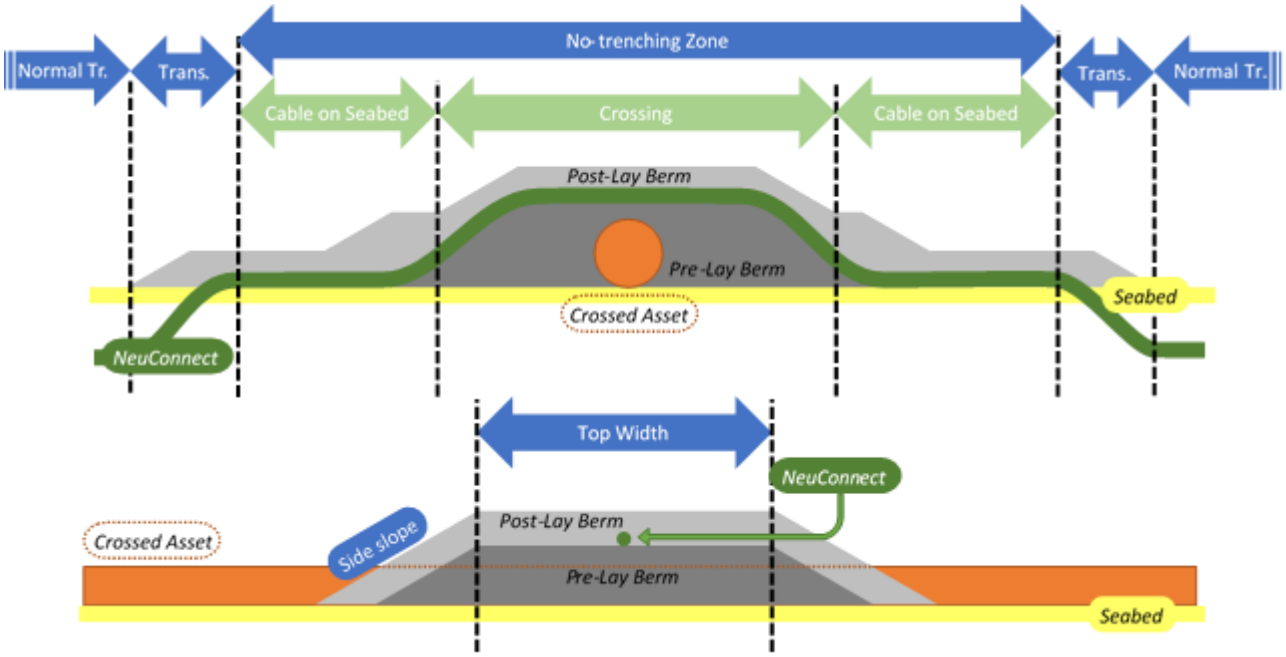

Figure 8 - Longitudinal section and cross-section of Type D crossing

Such pre-lay berms are typically much wider that post-lay-only berms, in order to allow for cable-lay tolerances. Moreover, the height will be more than for buried assets, as non-buried assets are typically large diameter pipelines. Due to this combination, the volumes for such pre-lay berms can become considerable.

The actual required/possible cable-lay tolerance shall be discussed with cable-lay contractors, hence the value shown here is to be considered as an initial proposal.

When trenching, the trencher will have to get out of the seabed at some distance before the pre-lay berm. Therefore, there is an additional distance of cable on the seabed, when compared to type A. This distance is also considered as part of the no-trenching zone.

This solution can be applied for assets that are on the seabed, including partially buried ones.

Figure 9 on the next page shows the definition of the proposed dimensions.

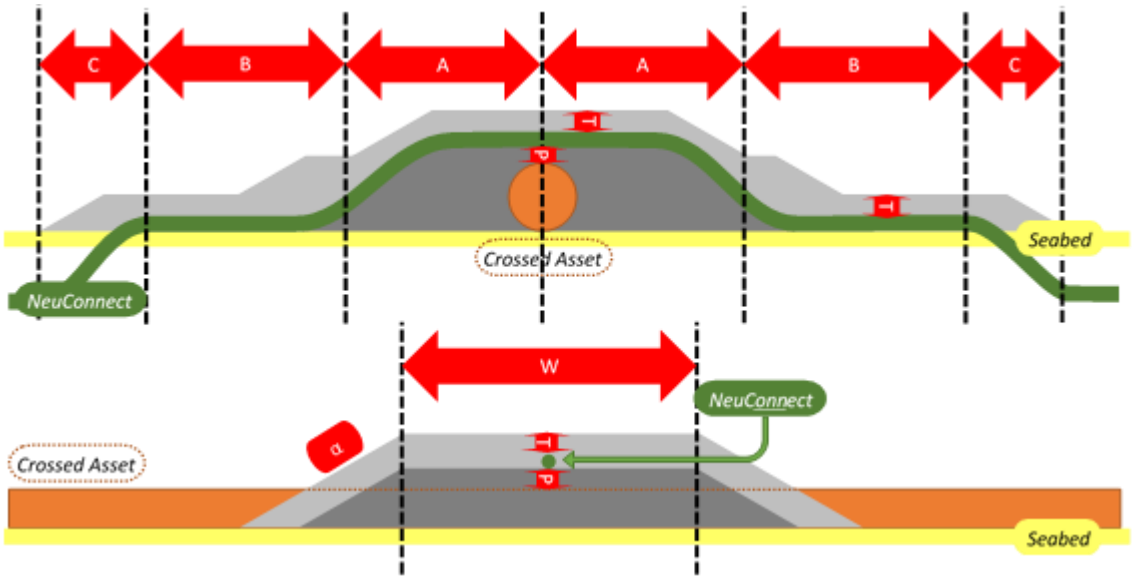

Figure 9 - Definition of Proposed Dimensions Type D Crossing

Proposed values for type D-crossings are as shown below. The no-trenching zone consist of zones A+B, on both sides of the crossed asset.

A	Crossing	25 m
B	Cable on Seabed	10 m
C	Transition zone	5 m
P	Pre-lay Berm Thickness	0.3 m on Top of Third-Party Asset
T	Layer Thickness	0.5 m on Top of Cable/Seabed
W	Top Width	3 m
α	Side Slope	1:3

7.0 Solution Type E

In solution type E, a spacer will be fitted on the NeuConnect cable, to ensure sufficient separation of the NeuConnect cable with the third-party asset. This eliminates the need for a pre-lay rock berm. Figure 10 below shows a typical longitudinal section and cross-section.

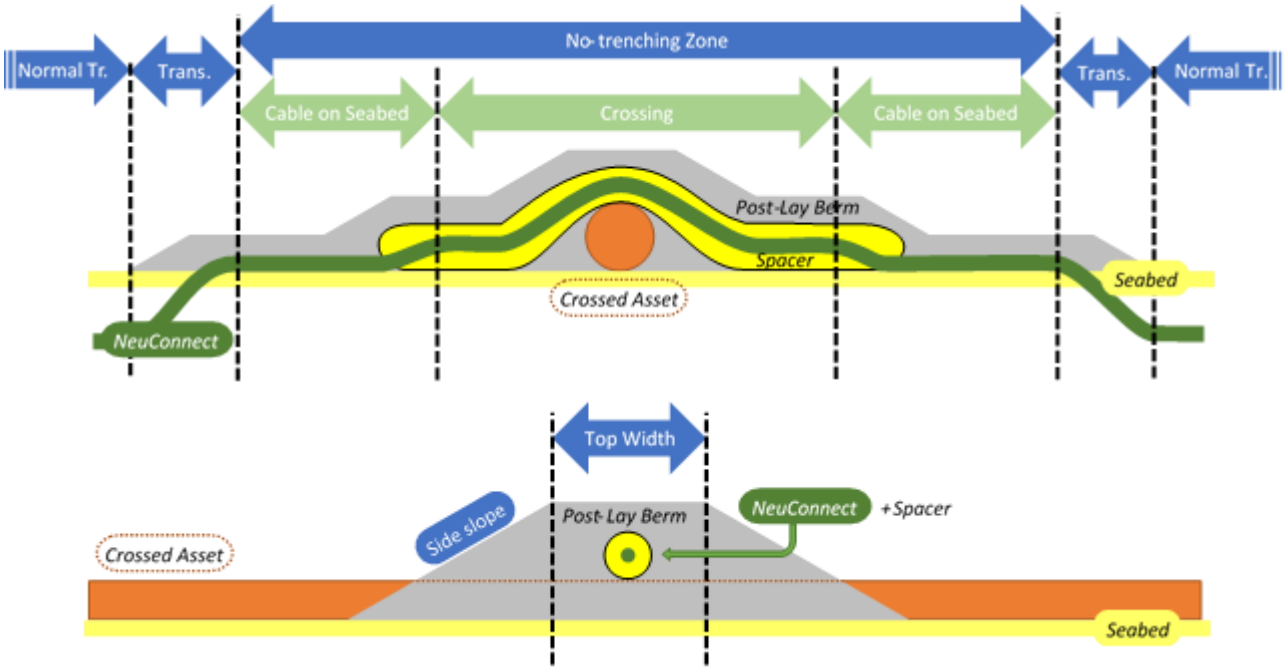

Figure 10 - Longitudinal section and cross-section of Type E crossing

Like type D, the height of the post-lay rock berms will be more than for buried assets. The total volume rock volume will be smaller than for type D, due to the smaller top width.

When trenching, the trencher will have to get out of the seabed at some distance before encountering the spacer. Therefore, there is an additional distance of cable on the seabed, when compared to type A. This distance is also considered as part of the no-trenching zone.

This solution can be applied for assets that are on the seabed, including partially buried ones.

Figure 11 on the next page shows the definition of the proposed dimensions.

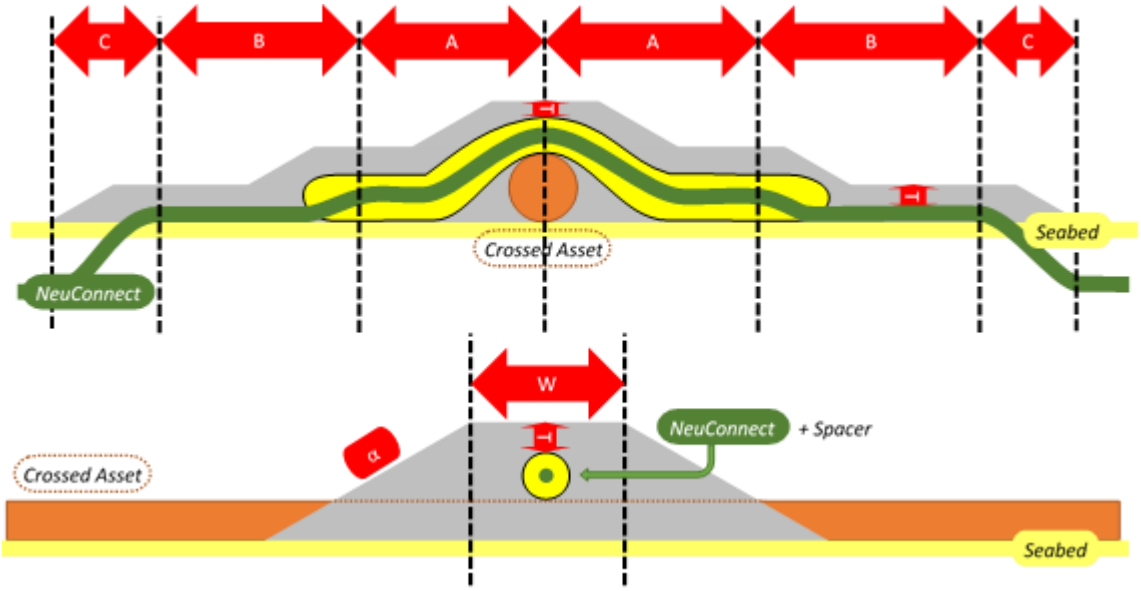

Figure 11 - Definition of Proposed Dimensions Type E Crossing

Proposed values for type E-crossings are as shown below. The no-trenching zone consist of zones A+B, on both sides of the crossed asset.

A	Crossing	25 m
B	Cable on Seabed	10 m
C	Transition zone	5 m
T	Layer Thickness	0.5 m on Top of Cable/Seabed
W	Top Width	1 m
α	Side Slope	1:3