IFC 4.3 Implementation & Validation Report

Appendix B – IFC Files and Description – Rail Part

Brief description of produced IFC files

Version:	*0.2*
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Authors (Alphabetical):	*IFC Rail Project*

Contents

1 Introduction

This document is built to summarize the IFC files created in IFC Rail Phase 2 project. It is part of the official deliverables of the report for implementation and validation of IFC 4.3, as shown in **Error! Reference source not found.** below. Please refer to the *IFC 4.3 Deployment Report: Executive Summary – Rail & Infra* for further details.

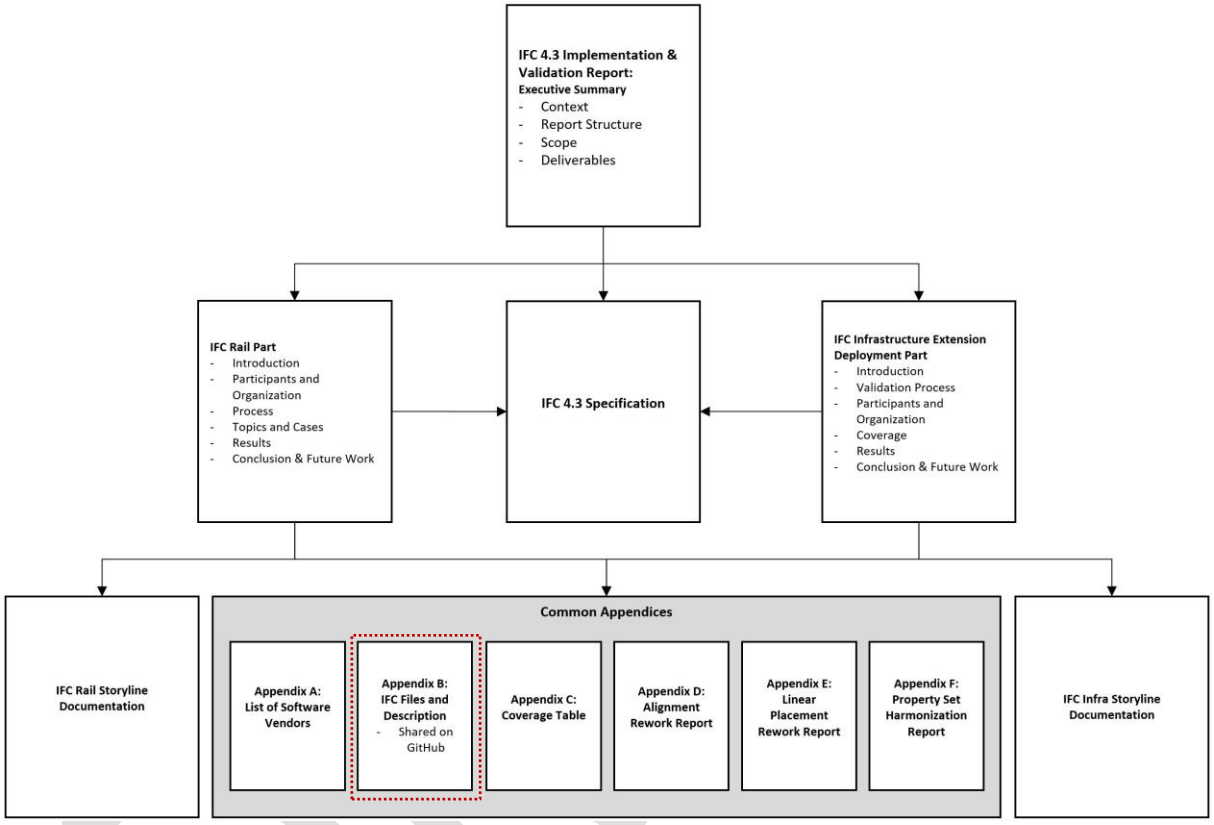


Figure 1 The position of this document in the structure of deliverables

In IFC Rail Phase 2 project, Unit Tests are grouped into 7 Topics: Alignment with Cant (AWC), Linear Placement (LP), Swept Area Solid (SAS), Railway Spatial Structure (RSS), System Breakdown Structure (RSS), Port Connectivity (PCC) and Domain Physical Elements (DPE). In total, more than 180 IFC files are produced for these topics. By removing duplicate files produced for the same case and files that require further improvement and validation, there are 144 unique IFC sample files produced. They are described in Chapter 2.

2 IFC Rail Files

In order to be consistent with Unit Test structure, created IFC files are grouped by Unit Test cases. For each Unit Test case described in this document, there are one or more IFC files created. The number of IFC files depend on the scenarios defined in the Unit Test and participation by software vendors.

For each Unit Test case that has the ID starts with "UT_", we provide a table at the beginning of the corresponding section as the overview information. These tables are in the same convention:

- **Case Provider**: the organization which provides the Unit Test as Datasets or descriptions
- **IFC Provider**: the organization which produce IFC 4.3 files for the Unit Test
- **Number of final IFC sample files**: the files that are chosen as valid file and put in the IFC-Rail-Sample-File GitHub repository. For the same Unit Test and same content, only one IFC file is chosen as the sample file, even if all the other files are also valid
- **Number of IFC files**: the number of IFC files that have been produced for the Unit Test. They are counted based on the number of IFC files in IFC-Rail-Unit-Test GitHub repository
- **Other Outcomes**: Outcomes other than IFC files for the Unit Test.

This document provides description of Unit Test cases and IFC files. IFC files and other details can be found in: https://github.com/IFCRail/IFC-Rail-Sample-Files

3 Alignment with Cant (AWC)

3.1 UT_AWC_0

Case Provider	IFC Rail Technical Service
IFC Provider	IFC Rail Technical Service; RDF
Number of final IFC sample files	112
Number of IFC files	112
Other Outcomes	PNG images; Point list in Excel

UT_AWC_0 is sets of synthetic cases that test single or a few transition bend segment. They cover all the transition bend segments defined in the horizontal layout.

Covered transition bend segments are:

- Clothoid
- Helmert Curve
- Bloss Curve
- Viennese Bend
- Sine Curve
- Cosine Curve
- Cubic

For each type of transition bends, a set of atomic synthetic cases are provided for different segment length, start radius and end radius. Each synthetic case has one transition bend segment. A list files are provided:

- an IFC file that captures alignment semantics only
- an IFC file that captures alignment semantics and geometry
- point list along the segment
- plot image as visualization

3.1.1 Clothoid

Provided cases are:

Case	SegmentLength	StartRadius	EndRadius
TS1_Clothoid_100.0_inf_300_1_Meter	100.	0.	300.
TS2_Clothoid_100.0_-inf_-300_1_Meter	100.	0.	-300.
TS3_Clothoid_100.0_300_inf_1_Meter	100.	300.	0.
TS4_Clothoid_100.0_-300_-inf_1_Meter	100.	-300.	0.
TS5_Clothoid_100.0_1000_300_1_Meter	100.	1000.	300.
TS6_Clothoid_100.0_-1000_-300_1_Meter	100.	-1000.	-300.
TS7_Clothoid_100.0_300_1000_1_Meter	100.	300.	1000.
TS8_Clothoid_100.0_-300_-1000_1_Meter	100.	-300.	-1000

An example visualization:

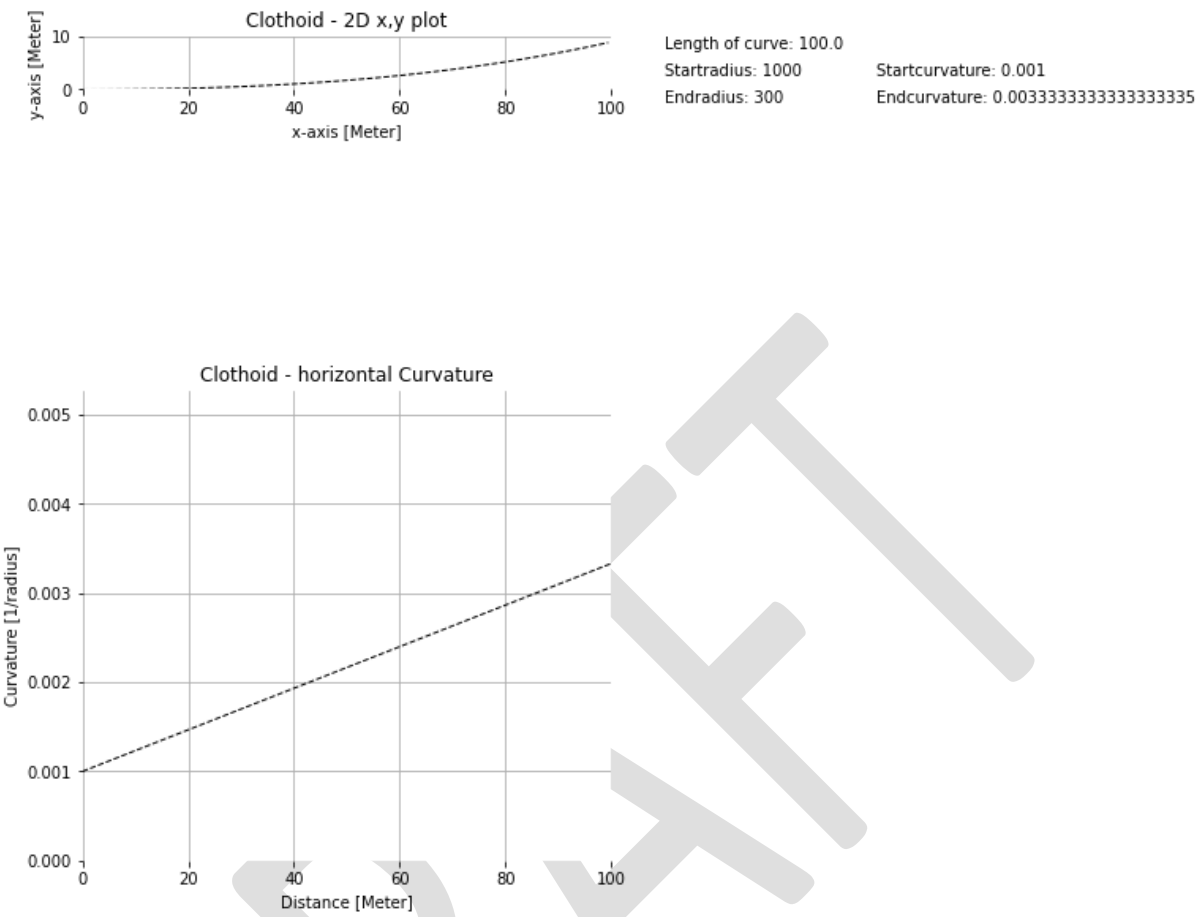


Figure 2 Plots to visualize the x, y coordinates and curvature change of a Clothoid segment case (TS5)

3.1.2 Helmert Curve

Provided cases are:

Case	SegmentLength	StartRadius	EndRadius
TS1_Helmert_100.0_inf_300_1_Meter	100.	0.	300.
TS2_ Helmert_100.0_-inf_-300_1_Meter	100.	0.	-300.
TS3_ Helmert_100.0_300_inf_1_Meter	100.	300.	0.
TS4_ Helmert_100.0_-300_-inf_1_Meter	100.	-300.	0.
TS5_ Helmert_100.0_1000_300_1_Meter	100.	1000.	300.
TS6_ Helmert_100.0_-1000_-300_1_Meter	100.	-1000.	-300.
TS7_ Helmert_100.0_300_1000_1_Meter	100.	300.	1000.
TS8_ Helmert_100.0_-300_-1000_1_Meter	100.	-300.	-1000

An example visualization:

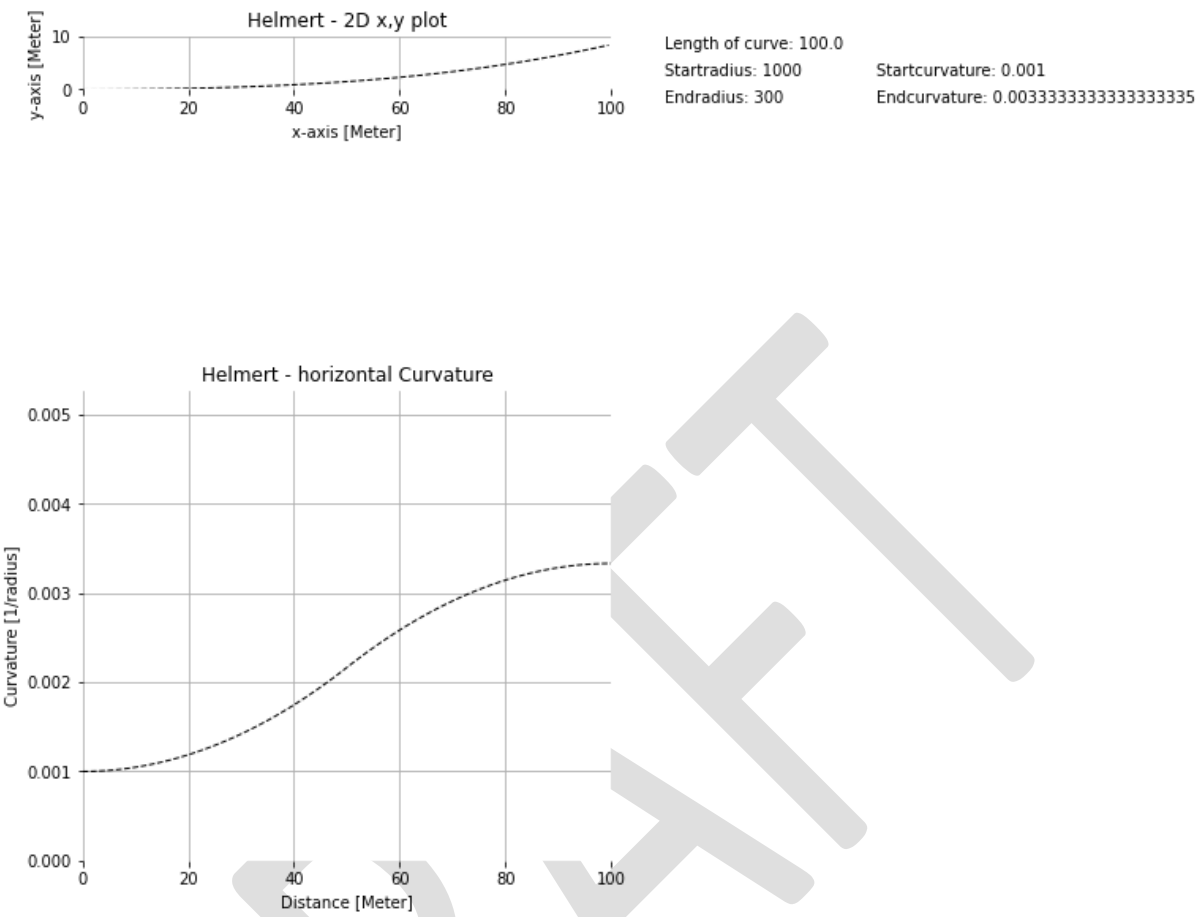


Figure 3 Plots to visualize the x, y coordinates and curvature change of a Helmert Curve segment case (TS5)

3.1.3 Bloss Curve

Provided cases are:

Case	SegmentLength	StartRadius	EndRadius
TS1_Bloss_100.0_inf_300_1_Meter	100.	0.	300.
TS2_ Bloss_100.0_-inf_-300_1_Meter	100.	0.	-300.
TS3_ Bloss_100.0_300_inf_1_Meter	100.	300.	0.
TS4_ Bloss_100.0_-300_-inf_1_Meter	100.	-300.	0.
TS5_ Bloss_100.0_1000_300_1_Meter	100.	1000.	300.
TS6_ Bloss_100.0_-1000_-300_1_Meter	100.	-1000.	-300.
TS7_ Bloss_100.0_300_1000_1_Meter	100.	300.	1000.
TS8_ Bloss_100.0_-300_-1000_1_Meter	100.	-300.	-1000

An example visualization:

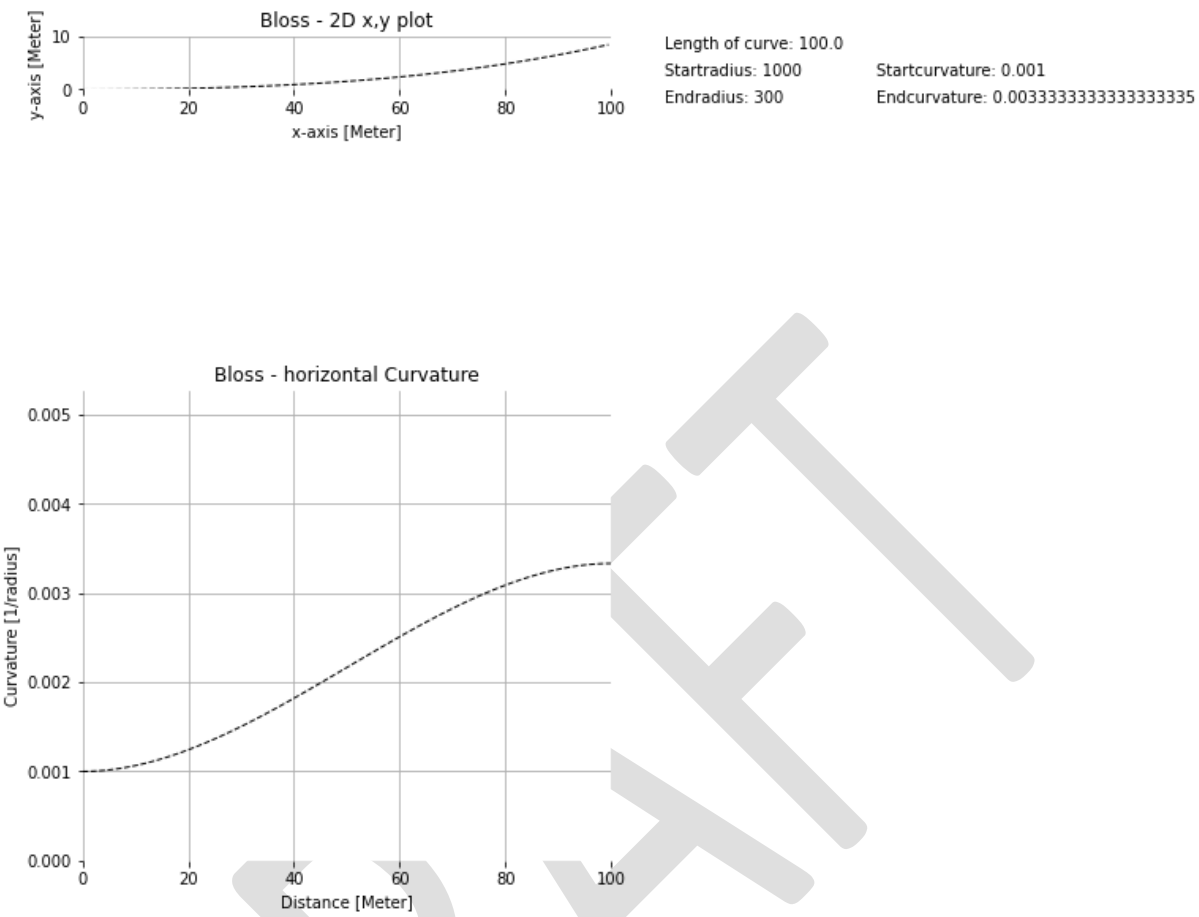


Figure 4 Plots to visualize the x, y coordinates and curvature change of a Bloss Curve segment case (TS5)

3.1.4 Viennese Bend

Provided cases are:

Case	SegmentLength	StartRadius	EndRadius
TS1_ Viennese Bend_100.0_inf_300_1_Meter	100.	0.	300.
TS2_ Viennese Bend_100.0_-inf_-300_1_Meter	100.	0.	-300.
TS3_ Viennese Bend_100.0_300_inf_1_Meter	100.	300.	0.
TS4_ Viennese Bend_100.0_-300_-inf_1_Meter	100.	-300.	0.
TS5_ Viennese Bend_100.0_1000_300_1_Meter	100.	1000.	300.
TS6_ Viennese Bend_100.0_-1000_-300_1_Meter	100.	-1000.	-300.
TS7_ Viennese Bend_100.0_300_1000_1_Meter	100.	300.	1000.
TS8_ Viennese Bend_100.0_-300_-1000_1_Meter	100.	-300.	-1000

An example visualization:

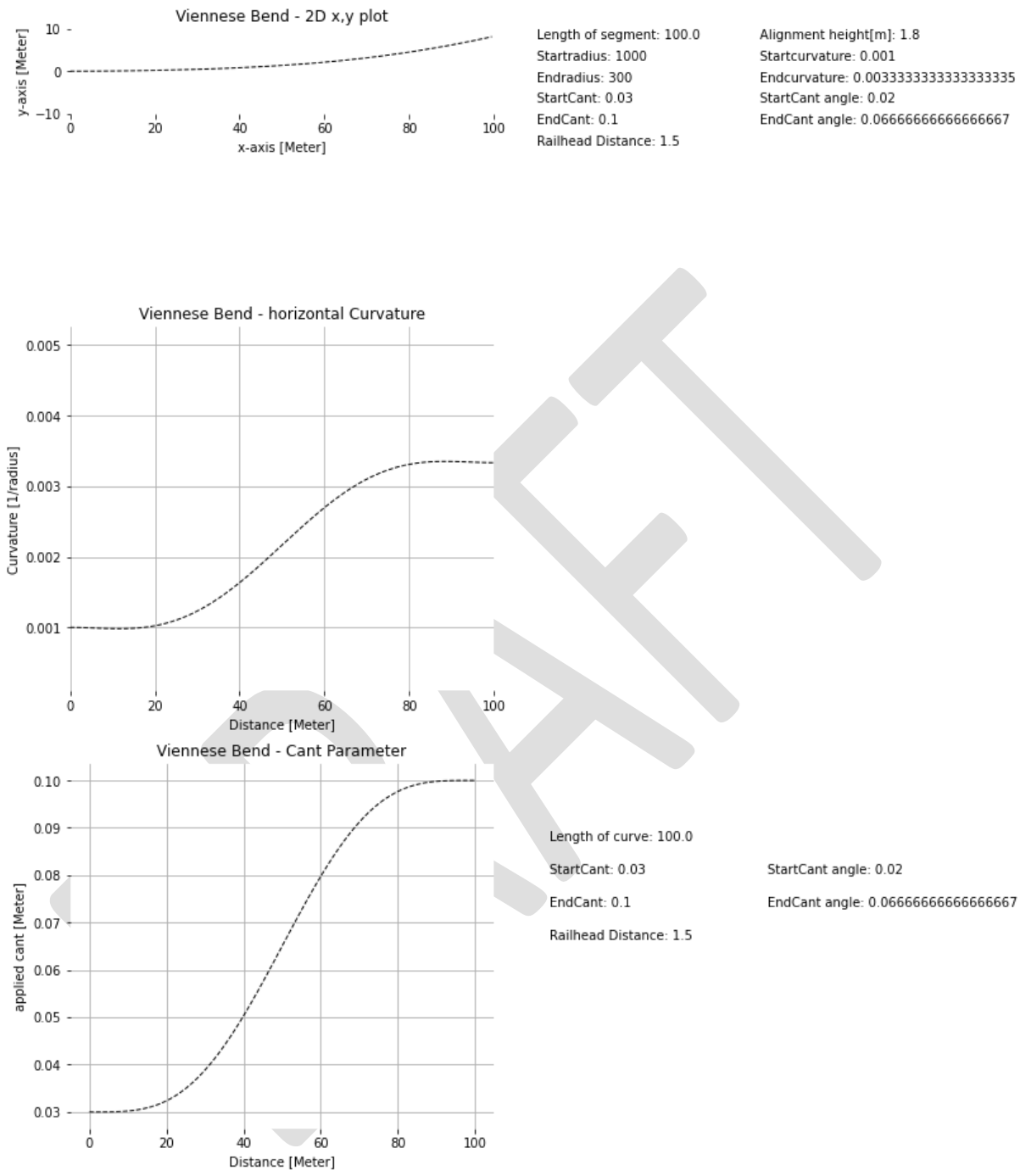


Figure 5 Plots to visualize the x, y coordinates, curvature change and cant change of a Viennese Bend segment case (TS5)

3.1.5 Sine Curve

Provided cases are:

Case	SegmentLength	StartRadius	EndRadius

TS1_Sine_100.0_inf_300_1_Meter	100.	0.	300.
TS2_Sine_100.0_-inf_-300_1_Meter	100.	0.	-300.
TS3_Sine_100.0_300_inf_1_Meter	100.	300.	0.
TS4_Sine_100.0_-300_-inf_1_Meter	100.	-300.	0.
TS5_Sine_100.0_1000_300_1_Meter	100.	1000.	300.
TS6_Sine_100.0_-1000_-300_1_Meter	100.	-1000.	-300.
TS7_Sine_100.0_300_1000_1_Meter	100.	300.	1000.
TS8_Sine_100.0_-300_-1000_1_Meter	100.	-300.	-1000

An example visualization:

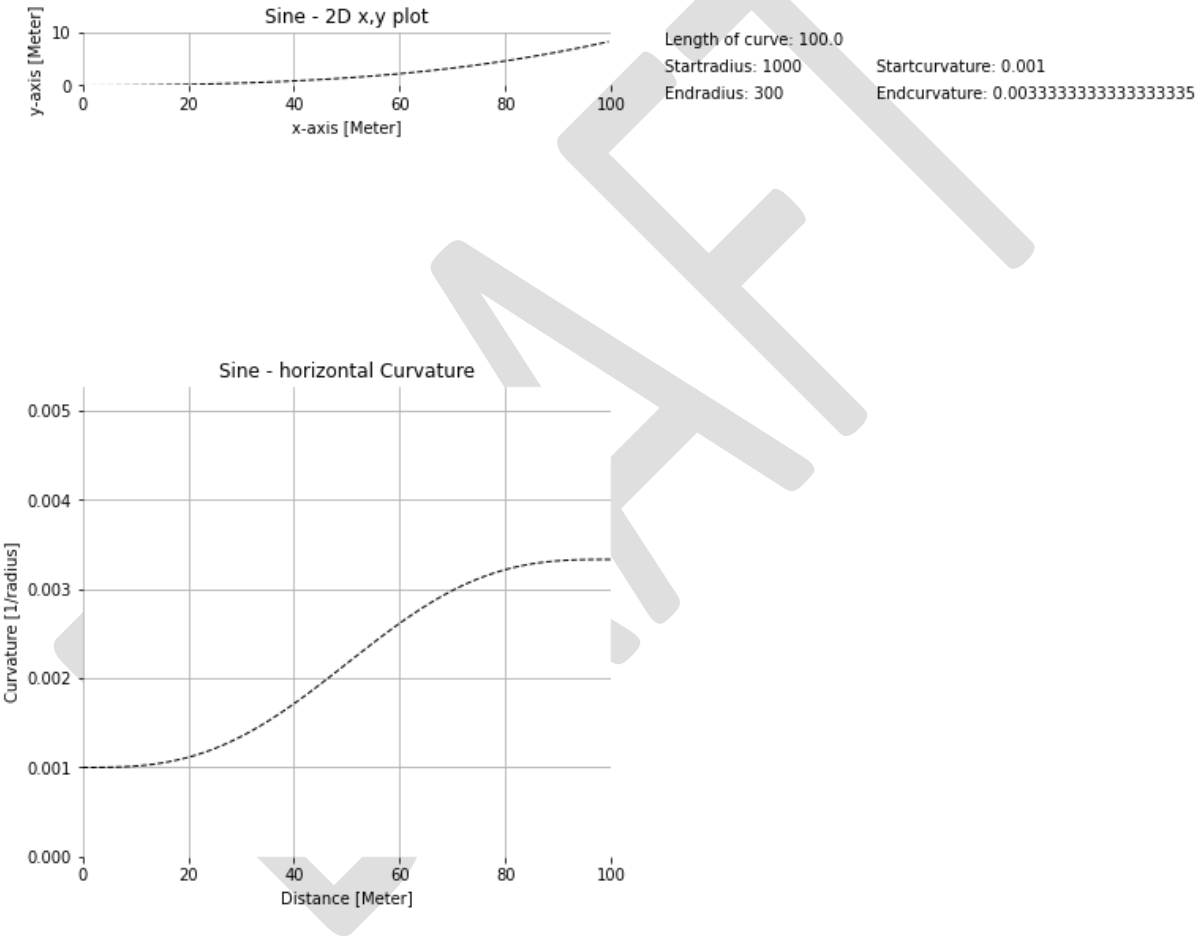


Figure 6 Plots to visualize the x, y coordinates and curvature change of a Sine segment case (TS5)

3.1.6 Cosine Curve

Provided cases are:

Case	SegmentLength	StartRadius	EndRadius

TS1_Cosine_100.0_inf_300_1_Meter	100.	0.	300.
TS2_ Cosine_100.0_-inf_-300_1_Meter	100.	0.	-300.
TS3_ Cosine_100.0_300_inf_1_Meter	100.	300.	0.
TS4_ Cosine_100.0_-300_-inf_1_Meter	100.	-300.	0.
TS5_ Cosine_100.0_1000_300_1_Meter	100.	1000.	300.
TS6_ Cosine_100.0_-1000_-300_1_Meter	100.	-1000.	-300.
TS7_ Cosine_100.0_300_1000_1_Meter	100.	300.	1000.
TS8_ Cosine_100.0_-300_-1000_1_Meter	100.	-300.	-1000

An example visualization:

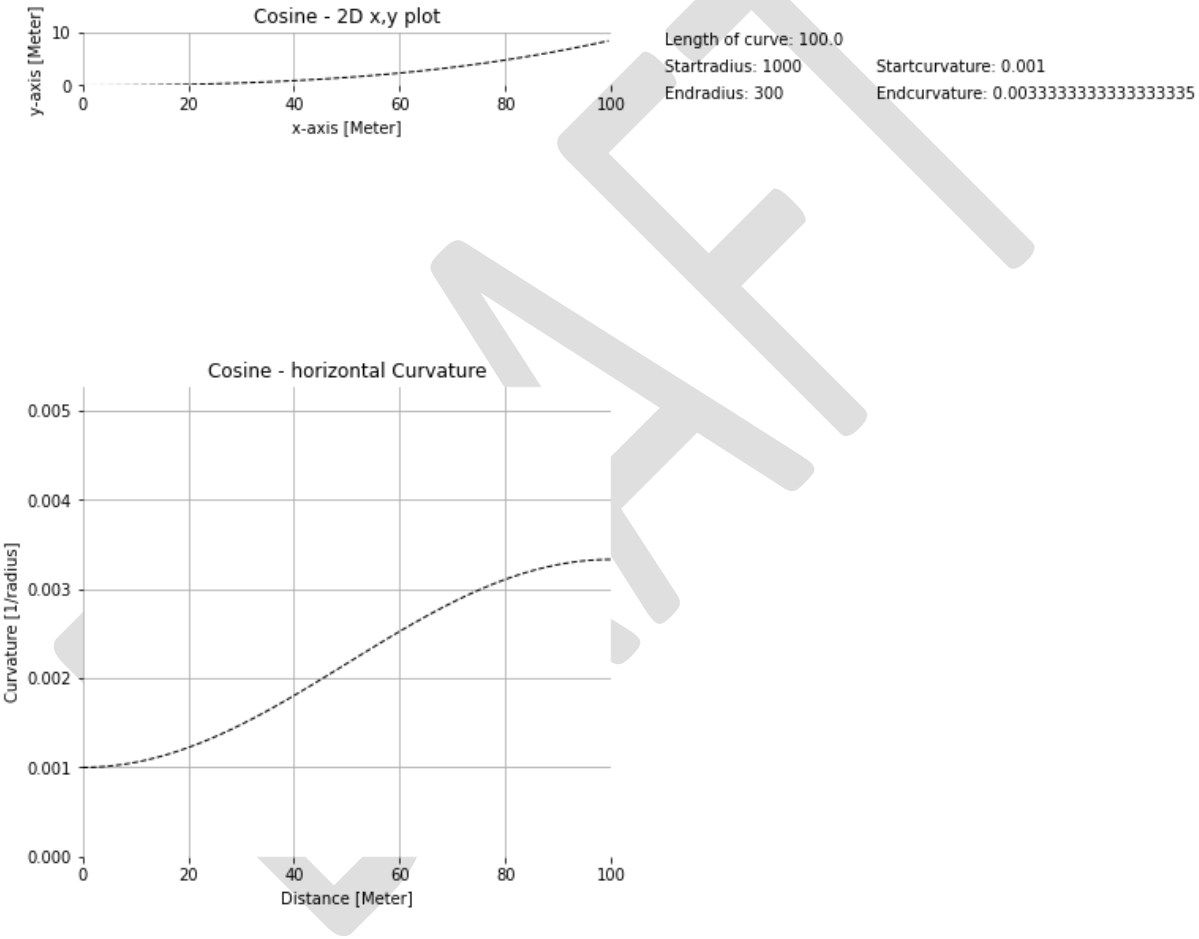


Figure 7 Plots to visualize the x, y coordinates and curvature change of a Cosine segment case (TS5)

3.2 UT_AWC_1

Case Provider	SBB
Raw Dataset Format	XTR

IFC Provider	IFC Rail Technical Service; RDF; Geodesia; ACCA; ODA; GeometryGym
Number of final IFC sample files	2
Number of all IFC files produced	17
Other Outcomes	Images

This Unit Test Scenario considers one alignment that is defined by three layouts: horizontal, vertical and cant. The horizontal alignment consists of straight line segments, circular segments and transition curve (Clothoid), vertical alignment consists of straight line and circular segments, and cant alignment consists of straight line segments.

The vertical alignment is measured from center line.

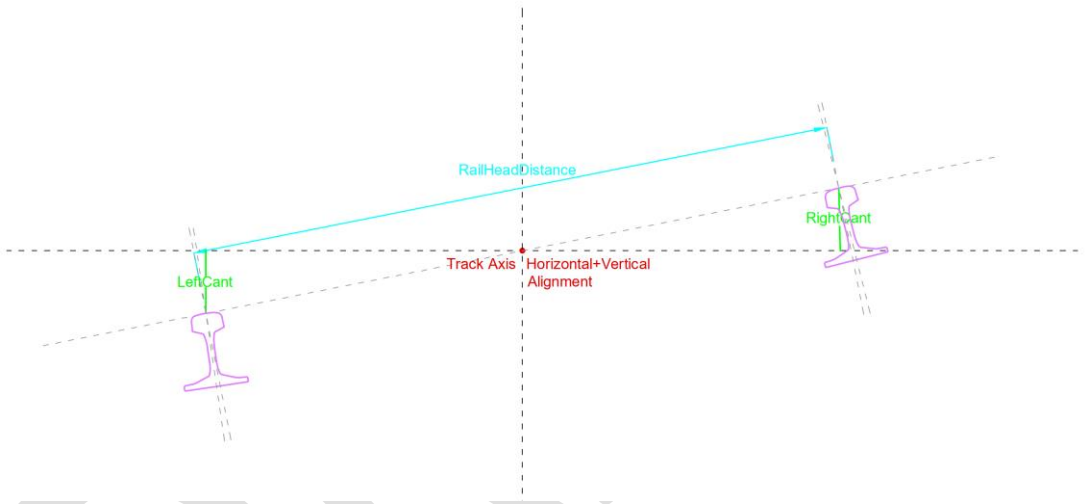


Figure 8 Vertical alignment is measured from center line in UT_AWC_1

The input dataset is provided by SBB in XTR format, which is an open format defined by SBB for data exchange between TopoRail, a software developed by SBB. This files describes an alignment of a single track of 2.5 km between two nodal points.

Figure 9 The raw dataset visualized in TopoRail

The IFC files have been produced by different vendors: ACCA, Geodesial, GeometryGym, ODA and RDF. Some visualization images are provided:

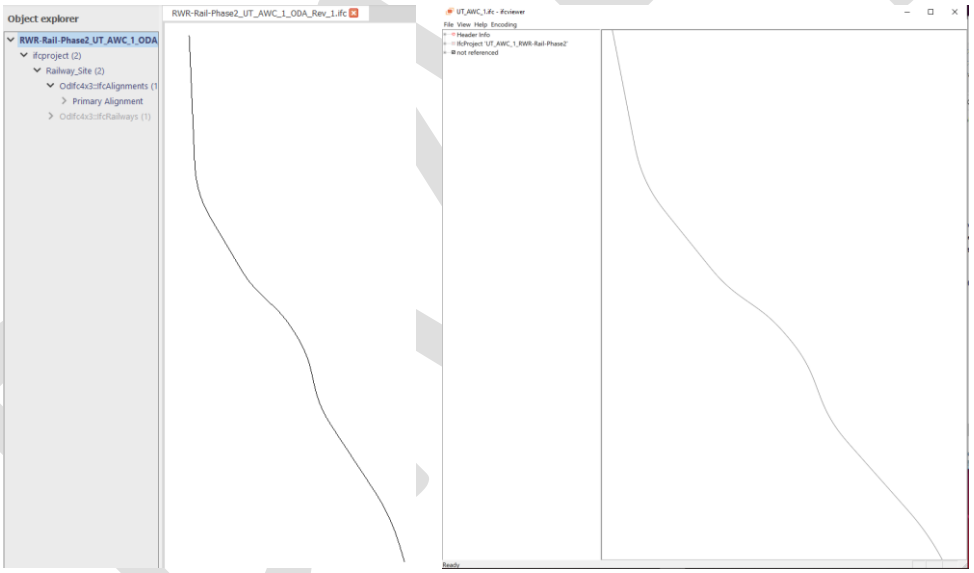


Figure 10 Produced IFC files visualized in software (left: ODA, right: RDF)

3.3 UT_AWC_2

Case Provider	SNCF
Raw Dataset Format	LandXML
IFC Provider	IFC Rail Technical Service; RDF; ACCA; ODA; Geodesial
Number of final IFC sample files	2

Number of all IFC files produced	12
Other Outcomes	Images

This Unit Test Scenario contains two alignments that are defined by three layouts : Horizontal, Vertical and Cant.

The horizontal alignment consists of straight line segments, circular segments and transition curve (Clothoid), vertical alignment consists of straight line and circular segments, and cant alignment consists of straight line segments. These 3 layouts are condensed in one LandXML file.

This dataset contains 2 curved tracks alignments linked by a switch. The particularity of this dataset is that the deviated track will have an off-Camber (it keeps the same cant as the first track even if the direction is opposite).

The input dataset is provided by SNCF Réseau in LandXML format. The software vendors joining the project will be expected to produce an IFC file.

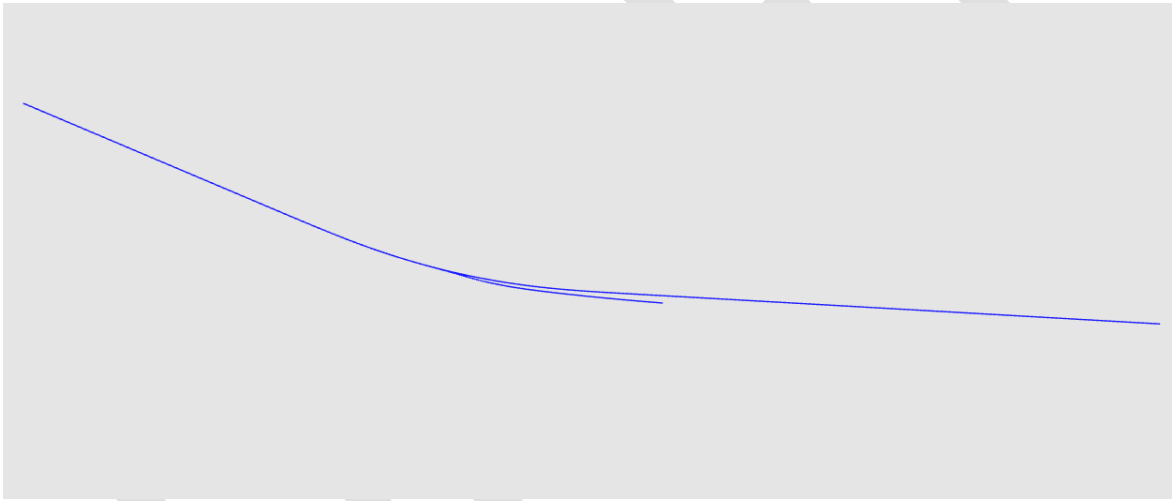


Figure 11 The LandXML raw data visualized

The IFC files have been produced by different vendors: ACCA, Geodesial, ODA and RDF. Some visualization images are provided:

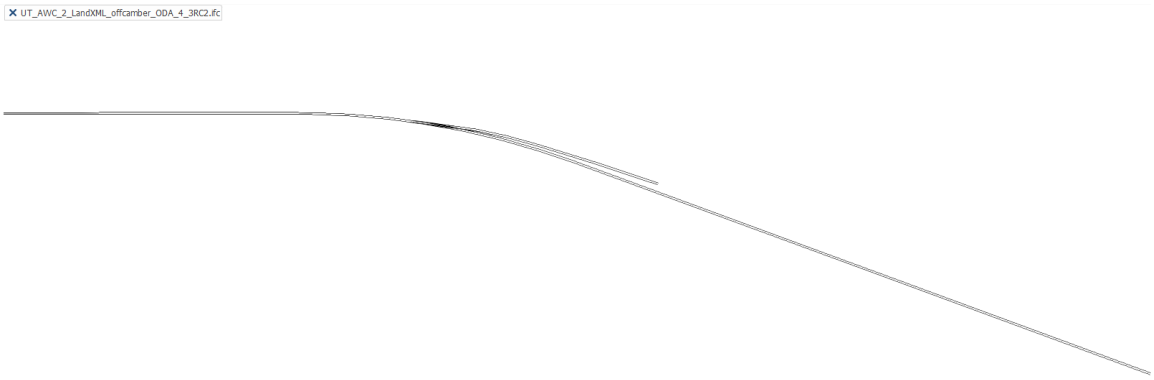


Figure 12 Produced IFC files visualized in software (top: ACCA, bottom: ODA)

3.4 UT_AWC_3

Case Provider	FTIA
Raw Dataset Format	LandXML
IFC Provider	IFC Rail Technical Service; ACCA; Geodesial; GeometryGym; ODA; RDF
Number of final IFC sample files	2
Number of all IFC files produced	13
Other Outcomes	Images

This Unit Test Scenario contains multiple alignments for a railway station scenario. Three layouts are available for some alignments, but other alignments only have horizontal and vertical layouts or even only the horizontal layout.

It is a case with wide track gauge. The nominal rail head distance, which is used to compute cant angle, is 1524mm instead of most cases which are 1500mm.

The vertical alignment is measured from the bottom of tie plate.

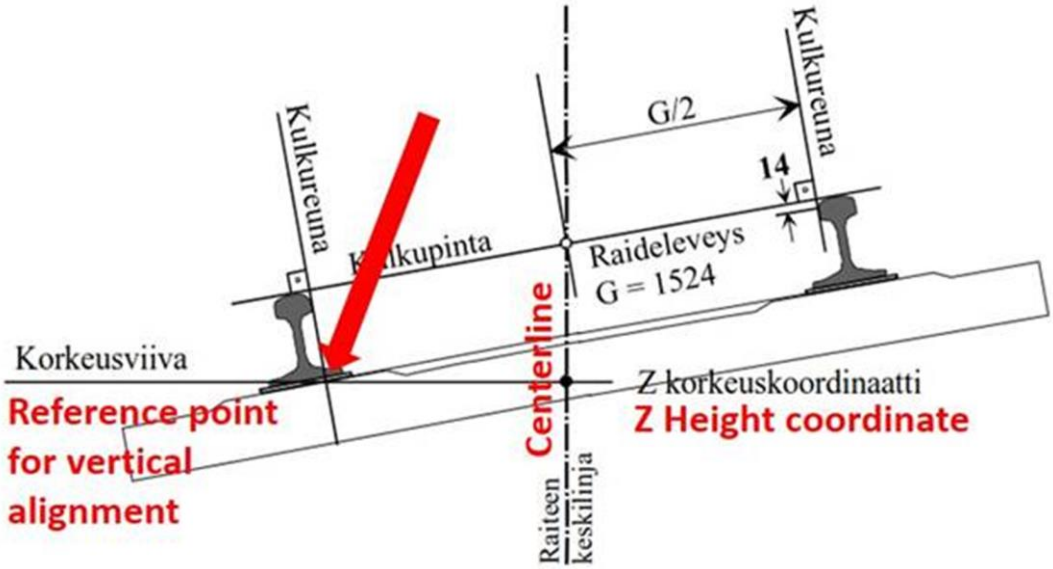


Figure 13 Vertical alignment is measured from the bottom of tie plate

The raw dataset is in LandXML format.

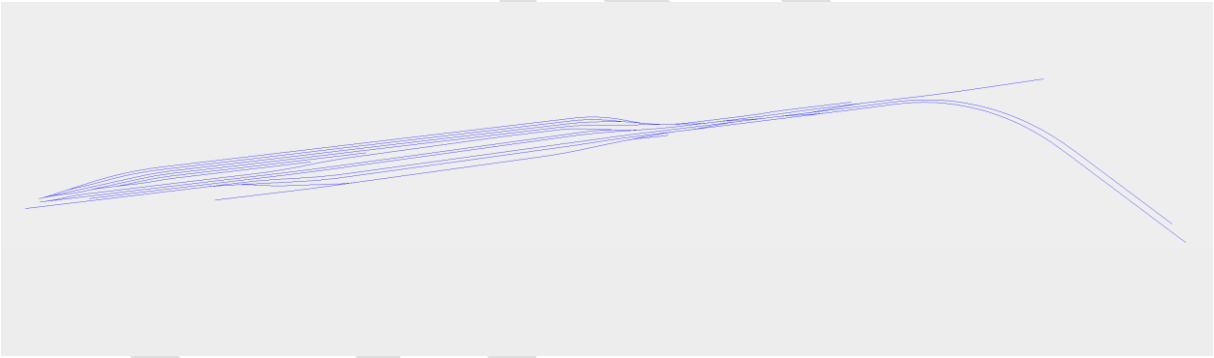


Figure 14 The raw data in LandXML visualized

Besides IFC Rail Technical Service, IFC files have been produced by different vendors: ACCA, Geodesial, GeometryGym, ODA and RDF. Some visualization images are provided:

3.5 UT_AWC_4

Case Provider	RFI
Raw Dataset Format	LandXML; Excel

IFC Provider	IFC Rail Technical Service; ACCA; Geodesial; GeometryGym; ODA; RDF
Number of final IFC sample files	2
Number of all IFC files produced	12
Other Outcomes	Images

This Unit Test intends to experiment the use of IFC for representing a railway alignment curve, starting from its parameters.

The provided parameters describe the alignment of a railway track of about 3,7 km between two nodal points. Visual representations of the track are provided below.

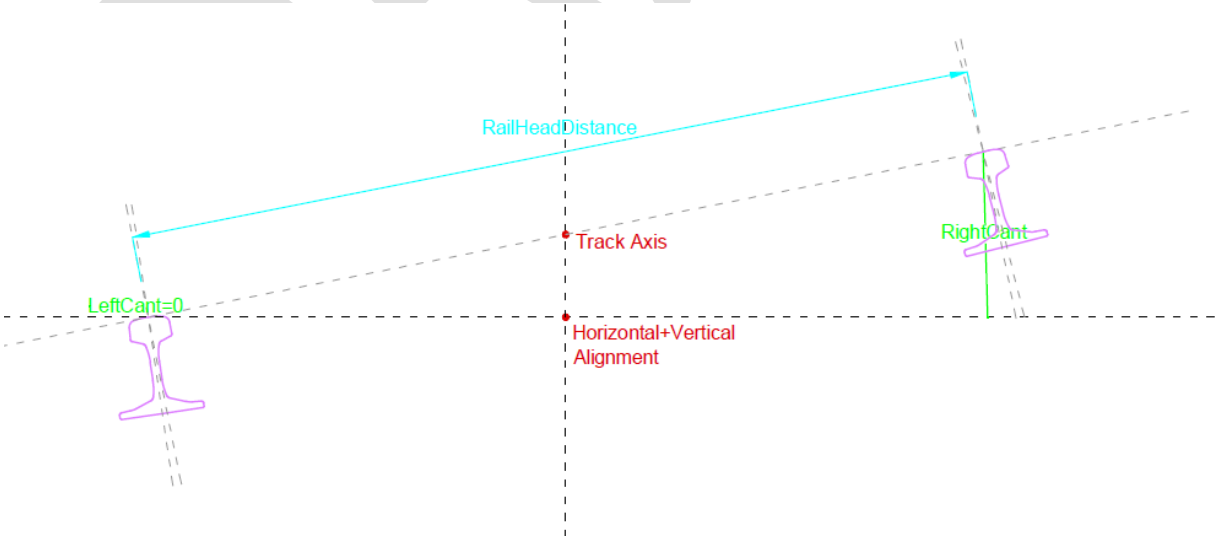
The peculiarities of this alignment curve are:

- cant presence
- a point of inflection
- an articulated vertical alignment

The EPSG code: 32632 (WGS 84 / UTM zone 32N).

IMPORTANT:

- In Italy, the vertical alignment is measured from the lower rail, as showed in the picture below.
- The RailHeadDistance is a normalized value used to compute the angle of cant. RFI uses 1500mm for a track gauge of 1435mm.



Besides IFC Rail Technical Serivce, the IFC files have been produced by different vendors: ACCA, Geodesial, GeometryGym, ODA and RDF. Some visualization images are provided:

3.6 UT_AWC_5

Case Provider	RailComplete
Raw Dataset Format	LandXML; RC-XML
IFC Provider	IFC Rail Technical Service; ACCA;
Number of final IFC sample files	2
Number of all IFC files produced	5
Other Outcomes	Images

This Unit Test Scenario considers RailCOMPLETE alignments expressed in the RC-XML format embedded as text inside a DWG file. A file which contains RC-XML is nick-named 'an RC-DWG' file.

The construction of the RC-XML format started out in 2015 using railML version 2.2 as a basis for C# class creation.

This is a case that uses Parabola in the vertical alignment.

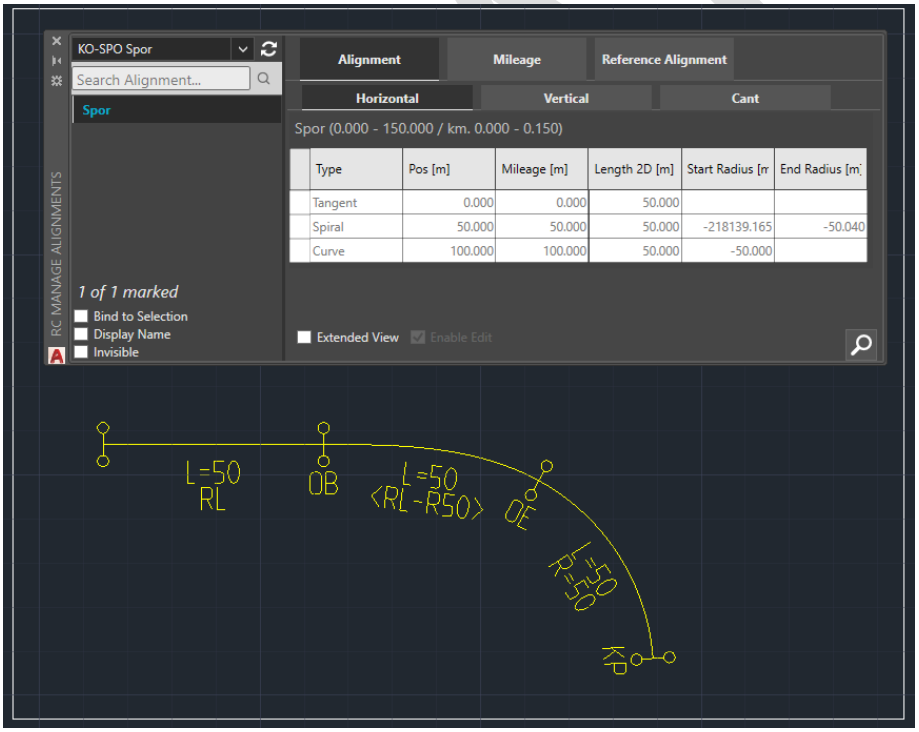


Figure 15 Original data from RailComplete

Besides IFC Rail Technical Serivce, the IFC files have been produced by ACCA. Some visualization images are provided:

3.7 UT_AWC_6

Case Provider	CRBIM
Raw Dataset Format	PF; Excel; IFC (early version)
IFC Provider	IFC Rail Technical Service; RDF
Number of final IFC sample files	2
Number of all IFC files produced	2
Other Outcomes	Images

This Unit Test contains two alignments which are parallel (double line scenario). The peculiarities of this cases are:

- Sine curve as transition bend in horizontal
- Clothoid as smoothing in vertical

These types of alignment segments are only used in maglev lines that have design speed more that 350km/h. These are newly regulated in a China national standard in early 2020.

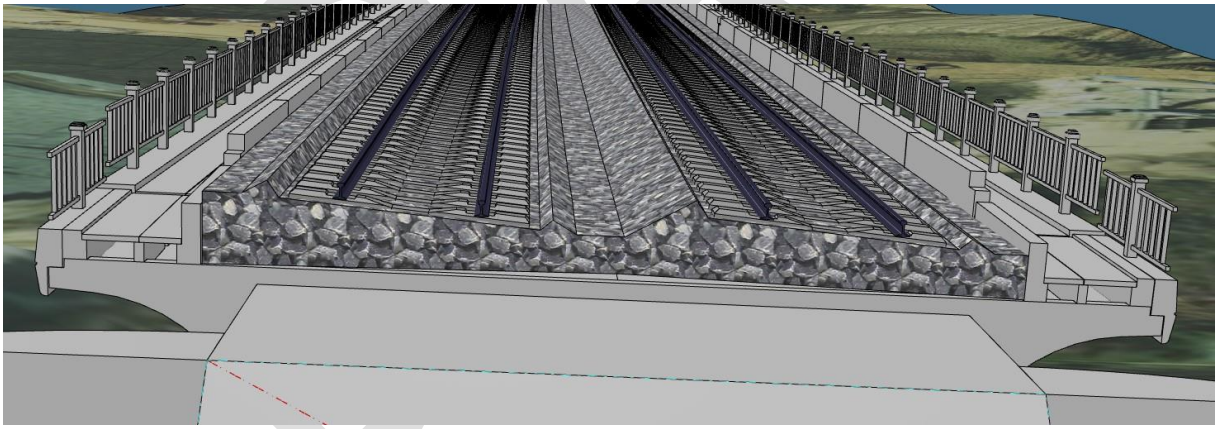


Figure 16 Double line as context of this case

The raw datasets are provided in a few formats: PF, Excel and early version of IFC.

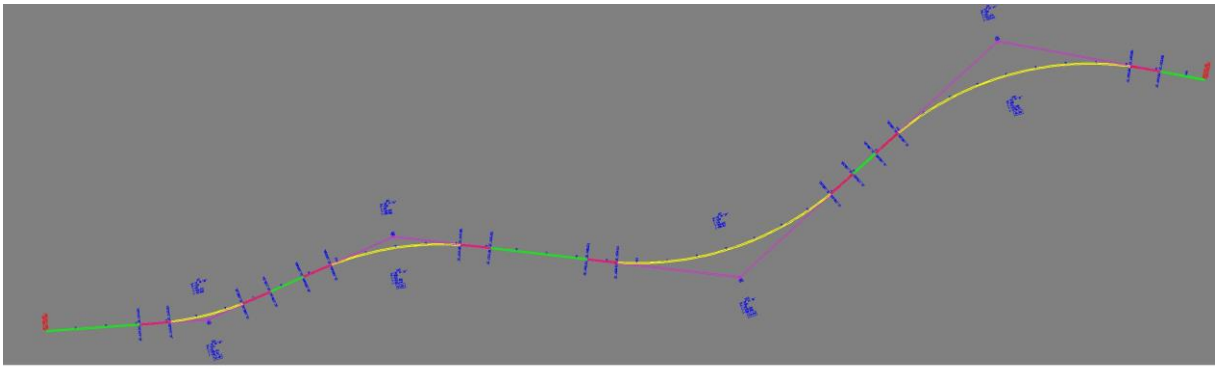


Figure 17 Original dataset visualized

IFC files are provided by IFC Rail Technical Service and RDF:

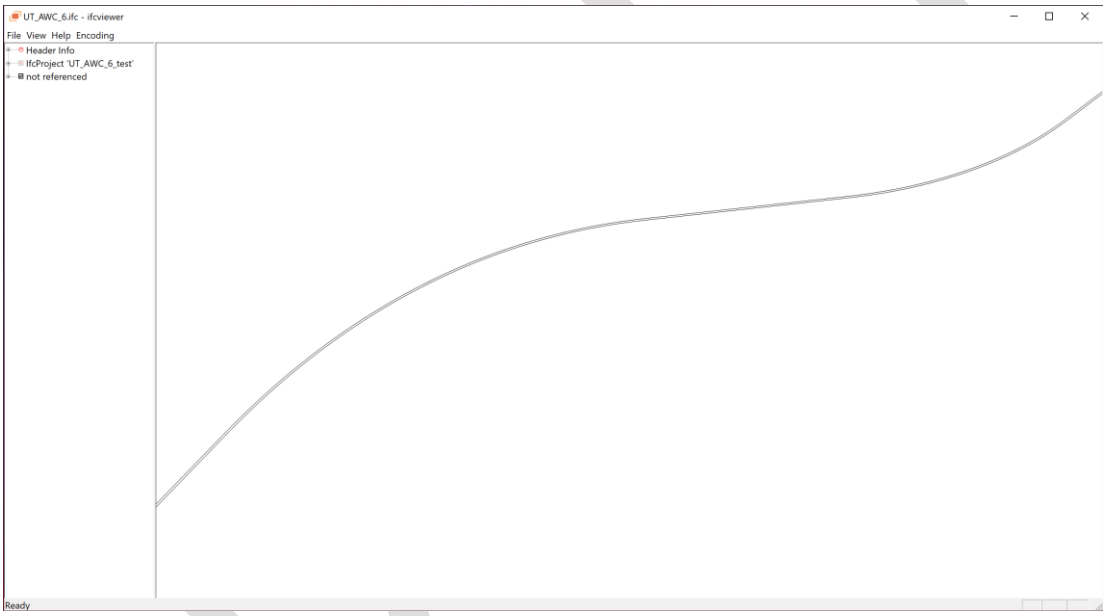


Figure 18 Produced IFC visualized in IfcEngine from RDF

3.8 UT_AWC_7

Case Provider	RFI
Raw Dataset Format	LandXML; Excel
IFC Provider	GeometryGym;
Number of final IFC sample files	1
Number of all IFC files produced	1

Other Outcomes	Images

This Unit Test intends to experiment the use of IFC for representing a railway alignment curve, starting from its parameters.

The provided parameters describe the alignment of a railway track of about 5,9 km between two nodal points.

The peculiarities of this alignment curve are:

- cant presence
- transition curve using cubic parabola

The dataset is provided by RFI/Itaferr.

EPSG code: TBD (WGS TBD / UTM zone TBD)

The IFC file is produced by GeometryGym:

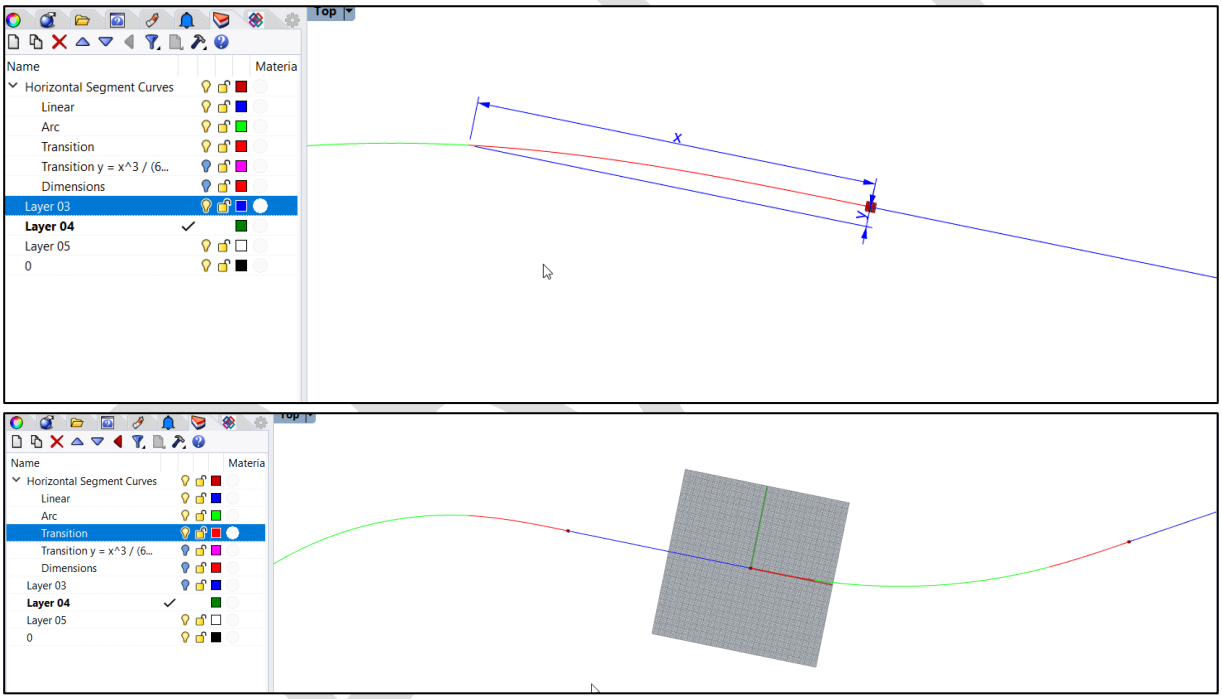


Figure 19 IFC file from GeometryGym visualized in Rhino

4 Linear Placement (LP)

4.1 UT_LP_1

Case Provider	RFI
Raw Dataset Format	LandXML; IFC; Excel
IFC Provider	ACCA; Geodesial; GeometryGym;

Number of final IFC sample files	1
Number of all IFC files produced	3
Other Outcomes	Images

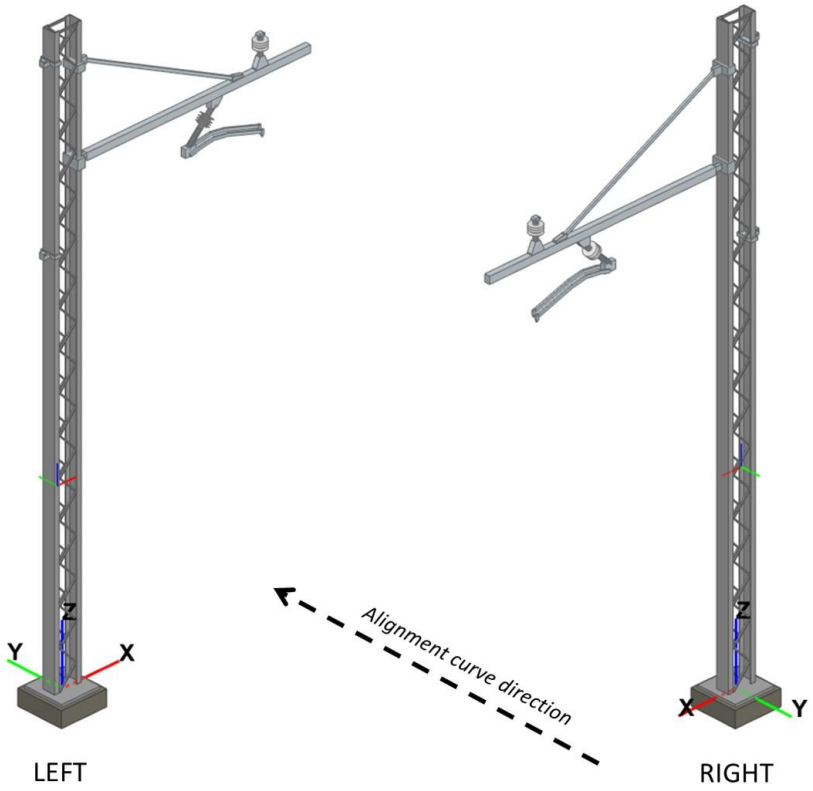
This Unit Test intends to experiment the use of IFC for representing the linear placement of the catenary posts. In the dataset, the placement is described as a set of parameters related to the alignment curve.

The dataset refers to the alignment curve provided in UT_AWC_4, without the cant layout. The dataset includes 84 posts that are placed according to the alignment curve.

The peculiarities of this unit test are:

- There is no parameter that depends on cant
- The distance between the posts along the curve is measured according to the projection of the alignment curve onto the horizontal plane, i.e., according to the horizontal alignment curve.
- The only rotation of the posts is around its vertical axis.
- The geometry of the posts type is simplified
    - The cantilever part of the pole is out of scope for this test, so its height is considered fixed for the specific type of post.

The dataset is provided by RFI/Itaferr.



The IFC files are produced by ACCA, Geodesial and GeometryGym:

4.2 UT_LP_3

Case Provider	SBB
Raw Dataset Format	XTR; IFC
IFC Provider	Geodesial; GeometryGym;
Number of final IFC sample files	1
Number of all IFC files produced	2
Other Outcomes	Images

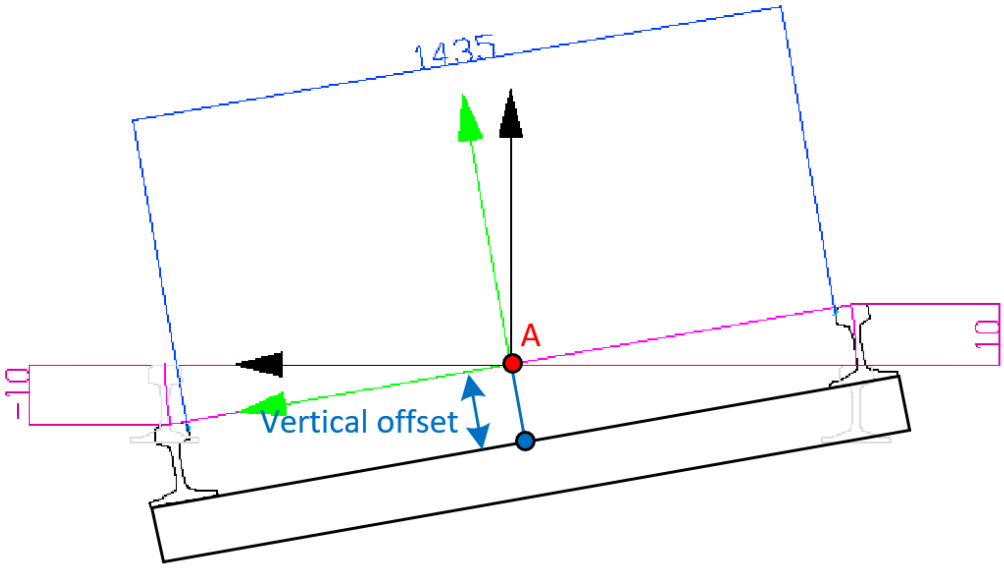
This Unit Test intends to experiment the use of IFC for representing the linear placement of sleeper. In the dataset, the placement of the sleeper is lineary referenced to the alignment curve.

The dataset refers to the alignment curve provided in file UT_LP_3_Alignment.XTR. The dataset includes 182 positions of sleepers that are placed according to the alignment curve.

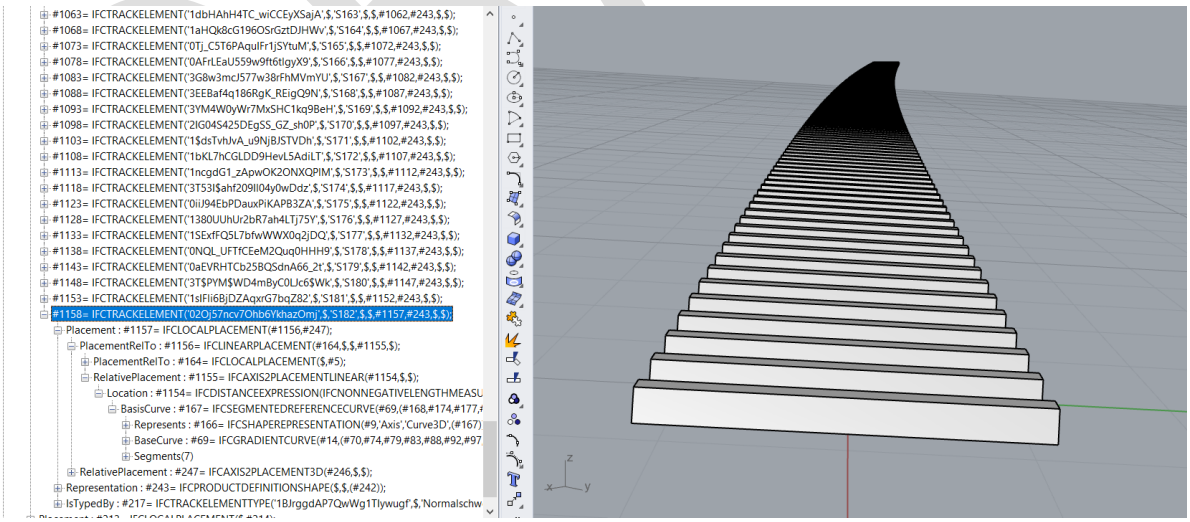
The specificities of this unit test are:

- The distance along for the placement of the sleeper is the distance measured according to the projection of the alignment in the horizontal plane i.e., according to the horizontal alignment curve.
- The rotation of the sleeper depends on cant
- The geometry of the sleeper is simplified

The dataset is provided by SBB.



The IFC files are produced by Geodesia and GeometryGym:



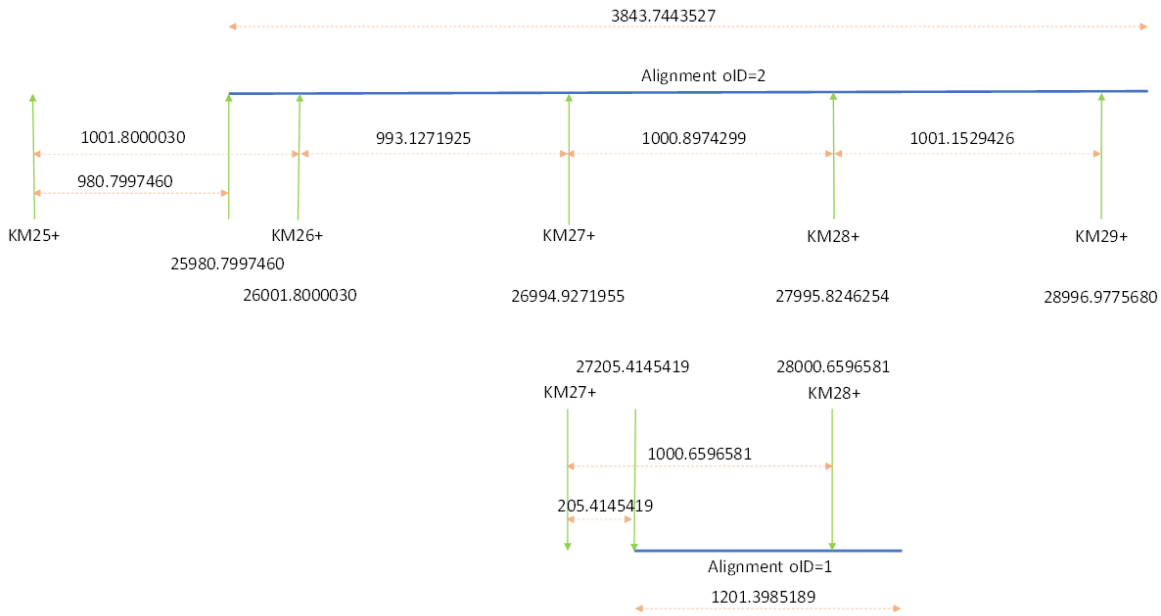
4.3 UT_LP_4

Case Provider	Trafikverket

Raw Dataset Format	LandXML
IFC Provider	IFC Rail Technical Service; GeometryGym;
Number of final IFC sample files	1
Number of all IFC files produced	2
Other Outcomes	Images

This Unit Test intends to experiment the use of IFC for representing broken chainage.

The dataset is provided by Trafikverket.



IFC files are provided by IFC Rail Technical Service and GeometryGym.

4.4 UT_LP_6

Case Provider	SNCF
Raw Dataset Format	LandXML; dwg; png
IFC Provider	IFC Rail Technical Service;
Number of final IFC sample files	1
Number of all IFC files produced	1
Other Outcomes	Images

This Unit Test intends to experiment the use of IFC for representing the linear placement of drainage element. In the dataset, the placement is described as a set of parameters related to an alignment curve from the earth surface.

This data sets aims to test the scenario of positioning objects at span locations (from/to) with lateral and vertical offsets.

This case aims to test the positioning of swept solids from a starting alignment station to an ending alignment Station, considering an horizontal offset from the rail alignment and different vertical constraints:

- Vertical offset from a surface
- Start/End elevation in NGF

This object is composed of a slotted pipe and a draining trench. This kind of drainage is positioned with a lateral offset from the rail alignment and two verticals constraints (the upper trench and the flowline position).

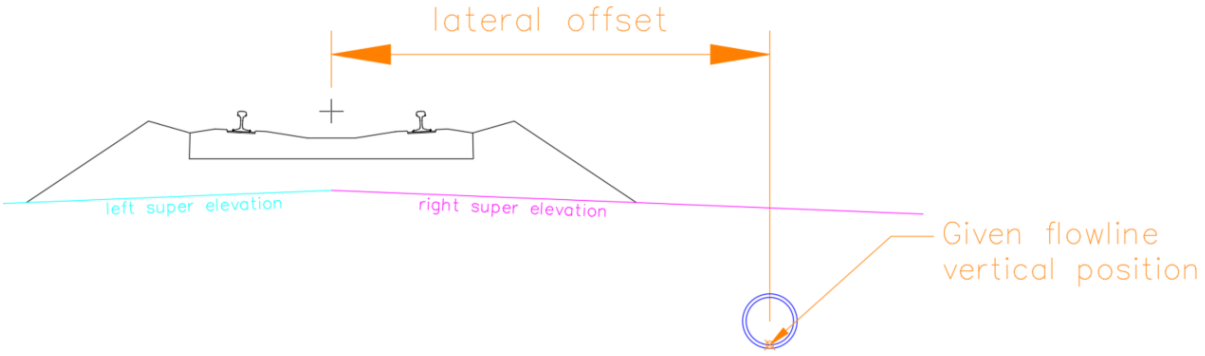
- Lateral positionning

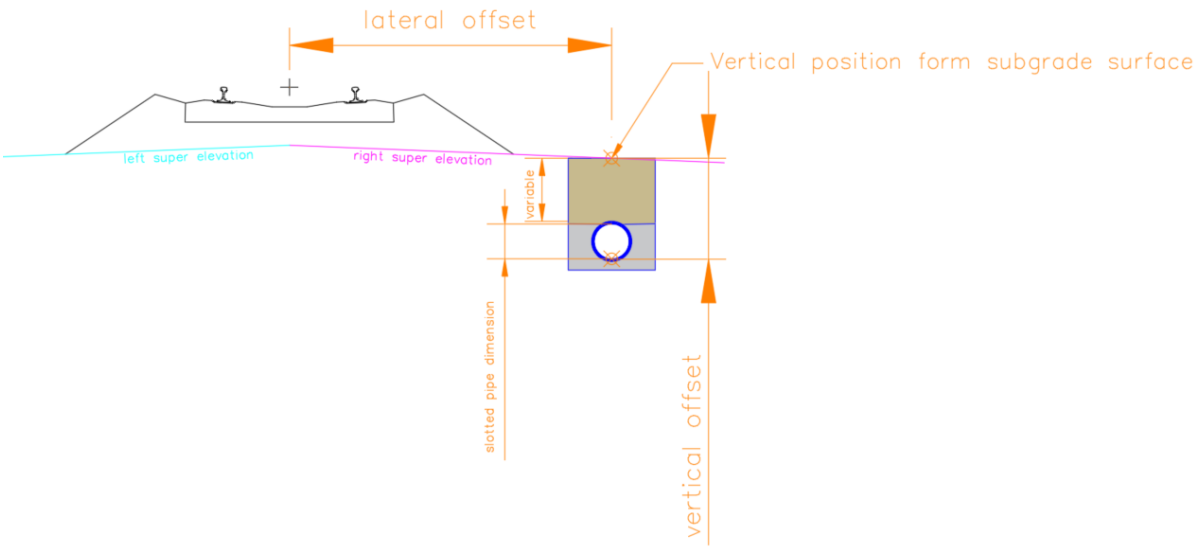
The upper trench and the flowline are always positioned in the same horizontal offset.

- Vertical positionning

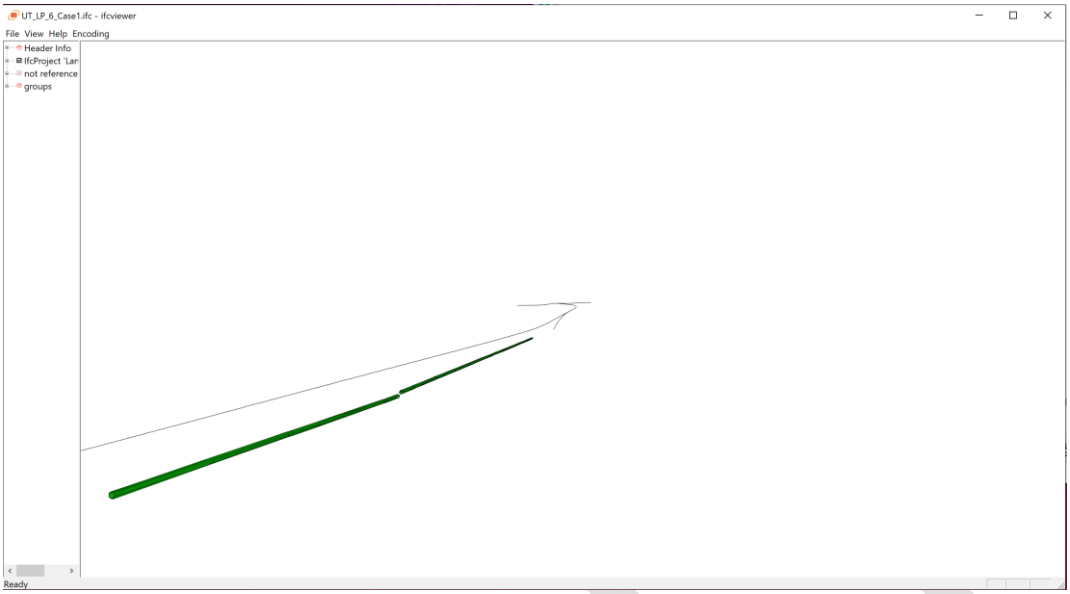
The upper trench position will inherit the vertical position of the subgrade.

The subgrade geometry should be generated in advance, please see subgrade placement data set provided. The flowline vertical is positioned using a vertical offset from the first point. See image below.





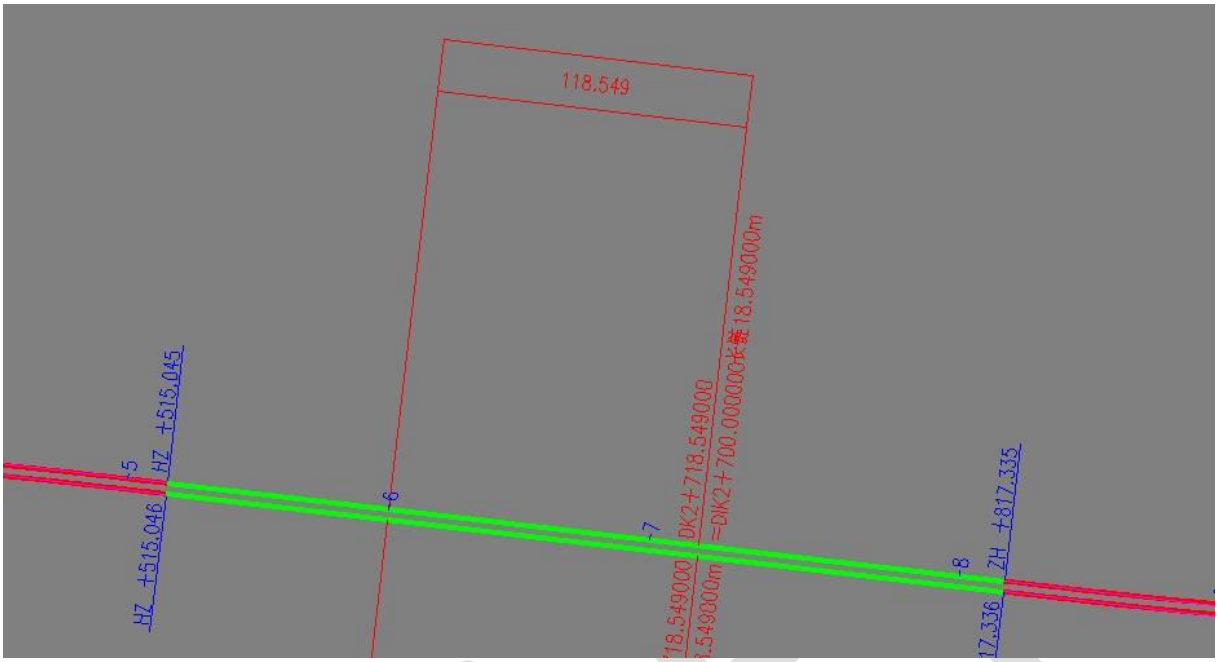
The IFC file is provided by IFC Rail Technical Service:



4.5 UT_LP_8

Case Provider	CRBIM
Raw Dataset Format	PF; Excel
IFC Provider	IFC Rail Technical Service; GeometryGym
Number of final IFC sample files	1
Number of all IFC files produced	2
Other Outcomes	Images

This Unit Test aims to test the railway broken chainage in the linear reference. In the line plane design, in order to express the mileage relationship uniformly, the starting and ending mileage of the line are generally expressed by broken chain.



The IFC files are provided by IFC Rail Technical Service and GeometryGym.

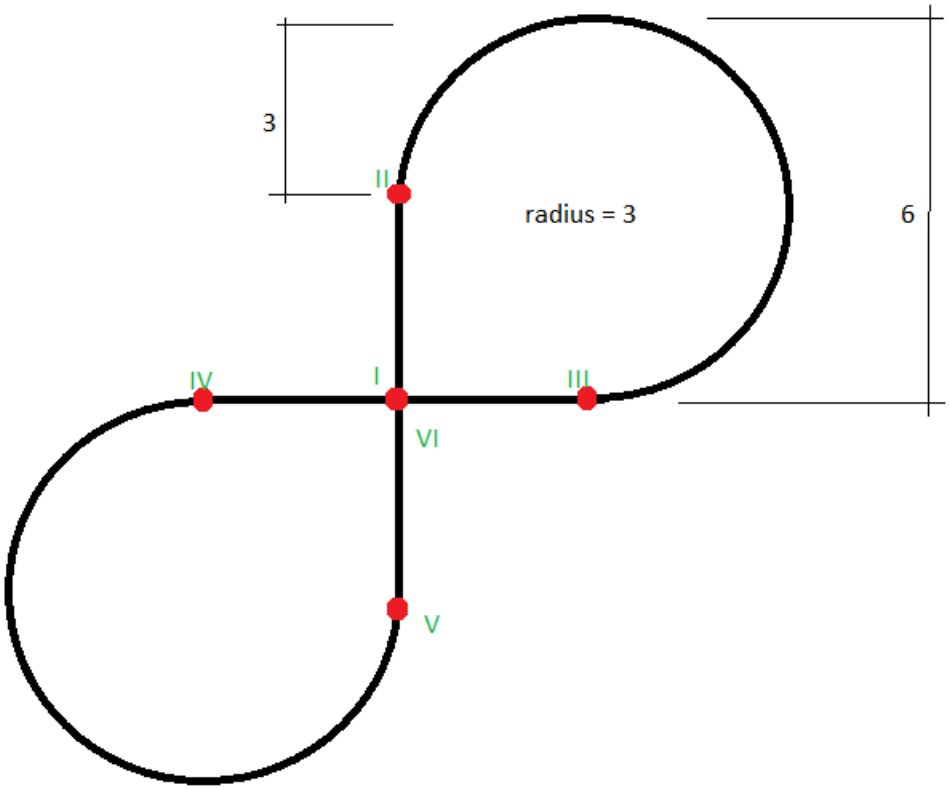
5 Swept Area Solid (SAS)

5.1 UT_SAS_0

Case Provider	IFC Rail Technical Service
Raw Dataset Format	Synthetic
IFC Provider	RDF
Number of final IFC sample files	2
Number of all IFC files produced	9
Other Outcomes	Images

This Unit Test aims to test the usage of Swept Area Solid in a synthetic scenario.

Horizontal Alignment (length = 40.274)



Segment 1 (I -> II)

LINE, direction up, length = 3.

Segment 2 (II -> III)

CIRCULARARC, clockwise, radius = 3, 270 degrees (length = 14.137)

Segment 3 (III -> IV)

LINE, direction left, length = 6.

Segment 4 (IV -> V)

CIRCULARARC, anti-clockwise, radius = 3, 270 degrees (length = 14.137)

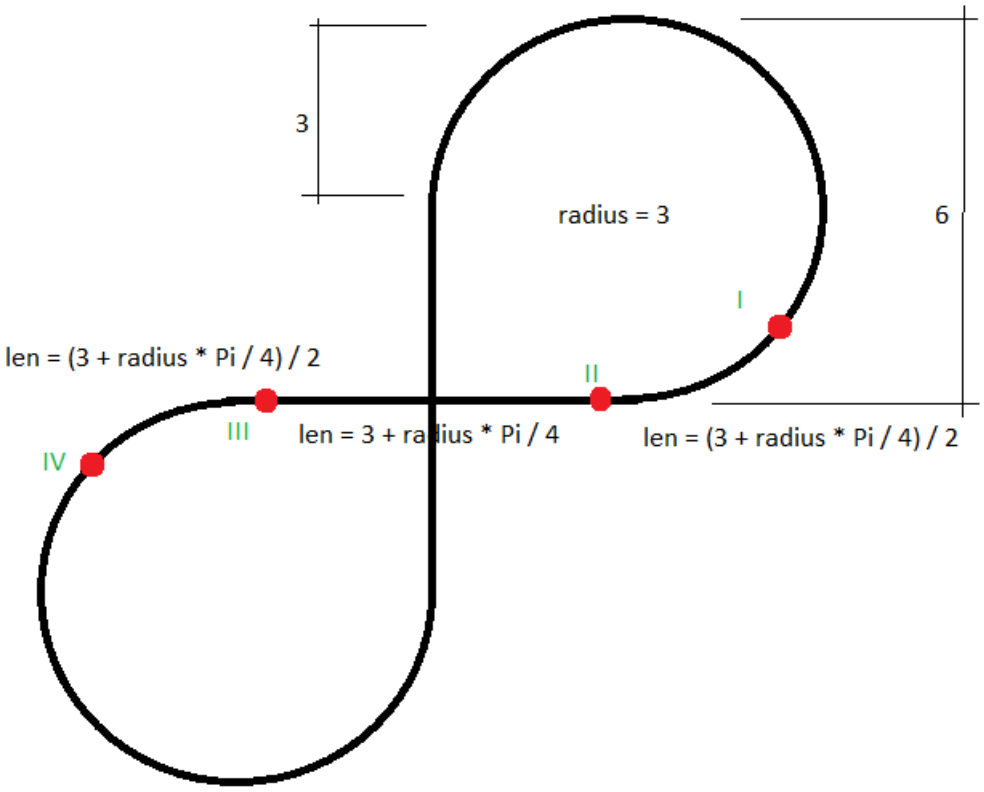
Segment 5 (V -> VI)

LINE, direction up, length = 3.

Segment 6 (VI)

LINE, direction up, length = 0.

Vertical Alignment (offset = 3 + 1.25 * radius * Pi, length = 6 + radius * Pi / 2)



Segment 1 (I -> II)

CIRCULARARC, start gradient 0, end gradient 0.7, length = 2.678. (Derived: radius = 4.67, anti-clockwise)

Segment 2 (II -> III)

CIRCULARARC, start gradient 0, end gradient 0.7, length = 5.356. (Derived: radius = 4.67, clockwise)

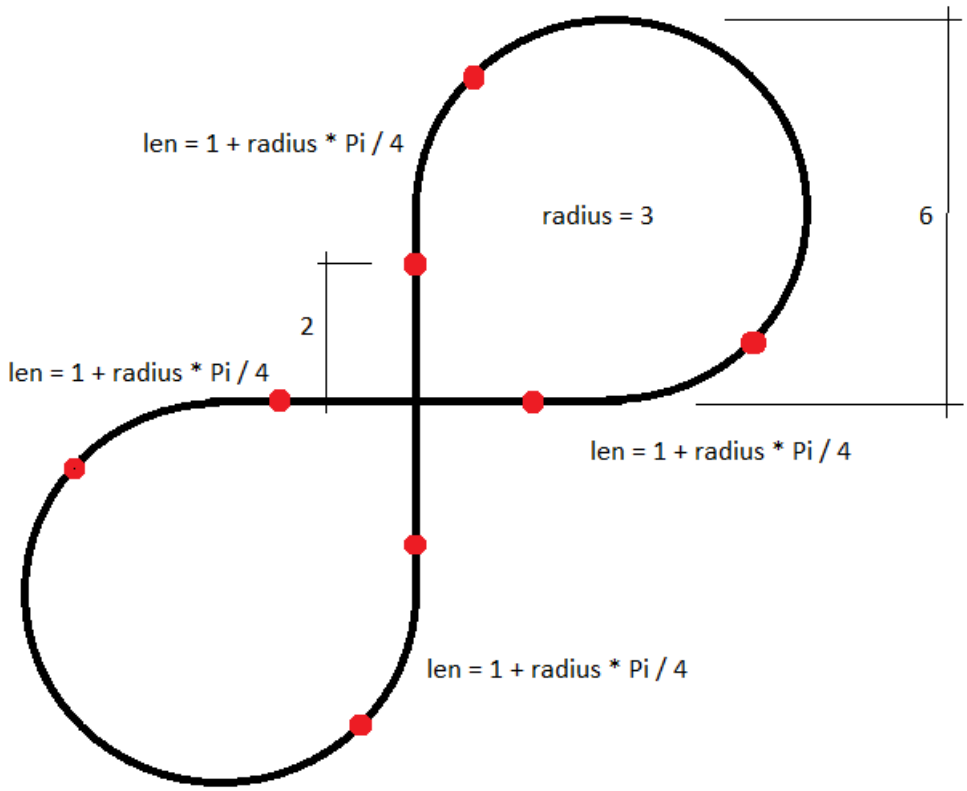
Segment 3 (III -> IV)

CIRCULARARC, start gradient 0, end gradient 0.7, length = 2.678. (Derived: radius = 4.67, anti-clockwise)

Segment 4 (IV)

CONSTANTGRADIENT, direction right, length = 0.

Cant Alignment (length = 40.274)



Segment 1 (I -> II)

CONSTANTCANT, direction right, length = 2.

Segment 2 (II -> III)

LINEARTRANSITION, horizontal length = 3.35619449019 (1 + radius * Pi / 4), direction right-up.

Segment 3 (III -> IV)

CONSTANTCANT, direction right, length = 9.42477796077 (i.e. radius * Pi).

Segment 4 (IV -> V)

LINEARTRANSITION, horizontal length = 3.35619449019 (1 + radius * Pi / 4), direction right-down.

Segment 5 (V -> VI)

CONSTANTCANT, direction right, length = 4.

Segment 6 (V -> VI)

LINEARTRANSITION, horizontal length = 3.35619449019 (1 + radius * Pi / 4), direction right-up.

Segment 7 (V -> VI)

CONSTANTCANT, direction right, length = 9.42477796077 (i.e. radius * Pi).

Segment 8 (V -> VI)

LINEARTRANSITION, horizontal length = 3.35619449019 (1 + radius * Pi / 4), direction right-down.

Segment 9 (V -> VI)

CONSTANTCANT, direction right, length = 2.

Segment 10 (VI)

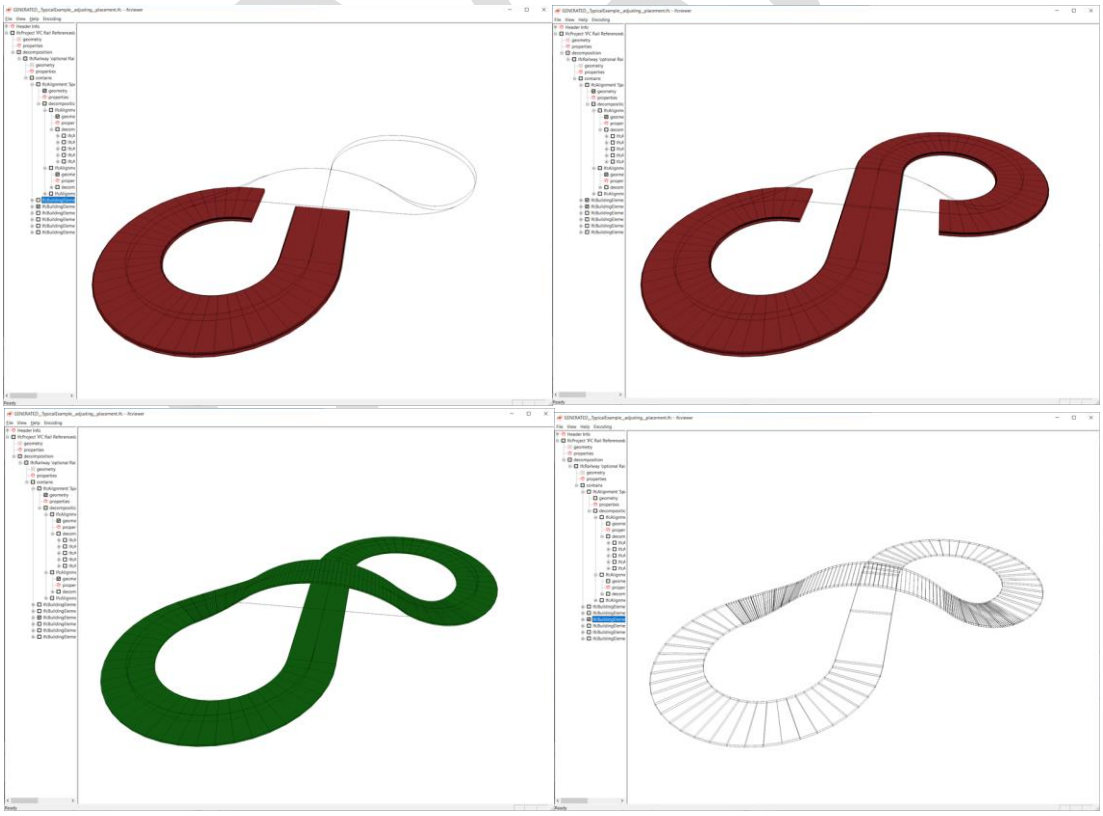
CONSTANTCANT, direction right, length = 0.

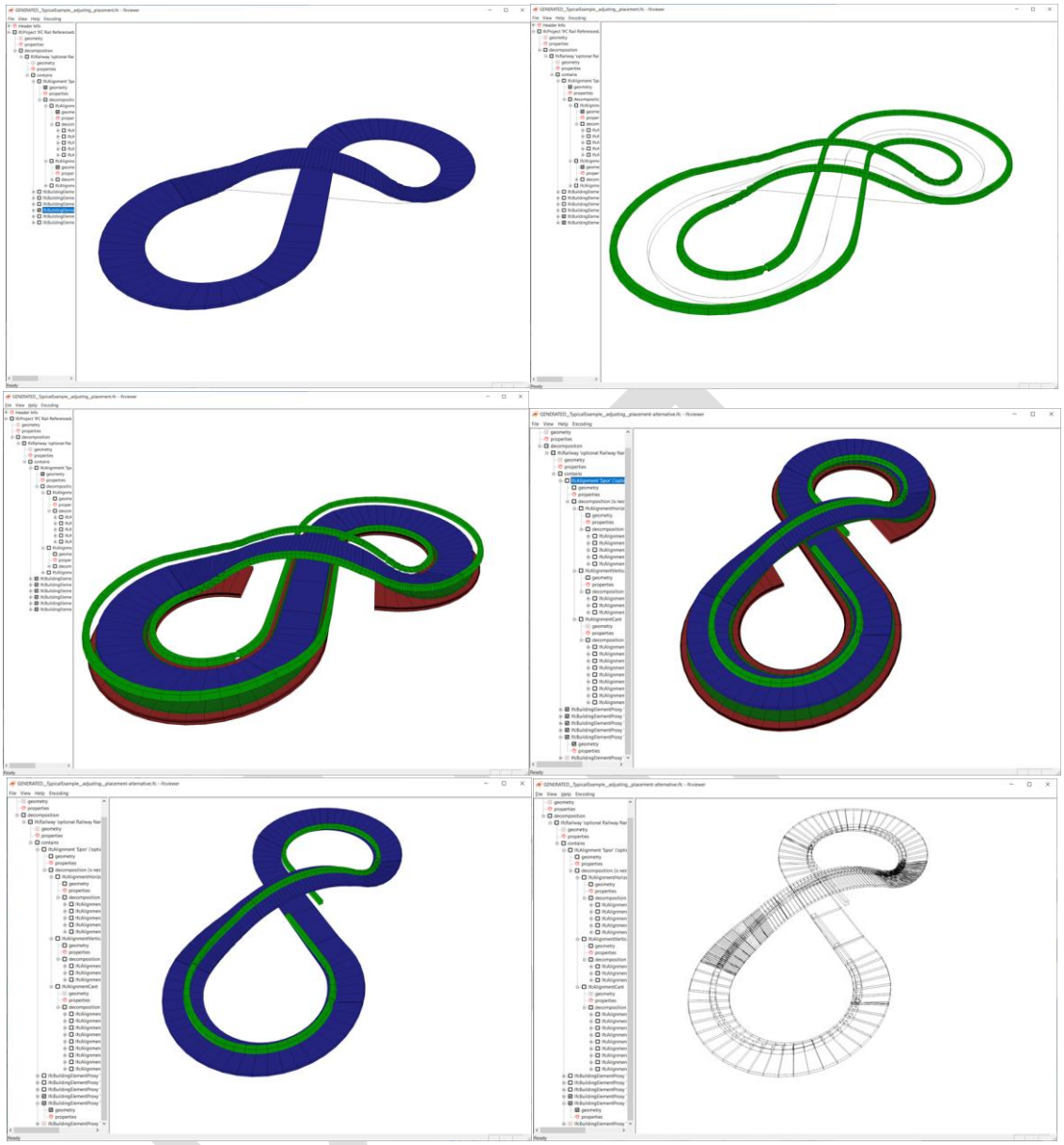
Important note (generic):

At each start of a segment the rotation is defined by a difference in StartCantLeft and StartCantRight in combination with half the value of the IfcAlignmentCant.RailHeadDistance.

In the geometry this rotation is stored as third dimension of the IfcCurveSegment.Placement definition.

The IFC files are produced by RDF:





5.2 UT_SAS_1

Case Provider	SBB
Raw Dataset Format	XTR; IFC (early version)
IFC Provider	RDF
Number of final IFC sample files	1
Number of all IFC files produced	1
Other Outcomes	Images

This Unit Test aims to prove the possibility using parametric form of geometry to create the shape of railway rails based on alignment. Cant shall be considered in creating the geometry.

The alignment data is using the same one from UT_AWC_1, which has one alignment based on horizontal, vertical and cant.

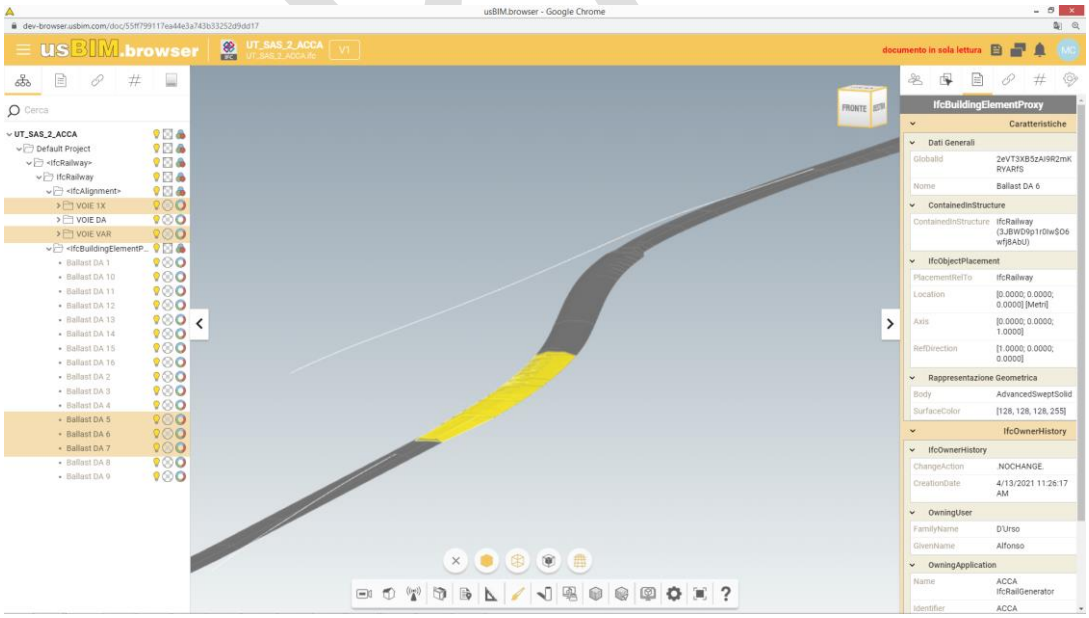
The profile of rail can be derived from the IFC file provided for this Unit Test, which contains a segment of rail based on a simple sweeping.

The IFC file is provided by IFC Rail Technical Service:

5.3 UT_SAS_2

Case Provider	ACCA
Raw Dataset Format	
IFC Provider	ACCA
Number of final IFC sample files	1
Number of all IFC files produced	1
Other Outcomes	Images

This Unit Test contains an exported IFC file from ACCA software. It shows a case that uses IfcSectionedSolidHorizontal to model ballast bed of railway.



5.4 UT_SAS_3

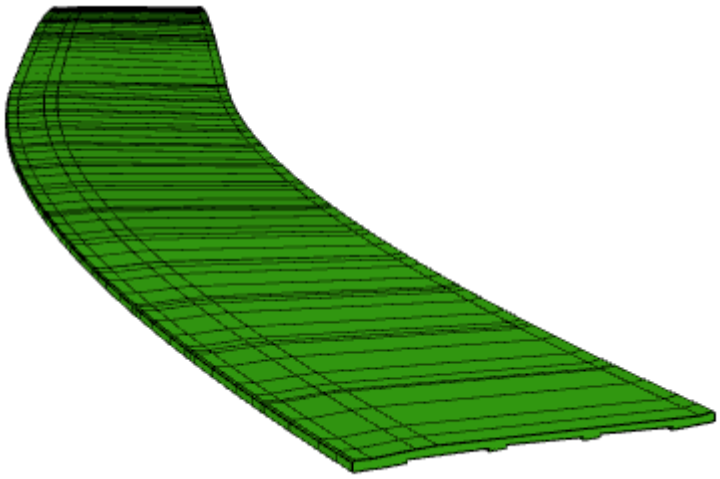
Case Provider	ACCA
Raw Dataset Format	
IFC Provider	ACCA
Number of final IFC sample files	1
Number of all IFC files produced	1
Other Outcomes	Images

This Unit Test contains an exported IFC file from ACCA software. It shows a case that uses IfcSectionedSolidHorizontal to model track loading gauge of railway.

5.5 UT_SAS_4

Case Provider	MINnD
Raw Dataset Format	
IFC Provider	RDF
Number of final IFC sample files	1
Number of all IFC files produced	1
Other Outcomes	Images

This Unit Test intends to demonstrate how variable profiles along an axis can provide a Swept Area Solid to represent a track bed. The reference file (filtered) used to demonstrate swept volumes is updated from an IFC sample file from buildingSMART.



6 Railway Spatial Structure (RSS)

6.1 UT_RSS_1

Case Provider	PNG
Raw Dataset Format	Image
IFC Provider	IFC Rail Technical Service, ACCA, Geodesial
Number of final IFC sample files	1
Number of all IFC files produced	3
Other Outcomes	Images

This Unit Test intends to experiment the use of IFC to represent the project breakdown for a single domain spatial structure. The single domain taken as an example for this test is "Track".

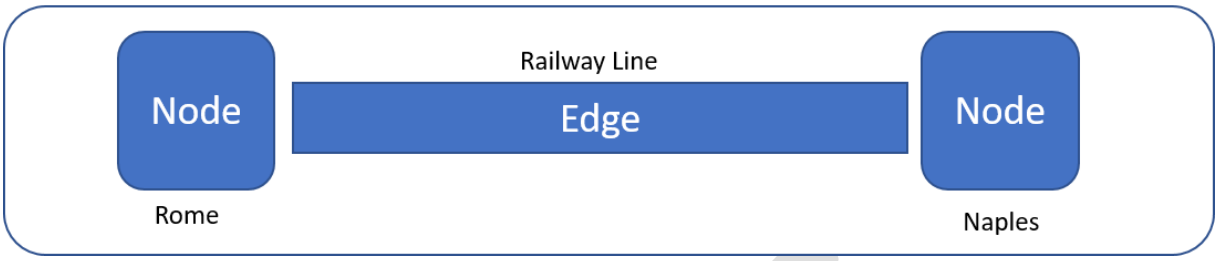
The dataset refers to a simple railway network, represented by using the paradigm "Node-Edge-Node", and break down using asset management criteria.

As the aim of this Unit Test is to implement the spatial structure, there is no need for the moment to introduce elements contained within.

The dataset is provided by RFI.

In this Unit Test the example project is a simple railway network connecting two stations, Rome and Naples. Using the "Node-Edge-Node" criteria, the Rome-Naples Network is composed by two "Nodes" and one "Edge", as shown in the following picture:

Rome-Naples Network



Each "Node" represents the area of the station as it is considered by the Track domain.

For the scope of this specific example, only one Node (i.e. Rome) and the Edge are further decomposed as follows:

The chosen Node, Rome, is decomposed in the following parts:

- Two tracks, named T1 and T2,
- One siding track, named T3,
- Two sidewalks, one for Track T1 named Sidewalk1 and one for Track T2 named Sidewalk2

The Railway Line, is decomposed in the following parts:

- Two tracks, named T1 an T2.

Additionally, in this Network there is an area crossing (overlapping) the Railway Line, in which there could be elements that constitute an interference, which are not part of the Railway Line decomposition itself. It is necessary to represent this area in the model, to make sure that any such interference is taken into consideration when managing the Network.

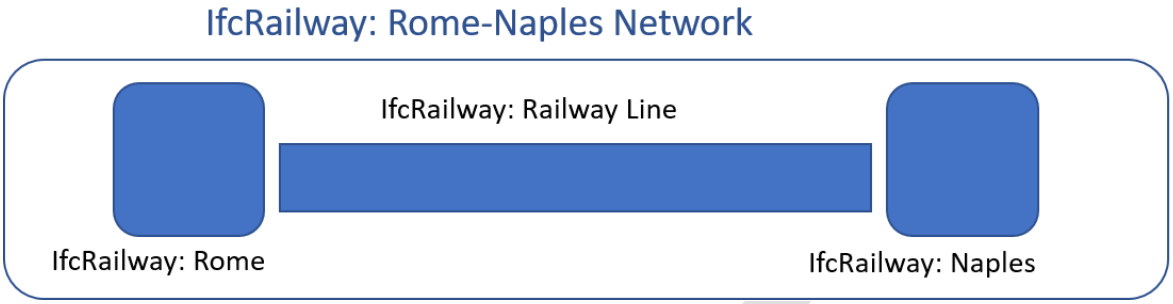
The following picture shows the Network decomposition as explained above.

To represent the project breakdown in the model, the spatial structure as defined in IFC 4.3 shall be used.

Therefore, the higher level structure shall be:

- The Network shall be represented as an IfcSpatialstructureElement,
  specifically IfcRailway (sub-entity of IfcFacility). It shall have the following attributes:
  - Name: Rome-Naples Network
- The Edge shall be represented as an IfcSpatialstructureElement, specifically IfcRailway (sub-entity of IfcFacility). It shall have the following attributes:
  - Name: Railway Line
- The Node shall be represented as an IfcSpatialstructureElement, specifically IfcRailway (sub-entity of IfcFacility). It shall have the following attributes:
  - Name: Rome

The picture below shows the spatial structure as described above:



The Network decomposition shall be further represented using the spatial structure concepts of IfcFacilityPart.

In particular:

The chosen Node, Rome, is decomposed in the following parts:

- Two tracks:
    - T1 shall be represented as IfcFacilityPart, with the following attributes:
    - Name: T1
    - PredefinedType: IfcRailwayPartTypeEnum.TRACKSTRUCTUREPART
    - UsageType: LONGITUDINAL
    - T2 shall be represented as IfcFacilityPart, with the following attributes:
    - Name: T2
    - PredefinedType: IfcRailwayPartTypeEnum.TRACKSTRUCTUREPART
    - UsageType: LONGITUDINAL
- One siding track, represented as as IfcFacilityPart, with the following attributes:
    - Name: T3
    - PredefinedType: IfcRailwayPartTypeEnum.TRACKSTRUCTUREPART
    - UsageType: LONGITUDINAL
- Two sidewalks, also represented as IfcFacilityPart
    - one for Track T1, with the following attributes:
    - Name: Sidewalk1
    - PredefinedType: IfcRailwayPartTypeEnum.LINESIDESTRUCTUREPART
    - UsageType: LATERAL
    - one for Track T2, with the following attributres:
    - Name: Sidewalk2
    - PredefinedType: IfcRailwayPartTypeEnum.LINESIDESTRUCTUREPART
    - UsageType: LATERAL

The Railway Line, is decomposed in the following parts:

- Two tracks, represented as the ones in the Node, but as a part of the Railway Line:
    - T1 shall be represented as IfcFacilityPart of IfcRailway(Partial): Railway Line, with the following attributes:

- Name: T1
- PredefinedType: IfcRailwayPartTypeEnum.TRACKSTRUCTUREPART
- UsageType: LONGITUDINAL
- T2 shall be represented as IfcFacilityPart of IfcRailway(Partial): Railway Line, with the following attributes:
- Name: T2
- PredefinedType: IfcRailwayPartTypeEnum.TRACKSTRUCTUREPART
- UsageType: LONGITUDINAL

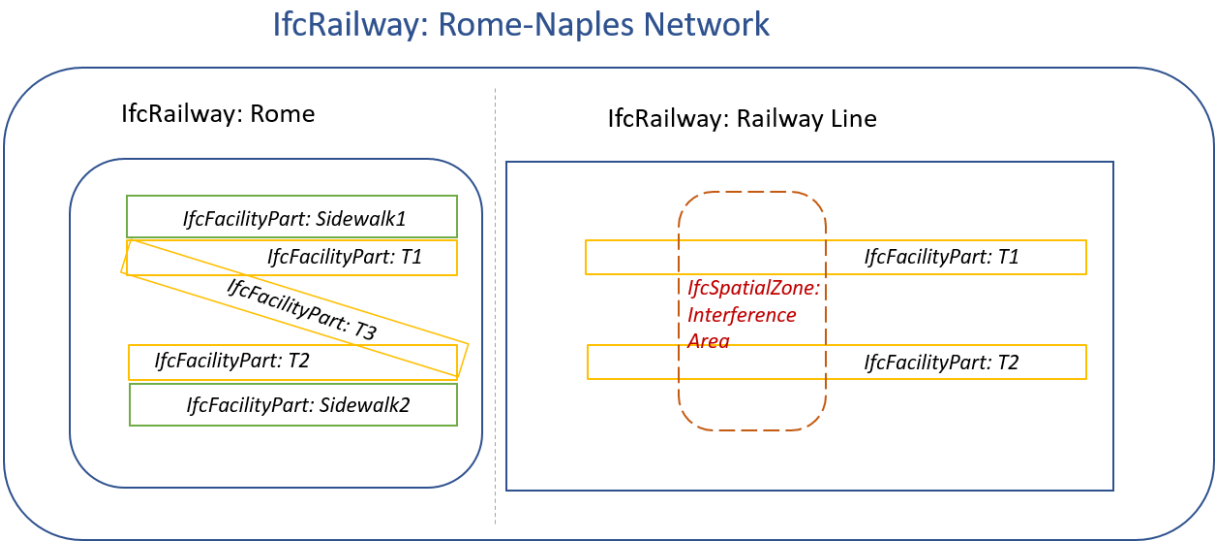
Additionally, the interference area shall be represented as an IfcSpatialZone with the following attributes:

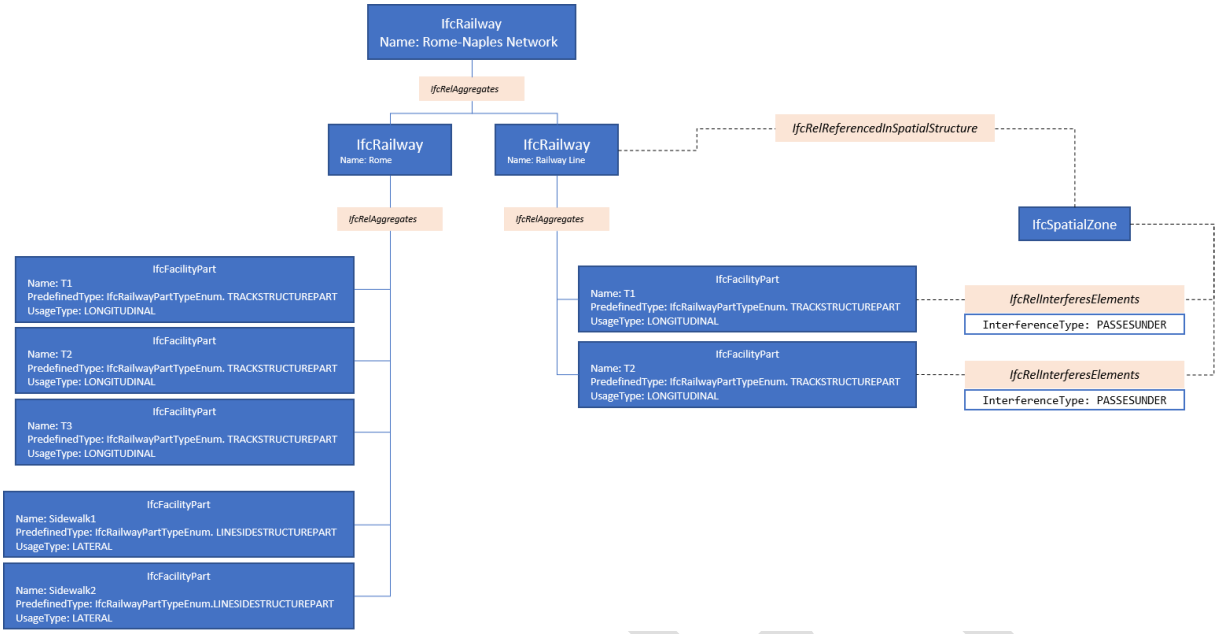
- Name: Interference Area
- InterferenceType: PASSESUNDER

This IfcSpatialZone is referenced by the Railway Line using IfcRelReferencedInSpatialStructure.

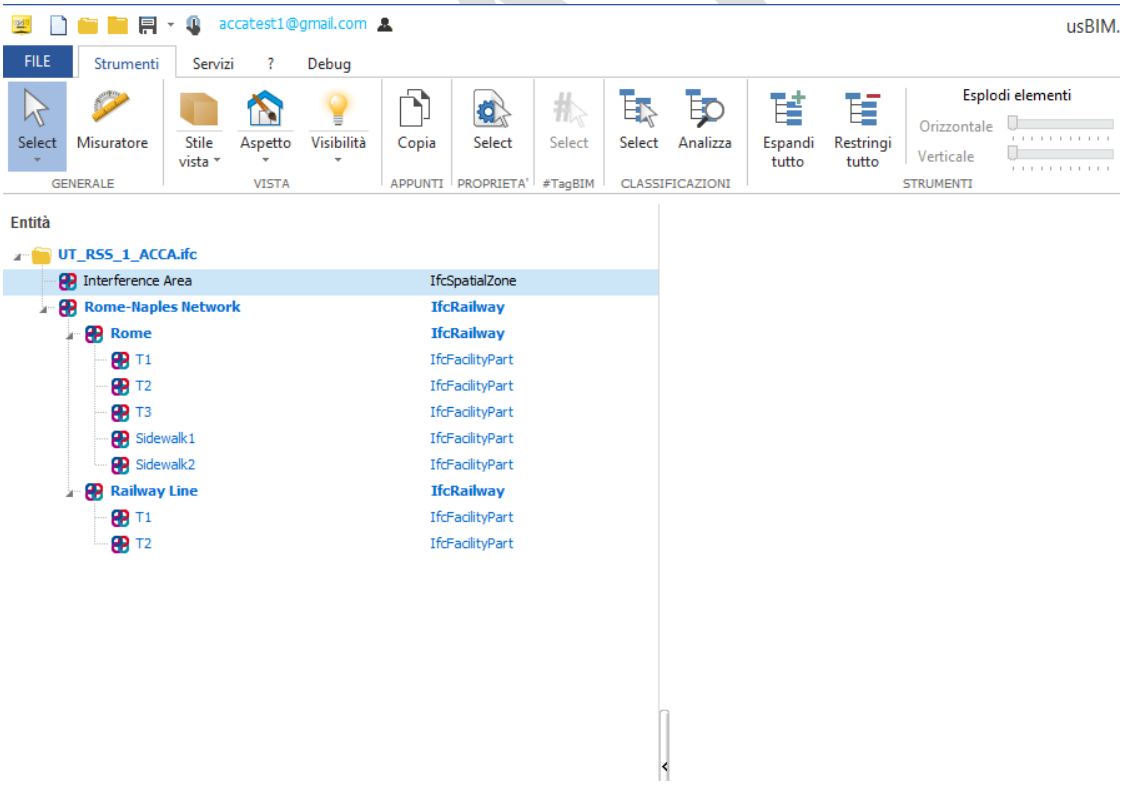
To better represent the interference with T1 and T2 of the Railway Line, the following relationship shall be used: IfcRelInterferesElement.

The following picture summarizes the Network representation using the spatial structure concepts of IfcFacility, IfcFacilityPart and IfcSpatialzone.





Besides by Technical Service, the IFC files are provided by ACCA and Geodesia:



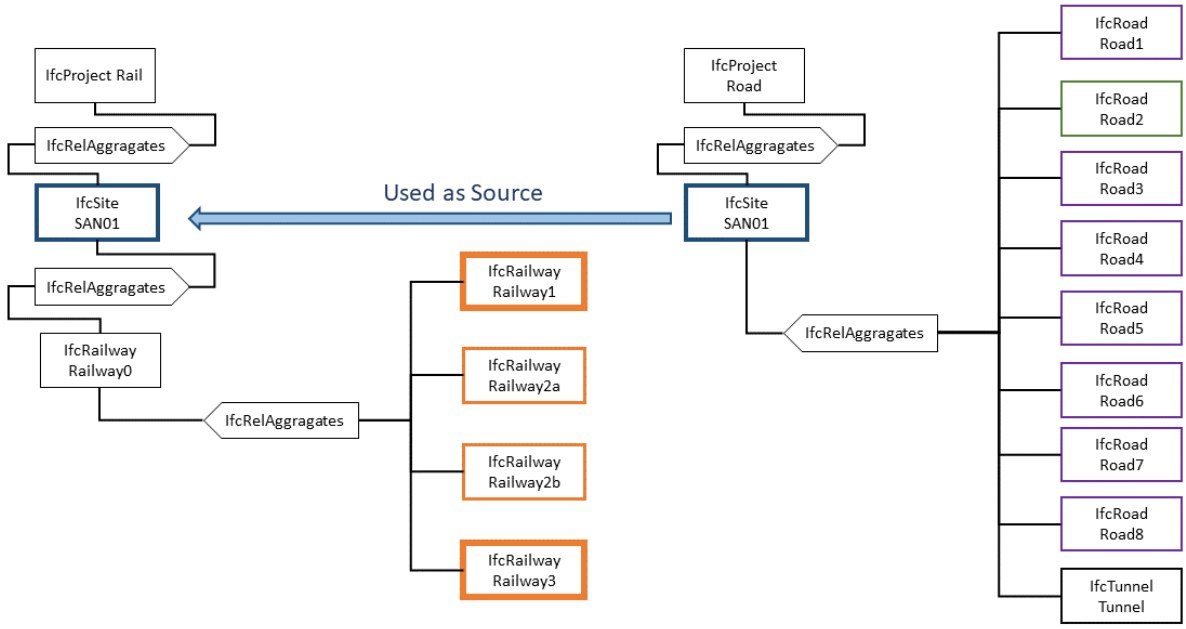
6.2 UT_RSS_2

Case Provider	MINnD
Raw Dataset Format	

IFC Provider	IFC Rail Technical Service
Number of final IFC sample files	1
Number of all IFC files produced	1
Other Outcomes	Images

This Unit Test intends to test the capability to have a project based on an existing IfcSite that contains an IfcRailway spatial structure.

Spatial structure intends to be as follows:



The IFC file is provided by IFC Rail Technical Service.

6.3 UT_RSS_4

Case Provider	FTIA
Raw Dataset Format	
IFC Provider	IFC Rail Technical Service, ACCA, Geodesial
Number of final IFC sample files	1
Number of all IFC files produced	3
Other Outcomes	Images

This Unit Test intends to experiment the use of IFC to represent the project breakdown for a road/railway level crossing spatial structure with an explicitly modelled relationship between the

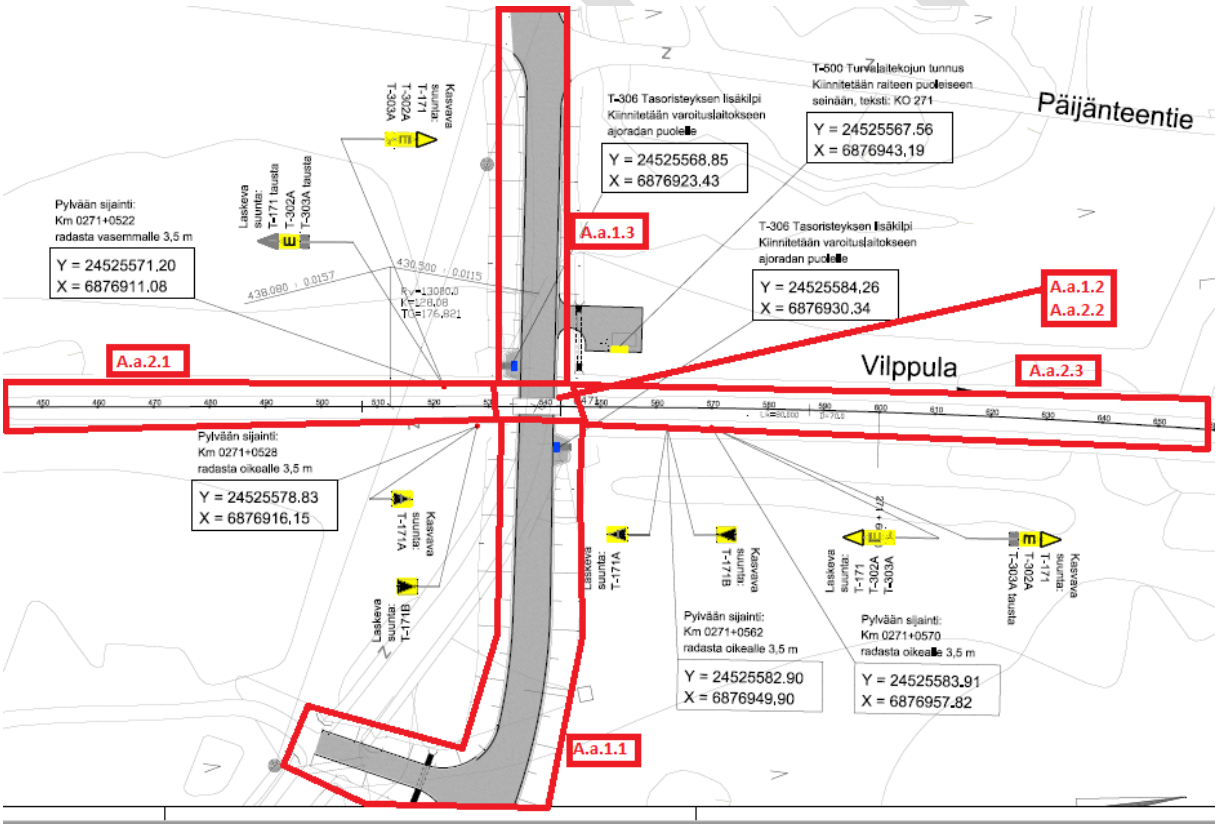
railway facility part and the corresponding road facility part representing the overlapping of the two facilities.

As the aim of the Unit Test is to implement the spatial structure, there is no need for the moment to introduce elements contained within.

The dataset is provided by FTIA.

The dataset is currently made of:

1 A project + site
2 A road facility with three facility parts where the level crossing overlaps the corresponding railway facility part
3 A railway facility with three facility parts where the level crossing overlaps the corresponding road facility part
4 The explicit interference relationship between the overlapping facility parts



To represent the project breakdown for this unit test, we envision the following project structure:

- A. IfcProject
  - A.a IfcSite
  - IfcGeoModel (or similar representing terrain - optional for this unit test)
  - A.a.1 IfcRoad

        - IfcAlignment (optional for this unit test)
        - A.a.1.1 IfcFacilityPart
        - PredefinedType*=IfcRoadPartTypeEnum.ROADSEGMENT
        - UsageType=LONGITUDINAL
        - A.a.1.2 IfcFacilityPart
        - PredefinedType*=IfcFacilityPartCommonTypeEnum.LEVELCROSSING
        - UsageType=LONGITUDINAL
        - A.a.1.3 IfcFacilityPart
        - PredefinedType*=IfcRoadPartTypeEnum.ROADSEGMENT
        - UsageType=LONGITUDINAL
    - A.a.2 IfcRailway
        - IfcAlignment (optional for this unit test)
        - A.a.2.1 IfcFacilityPart
        - PredefinedType*=IfcRailwayPartTypeEnum.TRACKSTUCTUREPART
        - UsageType=LONGITUDINAL
        - A.a.2.2 IfcFacilityPart
        - PredefinedType*=IfcFacilityPartCommonTypeEnum.LEVELCROSSING
        - UsageType=LONGITUDINAL
        - A.a.2.3 IfcFacilityPart
        - PredefinedType*=IfcRailwayPartTypeEnum.TRACKSTRUCTUREPART
        - UsageType=LONGITUDINAL
- IfcRelInterferesElements
    - InterferenceType="Crosses"
    - RelatingElement=#A.a.1.2
    - RelatedElement=#A.a.2.2
    - InterferenceGeometry=optional for this unit test

The IFC files are provided by IFC Rail Technical Service, ACCA and Geodesial:

7 System Breakdown Structure (SYS)

7.1 UT_SYS_1

Case Provider	RFI

Raw Dataset Format	
IFC Provider	IFC Rail Technical Service, ACCA, GeometryGym
Number of final IFC sample files	1
Number of all IFC files produced	3
Other Outcomes	Images

This Unit Test is the first of a series of tests, each one building on the previous step. The final goal is to provide the user with a functional view of the content of the model which is detached and decoupled from the spatial structure tree. This functional perspective (grouping) shall be defined by the user, using different criteria, and may change across the life-cycle of a model. The focus of this test is: first on the definition of the semantics of the relationships between the objects; then on the test of a panel/window in the UI of a tool, for the purpose of visualisation and navigation of the functional network.

For the scope of this UT, the TLC domain was taken as an example.

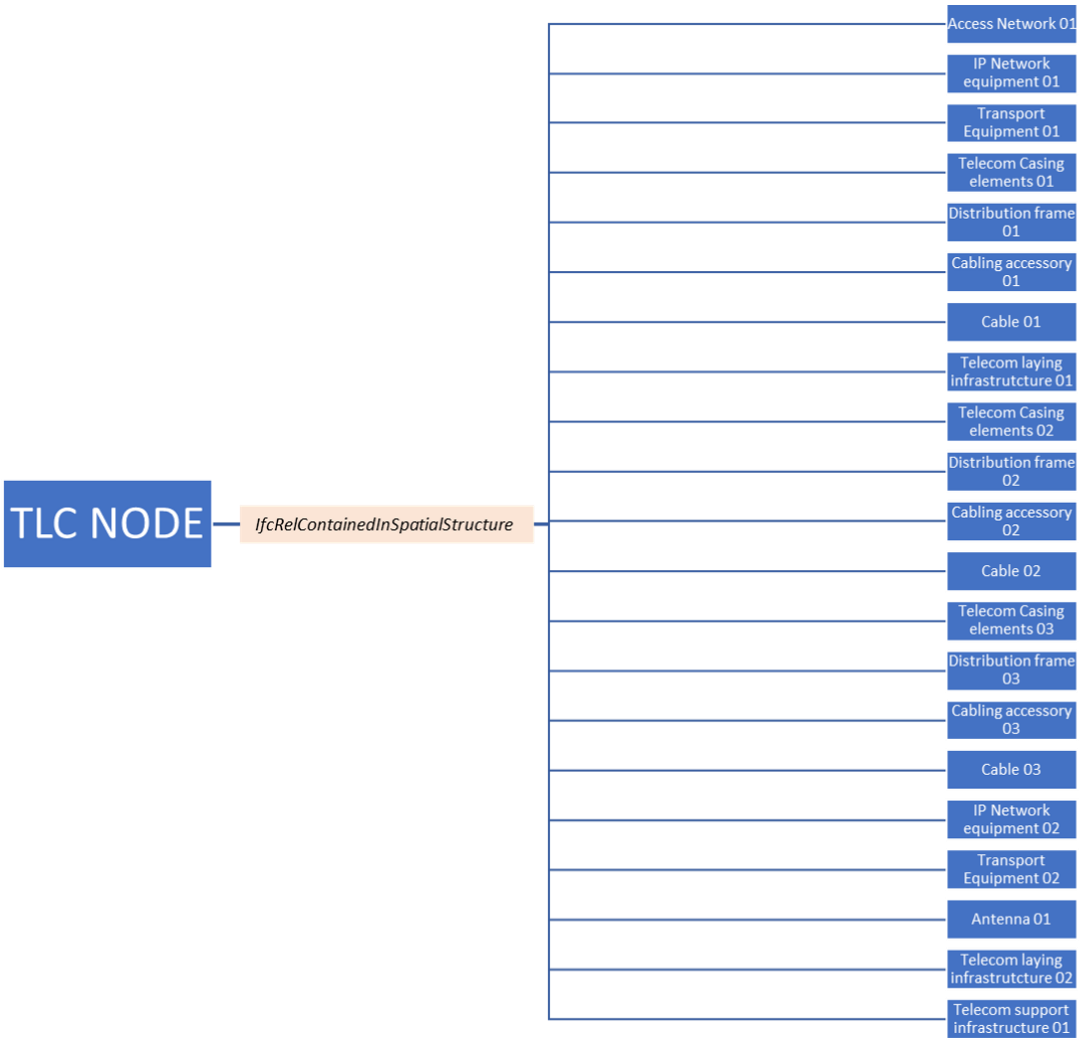
The dataset refers to a simple railway Node, which contains a list of elements grouped according to functional aspects.

As the aim of the Unit Test is to implement group assignment, there is no need for the moment to go further into the relationship between the Node and the functional groups.

The dataset is provided by RFI.

In this Unit Test the example project is represented by a single railway Node. In particular, a TLC Node was selected, together with some elements contained within.

The following picture shows the TLC Node and all the elements contained within.



The TLC Node shall be defined as an *IfcSpatialStructureElement*, and in particular as an:

- IfcRailway (subtype of IfcFacility)
  - Name: TLC Node

The elements taken into consideration shall de defined as:

- IfcBuiltElement

IfcRelContainedInSpatialStructure shall be the relationship used for spatial containment.

Each element shall be collected in a functional group, as shown in the Table_ Grouping of Elements. The table has 2 columns:

- "RelatedObjects", in which all objects to be grouped are listed by name.

- "RelatingGroup", where the groups to which the objects are assigned are listed by name.

Each object listed in the "RelatedObjects" column shall be assigned to the corresponding group in the "RelatingGroup" column. The groups shall be 6 in total (as shown also in the table):

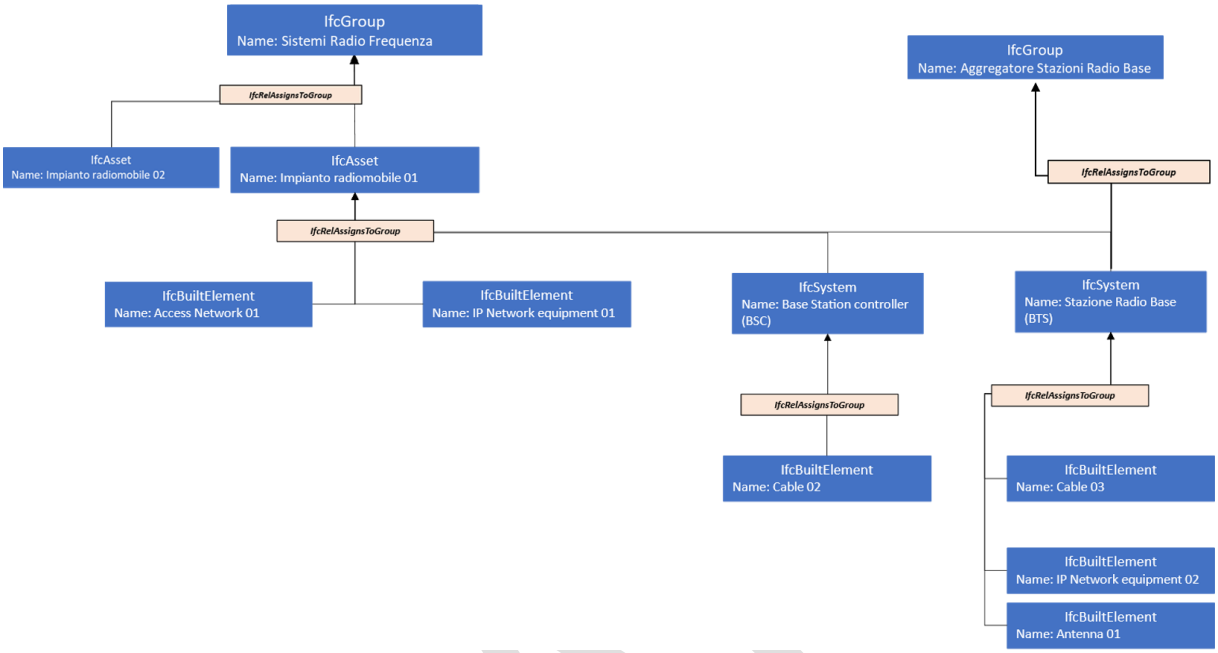
- 1 IfcGroup
  - Name: Sistemi Radio Frequenza
- 1 IfcGroup
  - Name: Aggregatore Stazioni Radio Base
- 1 IfcAsset
  - Name: Impianto radiomobile 01
- 1 IfcAsset
  - Name: Impianto radiomobile 02
- 1 IfcSystem
  - Name: Base Station controller (BSC)
- 1 IfcSystem
  - Name: Stazione Radio Base (BTS)

IfcRelAssignsToGroup shall be the relationship linking the objects in the "RelatedObjects" column to the respective group in the "RelatingGroup" column.

Note: for the scope of this test, only the objects assigned to one IfcAsset have been taken into consideration. However, the IfcGroup (Name: Sistemi Radiofrequenza) is to be considered as a non hierarchical collection of multiple IfcAsset (Impianto radiomobile 01..02). Please note that the IfcSystem is assigned both to an IfcAsset and to an IfcGroup. That is beacause the relationship is non hierarchical, but functional.

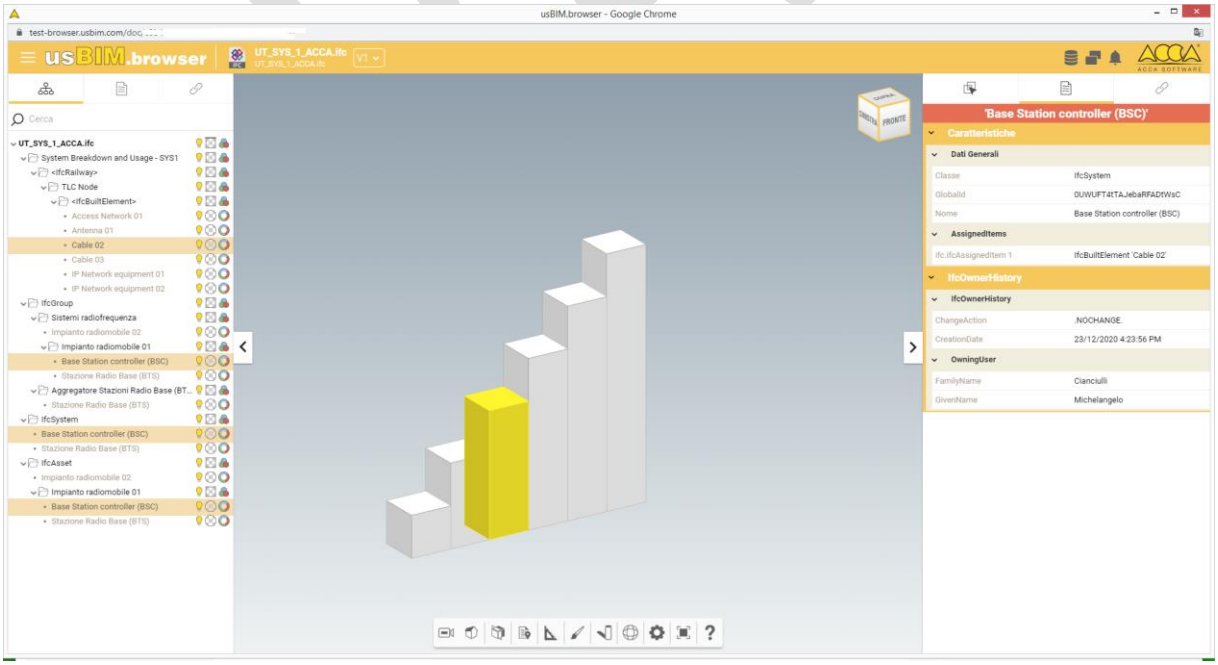
As an example, there is the Table_IFC Entities and an overview of the system breakdown in the picture below.

Group Assignment



IfcRelDeclares shall be the relationship linking all groups to the project.

The IFC files are provided by IFC Rail Technical Service, ACCA and GeometryGym:



7.2 UT_SYS_2

Case Provider	RFI
Raw Dataset Format	
IFC Provider	IFC Rail Technical Service, ACCA, GeometryGym
Number of final IFC sample files	1
Number of all IFC files produced	3
Other Outcomes	Images

This Unit Test is the second of a series of tests, each one building on the previous step. The final goal is to provide the user with a functional view of the content of the model which is detached and decoupled from the spatial structure tree. This functional perspective (grouping) shall be defined by the user, using different criteria, and may change across the life-cycle of a model.

The focus of this test is: first on the definition of the semantics of the relationship between groups and spatial structure elements; then on the test of a panel/window in the UI of a tool, for the purpose of visualisation and navigation of the functional network.

The dataset is the same as the one for UT_SYS_1, a simple railway Node, which contains a list of elements grouped according to functional aspects.

The dataset is provided by RFI. This Unit Test is built upon UT_SYS_1

In this Unit Test the example project is the one for UT_SYS_1. In particular, a TLC Node was selected, together with some elements contained within.

As stated in UT-SYS-1, the TLC Node shall be defined as an IfcRailway (subtype of IfcFacility), with "Name: TLC Node".

The elements selected in UT_SYS_1 shall de defined as IfcBuiltElement.

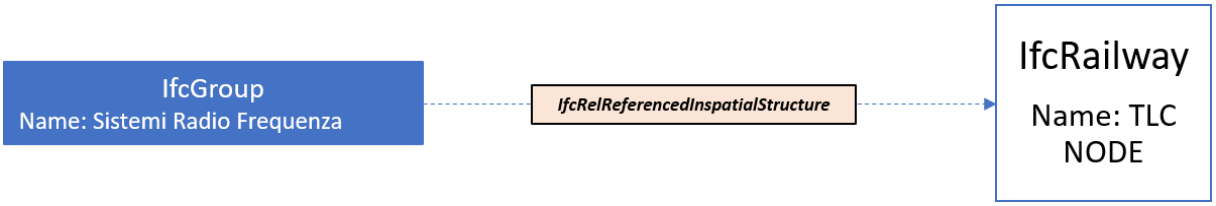
IfcRelContainedInSpatialStructure shall be the relationship used for spatial containment.

According to UT_SYS_1, each element shall be collected in a functional group and there shall be 6 groups in total.

For the business need of RFI, in this UT it is required that one specific group shall be referenced to the TLC Node through the IfcRelReferencedInspatialStructure relationship.

The group to be referenced shall be:

- IfcGroup
    - Name: Sistemi Radio Frequenza



7.3 UT_SYS_3

Case Provider	RFI
Raw Dataset Format	
IFC Provider	IFC Rail Technical Service, ACCA
Number of final IFC sample files	1
Number of all IFC files produced	2
Other Outcomes	Images

This Unit Test is the third of a series of tests, each one building on the previous step. The final goal is to provide the user with a functional view of the content of the model which is detached and decoupled from the spatial structure tree. This functional perspective (grouping) shall be defined by the user, using different criteria, and may change across the life-cycle of a model.

As for the other UTs in this topic, the focus of this test is: first on the definition of the semantics of the relationship between groups and spatial structure elements; then on the test of a panel/window in the UI of a tool, for the purpose of visualisation and navigation of the functional network.

Part of the dataset is the same as the one for UT_SYS_1 and UT_SYS_2, a simple railway Node, which contains a list of elements grouped according to functional aspects.

The dataset is provided by RFI. This Unit Test is built on UT_SYS_2.

In this Unit Test the example project is the one for UT_SYS_1 and UT_SYS_2. In particular, a TLC Node was selected, together with some elements contained within.

As stated in UT-SYS-1 and UT_SYS_2, the TLC Node shall be defined as an **IFcRailway** (subtype of IfcFacility), with "Name: TLC Node".

The elements selected in UT_SYS_1 shall de defined as **IfcBuiltElement**.

IfcRelContainedInSpatialStructure shall be the relationship used for spatial containment.

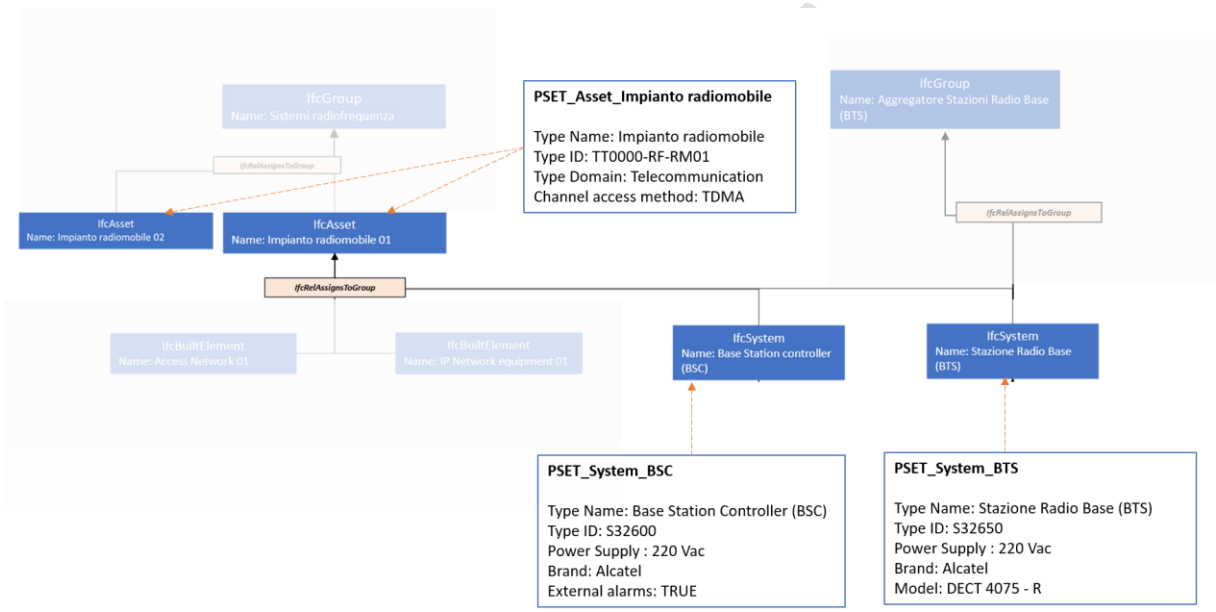
According to UT_SYS_1, each element shall be collected in a functional group and there shall be 6 groups in total.

According to UT_SYS_2, the group "Sistemi Radio Frequenza" shall be referenced to the TLC Node through the **IfcRelReferencedInspatialStructure** relationship.

For the sake of this UT, there are 3 relevant Property Sets to be considered and named as follows:

- PSET_Asset_Impianto radiomobile
- PSET_System_BSC
- PSET_System_BTS

As the name of the Pset says, the first one applies to all Assets of the type "Impianto radiomobile", while the second applies to all Systems of type "BSC" and the third to all Systems of type "BTS". Thus, according to this, these Psets shall be associated to the correct assets/systems through the **IfcRelDefinesByProperties** relationship.



7.4 UT_SYS_4

Case Provider	SNCF
Raw Dataset Format	
IFC Provider	IFC Rail Technical Service
Number of final IFC sample files	1
Number of all IFC files produced	1
Other Outcomes	Images

This Unit Test intends to experiment the use of IFC to represent the functionnal breakdown of the GSM-R access network.

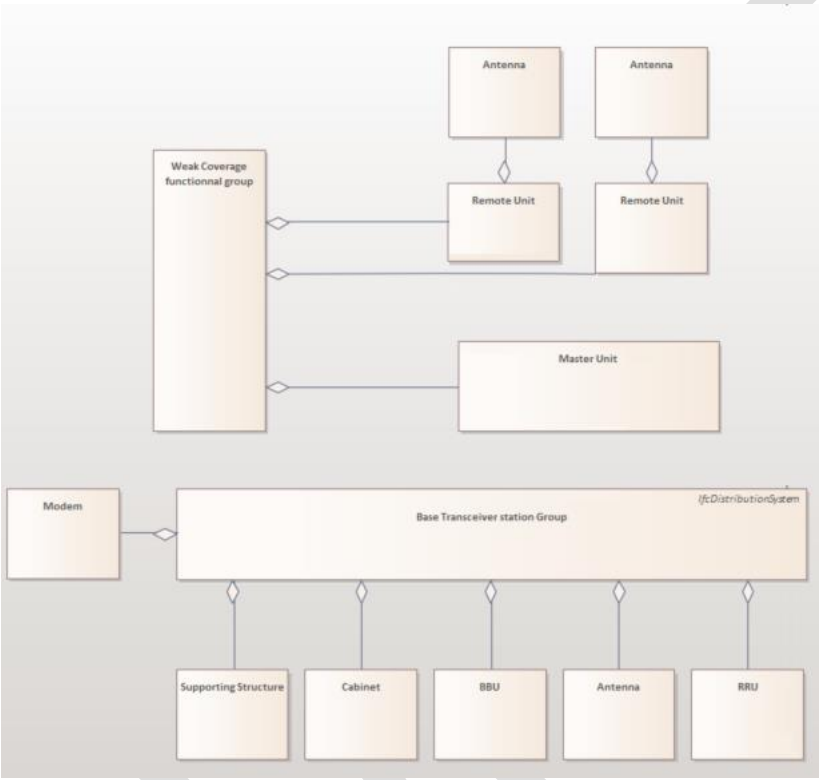
This mobile communication system is named GSM-R (Global System for Mobile communications - Railways) and together with the ETCS (European Train Control System), they constitute the 2 main technologies on which the ERTMS relies.

The functional breakdown that will be described in this documentation only corresponds to the GSM-R system. The functional model of the whole GSM-R system will indeed be presented, but since only

the Base Station Subsystem of GSM-R (also known as the access network) is involved in the storyline, it will therefore be the only subsystem to detail in this document.

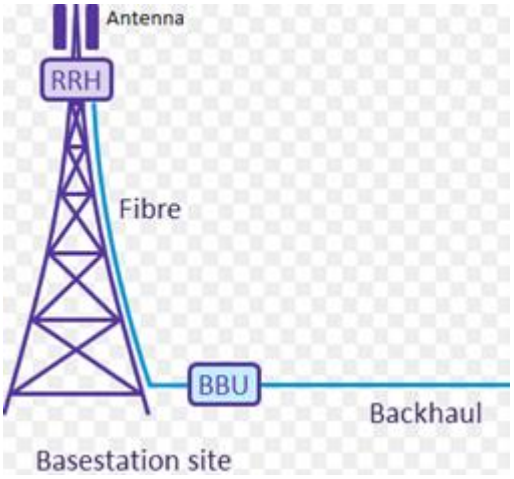
The functional model presented in this document allows understanding the functional hierarchies of the GSM-R system and especially its Base Station Subsystem (BSS). These functional hierarchies describe the decomposition of the required functional goal into sub-functions that can be achieved by agents, which are viewed as the main actor to achieve the function and do not necessarily correspond to the physical components.

The dataset is provided by SNCF.



The goal of this functional modelling is to verify if we can generate an IFC file that could include all the information provided by the current functional model of GSM-R system. The main function of a GSM-R Access Network (Base Station Subsystem) is to aggregates the global functions of wireless signal receiving/transmitting and radio resource management, which are respectively realized by the Base Transceiver Station (BTS) and the Base Station Controller (BSC);

As mentioned before, the ERTMS storyline scope is limited to the base station subsystem of GSM-R. The GSMR subsystem can be considered as an aggregation of other functional groups, which are: the base transceiver station functional group and the weak-field coverage functional group.



This group includes the telecom objects that transmit and receive information on the radio channel by providing a physical interface between the train and the Base Station Controller.

- IFC Mapping : IfcDistributionSystem

The grouping of objects within the Base transceiver station functional group is presented in the list below:

Remote Radio Unit (also called a remote radio head RRH), is usually sitting on top of cell tower. It mainly performs the following functions:

- Convert optical signal to electrical signal and vice versa;
- In transmitter section of RRU, it converts digital signal to radio frequency (RF) signal and amplifies that signal to the desire power level and antenna connected to it, radiates the RF signal in air;
- In receiver section of RRU, it receives the desired band of signal from antenna and amplify it;
- And convert RF signal back to digital signal in the receiver chain

IFC Mapping : IfcMobileTelecommunicationsAppliancePredefinedTypeREMOTERADIOUNIT

Base Band Unit (BBU), is usually placed inside a cabinet next to the cell tower. It performs frequency hopping and the digital signal processing. One BBU is connected to multiple RRUs depending upon the capability of base-band unit

IFC Mapping : IfcMobileTelecommunicationsAppliancePredefinedTypeBASEBANDEUNIT

Antennas, may also be considered as components of BTS. An antenna is a device that effectively radiates or receives electromagnetic waves. In open sites, it is placed on a radio mast, tower, or other raised structure.

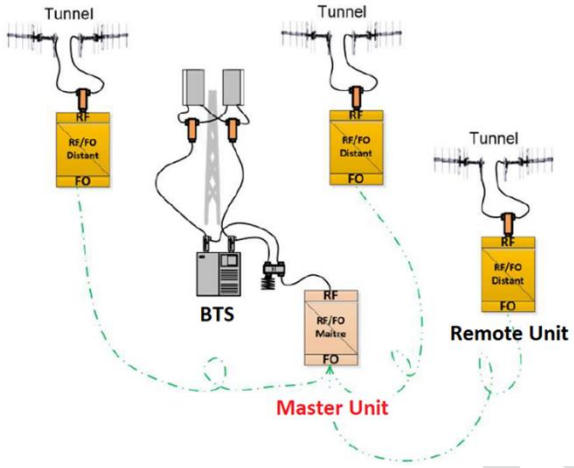
IFC Mapping : IfcCommunicationsAppliancePredefinedTypeANTENNA

Supporting System, represent the raised structure that support antennas and one or more RRU in open sites.

IFC Mapping : IfcElementAssemblyPredefinedTypeMAST

Cabinet

IFC Mapping : IfcElementAssemblyPredefinedTypeSHELTER



This group includes the telecom objects that expand the radio coverage of the BTS in areas where it is difficult to install one such as inside tunnels.

The grouping of objects within the weak-coverage functional group is presented in the list below:

- **Master Unit**, is a component of a repeater for coupling base station signals. It is used to expand the radio coverage, with the assistance of remote units, in the areas where we cannot put a BTS like in tunnels for example.
    - IFC Mapping : IfcMobileTelecommunicationsAppliancePredefinedTypeMASTERUNIT
- **Remote Unit**, is used to amplify a base station signal and insure its wireless transmission in the areas where it is difficult to put a BTS. It receives a coded signal from the master unit via a wired transport link (usually optical fiber cables) and transmits it to the antennas for being wirelessly transmitted
    - IFC Mapping : IfcMobileTelecommunicationsAppliancePredefinedTypeREMOTEUNIT
- **Antennas**, may also be considered as components of BTS. An antenna is a device that effectively radiates or receives electromagnetic waves. In open sites, it is placed on a radio mast, tower, or other raised structure.
    - IFC Mapping : IfcCommunicationsAppliancePredefinedTypeANTENNA
- **Supporting System**, represent the raised structure that support antennas and one or more RRU in open sites.
    - IFC Mapping : IfcElementAssemblyPredefinedTypeMAST

8 Port Connectivity (PCC)

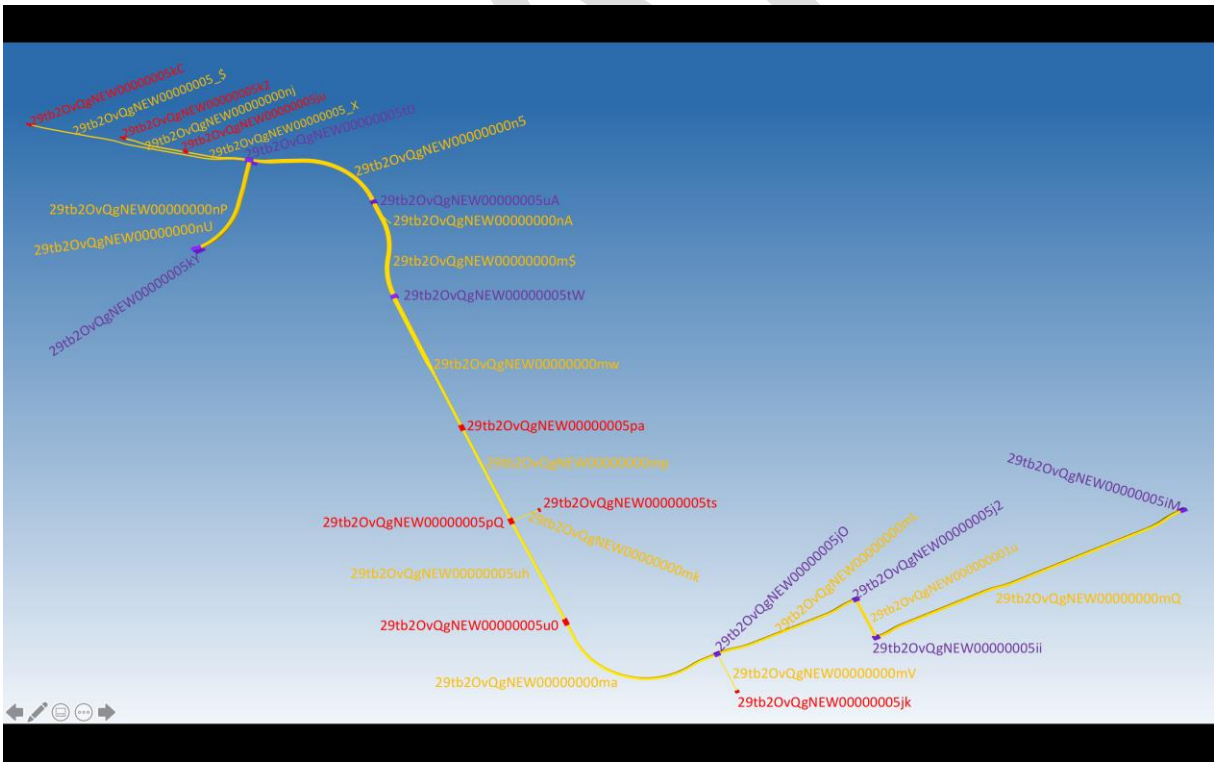
8.1 UT_PCC_1

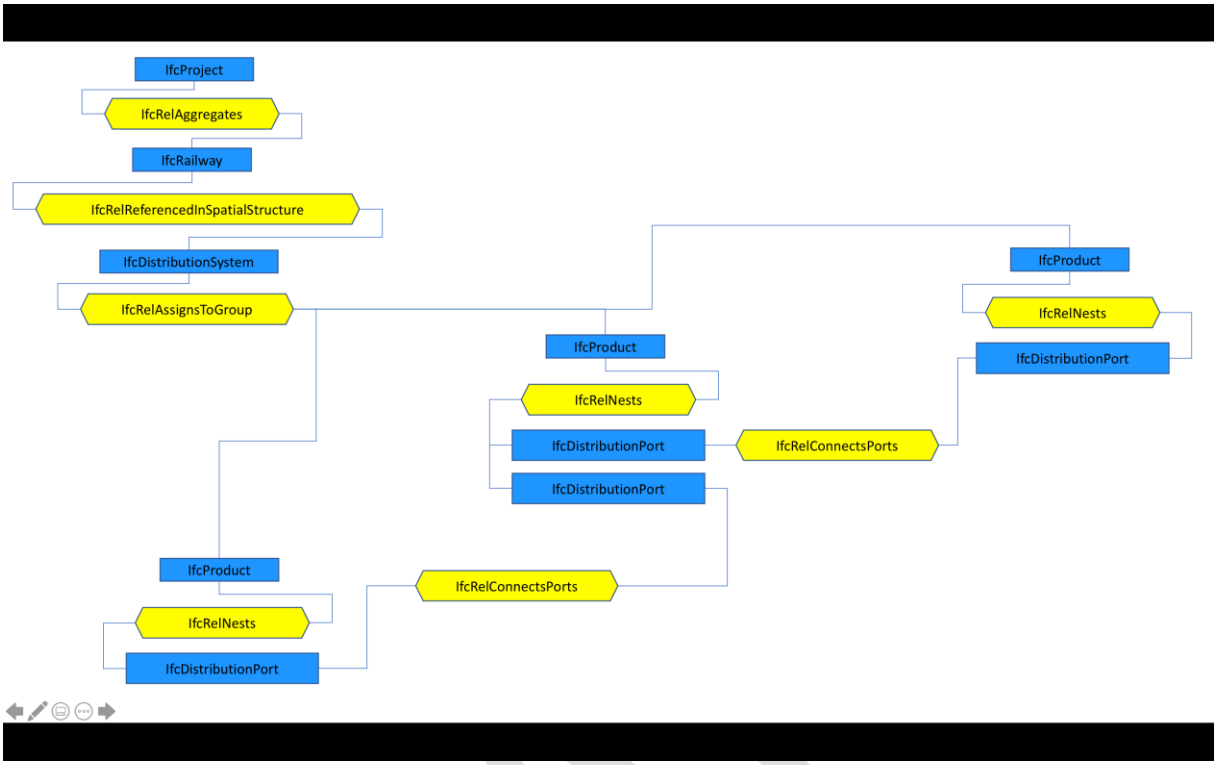
Case Provider	MINnD
Raw Dataset Format	
IFC Provider	IFC Rail Technical Service, ACCA
Number of final IFC sample files	1
Number of all IFC files produced	2
Other Outcomes	Images

This Unit Test intends to experiment the use of IFC to represent the topology of the multiduct system in order to complete the piping system description.

For the scope of this UT, part of an underground electrical system for an urban railway was taken as an example.

The dataset is provided by MINnD4Rail. A picture representing the multiduct topology for this example and a picture shows the IFC entities involved in this system topology are as follows.





One IFC reference file is provided including connected duct ports between duct segments.

The IFC files are provided by IFC Rail Technical Service and ACCA.

8.2 UT_PCC_2

Case Provider	SNCF
Raw Dataset Format	
IFC Provider	IFC Rail Technical Service
Number of final IFC sample files	1
Number of all IFC files produced	1
Other Outcomes	Images

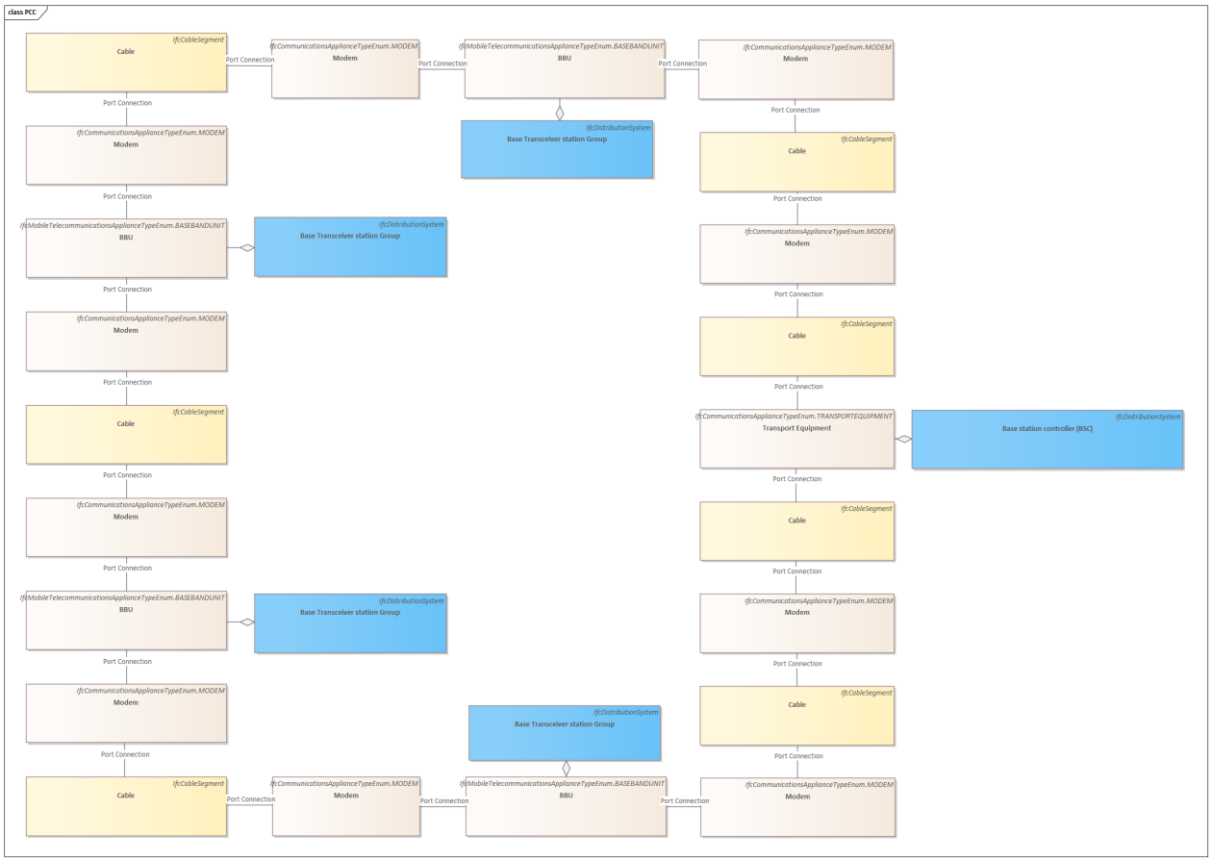
This Unit Test intends to experiment the use of IFC to represent a wired transmission network used in the GSM-R base station subsystem.

For the scope of this UT, illustration of the transmission segment connecting the base transceiver stations installed along the railway line N° 944000, was taken as an example.

The dataset is provided by SNCF.

The datasets aim to provide some technical constraints and requirements that are related to the wired transmission network and which need to be faithfully transcribed in an IFC model.

The schematic representation of the needs :



The IFC file is provided by IFC Rail Technical Service.

9 Domain Physical Elements (DPE)

9.1 UT_DPE_1

Case Provider	SBB
Raw Dataset Format	
IFC Provider	IFC Rail Technical Service
Number of final IFC sample files	
Number of all IFC files produced	2
Other Outcomes	Images

This Unit Test aims to prove the possibility to use current concepts in IFC to create a railway turnout panel, which is a comprehensive element in the track domain. Based on alignment and swept area solid, the basic shape of an rails shall be created. Other major elements like sleepers, frogs shall also be modelled.

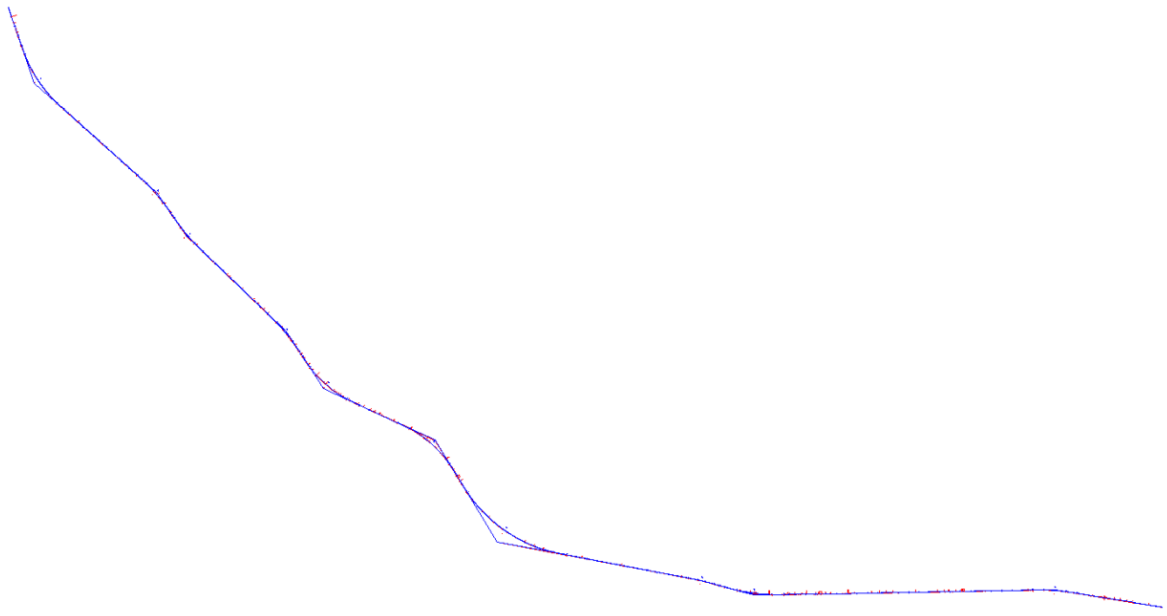
This test has draft IFC files created, done by IFC Rail Technical Service and ACCA. They show the possibility to model alignments and major elements in this case.

9.2 UT_DPE_4

Case Provider	CRBIM
Raw Dataset Format	
IFC Provider	IFC Rail Technical Service
Number of final IFC sample files	
Number of all IFC files produced	2
Other Outcomes	Images

This unit test intends to experiment the use of IFC for the linear placement of the BTS (Base Transceiver Station) site. In the dataset, the placement is described as a set of parameters related to the alignment curve and the location information of BTS site.

This document describes in detail the data organization of the plane, profile, and broken chain of a railway line through a railway line example. The telecom domain expert provide the placement details of BTS site along the curve, so as to facilitate the software service manufacturer to test the placement of the BTS along the curve.

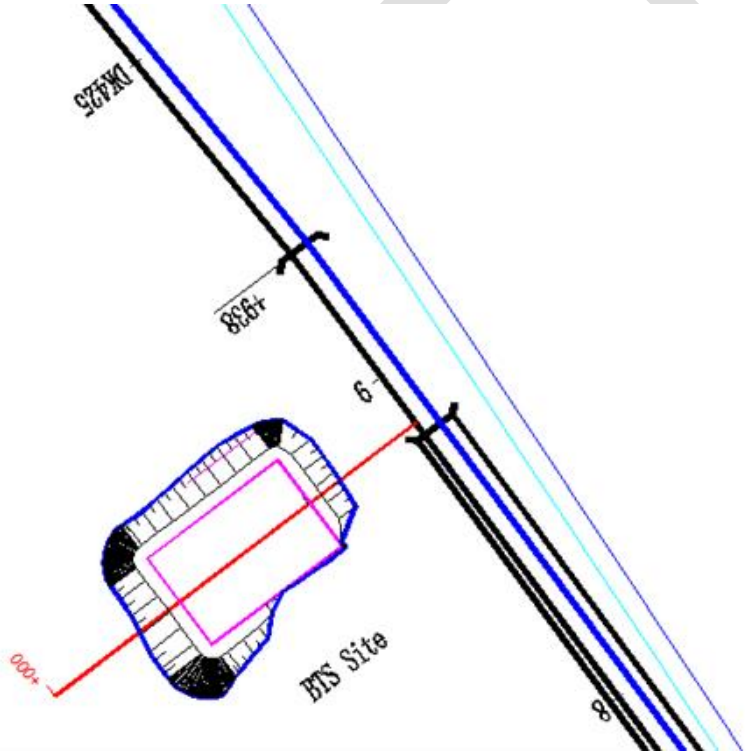


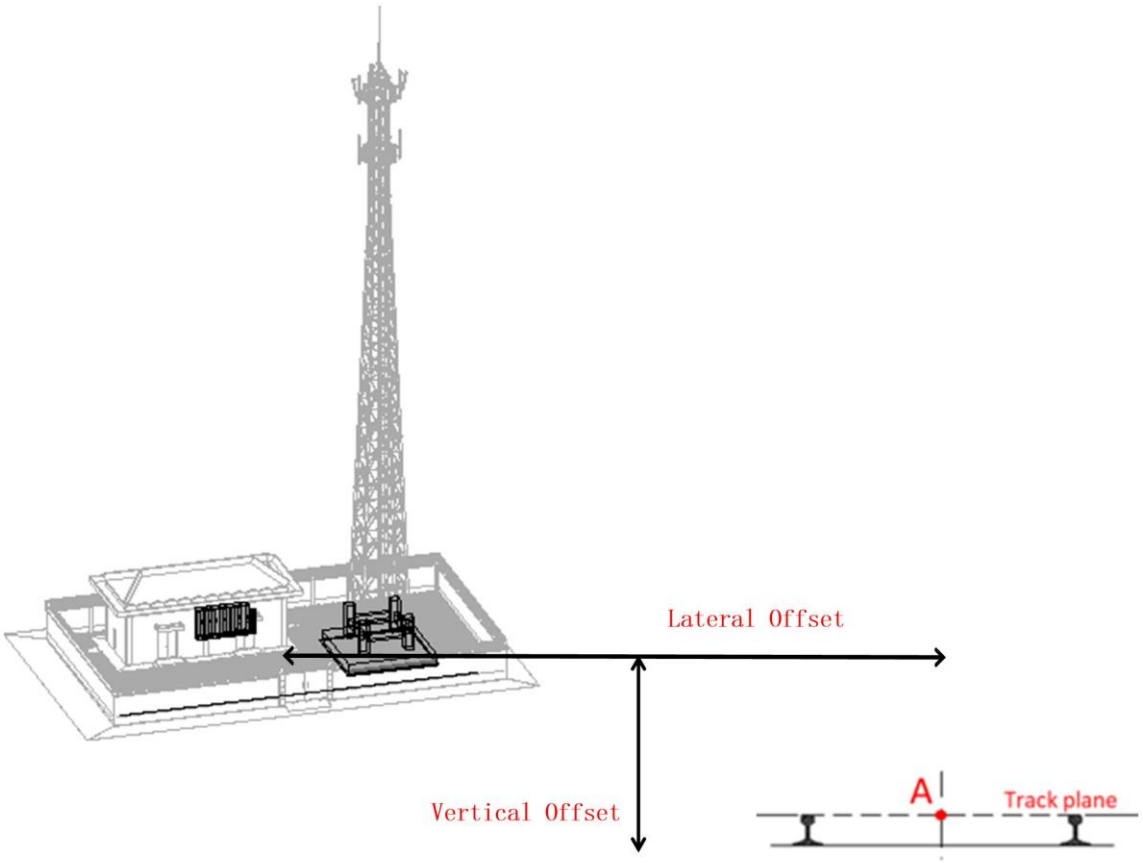
The dataset includes 5 BTS sites that placed according to the alignment curve. The geometry of the BTS site is simplified, which only includes the tower and technical room.

For the placement of a BTS site, there is no parameter that depends on cant.The placement of the BTS site will be determined by the mileage location and left/right side of the BTS site, the lateral and vertical offset.

The lateral offset is the distance between the position of the center point of the BTS site and the horizontal alignment curve at the corresponding mileage. This distance is measured along the axis that is perpendicular to the tangent of the horizontal alignment curve at the corresponding mileage. The offset is always a positive value. The direction of the offset is defined by the "Side" parameter.

The vertical offset is the distance between the position of the center point of the BTS site and the vertical alignment curve at the corresponding mileage. This distance is measured along the vertical axis of the general coordinate system. A positive vertical offset indicates that, in the general coordinate system, the vertical coordinate of the vertical alignment curve at the corresponding mileage is less than the vertical coordinate of the origin of the BTS site.





This test has draft IFC files created, done by IFC Rail Technical Service. They show the possibility to place spatial structure elements along alignment. Further updates are required for this test for physical elements.

9.3 UT_DPE_5

Case Provider	SNCF
Raw Dataset Format	
IFC Provider	IFC Rail Technical Service
Number of final IFC sample files	1
Number of all IFC files produced	1
Other Outcomes	Images

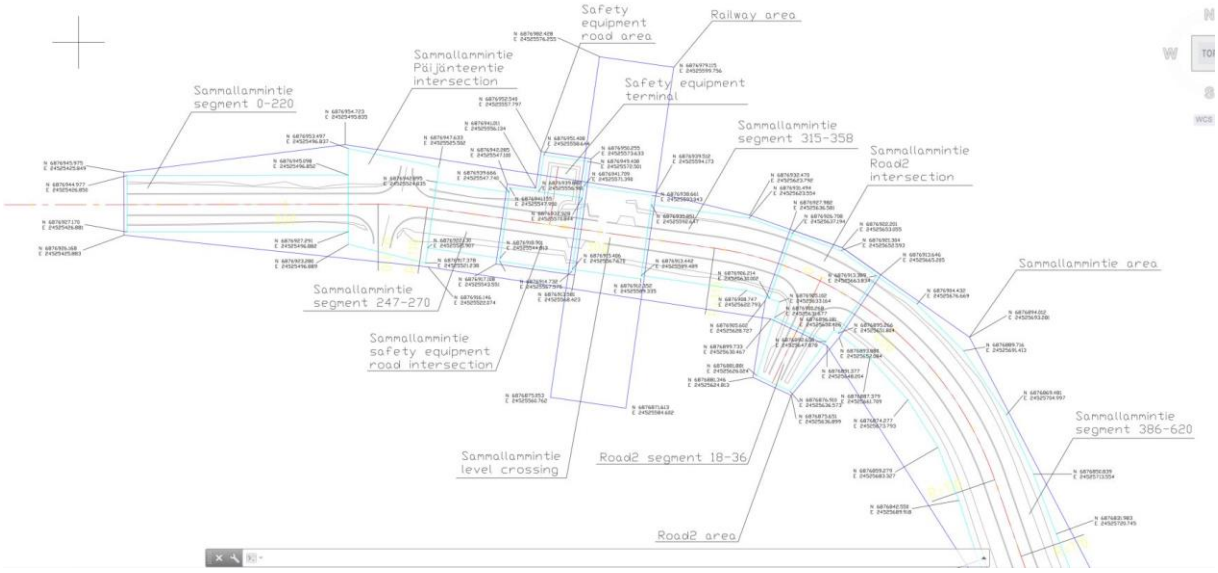
This unit test intends to experiment the use of IFC for the representation of signalling equipment located at a level crossing. The equipment included is:

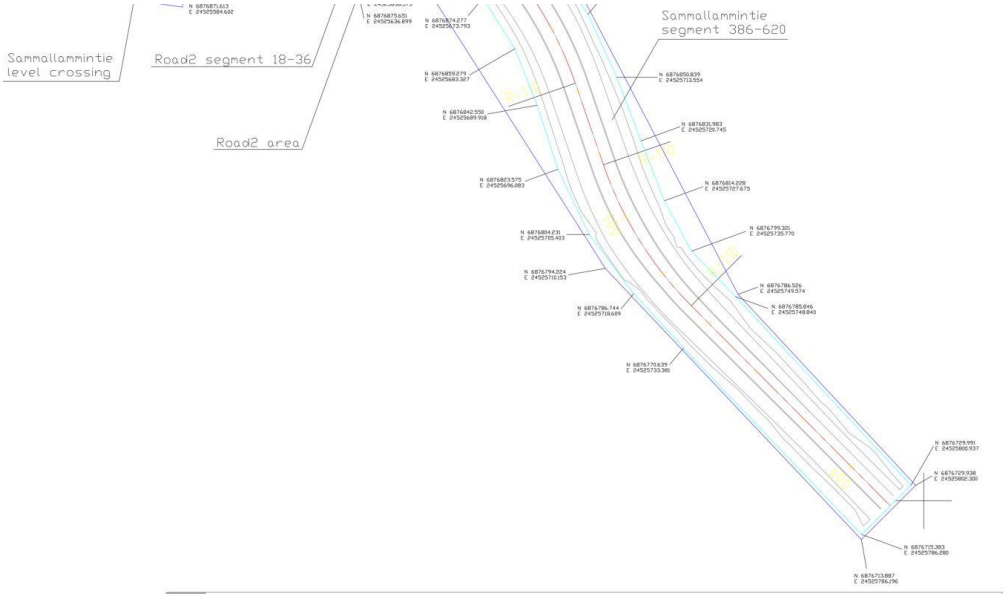
- A boom barrier
- A guardrail
- A signal assembly

    - audio signal
    - visual signal
    - sign
    - post
    - footing
- Axle counters and junction boxes
- Cabling
- Cabinets
- A technical building

A proposal for a spatial structure for the project is provided as well as track panel and ballast bed for context.

The proposed spatial structure is shown here:





The spatial structure can be simplified, but is available in the reference file.

The different elements have been provided in dwg-files as well as IFC 2x3 files (using IfcBuildingElementProxy elements).

The following mapping to IFC 4.3 is proposed (all these elements are available in the IFC reference file):

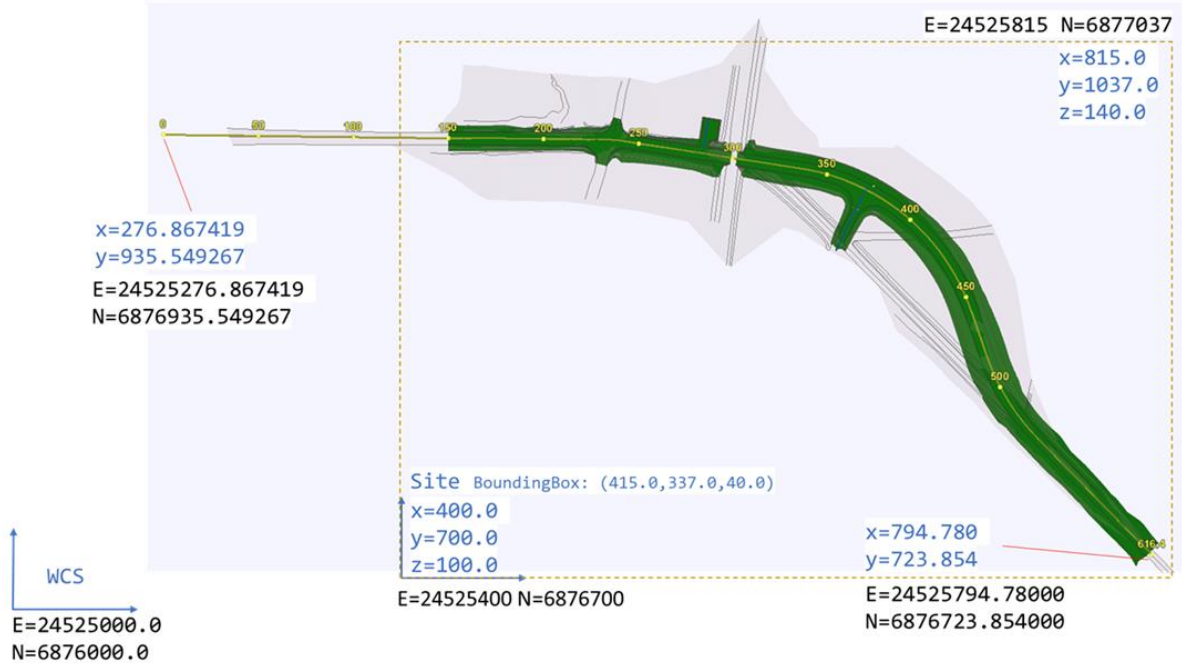
Element	IFC representation
Boom barrier	IfcDoor/BOOM_BARRIER
Signal assembly	IfcElementAssembly/SIGNALASSEMBLY
Audio signal	IfcSignal/AUDIO
Visual signal	IfcSignal/VISUAL
Sign	IfcSign/PICTORAL
Signal post	IfcMember/POST
Axle counter	IfcSensor/WHEELSENSOR
Junction box	IfcJunctionBox/DATA
Cables	IfcCableSegment
Cabinet	IfcFurniture/TECHNICALCABINET
Snow plough protection	IfcDiscreteAccessory/RAIL_MECHANICAL_EQUIPMENT

Controllers/Computers	IfcController/PROGRAMMABLE IfcCommunicationsAppliance/COMPUTER IfcSwitchingDevice/TOGGLESWITCH
Other optional equipment	IfcRailing/GUARDRAIL IfcFooting/PAD_FOOTING IfcStair/LADDER

An optional addition is to create a system structure. A proposed structure is available in the IFC reference file:

- IfcDistributionSystem/USERDEFINED/RoadProtection
  - IfcDistributionSystem/CONTROL (Boom barrier)
  - Signal assembly
  - Cables
  - Guardrail, Ladder
  - IfcDistributionSystem/Control ("Central intelligence")
  - Controllers/computers
  - IfcDistributionSystem/SIGNAL (axle counting)
  - Axle counters/junction boxes
  - Cabling connecting the axle counters/junction boxes to "Central intelligence"

Refer to the picture below for georeferencing parameters. The coordinate reference system used is EPSG:3878, datum is ETRS89 and vertical datum is N2000.



As stated above, there are IFC reference files available:

- Without georeferencing
- With georeferencing

Currently, the reference files use local placement for all elements. Desirable would be to have at least the axle counters/junction boxes and snow plough protection placed linearly along the alignment. The track alignment is not included in the IFC reference files either.

In addition to the elements listed above, the IFC reference files also includes a track panel (rails + sleepers) and ballast bed for context. These elements are classified correctly according to IFC 4.3, but also using local placement.