IFC Rail Phase 2 Report

WP4 – IFC Rail UML Report

Report of the updated IFC Rail UML model. It is based on the updated IFC 4.3 model during the test and implementation in IFC Rail project Phase 2.

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Contents

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1 Introduction

This document is built to report the documention of railway relevant concepts of IFC 4.3 in UML. It is part of the official deliverables of IFC Rail Phase 2 project, as shown in Figure 1 below. Please refer to the *IFC Rail Phase 2 Final Report: Executive Summary* for further details.
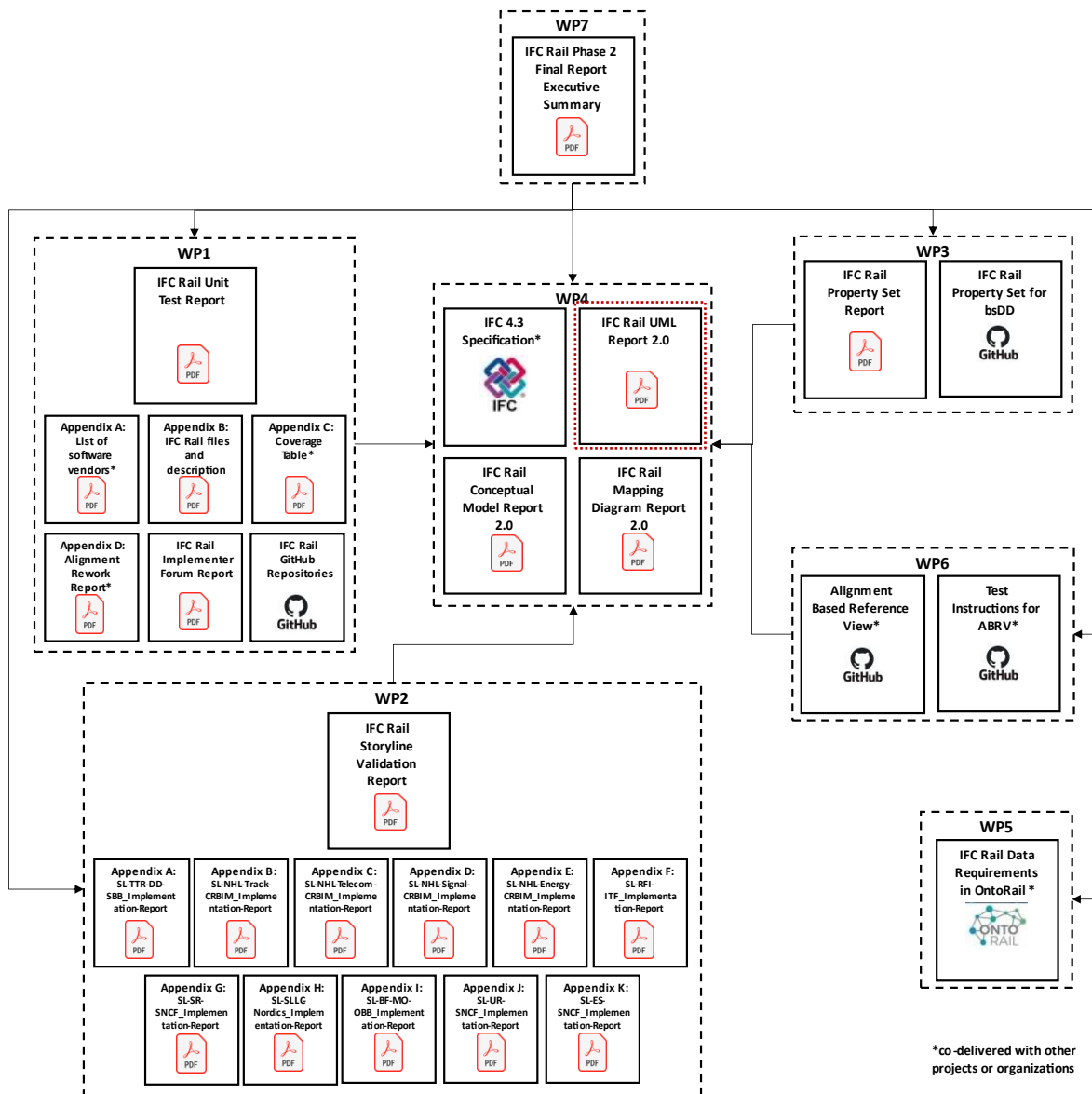
Figure 1 The position of this document in the structure of deliverables

This document is an updated version of the IFC Rail UML Report issued in IFC Rail project from 2018 to 2019. It contains all the new Concepts proposed and updated by the IFC Rail project that are already integrated into IFC 4.3. The main purpose of the document is to report these concepts in UML for communication with general IT experts and domain experts.

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Together with the Conceptual Model Report (CMR), this document is an input to read and fully understand the Mapping Diagrams Report (MDR).

2 Package structure and convention

Inside the "IFC Rail" package, all the sub-packages related to the extended concepts by IFC Rail are placed. This document reports the content in the "IFC Rail - PSM" package.
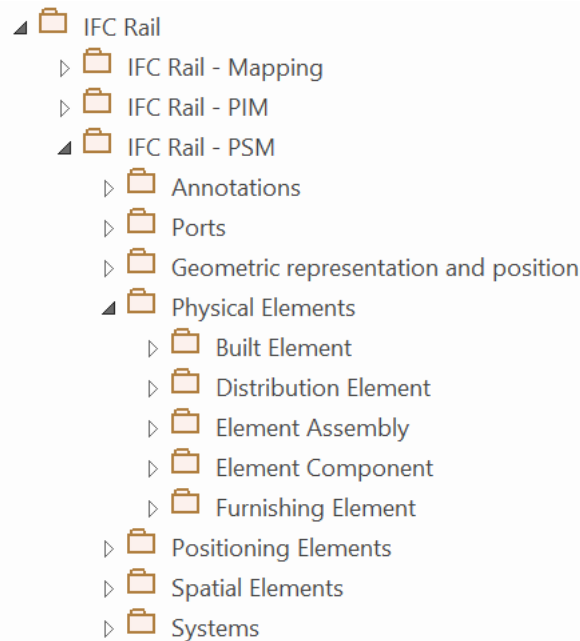
Figure 2 Structure of the IFC Rail package

According to the image above, the content of the "IFC Rail – PSM" package is structured as follows:

- 6 sub-packages which contain diagrams that present railway relevant concepts in IFC 4.3;
- These 6 sub-packages are structured based on the classification hierarchy of IFC 4.3;
- In principle, each IFC entity that is a subtype of IfcObject has its own package that contains diagrams
- The IFC 4.3 Model elements are in an external package out of "IFC Rail". All diagrams in "IFC Rail – PSM" package only reference these elements.

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3 Diagrams and Documentation

3.1 Package: Annotations
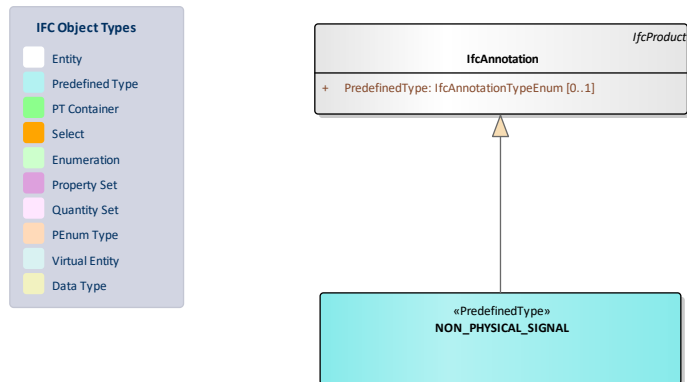
Figure 3: new2_IfcAnnotation

3.1.1 Predefined Type: NON_PHYSICAL_SIGNAL

Full Identifier: **IfcAnnotation.NON_PHYSICAL_SIGNAL**

A virtual or fictitious signal. As opposed to the physical signal, the non-physical signal does not need to send information to the train. E.g. a fictitious signal on the signalman''s display needed to define the route exit towards open line where there''s no real signal. A virtual ERTMS L2 signal is also a non-physical signal but can have a physical presence, i.e. a stop marker board along the track.

Status: Proposed

Package: IfcProductExtension

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.2 Package: Ports

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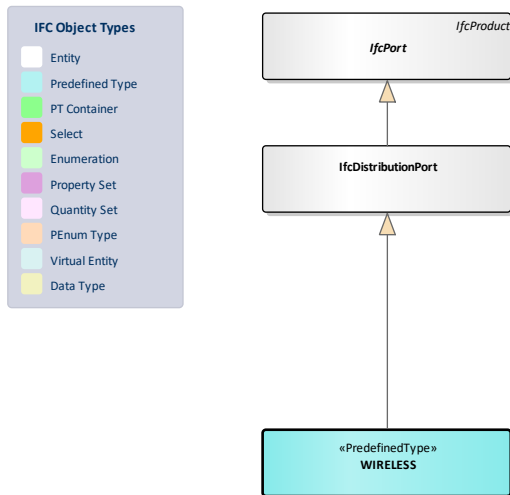
Figure 4: new2_IfcPort

3.2.1　Predefined Type: WIRELESS

Full Identifier: **IfcDistributionPort.WIRELESS**

Wireless connection to communication appliances for distribution of data or communication.

Status: Proposed

Package: IfcSharedBldgServiceElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.3　Package: Geometric representation and position

3.3.1　Package: Alignment Representation

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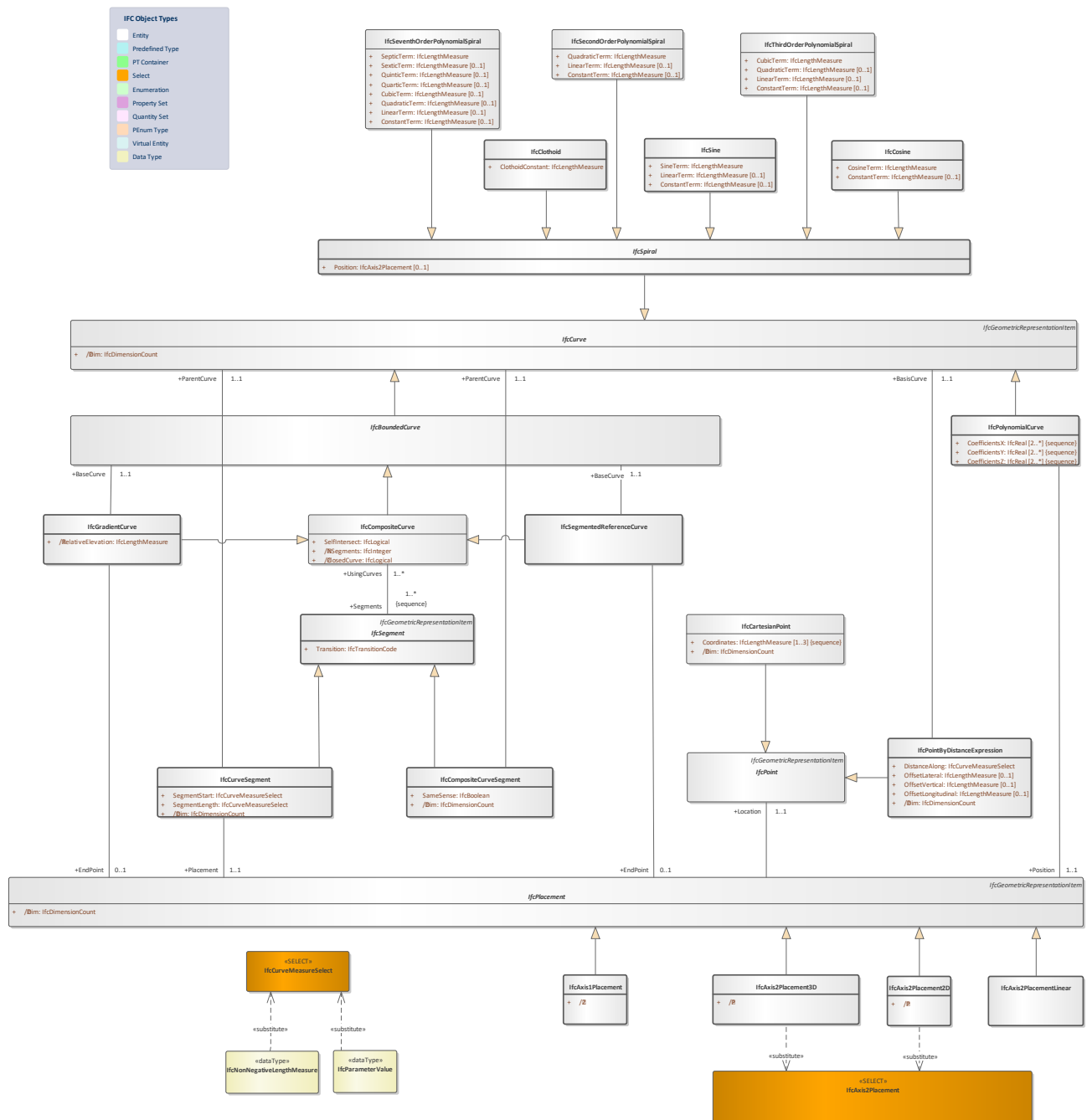
Figure 5: new2_Alignment Geometry

3.3.1.1 Class: IfcAxis2PlacementLinear

The _IfcAxis2PlacementLinear_ provides location and orientation to place items in a three-dimensional space confined to the context of a curve. Relative placement axes (Axis and RefDirection) are relative to the curve used for linear referencing provided in _IfcPlacement_ _Location_ (_IfcPointByDistanceExpression_ _BasisCurve_), maintaining the relationship to the tangent of the curve.

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Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement			
Subtype Of	IfcPlacement		
Subtypes	EXISTING		PROPOSED

3.3.1.2 Class: IfcClothoid

A clothoid is a planar curve in the form of a spiral. This curve has the property that the curvature varies linearly with the arc length.

{ .extDef}

> NOTE Definition according to ISO 10303-42:2003

>

> Interpretation of the data shall be as follows:

>>

>> ```

>> C = SELF\\IfcSpiral.Position.Location

>> x = SELF\\IfcSpiral.Position.P[1]

>> y = SELF\\IfcSpiral.Position.P[2]

>> A = ClothoidConstant

>> ```

> and the clothoid is parameterized as:

>

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>>
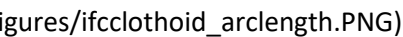
>>> ![formula](../../../../../../figures/ifcclothoid_parameterisation.PNG)

> and the parametric range is: $-\infty < \_u\_ < \infty$

>>

> The arc length _s_ of the curve, from the point C, is given by the formula:
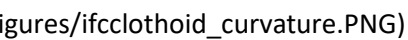
>>

>>> ![formula](../../../../../../figures/ifcclothoid_arclength.PNG)

>>

> The curvature _\X2\03BA\X0_ and radius of the curvature _\X2\03C1\X0_, at any point of the curve, are related to the arc length _s_ by the formulae:

>>

>>> ![formula](../../../../../../figures/ifcclothoid_curvature.PNG)

>>

{ .extDef}

> NOTE Formulae adapted from **clothoid** defined in ISO 10303-42

Status: Proposed

Package: IfcGeometryResource

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcSpiral	
Subtypes	EXISTING	PROPOSED

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Class Attributes

Name	Type	Multiplicity	Definition
ClothoidConstant	IfcLengthMeasure		The constant which defines the relationship between curvature and arc length for the curve.

3.3.1.3 Class: IfcCompositeCurve

An _IfcCompositeCurve_ is a continuous curve composed of curve segments.

Figure 1 illustrates an example of a composite curve.

!["formula"](../../../../../figures/ifccompositecurve.png "Figure 1 — Composite curve")

Consider an _IfcCompositeCurve_ having line segment and an arc segment. The line should be parameterized:

* _IfcPolyline_ with start= 0.,0. end= 0.,1., _SameSense_= TRUE, parametric length = 1.

The arch should be parameterized:

* _IfcTrimmedCurve_ with start= 180'', end= 90'', _SameSense_= FALSE, parametric length = 90.

Then the parameterization of the composite curve is:
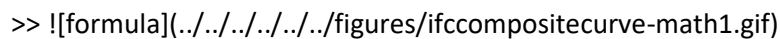
* _IfcCompositeCurve_ with 0. ≤ T ≤ 1. (line segment) and 1. ≤ T ≤ 91. (arc segment), parametric length = 91.

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{ .extDef}

> NOTE Definition according to ISO 10303-42:
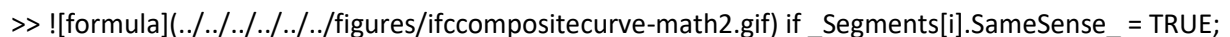
> A composite curve is a collection of curves joined end-to-end. The individual segments of the curve are themselves defined as composite curve segments. The parameterization of the composite curve is an accumulation of the parametric ranges of the referenced bounded curves. The first segment is parameterized from _0_ to _l\X\7E<small>1</small>\X\7E_ and for _i_ ≤ _2_, the _i^<small>th</small>^_ segment is parameterized from:

>

>> ![formula](../../../../../figures/ifccompositecurve-math1.gif)
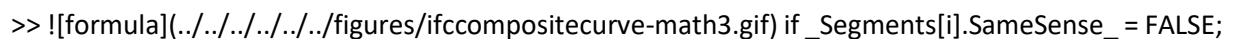
> where _l\X\7E<small>k</small>\X\7E_ is the parametric length (i.e., difference between maximum and minimum parameter values) of the curve underlying the _k^<small>th</small>^_ segment. Let _T_ denote the parameter for the composite curve. Then, if the _i_th segment is not a reparameterised composite curve segment, _T_ is related to the parameter _t\X\7Ei\X\7E_; _t\X\7Ei0\X\7E_ ≤ _t\X\7Ei\X\7E_ ≤ _t\X\7Ei1\X\7E_; for the _i_th segment by the equation:

>

>> ![formula](../../../../../figures/ifccompositecurve-math2.gif) if _Segments[i].SameSense_ = TRUE;

> or by the equation:

>
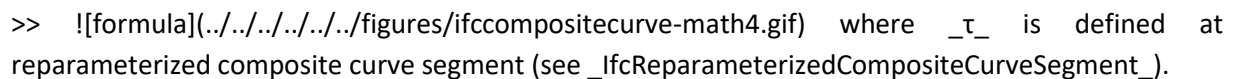
>> ![formula](../../../../../figures/ifccompositecurve-math3.gif) if _Segments[i].SameSense_ = FALSE;

> If the segments[i] is of type reparameterised composite curve segment,

>

>> ![formula](../../../../../figures/ifccompositecurve-math4.gif) where _τ_ is defined at reparameterized composite curve segment (see _IfcReparameterizedCompositeCurveSegment_).

>

> NOTE Entity adapted from **composite_curve** defined in ISO 10303-42.

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> HISTORY New entity in IFC1.0

{ .spec-head}

Informal Propositions:

1. The _SameSense_ attribute of each segment correctly specifies the senses of the component curves. When traversed in the direction indicated by _SameSense_, the segments shall join end-to-end.

Status: Proposed

Package: IfcGeometryResource

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcBoundedCurve	
Subtypes	**EXISTING**	**PROPOSED**
	IfcCompositeCurveOnSurface	IfcSegmentedReferenceCurve IfcGradientCurve

Class Attributes

Name	Type	Multiplicity	Definition
SelfIntersect	IfcLogical		Indication of whether the curve intersects itself or not; this is for information only.
NSegments	IfcInteger		
ClosedCurve	IfcLogical		

3.3.1.4 Class: IfcCompositeCurveSegment

An _IfcCompositeCurveSegment_ is a bounded curve constructed for the sole purpose to be a segment within an _IfcCompositeCurve_.

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{ .extDef}

> NOTE Definition according to ISO/CD 10303-42:1992

> A composite curve segment is a bounded curve together with transition information which is used to construct a composite curve.

> NOTE Entity adapted from **composite_curve_segment** defined in ISO 10303-42.

> HISTORY New entity in IFC1.0

Status: Proposed

Package: IfcGeometryResource

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcSegment	
Subtypes	EXISTING	PROPOSED
	IfcReparametrisedCompositeCurveSegment	

Class Attributes

Name	Type	Multiplicity	Definition

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			An indicator of whether or not the sense of the segment agrees with, or opposes, that of the parent curve. If _SameSense_ is false, the point with highest parameter value is taken as the first point of the segment.
SameSense	IfcBoolean		> NOTE If the datatype of _ParentCurve_ is _IfcTrimmedCurve_, the value of _SameSense_ overrides the value of _IfcTrimmedCurve.SenseAgreement_
Dim	IfcDimensionCount		

3.3.1.5 Class: IfcCosine

A type of spiral curve for which the curvature change is dependent on the cosine function.

The curvature is defined as:

K = K0/2 (Constant - cos&pi s/CosineTerm)

Status: Proposed

Package: IfcGeometryResource

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcSpiral	
Subtypes	EXISTING	PROPOSED

Class Attributes

Name	Type	Multiplicity	Definition
CosineTerm	IfcLengthMeasure		$
ConstantTerm	IfcLengthMeasure	[0..1]	$

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3.3.1.6 Select: IfcCurveMeasureSelect

Status: Proposed

Package: IfcGeometryResource

Select Properties	
Stereotype	«SELECT»
Substitutions	IfcParameterValue IfcNonNegativeLengthMeasure

3.3.1.7 Class: IfcCurveSegment

A type of segment positioned along a curve cutting a segment from the parent curve. The positioning curve (StartPlacement.PlacementMeasuredAlong) does not neccessarily correspond with the ParentCurve.

Status: Proposed

Package: IfcGeometryResource

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcSegment	
Subtypes	EXISTING	PROPOSED

Class Attributes

Name	Type	Multiplicity	Definition
SegmentStart	IfcCurveMeasureSelect		First trimming point of the curve segment on the _ParentCurve_. This point is used as the insertion point into the segmented, gradient or composite curve using this segment.

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SegmentLength	IfcCurveMeasureSelect		Length of segment measured as length or parameter value from _SegmentStart_. The sign of this value defines the sense agreement.
Dim	IfcDimensionCount		

3.3.1.8 Class: IfcGradientCurve

Gradient curve is a type of curve 3D curve representation that is based on its 2D projection (BaseCurve) and a height deifned by its gradient segments which can be derived from a function that retrieves it from the segment start height, its placement and the ParentCurve instance and the type of the ParentCurve.

The parametrization of the gradient curve is based on the underlying segments of its _BaseCurve_. The value of the parameter equals the parameter value of _BaseCurve_.

Status: Proposed

Package: IfcGeometryResource

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcCompositeCurve	
Subtypes	EXISTING	PROPOSED

Class Attributes

Name	Type	Multiplicity	Definition
RelativeEle vation	IfcLengthMeasure		

3.3.1.9 Class: IfcPointByDistanceExpression

An _IfcPointByDistanceExpression_ describes a point relative to a basis curve according to distance along the basis curve. The offsets default to the initial context of the curve relative to it''s tangent

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either specified in _IfcProduct.Placement_ or in the case of a segmented curve to the _IfcCurveSegment_ _StartPlacement_ where the values correspond to the following:

* lateral to the basis curve

* offset vertical to the basis curve

* optional additional offset parallel to the basis curve that may be used to address locations otherwise unreachable where the basis curve is tangentially discontinuous.

Status: Proposed

Package: IfcGeometryResource

Class Properties			
Status	Proposed	Is Abstract	
Property sets			

Inheritance Statement		
Subtype Of	IfcPoint	
Subtypes	EXISTING	PROPOSED

Class Attributes

Name	Type	Multiplicity	Definition
DistanceAlong	IfcCurveMeasureSelect		The distance along the basis curve measured as either a _IfcLengthMeasure_ or _IfcParameterValue_.
OffsetLateral	IfcLengthMeasure	[0..1]	Default offset horizontally is measured perpendicular to the basis curve, where positive values indicate to the left of the basis curve as facing in the positive parametrization direction of the basis curve, and negative values indicate to the right. If DistanceAlong coincides with a point of tangential discontinuity (within precision limits), then the tangent of the previous segment governs.

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			Default offset vertical to the basis curve where positive values indicate perpendicular to the tangent at DistanceAlong in the plane of the tangent perpendicular to the global XY plane.
OffsetVertical	IfcLengthMeasure	[0..1]	
OffsetLongitudinal	IfcLengthMeasure	[0..1]	Offset parallel to the basis curve after applying DistanceAlong, OffsetLateral, and OffsetVertical to reach locations for the case of a tangentially discontinuous basis curve.
Dim	IfcDimensionCount		

3.3.1.10 Class: IfcPolynomialCurve

Status: Proposed

Package: IfcGeometryResource

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcCurve	
Subtypes	EXISTING	PROPOSED

Class Attributes

Name	Type	Multiplicity	Definition
CoefficientsX	IfcReal	[2..*]	$
CoefficientsY	IfcReal	[2..*]	$
CoefficientsZ	IfcReal	[2..*]	$

3.3.1.11 Class: IfcSecondOrderPolynomialSpiral

The _IfcSecondOrderPolynomialSpiral_ is a specialization of _IfcSpiral_. The curvature _\X2\03BA\X0_ and radius of the curvature _\X2\03C1\X0_, at any point of the curve, are related to the arc length _s_ by the second order formulae:

>>

>> ![formula](../../../../../figures/ifcsecondorderpolynomialspiral_curvature.PNG)

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>>

> Interpretation of the parameters:

>>

>>

>> C = SELF\\IfcSpiral.Position.Location

>> x = SELF\\IfcSpiral.Position.P[1]

>> y = SELF\\IfcSpiral.Position.P[2]

>> A_2 = QuadraticTerm

>> A_1 = LinearTerm

>> A_0 = ContantTerm

>>

> and the second order polynomial spiral is parameterized as:

>>

>> ![formula](../../../../../figures/ifcspiral_parameterization.PNG)

>>

> where:

>>

>> ![formula](../../../../../figures/ifcsecondorderpolynomialspiral_theta.PNG)

>>

> and the parametric range is: -∞ < _u_ < ∞.

Status: Proposed

Package: IfcGeometryResource

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

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Inheritance Statement		
Subtype Of	IfcSpiral	
Subtypes	EXISTING	PROPOSED

Class Attributes

Name	Type	Multiplicity	Definition
QuadraticTerm	IfcLengthMeasure		The constant that defines the quadratic term in the equation which defines the relation between curvature and arc length for the curve.
LinearTerm	IfcLengthMeasure	[0..1]	The constant that defines the linear term in the equation which defines the relation between curvature and arc length for the curve.
ConstantTerm	IfcLengthMeasure	[0..1]	The constant that defines the constant term in the equation which defines the relation between curvature and arc length for the curve.

3.3.1.12 Class: IfcSegment

Definition of a curve segment with a trimming mechanism built in with a StartPlacement (first point) and SegmentLength (second point).

Status: Proposed

Package: IfcGeometryResource

Class Properties			
Status	Proposed	**Is Abstract**	Abstract
Property sets			

Inheritance Statement		
Subtype Of	IfcGeometricRepresentationItem	
Subtypes	EXISTING	PROPOSED

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		IfcCurveSegment
		IfcCompositeCurveSegment

Class Attributes

Name	Type	Multiplicity	Definition
Transition	IfcTransitionCode		Connectivity between the continuous segments is not enforced per se to be tangential. Setting "TangentialContinuity" to True means that the current segment shall continue with tangential continuity to the previous one.

3.3.1.13 Class: IfcSegmentedReferenceCurve

A segmented reference curve is constructed from a referenced base curve (_BaseCurve_) that should in most cases (there can be exceptions) be used for positioning of a list of _IfcCurveSegment_ occurrences. The type of the base curve that _IfcCurveSegment_ references provides the information of the interpolation method between the start point of the segment and its end point defined by the segment length of the _IfcCurveSegment_._ParentCurve_.

The parametrization of _IfcSegmentReferenceCurve_ is based on the parametrization of _BaseCurve_ and is not altered by the _Segments_.

Figure 1 shows a cross section of a _IfcSegmentedReferenceCurve_ usage for an alignmnent representation featuring cant

!["segmented reference curve usage"](../../../../../../figures/IfcSegmentedReferenceCurve.JPG "Figure 1 — use of a segmented reference curve on a cant segment based on a gradient curve")

Status: Proposed

Package: IfcGeometryResource

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

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Inheritance Statement		
Subtype Of	[IfcCompositeCurve](#)	
Subtypes	**EXISTING**	**PROPOSED**

3.3.1.14 Class: IfcSeventhOrderPolynomialSpiral

The _IfcSeventhOrderPolynomialSpiral_ is a specialization of _IfcSpiral_. The curvature _\X2\03BA\X0_ and radius of the curvature _\X2\03C1\X0_, at any point of the curve, are related to the arc length _s_ by the seventh order formulae:

>>

>> ![formula](../../../../../../figures/ifcseventhorderpolynomialspiral_curvature.PNG)

>>

> Interpretation of the parameters:

>>

>>

>> C = SELF\\IfcSpiral.Position.Location

>> x = SELF\\IfcSpiral.Position.P[1]

>> y = SELF\\IfcSpiral.Position.P[2]

>> A_7 = SepticTerm

>> A_6 = SexticTerm

>> A_5 = QuinticTerm

>> A_4 = QuarticTerm

>> A_3 = CubicTerm

>> A_2 = QuadraticTerm

>> A_1 = LinearTerm

>> A_0 = ContantTerm

>>

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> and the seventh order polynomial spiral is parameterized as:

>>

>> ![formula](../../../../../../figures/ifcspiral_parameterization.PNG)

>>

> where:

>>

>> ![formula](../../../../../../figures/ifcseventhorderpolynomialspiral_theta.PNG)

>>

> and the parametric range is: -∞ < _u_ < ∞.

Status: Proposed

Package: IfcGeometryResource

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	[IfcSpiral](#)	
Subtypes	EXISTING	PROPOSED

Class Attributes

Name	Type	Multiplicity	Definition
SepticTerm	IfcLengthMeasure		The constant that defines the septic term in the equation which defines the relation between curvature and arc length for the curve.

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SexticTerm	IfcLengthMeasure	[0..1]	The constant that defines the sextic term in the equation which defines the relation between curvature and arc length for the curve.
QuinticTerm	IfcLengthMeasure	[0..1]	The constant that defines the quintic term in the equation which defines the relation between curvature and arc length for the curve.
QuarticTerm	IfcLengthMeasure	[0..1]	The constant that defines the quartic term in the equation which defines the relation between curvature and arc length for the curve.
CubicTerm	IfcLengthMeasure	[0..1]	The constant that defines the cubic term in the equation which defines the relation between curvature and arc length for the curve.
QuadraticTerm	IfcLengthMeasure	[0..1]	The constant that defines the quadratic term in the equation which defines the relation between curvature and arc length for the curve.
LinearTerm	IfcLengthMeasure	[0..1]	The constant that defines the linear term in the equation which defines the relation between curvature and arc length for the curve.
ConstantTerm	IfcLengthMeasure	[0..1]	The constant that defines the constant term in the equation which defines the relation between curvature and arc length for the curve.

3.3.1.15 Class: IfcSine

A type of spiral curve for which the curvature change is dependent on the sine function. It is also known as the Klein curve.

The curvature is defined as:

K = K0 (s LinearTerm - 1/2&pi sin2&pi/SineTerm)

Status: Proposed

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Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	[IfcSpiral](#)	
Subtypes	EXISTING	PROPOSED

Class Attributes

Name	Type	Multiplicity	Definition
SineTerm	IfcLengthMeasure		$
LinearTerm	IfcLengthMeasure	[0..1]	$
ConstantTerm	IfcLengthMeasure	[0..1]	$

3.3.1.16 Class: IfcSpiral

Spirals are curves that revolve around a point while increasing its length. In general, these curves are parameterized in the following way:

x = r(\X2\03C6\X0\) cos\X2\03C6\X0\

y = r(\X2\03C6\X0\) sin\X2\03C6\X0\

In the case of the clothoid and higher order transition spirals, the parametrization is:

x = \X2\222B\X0\cos &Theta dl

y = \X2\222B\X0\sin &Theta dl

where &Theta is the deflection or bearing angle and dl the differential of the spiral length.

<div align="right">Status: Proposed</div>

<div align="right">Package: IfcGeometryResource</div>

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Class Properties			
Status	Proposed	**Is Abstract**	Abstract
Property sets			

Inheritance Statement		
Subtype Of	IfcCurve	
Subtypes	EXISTING	PROPOSED
		IfcSecondOrderPolynomialSpiral
		IfcThirdOrderPolynomialSpiral
		IfcSine
		IfcSeventhOrderPolynomialSpiral
		IfcCosine
		IfcClothoid

Class Attributes

Name	Type	Multiplicity	Definition
Position	IfcAxis2Placement	[0..1]	$

3.3.1.17 Class: IfcThirdOrderPolynomialSpiral

The _IfcThirdOrderPolynomialSpiral_ is a specialization of _IfcSpiral_. The curvature _\X2\03BA\X0_ and radius of the curvature _\X2\03C1\X0_, at any point of the curve, are related to the arc length _s_ by the third order formulae:

>>

>> ![formula](../../../../../../figures/ifcthirdorderpolynomialspiral_curvature.PNG)

>>

> Interpretation of the parameters:

>>

>>

>> C = SELF\\IfcSpiral.Position.Location

>> x = SELF\\IfcSpiral.Position.P[1]

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>> y = SELF\\IfcSpiral.Position.P[2]

>> A_3 = CubicTerm

>> A_2 = QuadraticTerm

>> A_1 = LinearTerm

>> A_0 = ContantTerm

>>

> and the third order polynomial spiral is parameterized as:

>>

>> ![formula](../../../../../../figures/ifcspiral_parameterization.PNG)

>>

> where:

>>

>> ![formula](../../../../../../figures/ifcthirdorderpolynomialspiral_theta.PNG)

>>

> and the parametric range is: $-\infty < \_u\_ < \infty$.

Status: Proposed

Package: IfcGeometryResource

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcSpiral	
Subtypes	EXISTING	PROPOSED

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Class Attributes

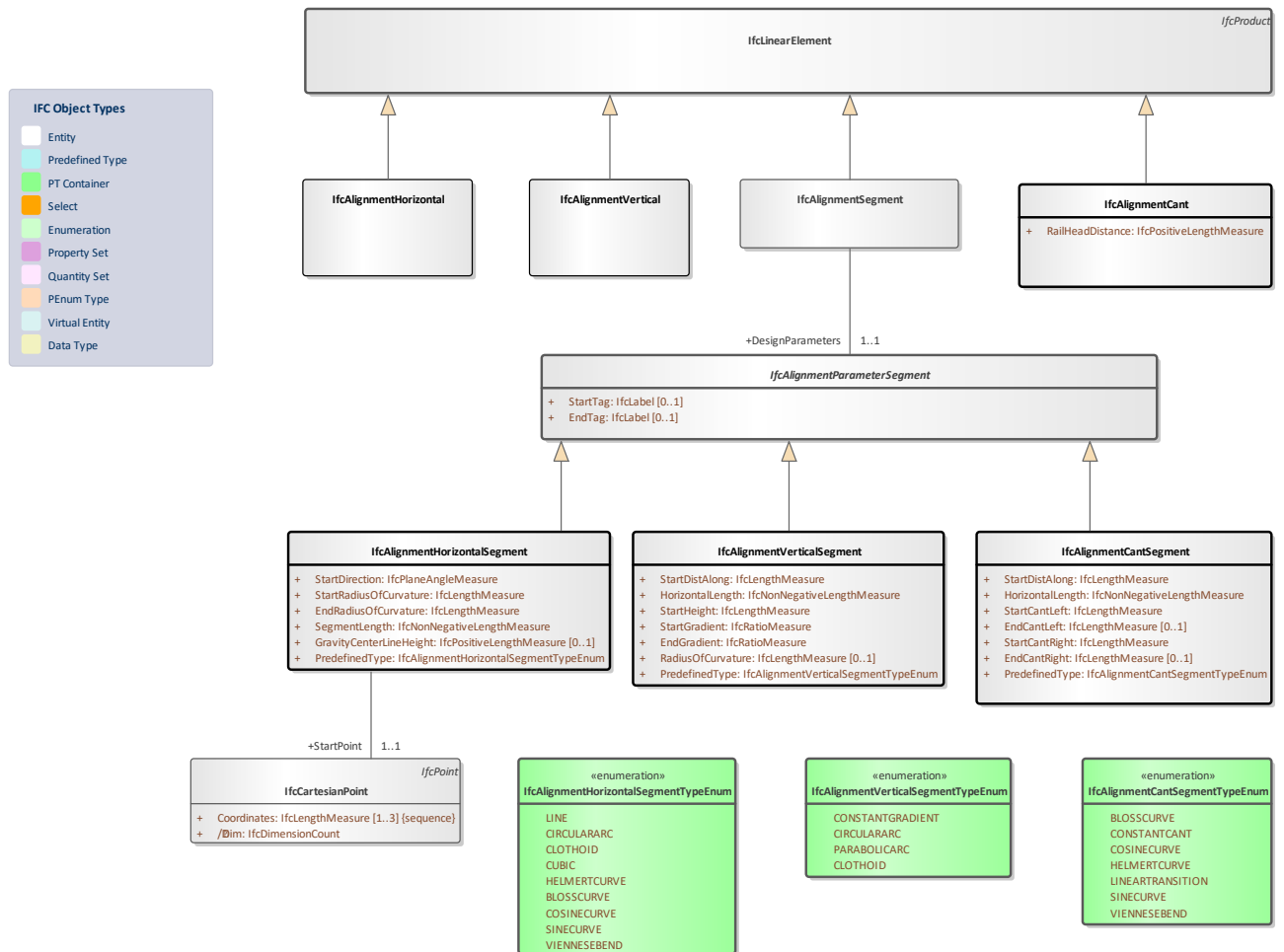| Name	Type	Multiplicity	Definition
CubicTerm	IfcLengthMeasure		The constant that defines the cubic term in the equation which defines the relation between curvature and arc length for the curve.
QuadraticTerm	IfcLengthMeasure	[0..1]	The constant that defines the quadratic term in the equation which defines the relation between curvature and arc length for the curve.
LinearTerm	IfcLengthMeasure	[0..1]	The constant that defines the linear term in the equation which defines the relation between curvature and arc length for the curve.
ConstantTerm	IfcLengthMeasure	[0..1]	The constant that defines the constant term in the equation which defines the relation between curvature and arc length for the curve.

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Figure 6: new2_Alignment Semantics

3.3.1.18 Class: IfcAlignmentCantSegment

An _IfcAlignmentCantSegment_ is an individual segment along _IfcAlignmentCant_.

The cant alignment is defined by ordered segments that connect end-to-start. The points defined in a cant alignment segment are defined in a plane with x = distance along horizontal alignment and y = height relative to projected points in vertical alignment.

The following cant segment types are defined:

- Bloss transition - _IfcAlignmentCantSegmentTypeEnum_ .BLOSSCURVE.
- Constant cant - _IfcAlignmentCantSegmentTypeEnum_ .CONSTANTCANT.
- Cosine transition - _IfcAlignmentCantSegmentTypeEnum_ .COSINECURVE.
- Helmert transition - _IfcAlignmentCantSegmentTypeEnum_ .HELMERTCURVE.
- Linear transition - _IfcAlignmentCantSegmentTypeEnum_ .LINEARTRANSITION.
- Sine transition - _IfcAlignmentCantSegmentTypeEnum_ SINECURVE

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- Viennese Bend (R) transition - _IfcAlignmentCantSegmentTypeEnum_ .VIENNESEBEND.

For each cant segment, the following information is provided:

- the start point, defined by distance along the horizontal alignment
- the length (as horizontal length along the distance along (not the curve segment length))
- the start cant, given by the values of left cant and right cant, measured relatively to vertical alignment
- the end cant, given by the values of left cant and right cant, measured from vertical alignment
- the information of tangential continuity that can be used to check continuity of segments (e.g. invalid sudden change of cant or missing cant information if end point and starting point differ over a threshold).

Status: Proposed

Package: IfcGeometricConstraintResource

Class Properties			
Status	Proposed	Is Abstract	
Property sets			

Inheritance Statement		
Subtype Of	IfcAlignmentParameterSegment	
Subtypes	EXISTING	PROPOSED
	IfcAlignmentCantSegment.VIENNESEBEND IfcAlignmentCantSegment.SINECURVE IfcAlignmentCantSegment.LINEARTRANSITION IfcAlignmentCantSegment.HELMERTCURVE IfcAlignmentCantSegment.COSINECURVE IfcAlignmentCantSegment.CONSTANTCANT IfcAlignmentCantSegment.BLOSSCURVE	

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Class Attributes

Name	Type	Multiplicity	Definition
StartDistAlong	IfcLengthMeasure		Distance along the horizontal alignment, measured along the IfcAlignment2DHorizontal given in the length unit of the global IfcUnitAssignment.
HorizontalLength	IfcNonNegativeLengthMeasure		Length measured as distance along the horizontal alignment of the segment.
StartCantLeft	IfcLengthMeasure		Length measured for the left cant at the beginning of the segment.
EndCantLeft	IfcLengthMeasure	[0..1]	Length measured for the left cant at the end of the segment.
StartCantRight	IfcLengthMeasure		Length measured for the right cant at the beginning of the segment.
EndCantRight	IfcLengthMeasure	[0..1]	Length measured for the right cant at the end of the segment.
PredefinedType	IfcAlignmentCantSegmentTypeEnum		$

1.1.1.1 Class: IfcAlignmentCantSegmentTypeEnum

The IfcAlignmentCantSegmentTypeEnum indicates the type of a segment of a cant alignment segment (IfcAlignmentCantSegment).

Cant is defined as the amount by which one running rail is raised above the other running rail, in a track cross section.

>NOTE Definition according to EN 13803/2017

For 3D modeling both the cant value and the cant angle (bank angle, lateral angle, cross slope angle) are relevant.

The relation between cant value **D**, Railhead distance **b** and cant angle **ψ** is shown below.

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!["Cant angle ψ"](../../../../../../figures/ifcalignmentcantsegmenttypeenum-CantAngle.png "Figure 1 — Cant angle, Cant, Railhead distance")

>NOTE in contempory track engineering ψ is approximated by sinus of ψ or tangens of ψ very often.

Variation of Cant	Segmenttype	Enumeration Values
0	both rails without relative elevation	CONSTANTCANT
constant in the complete segment, <> 0	elevated rail	CONSTANTCANT
variation along the segment	Transition with linear cant variation	LINEARTRANSITION
variation along the segment	Transition with non-linear cant variation	HELMERTCURVE, BLOSSCURVE, COSINECURVE, SINECURVE, VIENNESEBEND

Cant variation in high performance transition bends

While for combinations of horizontal clothoids and linear cant transitions the extension along the base line differs in some cases, curvature transition and cant transition for high performance horizontal transition bends are expected to have the same start position and end position. In some regulations the same linear extension requirement is mandatory for high performance transition bends.

Whether the cant variation is defined by the same base formula as the curvature of the corresponding horizontal high performance transition bend or by a linear ramp also might differ between regulations.

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Used Symbols and their meaning

Symbol	meaning	Unit, value range
L	full length of segment	positive length $L > 0$
s	current position on segment	$0 < s < L$
ξ	$= s / L$ (Greek "xi") standardised, dimensionless path length along the alignment / track centre line	$0 < \xi < 1$
D	cant .... amount by which one running rail is raised above the other running rail, in a track cross section	length
D_1	cant at beginning of the alignment segment	length
D(s)	variable cant at station "s" along the alignment cant segment.	length
b	Railhead distance; distance between the nominal centre points of the two contact patches of a wheelset (e.g. about 1500 mm for nominal track gauge 1435 mm)	length
ψ	(Greek "psi") Angle of cant (cross slope angle, bank angle)	rad
ϕ	(Greek "phi") Directional angle (azimuth, bearing)	rad

>NOTE Symbols according to EN 13803/2017

Status: Proposed

Package: IfcGeometricConstraintResource

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement	
Subtype Of	

Subtypes	EXISTING	PROPOSED

Class Attributes

Name	Type	Multiplicity	Definition
BLOSSCURVE			Non linear cant variation according to Bloss curve base formula. **Base formula (Cant)** !["Bloss cant transition segment"](../../figures/ifcalignmentcantsegmenttypeenum-blosscurve.png "Figure 1 — Cant for Bloss curve transition segment")
CONSTANTCANT			For horizontal straight lines, compensation of lateral acceleration is not required and should be avoided. Therefore the applied cant value is constant 0. For horizontal circular arcs, compensation of lateral acceleration is very common. In these cases the applied cant value is constant value greater 0. **Base formula (Cant)** !["Constant cant segment"](../../figures/ifcalignmentcantsegmenttypeenum-constantcant.png "Figure 1 — Constant cant segment")

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COSINECURVE			Non linear cant variation according to Cosine curve base formula. **Base formula (Cant)** !["Cosine cant transition segment"](../../figures/ifcalignmentcantsegmenttypeenum-cosinecurve.png "Figure 1 — Cant for Cosine curve transition segment")
HELMERTCURVE			Non linear cant variation according to Helmert curve base formula. **Base formula (Cant)** !["Helmert cant transition segment"](../../figures/ifcalignmentcantsegmenttypeenum-helmertcurve.png "Figure 1 — Cant for Helmert curve transition segment")
LINEARTRANSITION			Linear cant variation. This is the "natural" formula for horizontal clothoids. **Base formula (Cant)** !["Linear ramp transition segment"](../../figures/ifcalignmentcantsegmenttypeenum-lineartransition.png "Figure 1 — Cant for linear ramp transition segment")
SINECURVE			Non linear cant variation according to Sine curve base formula. **Base formula (Cant)** !["Sine cant transition segment"](../../figures/ifcalignmentcantsegmenttypeenum-sinecurve.png "Figure 1 — Cant for Sine curve transition segment")

VIENNESEBEND			Non linear cant variation according to Viennese bend base formula. The determining influence of the cant variation for the curve in the horizontal Cartesian 2D coordinate space is unique within all other transition curves. .**Base formula (Cant)** !["Viennese Bend(R) cant transition segment"](../../figures/ifcalignmentcantsegm enttypeenum-viennesebend.png "Figure 1 — Cant for Viennese Bend(R) transition segment")

3.3.1.19 Class: IfcAlignmentHorizontalSegment

Individual segment along the _IfcAlignmentHorizontal_, being defined in the x/y coordinate space. Each single horizontal alignment segment has an optional associated segment definition. The placement of _IfcAlignmentHorizontalSegment_ and the _IfcCurveSegment_ _StartPlacement_ correspond to each other.

The following information can be calculated (and is therefore not exchanged explicitly to avoid redundancy and inconsistencies)

* the end point (from start point, direction, segment length and curve parameter)

* the start distance along (from the end distance along of the previous segment, or the start distance along of the horizontal alignment (if it is the first segment)

* the end distance along (from the start distance and the segment length)

* the end direction (from the curve parameter, the start direction and the segment length)

* the point of intersection (from the start direction and the end direction)

The following checks can be done to validate the correct exchange:

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* continuity \X2\2013\X0\ does the calculated end point of the previous segment matches with the provided start point of this segment

* tangential continuity \X2\2013\X0\ does the calculated end direction of the previous segment matches with the provided start direction of this segment

Status: Proposed

Package: IfcGeometricConstraintResource

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcAlignmentParameterSegment	
Subtypes	**EXISTING**	**PROPOSED**
	IfcAlignmentHorizontalSegment.VIENNESEBEND	
	IfcAlignmentHorizontalSegment.SINECURVE	
	IfcAlignmentHorizontalSegment.LINE	
	IfcAlignmentHorizontalSegment.HELMERTCURVE	
	IfcAlignmentHorizontalSegment.CUBIC	
	IfcAlignmentHorizontalSegment.COSINECURVE	
	IfcAlignmentHorizontalSegment.CLOTHOID	
	IfcAlignmentHorizontalSegment.CIRCULARARC	
	IfcAlignmentHorizontalSegment.BLOSSCURVE	

Class Attributes

Name	Type	Multiplicity	Definition

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StartDirection	IfcPlaneAngleMeasure		The direction of the tangent at the start point. Direction value 0. indicates a curve with a start tangent along the positive x-axis. Values increases counter-clockwise, and decreases clockwise. Depending on the plane angle unit, either degree or radians, the sensible range is -360\S\0 \X2\2264\X0\ n \X2\2264\X0\ 360\S\0 (or -2\X2\03C0\X0\ \X2\2264\X0\ n \X2\2264\X0\ 2\X2\03C0\X0\). Values larger then a full circle (>|360\S\0| or >|2 \X2\03C0\X0\\| shall not be used.
StartRadiusOfCurvature	IfcLengthMeasure		For a NONLINEAR horizontal segment type the radius of the curve at the start point (_Placement_ of the segment). For CIRCULAR type it is constant i.e. _StartRadiusOfCurvature_ and _EndRadiusOfCurvature_ are always the same. For LINE type, both _StartRadiusOfCurvature_ and _EndRadiusOfCurvature_ is 0. If the radius is 0 it shall be interpreted as INFINITE. Positive values imply a CCW direction whereas negative CW.
EndRadiusOfCurvature	IfcLengthMeasure		For a NONLINEAR horizontal segment type the radius of the curve at the end point. If the radius is 0 it shall be interpreted as INFINITE. Positive values imply a CCW direction whereas negative CW.
SegmentLength	IfcNonNegativeLengthMeasure		The length along the curve.
GravityCenterLineHeight	IfcPositiveLengthMeasure	[0..1]	Optional attribute require for the exchange of Vienna bend transition segment.
PredefinedType	IfcAlignmentHorizontalSegmentTypeEnum		Predefined type of the horizontal alignmnent segment.

3.3.1.20 Class: IfcAlignmentHorizontalSegmentTypeEnum

The IfcAlignmentHorizontalSegmentTypeEnum indicates the type of a segment of a horizontal alignment segment (IfcAlignmentHorizontalSegment). Horizontal segments can be viewed from a geometric perspective and from a kinematic perspective. In recent times the kinematic perspective

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gained importance. The enumerations are detailed according to this development especially in modern track design.

Kinematic perspective on horizontal alignment segments

The central parameter of the kinematic perspective is lateral acceleration of the vehicle induced by change of direction while driving. In the horizontal layout this is the represented by the curvature of the segment. According to the curvature value the following categorization can be made:

Curvature	Segmenttype	Enumeration Values
0	straight line	LINE
constant in the complete segment, <> 0	Circular arc	CIRCULARARC
variation along the segment	Transition with linear curvature variation	CLOTHOID, CUBIC
variation along the segment	Transition with non-linear curvature variation	HELMERTCURVE, BLOSSCURVE, COSINECURVE, SINECURVE, VIENNESEBEND

Geometric perspective on horizontal alignment segments

The traditional view is denoted by the geometric perspective in the context of the business terminology related IfcAlignment documentation. Before the availability of modern computers alignment design was performed using "traditional" drawing techniques. In the first phase of computerization this origin led to a representation in the x,y space first and a check of safety related properties in a second step. This can still be seen in regulations which have been put into effect 1980 or earlier. Of course designs which have been produced on basis of these regulations reflect the "good enough" attitude in the precision of the documentation.

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In a later phase an increasing importance of the kinematic perspective can be observed. Here precise control of the lateral acceleration (horizontal and cant layout) and vertical acceleration (vertical layout) became prevalent. Designers started to use high performance transition bends especially in high speed scenarios. In the kinematic perspective precise curvature fitting between consecutive segments needs to be better than in the "good enough" approach of traditional geometric perspective. Central terms are e.g. "jerks", "theoretical cant" or "cant deficiency".

Generic calculation of intrinsic x, y-coordinates for a given curvature

For each horizontal alignment segment with a known curvature formula a generic method to calculate segment intrinsic coordinates exists.

!["Double integration"](../../figures/ifcalignmenthorizontalsegmenttypeenum-curvature2coord.png "Figure 1 — Double integration of curvature yielding intrinsic coordinates")

>NOTE:While it is possible to apply the generic calculation also for trivial cases like LINE or CIRCULARARC it is much more efficient to use available formulas.

Word of warning

"Good enough" traditional designs have to be carefully checked before being included into a high precision 3D model. Intermediate corrections might be necessary. Fortunately the clothoid works very well with comparable documentation quality both in the classic geometric perspective and in the more recent kinematic perspective. Fortunately the vast majority of horizontal transition bends are designed and implemented as clothoids.

Recommendation

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Check the relevant regulations for the network in question. Alignment designs as such are very stable over the lifetime of the road or track. Especially for old designs quality and precision of available documentation has to be checked very carefully. A clear understanding of limitations should be established before implementing automated data flows between high precision BIM environments and legacy documentation systems. This applies both to legacy, central databases and to legacy, individual documents.

Used Symbols and their meaning

Symbol	meaning	Unit, value range
L	full length of segment	positive length $L > 0$
s	current position on segment	$0 < s < L$
ξ	$= s / L$ (Greek "xi") standardised, dimensionless path length along the alignment / track centre line	$0 < \xi < 1$
κ	(Greek "kappa") Curvature (inverse radius) of the alignment / track centre line in plan view (horizontal layout).	1/radius
κ_1	Curvature (inverse radius) at beginning of the alignment / track centre line in plan view (horizontal layout).	1/radius
h	height of the gravity center line used for calculation above the track centreline in the ground plan.	length
ψ	(Greek "psi") Angle of cant (cross slope angle, bank angle)	rad
ϕ	(Greek "phi") Directional angle (azimuth, bearing)	rad
x(s)	variable longitudinal coordinate of the projection of the alignment / track centreline into the ground plan.	length
y(s)	variable transverse coordinate of the projection of the alignment / track centreline into the ground plan.	length

Terminology

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Intrinsic coordinate, intrinisc coordinate system of an alignment segment:

The origin of an intrinsic coordinate system is the start of the segment. The direction of the positive x-axis is the start direction of the segments.

Status: Proposed

Package: IfcGeometricConstraintResource

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of		
Subtypes	EXISTING	PROPOSED

Class Attributes

Name	Type	Multiplicity	Definition
LINE			In the geometry perspective it denotes a straight connection between two points. In the dynamic perspective, it denotes a segment with a curvature with a value of 0. This means that no lateral acceleration acts on the moving vehicle. **Base formula (Curvature) ** !["Horizontal line segment"](../../figures/ifcalignmenthorizontal segmenttypeenum-line.png "Figure 1 — Curvature for horizontal straight line segment")

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CIRCULARARC			In the geometric perspective, it denotes a connection between two points that follows a circular path. In the dynamic perspective, it denotes a segment with constant lateral acceleration on the moving vehicle, i.e. constant curvature. **Base formula (Curvature) ** !["Circular arc segment"](../../figures/ifcalignmenthorizontal segmenttypeenum-circulararc.png "Figure 1 — Curvature for horizontal circular segment")

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CLOTHOID			In the geometric perspective, a clothoid denotes a connection between two points where the radius of curvature changes along the segment at a constant rate. The clothoid was an early achievement of geometry, also known as Euler''s spiral or Cornu''s spiral. It became very popular in road and rail design even before the widespread availability of computers because of the availability of tabulations of the normalized clothoid. Proper application of the so called clothoid constant provided fast solutions for all relevant parameters necessary to integrate clothoid segments between two consecutive segments with constant curvature. In most cases the clothoid smooths the curvature between a straight line and a ciruclar arc. In the dynamic perspective, it denotes a segment with constant rate of lateral acceleration change induced by the curvature. The kinematic properties of the clothoid both reduce the exerted forces on the track by a train, improve the travel experience of train passengers and also reduce the stress of a car driver by avoiding sudden movements of the steering wheel. The kinematic advantages of the clothoid as a smoothing segment are true also for all the other transition bends currently in use. **Base formula (Curvature)** !["Clothoid transition segment"](../../figures/ifcalignmenthorizontal segmenttypeenum-clothoid.png "Figure 1 — Curvature for horizontal Clothoid transition segment")

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CUBIC			In IFC CUBIC denotes a transition segment where x and y coordinates obey a cubic formula. **General formula**!["Cubic"](../../figures/ifcalignmenthorizontalsegmenttypeenum-cubic_general.png "Figure 1 — General formula for cubic")</Documentation> It was discovered very early that setting **a** to "1/6RL" and **b**, **c** and **d** to 0 yields a good enough approximation of the clothoid in many situations. **Cubic formula for alignment**!["Cubic transition"](../../figures/ifcalignmenthorizontalsegmenttypeenum-cubic.png "Figure 2 — Alignment formula for cubic")</Documentation> Since the manual computation of cubics was considerable easier compared to the theoretically sound clothoid, cubic transistions became very popular as "good enough" replacement curves. Cubic transition bends can still be found in many legacy alignments based on earlier design regulations. There also exist regulations containing cubic transitions for new designs.

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			It is obvious that simple approximations cannot fulfil all requirements for a kinematically correct track design. For example, the requirement of tangential continuity has often been neglected in favour of lower design costs by using sufficiently good cubic curves. The cubic is known in two variants as **Cubic Parabola** or **Cubic Spiral** setting either the sinus or the cosinus of the deflection angle to 0.
HELMERTCURVE			The Helmert curve or Helmert transition is an early example of a high performance transition bend. It is now widely accepted in relevant science and engineering that the linear change of the clothoid induces unwanted kinematic influences to a running train at speeds higher than 125 km/h. In the geometry perspective the Helmert segment is the assembly of two parts of same length which mirror the same change in radius of curvature. A rough approximation is known as the biquadratic parabola. >NOTE also referred to as Schramm curve. **Base formula (Curvature)** !["Helmert curve transition segment"](../../figures/ifcalignmenthorizontal segmenttypeenum-helmertcurve.png "Figure 1 — Curvature for horizontal Helmert transition segment")

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BLOSSCURVE			The Bloss transition is a more recent form of a high performance transition bend. Proposed in 1936. it is now in use in several railway networks. There is no established rough geometric approximation. >NOTEFurther reading: Constantin Ciobanu, BLOSS TRANSITION \X2\2013\X0\ A SHORT DESIGN GUIDE **Base formula (Curvature)** !["Bloss curve transition segment"](../../figures/ifcalignmenthorizontal segmenttypeenum-blosscurve.png "Figure 1 — Curvature for horizontal Bloss curve transition segment")
COSINECURVE			Cosine transition. The cosine transition was already discussed in 1868. Width the advent of high-speed rail it was applied in production designs. It is e.g. installed on Japanese high speed lines **Base formula (Curvature)** !["Cosine curve transition segment"](../../figures/ifcalignmenthorizontal segmenttypeenum-cosinecurve.png "Figure 1 — Curvature for horizontal Cosine curve transition segment")

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SINECURVE			Sine transition or sinusoidal transition was suggested 1937. The curvature function is built up of one period of a sine function. The sine curve is characterised by particularly advantageous smoothing properties at the end points. Compared to the clothoid, it is twice as long. >NOTE also referred to as Klein curve. **Base formula (Curvature)** !["Sine curve transition segment"](../../figures/ifcalignmenthorizontal segmenttypeenum-sinecurve.png "Figure 1 — Curvature for horizontal Sine curve transition segment")
VIENNESEBEND			The Viennese Bend (R) is an innovative track geometry transition element. Instead of analyzing the vehicle movement at the track plane the optimization efforts target a gravity center line at a defined height above the rails. As a consequence the path of the horizontal alignment center line is also influenced by the cant layout. The first part of the curvature formula is assembled from the basic function like the other transition bends. The additional term contains the bank angle "ψ" and the gravity center line height "h" and is unique to the Viennes Bend (R). This term causes a small movement contrary to the main direction in the x,y layout. **Curvature formula** !["Viennese bend (R) transition segment"](../../figures/ifcalignmenthorizontal segmenttypeenum-viennesebend.png "Figure 1 — Curvature for horizontal Viennese bend (R) transition segment")

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3.3.1.21 Class: IfcAlignmentParameterSegment

An abstract entity defining common information about horizontal, vertical and cant alignment segments.

> NOTE The start and end tag are defined as annotations, not as referents along the alignment. Only absolute distance expressions are in scope, not distances ahead or behind a referent, such as a station. However such information can be exchanged as tags.

Status: Proposed

Package: IfcGeometricConstraintResource

Class Properties			
Status	Proposed	**Is Abstract**	Abstract
Property sets			

Inheritance Statement		
Subtype Of		
Subtypes	EXISTING	PROPOSED
		IfcAlignmentVerticalSegment
		IfcAlignmentHorizontalSegment
		IfcAlignmentCantSegment

Class Attributes

Name	Type	Multiplicity	Definition
StartTag	IfcLabel	[0..1]	Tag to annotate the start point of the alignment segment.
EndTag	IfcLabel	[0..1]	Tag to annotate the end point of the alignment segment.

3.3.1.22 Class: IfcAlignmentVerticalSegment

Individual segment along the _IfcAlignmentVertical_, being defined in the distance-along/z coordinate space.

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The vertical alignment is defined by segments that connects end-to-start. The vertical alignment curve geometry is defined in a plane with x = distance along horizontal, the y = height (or elevation). The transition at the segment connection is not enforced to be tangential, The _IfcSegment_ _Transition_ enumeration specifies the type of transition explicitly.

The following vertical segment types are defined:

* line segment - _IfcAlignmentVerticalSegmentTypeEnum_ .LINE.

* circular arc segment - _IfcAlignmentVerticalSegmentTypeEnum_ .ARC.

* parabolic arc segment - _IfcAlignmentVerticalSegmentTypeEnum_ .PARABOLICARC. which can describe symmetric and unsymmetric parabolas

* transition segment with linear curvature variation - _IfcAlignmentVerticalSegmentTypeEnum_ .CLOTHOID.

For each vertical segment, the following non-redundant information is provided:

* the start point (in distance along/ height coordinates)

* the start gradient (as a ratio measure with horizontal being 0, uphill positive, and downhill negative) usually between 1 < n < -1 (equal to a percentage of 100% < n < -100%, or to a degree of 45° < n < -45° but higher values are possible)

* the length (as horizontal length along the distance along (not the curve segment length))

* the curve parameter needed for circular and parabolic arc segments

The following information can be calculated (and is therefore not exchanged explicitly to avoid redundancy and inconsistencies)

* the end distance along (from the distance along and segment length)

* the end height (from start distance along, gradient, length and curve parameter)

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* the end direction (from start direction, segment length and curve parameter)

* the point of vertical intersection (from start direction and end direction)

The following checks can be done to validate the correct exchange:

* continuity \X2\2013\X0\ does the calculated end distance along of the previous segment matches with the provided start distance along of this segment

* tangential continuity \X2\2013\X0\ does the calculated end gradient of the previous segment matches with the provided start gradient of this segment

> NOTE Specific subtypes of the IfcAlignmentVerticalSegment add specific geometric curve parameters. Connectivity between vertical segments is not necessarily tangential, but this can be enforced as a requirement through the attribute _TangentialContinuity_.

!["Alignment vertical segment"](../../../../../../figures/ifcalignment2dverticalsegment.png "Figure 1 — Alignment vertical segment")

Status: Proposed

Package: IfcGeometricConstraintResource

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcAlignmentParameterSegment	
Subtypes	EXISTING	PROPOSED

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IfcAlignmentVerticalSegment.PARABOLIC
ARC

IfcAlignmentVerticalSegment.CONSTANT
GRADIENT

IfcAlignmentVerticalSegment.CLOTHOID

IfcAlignmentVerticalSegment.CIRCULARA
RC

Class Attributes

Name	Type	Multiplicity	Definition
StartDistAlong	IfcLengthMeasure		Distance along the horizontal alignment as measured along the corresponding _IfcAlignmentHorizontal_. > NOTE 1 The distance along is measured from the start point of _IfcAlignmentHorizontal_, any optionally provided offset expressed by _IfcAlignmentHorizontal_.StartDistanceAlong is not taken into account. > NOTE 2 The unit of measurement is the global length unit, as set by _IfcContext_.UnitInContext
HorizontalLength	IfcNonNegativeLengthMeasure		Length measured as distance along the horizontal alignment of the segment.
StartHeight	IfcLengthMeasure		Elevation in Z of the start point relative to the IfcAlignment coordinate system. > NOTE It is strongly advised to not offset the IfcAlignment coordinate system from the project engineering coordinate system.
StartGradient	IfcRatioMeasure		Start gradient of the segment.
EndGradient	IfcRatioMeasure		End gradient of the segment. In the case of a PredefinedType=''.CONSTANTGRADIENT.'' the value is the same as _StartGradient_.

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| RadiusOfCurvature | IfcLengthMeasure | [0..1] | Radius of parabola or arc. Positive values imply a CCW direction whereas negative CW.
 > NOTE1 For _PredefinedType_ is ARC. The radius of the basis circle for the arc.
 > NOTE2 For _PredefinedType_ is PARABOLICARC. Parabola constant (determining the \X2\201C\X0\steepness\X2\201D\X0\ of the parabola). The parabola constant is provided by the \X2\201C\X0\minimum parabola radius\X2\201D\X0\, the true radius of a parabola at its vertical axis (the zero-gradient point of the parabola). The minimum radius is twice the focal length of the parabola (the distance between the focal point and the vertex).
 > NOTE3 For _PredefinedType_ that is not either ARC or PARABOLICARC the value should be empty. |
| PredefinedType | IfcAlignmentVerticalSegmentTypeEnum | | Predefined type of the vertical alignmnent segment. |

3.3.1.23 Class: IfcAlignmentVerticalSegmentTypeEnum

The IfcAlignmentVerticalSegmentTypeEnum indicates the type of a segment of a vertical alignment segment (IfcAlignmentVerticalSegment).

Vertical curvature	Segmenttype	Enumeration Values
No vertical curvature	constant gradient	CONSTANTGRADIENT
Derivative of gradient with respect to horizontal projection of alignment is constant	Vertical curve, parabola	PARABOLICARC
Derivative of vertical angle with respect to 3D arc length along the alignment is constant	Vertical curve, circular	CIRCULARARC
Variation of vertical curvature is constant	Vertical curve, clothoid	CLOTHOID

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>NOTE A vertical curve in track that starts or ends in canted switches and crossings can be of a higher order polynomial than a parabola.

>NOTE chainage is longitudinal distance along the horizontal projection of the alignment (e.g. track centre line).

>NOTE Definitions according to EN 13803/2017 (except CLOTHOID)

Used Symbols and their meaning

Symbol	meaning	Unit, value range
L	full length of segment	positive length L > 0
s	current position on segment	$0 < s < L$
θ	(Greek "theta") Longitudinal slope angle (incline or decline)	rad
g	gradient (math); g=tan(θ)	
x(s)	variable longitudinal coordinate of the projection of the alignment / track centreline into the ground plan.	length
y(s)	variable transverse coordinate of the projection of the alignment / track centreline into the ground plan.	length

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| $z(s)$ | Variable vertical coordinate of the projection of the track centreline in plan in a Cartesian coordinate system in the vertical direction. | length |

| $z_c(s)$ | Ordinate of the vertical circular arc of measured away from the tangent line at position s. | length |

| L_V | length of vertical radius radius (inverse curvature) | length |

| R_V | radius (inverse curvature) of the track centreline at a point in the elevation diagram (longitudinal section) | length |

| κ_V | (Greek "kappa") Vertical curvature | $1/radius_V$ |

| Z_G | Distance of the tangent intersection from the chord of the vertical circular arc | length |

| Z_M | Distance of the centre of the vertical circular arc to the tangent intersection point (stitch height) | length |

| l_T | Length of the tangents of the vertical circular arc | length |

>NOTE Symbols according to EN 13803/2017

>NOTE gradient has a slightly different definition in civil engineering. "Gradient (Civ.Eng.) is the degree of slope, e.g. of a highway or a railway. US grade".

>NOTE most railway track designs use the **small angle assumption**. That means θ=tan(θ)=gradient.

References to EN 13803/2017

EN 13803/2017 covers "Track alignment design parameters". As such it is not fully compatible with definitions for IFC Alignment. Therefore rail specific terms like track have been replaced with more general terms also applicable to road design.

Referenced content of EN 13803/2017 "Table 2 - Elements for vertical alignment" has been modified as follows:

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Vertical curve, parabola: Derivative of gradient with respect to chainage is constant

Generalized: Derivative of gradient with respect to horizontal projection of alignment is constant

Vertical curve, circular: Derivative of vertical angle with respect to sloping length along the track is constant

Generalized: Derivative of vertical angle with respect to 3D arc length along the alignment is constant

EN13803 clause 3.5:

Chainage: longitudinal distance along the horizontal projection of the track centre line.

Status: Proposed

Package: IfcGeometricConstraintResource

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of		
Subtypes	EXISTING	PROPOSED

Class Attributes

Name	Type	Multiplicity	Definition
CONSTANTGRADIENT			Vertical alignment segment with constant gradient.

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CIRCULARARC			Vertical alignment segment where the derivative of vertical angle with respect to sloping length along the track (3D length) is constant. **Vertical Curvature** !["Vertical circular arc segment"](../../figures/ifcalignmentverticalsegmenttypeenum-arc_curvature.png "Figure 1 — Curvature for vertical circular arc segment") **Segment length** !["Vertical circular arc segment"](../../figures/ifcalignmentverticalsegmenttypeenum-arc_length.png "Figure 2 — Length for vertical circular arc segment") **Distance between point on segment to tangent** !["Vertical circular arc segment"](../../figures/ifcalignmentverticalsegmenttypeenum-arc_z_s.png "Figure 3 — Distance of point an vertical circular arc segment to tangent")

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PARABOLICARC			Vertical alignment segment where the derivative of gradient with respect to distance along is constant. **general equation of the parabolic arc segment** !["Vertical parabolic arc segment"](../../figures/ifcalignmentverticalsegmenttypeenum-parabola1.png "Figure 1 — general equation of the parabolic arc segment") **gradient (slope) of this curve at any point (first derivative)** !["Vertical parabolic arc segment"](../../figures/ifcalignmentverticalsegmenttypeenum-parabola2.png "Figure 2 — gradient (slope) of the parabolic arc segment at any point") **variation of curvature** !["Vertical parabolic arc segment"](../../figures/ifcalignmentverticalsegmenttypeenum-parabola3.png "Figure 3 — the rate of change of gradient of the parabolic arc segment is constant")

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CLOTHOID			Vertical alignment segment where the derivative of vertical angle with respect to sloping length along the track (3D length) obeys a linear change. !["Vertical clothoid segment"](../../figures/ifcalignmentverticalsegmenttypeenum-clothoid_curvature.png "Figure 1 — curvature equation of the vertical clothoid segment")

3.3.1.24 Class: IfcAlignmentCant

An _IfcAlignmentCant_ is a lateral inclination profile defined along the horizontal alignment. All points defined in this profile have two coordinate values. The first value is the distance along the horizontal alignment, and the second value is the height relative to the projection of the point along vertical alignment.

Cant as a railway specificity

!["Why cant is applied"](../../figures/ifcalignmentcant_wojtczak_2018.png "Figure 1 — Cant - compensation for lateral acceleration.")

>NOTE figure was first published in (Basics of) Railway Curve Kinematics Presentation, (Wojtczak 2018)

The diagram in the figure above shows the principle of compensating part of the lateral acceleration by elevating the outer rail relative to the inner rail of a track.

Almost always the following principles for the placement of horizontal segments and cant segments are implemented:

* Straight horizontal line: no applied cant

* Horizontal circular arc: constant applied cant

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* Horizontal transition bend: variation of applied cant according to a defined formula

In specific difficult topographic environments like mountain lines the extension of a cant transition may differ from the horizontal transition. So far this has only been found for clothoids and is either a so called shortened ramp (can transition is shorter than the corresponding horizontal curvature transition) or a so called \X2\201C\X0\scissor\X2\201D\X0\ ramp (overlapping variations of cant on both rails with opposite direction).

Application of high-performance horizontal transition bends is always combined with a cant transition with identical start and end location.

In real world designs, such as slow speed sections in railway stations, exceptions to the above principles can be found. It might even happen that the inner rail is elevated relative to the outer rail.

Detailed geometric modelling of the superelevation has a low priority in the existing processes in most rail companies. This will very probably change with the introduction of 3D modelling in rail design. The following list shows some use cases:

* Correct 3D placement of certain assets (e.g. sleepers)

* Relevant input for calculation of structural gauge space

* Correct calculation of horizontal coordinate values for the Viennese Bend\S\. (high performance transition bend)

!["Cant and structural gauge space"](../../figures/ifcalignmentcant_structural_gauge_and_cant.png "Figure 2 — Cant and structural gauge space")

Status: Proposed

Package: IfcProductExtension

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Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	[IfcLinearElement](#)	
Subtypes	EXISTING	PROPOSED

Class Attributes

Name	Type	Multiplicity	Definition
RailHeadDistance	IfcPositiveLengthMeasure		Length measured as distance between the nominal centre points of the two contact patches of a wheelset and rails.

3.3.1.25 Class: IfcAlignmentHorizontal

An _IfcAlignmentHorizontal_ is a linear reference projected onto the horizontal x/y plane. Points along a horizontal alignment have two coordinate values, x and y in the local Cartesian engineering system.

The horizontal alignment is defined by segments that are connected end-to-start. The transition at the segment connection is not enforced to be tangential, if the \X2\201C\X0\tangential continuity\X2\201D\X0\ flag is set to false, otherwise a tangential continuity shall be preserved. Based on the context of the project, they are geo-referenced and convertible into Northing and Easting values.

> NOTE Georeferencing is provided by _IfcMapConversion_ through the _IfcGeometricRepresentationContext_ defined at _IfcProject_.

Status: Proposed

Package: IfcProductExtension

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

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Inheritance Statement		
Subtype Of	IfcLinearElement	
	EXISTING	PROPOSED
Subtypes		

3.3.1.26 Class: IfcAlignmentSegment

An IfcAlignmentSegment is a segment of an IfcAlignment where either the vertical or horizontal direction or cant (in the case of trackdesign) obey a unique mathematical description as a function of the horizontal projection segment length of the alignment.

>NOTE 1 to entry: Unless otherwise stated, for railway, the appertaining track alignment design parameters are defined for the track center line.

>NOTE 2 to entry: For roads, the alignment typically describes the path of the road center line, but in certain situations, e.g. ramps, the alignment may describe the path of other edges of the road body

>NOTE Rail domain definitions according to EN 13803:2017

Status: Proposed

Package: IfcProductExtension

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcLinearElement	
	EXISTING	PROPOSED
Subtypes		

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3.3.1.27 Class: IfcAlignmentVertical

An _IfcAlignmentVertical_ is a height profile along the horizontal alignment. Points along a vertical alignment have two coordinate values. The first value is the distance along the horizontal alignment, the second value is the height according to the project engineering coordinate system. Based on the context of the project, they are georeferenced and the height value is convertible into orthogonal height above/below the vertical datum.

> NOTE   Georeferencing   is   provided   by   _IfcCoordinateOperation_   through   the _IfcGeometricRepresentationContext_ defined at _IfcProject_.

Status: Proposed

Package: IfcProductExtension

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcLinearElement	
Subtypes	EXISTING	PROPOSED

3.3.1.28 Class: IfcLinearElement

A generalization of all linear elements that are parts of an alignment.

Status: Proposed

Package: IfcProductExtension

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement

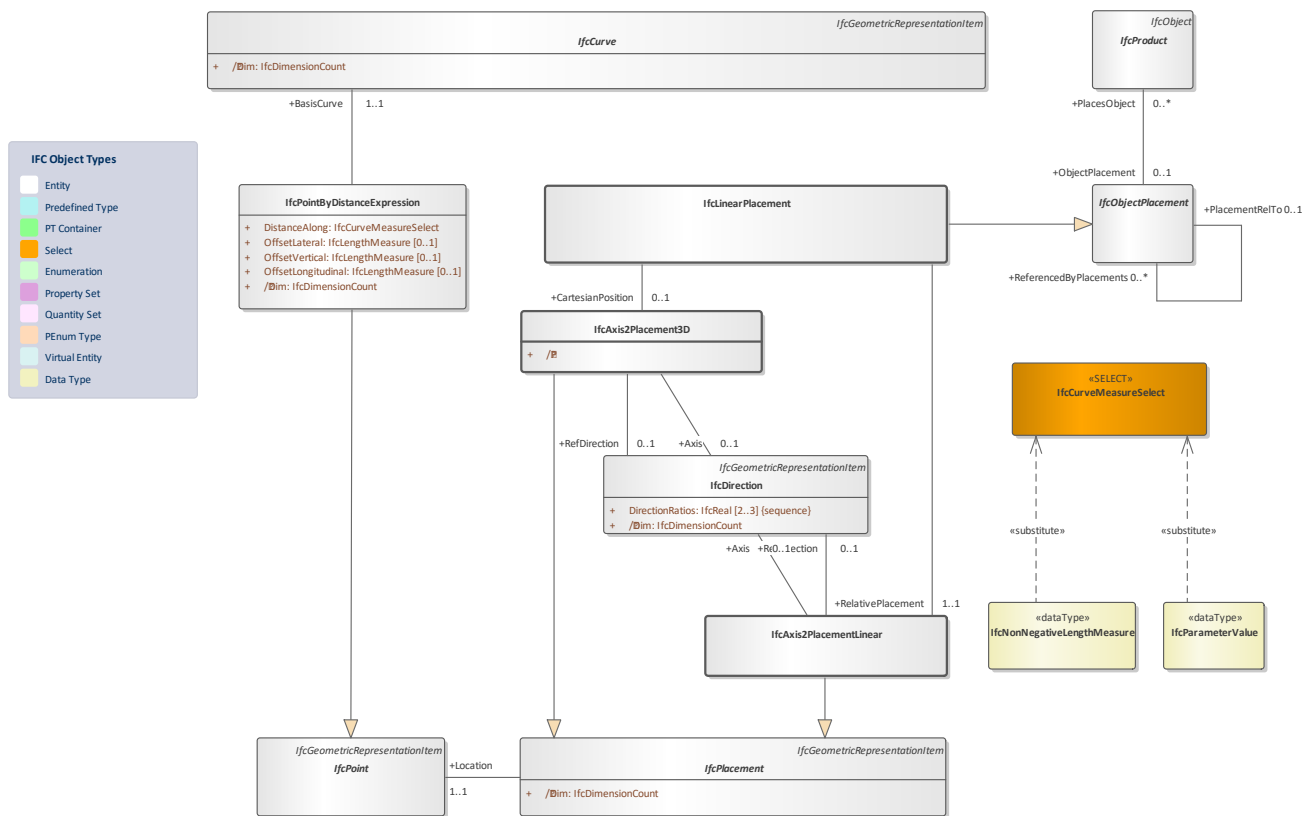| Subtype Of	IfcProduct	
	EXISTING	PROPOSED
Subtypes		IfcAlignmentVertical IfcAlignmentSegment IfcAlignmentHorizontal IfcAlignmentCant

Figure 7: new2_Linear Placement

3.3.1.29 Class: IfcLinearPlacement

IfcLinearPlacement provides a specialization of _IfcObjectPlacement_ in which the placement and axis direction of the object coordinate system is defined by a reference to a curve. RelativePlacement is therefore restricted to _IfcAxis2PlacementLinear_.

Status: Proposed

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Package: IfcGeometricConstraintResource

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcObjectPlacement	
	EXISTING	**PROPOSED**
Subtypes		

3.3.1.30 Class: IfcAxis2PlacementLinear

The _IfcAxis2PlacementLinear_ provides location and orientation to place items in a three-dimensional space confined to the context of a curve. Relative placement axes (Axis and RefDirection) are relative to the curve used for linear referencing provided in _IfcPlacement_ _Location_ (_IfcPointByDistanceExpression_ _BasisCurve_), maintaining the relationship to the tangent of the curve.

Status: Proposed

Package: IfcGeometryResource

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcPlacement	
	EXISTING	**PROPOSED**
Subtypes		

3.3.1.31 Select: IfcCurveMeasureSelect

Status: Proposed

Package: IfcGeometryResource

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Select Properties	
Stereotype	«SELECT»
Substitutions	IfcParameterValue IfcNonNegativeLengthMeasure

3.3.1.32 Class: IfcPointByDistanceExpression

An _IfcPointByDistanceExpression_ describes a point relative to a basis curve according to distance along the basis curve. The offsets default to the initial context of the curve relative to it''s tangent either specified in _IfcProduct.Placement_ or in the case of a segmented curve to the _IfcCurveSegment_ _StartPlacement_ where the values correspond to the following:

* lateral to the basis curve

* offset vertical to the basis curve

* optional additional offset parallel to the basis curve that may be used to address locations otherwise unreachable where the basis curve is tangentially discontinuous.

Status: Proposed

Package: IfcGeometryResource

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcPoint	
Subtypes	EXISTING	PROPOSED

Class Attributes

Name	Type	Multiplicity	Definition
DistanceAlong	IfcCurveMeasureSelect		The distance along the basis curve measured as either a _IfcLengthMeasure_ or _IfcParameterValue_.

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OffsetLateral	IfcLengthMeasure	[0..1]	Default offset horizontally is measured perpendicular to the basis curve, where positive values indicate to the left of the basis curve as facing in the positive parametrization direction of the basis curve, and negative values indicate to the right. If DistanceAlong coincides with a point of tangential discontinuity (within precision limits), then the tangent of the previous segment governs.
OffsetVertical	IfcLengthMeasure	[0..1]	Default offset vertical to the basis curve where positive values indicate perpendicular to the tangent at DistanceAlong in the plane of the tangent perpendicular to the global XY plane.
OffsetLongitudinal	IfcLengthMeasure	[0..1]	Offset parallel to the basis curve after applying DistanceAlong, OffsetLateral, and OffsetVertical to reach locations for the case of a tangentially discontinuous basis curve.
Dim	IfcDimensionCount		

3.3.2   Package: SweptAreaSolid
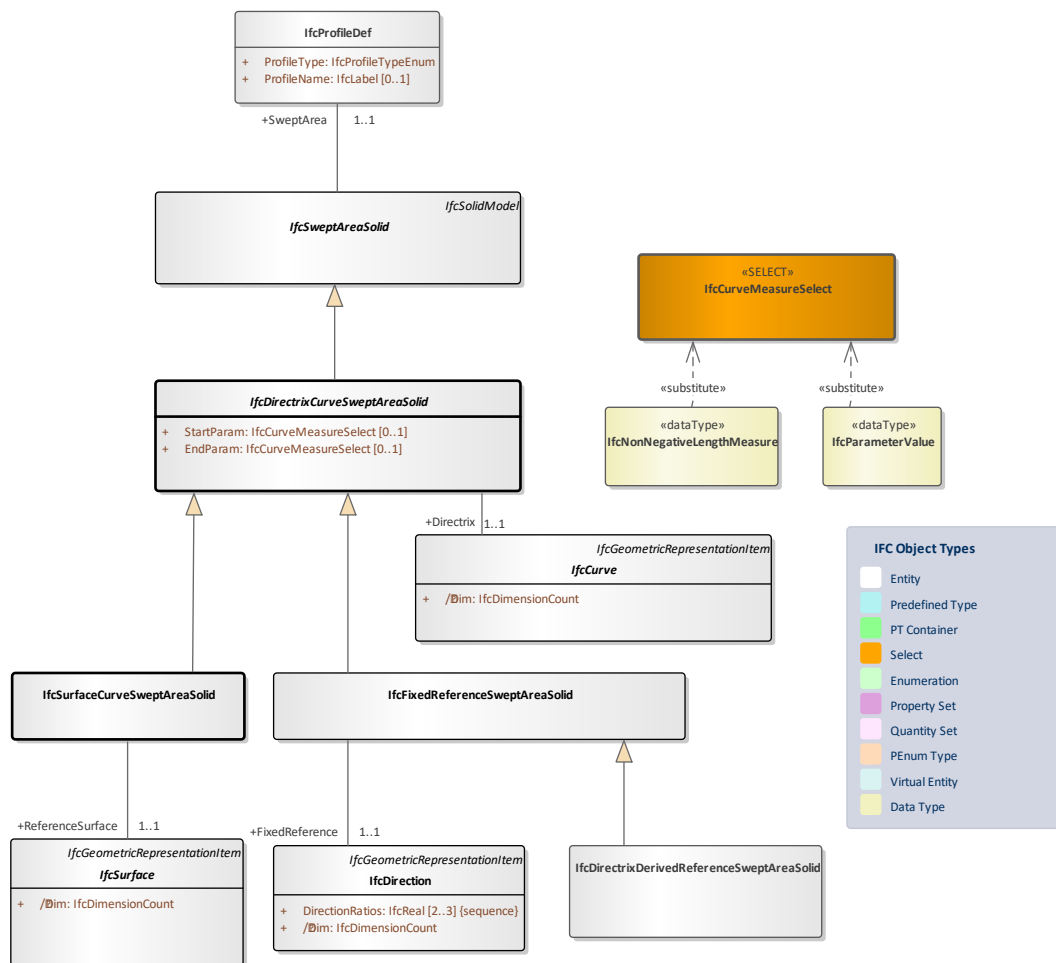
Figure 8: new2_FixedReferenceSweptAreaSolid

3.3.2.1 Class: IfcDirectrixDerivedReferenceSweptAreaSolid

Status: Proposed

Package: IfcGeometricModelResource

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcFixedReferenceSweptAreaSolid	
Subtypes	EXISTING	PROPOSED

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3.3.2.2 Class: IfcFixedReferenceSweptAreaSolid

An _IfcFixedReferenceSweptAreaSolid_ is a type of swept area solid which is the result of sweeping an area along a _Directrix_. The swept area is provided by a subtype of _IfcProfileDef_. The profile is placed by an implicit cartesian transformation operator at the start point of the sweep, where the profile normal agrees to the start tangent of the directrix at this point, and the profile''s x-axis agrees to the orthogonal projection of the _FixedReference_ direction within the plane of start tangent and _Fixed_Reference_. The orientation of the curve during the sweeping operation is controlled by the _FixedReference_ direction.

The _SweptArea_ is swept along the _Directrix_ in such a way that the origin of the local coordinate system used to define the _SweptArea_ is on the _Directrix_ and the local x-axis is in the direction of the projection of _FixedReference_ onto the normal plane to the directrix at this point. The resulting solid has the property that the cross section of the surface by the normal plane to the _Directrix_ at any point is a copy of the _SweptArea_. The resulting swept solid is placed by the _Position_ coordinate system.

The _Directrix_ and the _ReferenceSurface_ are positioned within the object coordinate system. The start of the sweeping operation is at the _StartParam_, being either the parameter value based on the curve parameterization, or by a length measured along the directrix from its beginning. If no _StartParam_ is provided the start defaults to the begin of the directrix. The end of the sweeping operation is at the _EndParam_, being either the parameter value based on the curve parameterization, or by a length measured along the directrix from its beginning. If no _EndParam_ is provided the end defaults to the end of the directrix.

> NOTE The _StartParam_ and the _EndParam_, if provided as a parameter value, are not normalized by default, they depend upon the parameterization of the curve. However using the _IfcReparametrisedCompositeCurveSegment_ within an _IfcCompositeCurve_ as the directrix allows to explicitly reparameterize the underlying sweeping curve.

> NOTE In the case of a curve composed of _IfcCurveSegment_, the _IfcSweptAreaSolid_ _Position_ is dependent on the _IfcCurveSegment_ _StartPlacement_ and the type of _BasisCurve_ which defines the _name-function_ between the start and end (explicitly defined as the start point of the next segment) points of the segment

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> EXAMPLE The reference surface is any surface (plane, cylindric, composite) situated in 3D space and positioned in the object coordinate system. In many cases, it is a surface of extrusion. The directrix lies on the surface, often defined as a p-curve at this reference surface. At any point of the directrix, a plane can be constructed. The origin of the position coordinate system lies at the directrix. The Axis3 (the z-axis, or normal) of the position coordinate system is identical to the tangent of the directrix at this point, the Axis1 (the x axis, or u) of the position coordinate system is identical to the _FixedReference_ direction. The Axis2 (the y axis, or v) is constructed. In this case the resulting swept solid is not repositioned.

The orientation of the _SweptArea_ as it sweeps along the _Directrix_ is precisely defined by a _CartesianTransformationOperator3d_ with attributes:

* _LocalOrigin_ as point (0; 0; 0),

* _Axis1_ as the orthogonal projection of the _FixedReference_ onto the normal plane defined by _Axis3_.

* _Axis3_ as the direction of the tangent vector **t** at the point of the _Directrix_ with parameter **u**.

The remaining attributes are defaulted to define a corresponding transformation matrix **T(u)**, which varies with the _Directrix_ parameter **u**.

> NOTE The geometric shape of the solid is not dependent upon the curve parameterization; the volume depends upon the area swept and the length of the _Directrix_.

> NOTE Entity adapted from **fixed_reference_swept_surface** defined in ISO 10303-42.

> HISTORY New entity in IFC4.

{ .spec-head}

Informal Propositions:

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1. The _SweptArea_ shall lie in the plane z = 0.

2. The _FixedReference_ shall not be parallel to a tangent vector to the directrix at any point along this curve.

3. The _Directrix_ curve shall be tangent continuous.

Status: Proposed

Package: IfcGeometricModelResource

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcDirectrixCurveSweptAreaSolid	
Subtypes	EXISTING	PROPOSED
		IfcDirectrixDerivedReferenceSweptAreaSolid

3.3.2.3 Select: IfcCurveMeasureSelect
$

Status: Proposed

Package: IfcGeometryResource

Select Properties	
Stereotype	«SELECT»
Substitutions	IfcParameterValue
	IfcNonNegativeLengthMeasure

3.3.2.4 Class: IfcDirectrixCurveSweptAreaSolid

An abstract entity defining common information about a type of swept area solid which is the result of sweeping an area along a Directrix. The swept area is provided by a subtype of IfcProfileDef. The profile

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is placed by an implicit cartesian transformation operator at the start point of the sweep, where the profile normal agrees to the tangent of the directrix at this point. The direction of profile\X2\FFFD\X0\s x-axis is specialized by the subtypes of IfcDirextrixCurveSweptAreaSolid.

The start of the sweeping operation is at the StartParam, the parameter value is provided based on the curve parameterization. If no StartParam is provided the start defaults to the begin of the directrix. The end of the sweeping operation is at the EndParam, the parameter value is provided based on the curve parameterization. If no EndParam is provided the end defaults to the end of the directrix.

Status: Proposed

Package: IfcGeometryResource

Class Properties			
Status	Proposed	**Is Abstract**	Abstract
Property sets			

Inheritance Statement		
Subtype Of	IfcSweptAreaSolid	
Subtypes	EXISTING	PROPOSED
	IfcSurfaceCurveSweptAreaSolid	IfcFixedReferenceSweptAreaSolid

Class Attributes

Name	Type	Multiplicity	Definition
StartParam	IfcCurveMeasureSelect	[0..1]	The parameter value on the Directrix at which the sweeping operation commences. If no value is provided the start of the sweeping operation is at the start of the Directrix.
EndParam	IfcCurveMeasureSelect	[0..1]	The parameter value on the Directrix at which the sweeping operation ends. If no value is provided the end of the sweeping operation is at the end of the Directrix.

3.4 Package: Physical Elements

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3.4.1 Package: Built Element

3.4.1.1 Package: IfcCourse

Name: new_IfcCourse
Package: IfcCourse
Version: 1.0
Author: Evandro Alfieri
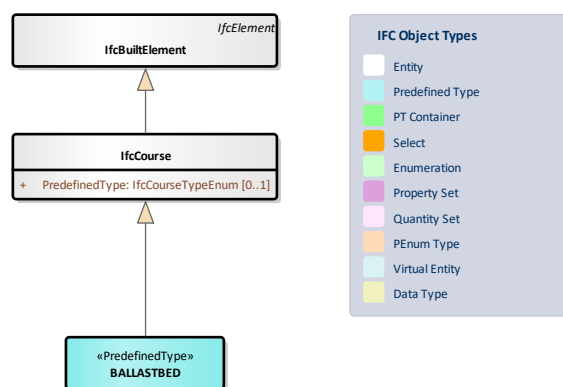
Figure 9: new_IfcCourse

3.4.1.1.1 Predefined Type: BALLASTBED

Full Identifier: **IfcCourse.BALLASTBED**

Automatically generated by IFC-ModelSearch.TranslatePredefinedType 2022-02-19

Status: Proposed

Package: IfcSharedInfrastructureElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.1.2 Package: IfcMember

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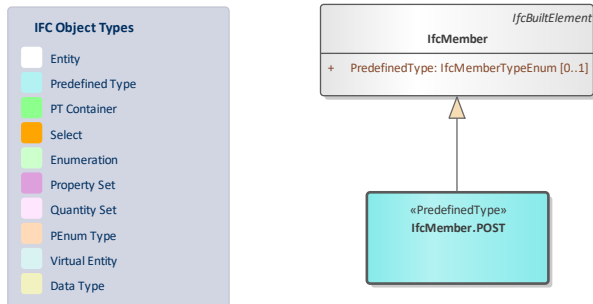
Figure 10: new2_IfcMember

3.4.1.2.1   Predefined Type: POST

Full Identifier: **IfcMember.POST**

A linear (usually vertical) member used to support something or to mark a point.

Status: Proposed

Package: IfcSharedBldgElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.1.3 Package: IfcDoor
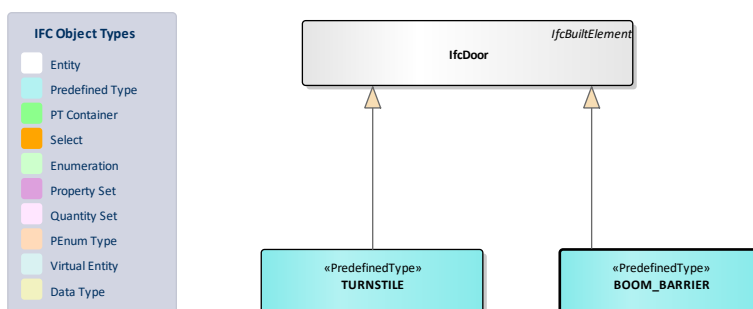
Figure 11: new2_IfcDoor

3.4.1.3.1   Predefined Type: BOOM_BARRIER

Full Identifier: **IfcDoor.BOOM_BARRIER**

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A boom barrier (also known as a boom gate) is a bar, or pole pivoted to allow the boom to block vehicular or pedestrian access through a controlled point.

Status: Proposed

Package: IfcSharedBldgElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.1.3.2 Predefined Type: TURNSTILE

Full Identifier: **IfcDoor.TURNSTILE**

A mechanical gate consisting of revolving arms, allowing only one person at a time to pass through.

Status: Proposed

Package: IfcSharedBldgElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.1.4 Package: IfcRail

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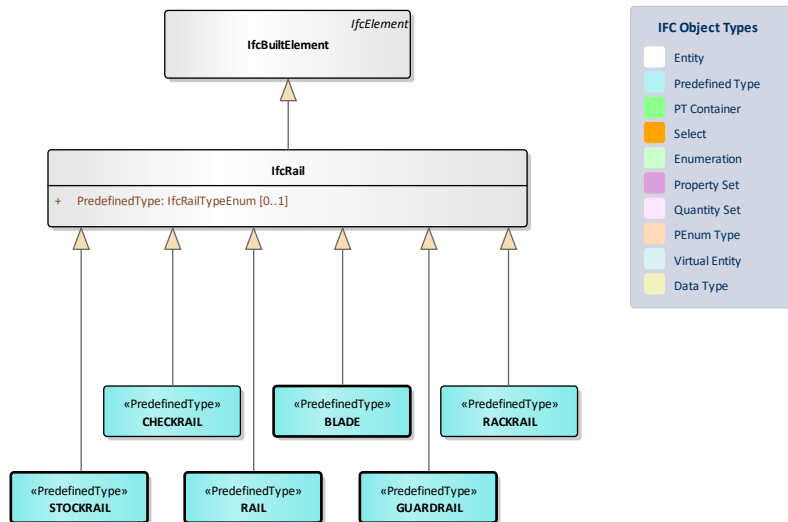
Figure 12: new2_IfcRail

3.4.1.4.1   Class: IfcRail

A rail is a predominately linear built element that has a special section profile. Rail is distinctive from built elements with similar geometric shapes (e.g. beam, member) that its major function is to ensure guidance of moving for vehicles or other kinds of machineries.

Status: Proposed

Package: IfcRailDomain

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcBuiltElement	
	EXISTING	PROPOSED
Subtypes		IfcRail.STOCKRAIL
		IfcRail.RAIL
		IfcRail.RACKRAIL
		IfcRail.GUARDRAIL
		IfcRail.CHECKRAIL
		IfcRail.BLADE

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Class Attributes

Name	Type	Multiplicity	Definition
PredefinedType	IfcRailTypeEnum	[0..1]	

3.4.1.4.2   Predefined Type: BLADE

Full Identifier: **IfcRail.BLADE**

A blade is a machined rail, often of special section, but fixed and/or joined at the heel end to a rail to provide continuity of wheel support. The two switch rails in a set are the two inside rails. A switch rail is described as right or left hand according to whether it is part of a right hand or left hand half-set of switches.

Note: definition from EN 13232-1-2004.

Status: Proposed

Package: IfcRailDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.1.4.3   Predefined Type: CHECKRAIL

Full Identifier: **IfcRail.CHECKRAIL**

A check rail is a rail laid close to the gauge face of a running rail which takes part in lateral guidance of the wheel and prevents derailment in small radius curved track and switches and crossings.

Note: definition from EN 13481-1.

Status: Proposed

Package: IfcRailDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

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3.4.1.4.4   Predefined Type: GUARDRAIL

Full Identifier: **IfcRail.GUARDRAIL**

A guard rail is a rail that limits risk of train derailment, normally not loaded.

Status: Proposed

Package: IfcRailDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.1.4.5   Predefined Type: RACKRAIL

Full Identifier: **IfcRail.RACKRAIL**

A rack rail is a building module for enhancing traction and break performance.

Status: Proposed

Package: IfcRailDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.1.4.6   Predefined Type: RAIL

Full Identifier: **IfcRail.RAIL**

A rail is a special section bar (usually of steel) ensuring the guidance of the wheel of a rolling stock or other heavy machineries. In railway, two rails are combined to form a track.

Status: Proposed

Package: IfcRailDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	

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Stereotype	«PredefinedType»		
Property sets			

3.4.1.4.7   Predefined Type: STOCKRAIL

Full Identifier: **IfcRail.STOCKRAIL**

A stock rail is a fixed machined rail, ensuring the continuity on the main or diverging track with the switch in the open position. The machined part of the stock rail supports its switch rail in the closed position, giving continuity of line through this switch rail. The two stock rails in a set of switches are the two outside rails. A stock rail is described as right or left hand according to whether it is part of a right hand or left hand half-set of switches.

Note: definition from EN 13232-1-2004.

Status: Proposed

Package: IfcRailDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.1.5   Package: IfcSlab
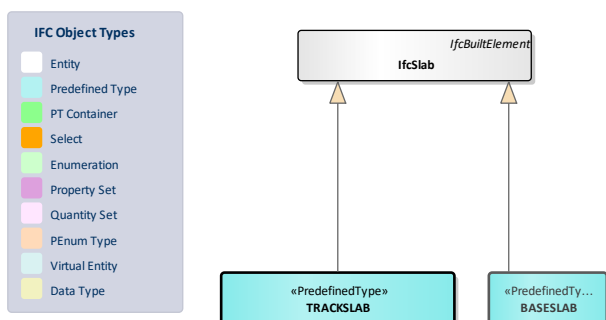
Figure 13: new2_IfcSlab

3.4.1.5.1   Predefined Type: BASESLAB

Full Identifier: **IfcSlab.BASESLAB**

RWR_IFC_RAIL_P2_WP4_B

The slab is used to represent a floor slab against the ground (and thereby being a part of the foundation). Another name is mat foundation.

Status: Proposed

Package: IfcSharedBldgElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.1.5.2   Predefined Type: TRACKSLAB

Full Identifier: **IfcSlab.TRACKSLAB**

A track slab is a reinforced concrete slab or prestressed reinforced concrete slab, which is a main element of slab track. It can be prefabricated or cast on site and may have sleepers embedded.

Status: Proposed

Package: IfcSharedBldgElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.1.6 Package: IfcTrackElement

RWR_IFC_RAIL_P2_WP4_B
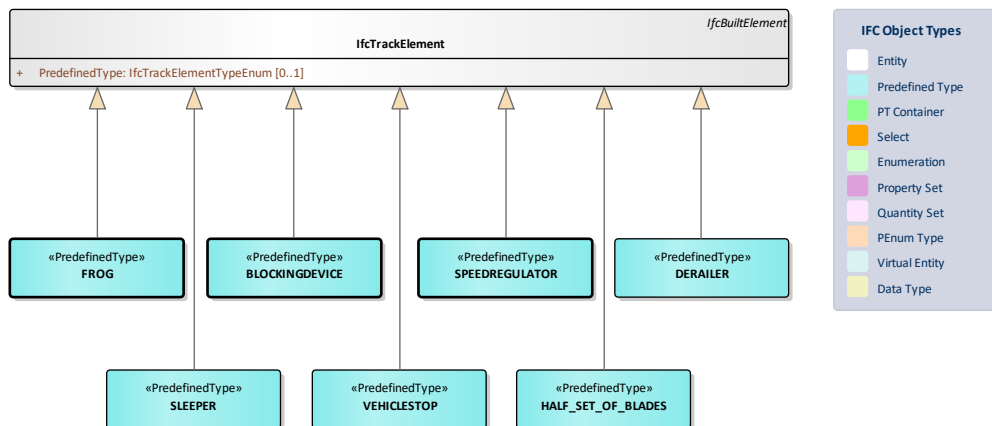
Figure 14: new2_IfcTrackElement

3.4.1.6.1   Class: IfcTrackElement

A track element is a built element used specifically in the track domain in railway.

Status: Proposed

Package: IfcRailDomain

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcBuiltElement	
	EXISTING	**PROPOSED**
Subtypes	IfcTrackElement.TRACKENDOFALIGNMENT	IfcTrackElement.VEHICLESTOP
		IfcTrackElement.SPEEDREGULATOR
		IfcTrackElement.SLEEPER
		IfcTrackElement.HALF_SET_OF_BLADES
		IfcTrackElement.FROG
		IfcTrackElement.DERAILER
		IfcTrackElement.BLOCKINGDEVICE

Class Attributes

RWR_IFC_RAIL_P2_WP4_B

Name	Type	Multiplicity	Definition
PredefinedType	IfcTrackElementTypeEnum	[0..1]	

3.4.1.6.2   Predefined Type: BLOCKINGDEVICE

Full Identifier: **IfcTrackElement.BLOCKINGDEVICE**

A device composed of pneumatic, mechanic or electric components causing the braking of a train in case of emergency.

Status: Proposed

Package: IfcRailDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.1.6.3   Predefined Type: DERAILER

Full Identifier: **IfcTrackElement.DERAILER**

A fixed device which, when placed on the rail, derails the wheels of a vehicle, and serves to protect a converging line.

Note: definition from IEC 60050-821.

Status: Proposed

Package: IfcRailDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.1.6.4   Predefined Type: FROG

Full Identifier: **IfcTrackElement.FROG**

A frog is an arrangement ensuring the intersection of two opposite running edges of turnouts or diamond crossings and having one crossing vee and two wing rails.

RWR_IFC_RAIL_P2_WP4_B

Note: definition from EN 13232-1-2004.

<div align="right">

Status: Proposed

Package: IfcRailDomain

</div>

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.1.6.5   Predefined Type: HALF_SET_OF_BLADES

Full Identifier: **IfcTrackElement.HALF_SET_OF_BLADES**

A half set of blades consists of one stock rail and its switch rail complete with small fittings. It is right or left hand as seen by an observer in the centre of the track facing the switch heel from the switch toe.

Note: definition from EN 13232-1-2004.

<div align="right">

Status: Proposed

Package: IfcRailDomain

</div>

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.1.6.6   Predefined Type: SLEEPER

Full Identifier: **IfcTrackElement.SLEEPER**

A sleeper is a track element that supports running rails, guard rails and check rails usually at right angles to its axis.

<div align="right">

Status: Proposed

Package: IfcRailDomain

</div>

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	

RWR_IFC_RAIL_P2_WP4_B

Stereotype	«PredefinedType»		
Property sets			

3.4.1.6.7   Predefined Type: SPEEDREGULATOR

Full Identifier: **IfcTrackElement.SPEEDREGULATOR**

A device composed of pneumatic, mechanic or electric components causing the breaking of a train in case of emergency.

Status: Proposed

Package: IfcRailDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.1.6.8   Predefined Type: VEHICLESTOP

Full Identifier: **IfcTrackElement.VEHICLESTOP**

A fixed installation at the end of the track which stops any vehicle movement (e.g., buffer stop, sand hump, etc.).

Status: Proposed

Package: IfcRailDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2   Package: Distribution Element

3.4.2.1 Package: IfcAlarm

RWR_IFC_RAIL_P2_WP4_B
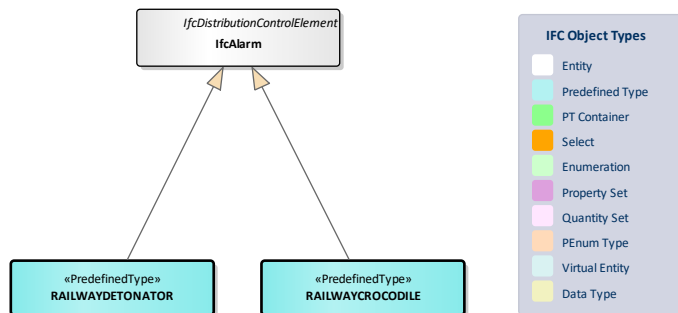
Figure 15: new2_IfcAlarm

3.4.2.1.1 Predefined Type: RAILWAYCROCODILE

Full Identifier: **IfcAlarm.RAILWAYCROCODILE**

An electrical contact placed between the rails (in the four-foot way) to provide warnings in the locomotive cab.

Status: Proposed

Package: IfcBuildingControlsDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.1.2 Predefined Type: RAILWAYDETONATOR

Full Identifier: **IfcAlarm.RAILWAYDETONATOR**

A coin-sized device that is used as a loud warning signal to train drivers. It is usually placed on the top of the rail, usually secured with two lead straps, one on each side.

Status: Proposed

Package: IfcBuildingControlsDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

RWR_IFC_RAIL_P2_WP4_B

3.4.2.2 Package: IfcAudioVisualAppliance
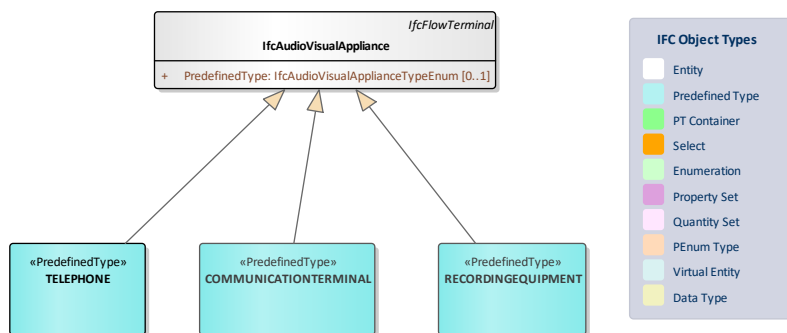
Figure 16: new2_IfcAudioVisualAppliance

3.4.2.2.1 Predefined Type: COMMUNICATIONTERMINAL

Full Identifier: **IfcAudioVisualAppliance.COMMUNICATIONTERMINAL**

A communication terminal is an audio communication device that is usually installed along transportation infrastructure (railways, roads, tunnels etc.) in order to be used by the general public or operation agents for communication. It may specifically be used to make calls to emergency services in tunnels.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.2.2 Predefined Type: RECORDINGEQUIPMENT

Full Identifier: **IfcAudioVisualAppliance.RECORDINGEQUIPMENT**

A recording equipment is a device that records telephone calls or other types of audio data. It also provides the function of archiving and immediate replay.

Status: Proposed

RWR_IFC_RAIL_P2_WP4_B

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.2.3   Predefined Type: TELEPHONE

Full Identifier: **IfcAudioVisualAppliance.TELEPHONE**

A telecommunications device that is used to transmit and receive sound, and optionally video.

Status: Proposed

Package: IfcElectricalDomain

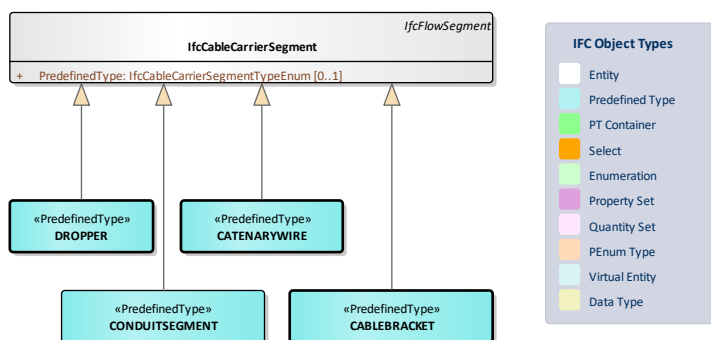| Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.3   Package: IfcCableCarrierSegment

Figure 17: new2_IfcCableCarrierSegment

3.4.2.3.1   Predefined Type: CABLEBRACKET

Full Identifier: **IfcCableCarrierSegment.CABLEBRACKET**

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A cable bracket is a horizontal cable support fixed at one end only, spaced at intervals, on which cables rest.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.3.2   Predefined Type: CATENARYWIRE

Full Identifier: **IfcCableCarrierSegment.CATENARYWIRE**

A catenary wire is a longitudinal wire supporting the grooved contact wires either directly or indirectly.

Note: definition from UIC 719-1.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.3.3   Predefined Type: CONDUITSEGMENT

Full Identifier: **IfcCableCarrierSegment.CONDUITSEGMENT**

An enclosed tubular carrier segment through which cables are pulled.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		

RWR_IFC_RAIL_P2_WP4_B

Property sets	

3.4.2.3.4

1.1.1.1.1 Predefined Type: DROPPER

Full Identifier: **IfcCableCarrierSegment.DROPPER**

A dropper is a cable carrier used to suspend cable from another cable. It could also conduct electricity.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

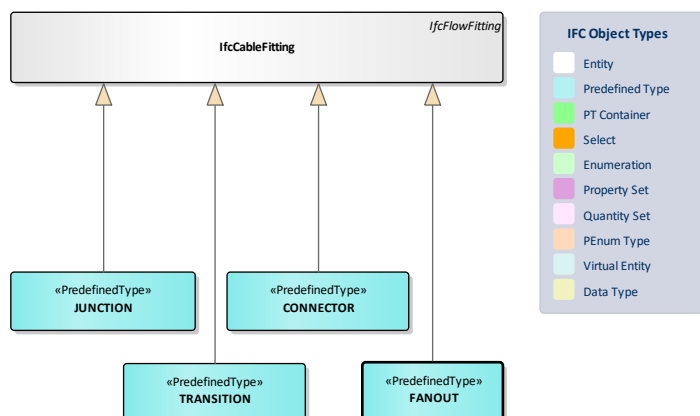### 3.4.2.4   Package: IfcCableFitting

Figure 18: new2_IfcCableFitting

3.4.2.4.1   Predefined Type: CONNECTOR

Full Identifier: **IfcCableFitting.CONNECTOR**

A fitting that joins two cable segments of the same connector type (though potentially different gender).

Status: Proposed

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Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		Parent Entity	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.4.2

1.1.1.1.2 Predefined Type: FANOUT

Full Identifier: **IfcCableFitting.FANOUT**

A fan out is a special cable fitting that provides a safe transition from multi-fiber cable units to individual fibers.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		Parent Entity	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.4.3   Predefined Type: JUNCTION

Full Identifier: **IfcCableFitting.JUNCTION**

A fitting that joins three or more segments of arbitrary connector types for signal splitting or multiplexing.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		Parent Entity	
Stereotype	«PredefinedType»		
Property sets			

RWR_IFC_RAIL_P2_WP4_B

3.4.2.4.4   Predefined Type: TRANSITION

Full Identifier: **IfcCableFitting.TRANSITION**

A fitting that joins two cable segments of different connector types.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.5   Package: IfcCableSegment

Figure 19: new2_IfcCableSegment
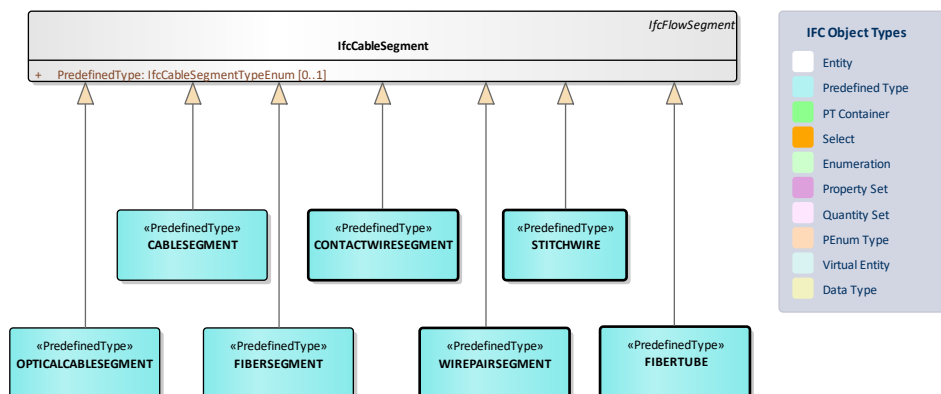
3.4.2.5.1   Predefined Type: CABLESEGMENT

Full Identifier: **IfcCableSegment.CABLESEGMENT**

Cable with a specific purpose to lead electric current within a circuit or any other electric construction. Includes all types of electric cables, mainly several core segments or conductor segments wrapped together.

Status: Proposed

Package: IfcElectricalDomain

RWR_IFC_RAIL_P2_WP4_B

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.5.2   Predefined Type: CONTACTWIRESEGMENT

Full Identifier: **IfcCableSegment.CONTACTWIRESEGMENT**

An electric conductor of an overhead contact line with which the current collectors make contact.

Note: definition from IEC60050 811-33-15.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.5.3   Predefined Type: FIBERSEGMENT

Full Identifier: **IfcCableSegment.FIBERSEGMENT**

A fiber segment is an individual optical fiber used in telecommunication systems to transmit data by means of optical signals.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.5.4   Predefined Type: FIBERTUBE

Full Identifier: **IfcCableSegment.FIBERTUBE**

RWR_IFC_RAIL_P2_WP4_B

A fiber tube is semi-rigid hollow plastic tube with a very small radius that houses and protects a certain number of optical fiber segments. An optical cable segment may contain many fiber tubes.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.5.5   Predefined Type: OPTICALCABLESEGMENT

Full Identifier: **IfcCableSegment.OPTICALCABLESEGMENT**

An optical cable segment is a cable segment that contains a variable number of optical fiber segments.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.5.6   Predefined Type: STITCHWIRE

Full Identifier: **IfcCableSegment.STITCHWIRE**

A stitch wire consists of auxiliary wires and different components (clamp) used in stitched suspension.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

RWR_IFC_RAIL_P2_WP4_B

3.4.2.5.7 Predefined Type: WIREPAIRSEGMENT

Full Identifier: **IfcCableSegment.WIREPAIRSEGMENT**

A pair of conductors contained in a copper cable. The pair is always used together to form a circuit to transmit data by means of electric signals.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.6   Package: IfcCommunicationsAppliance
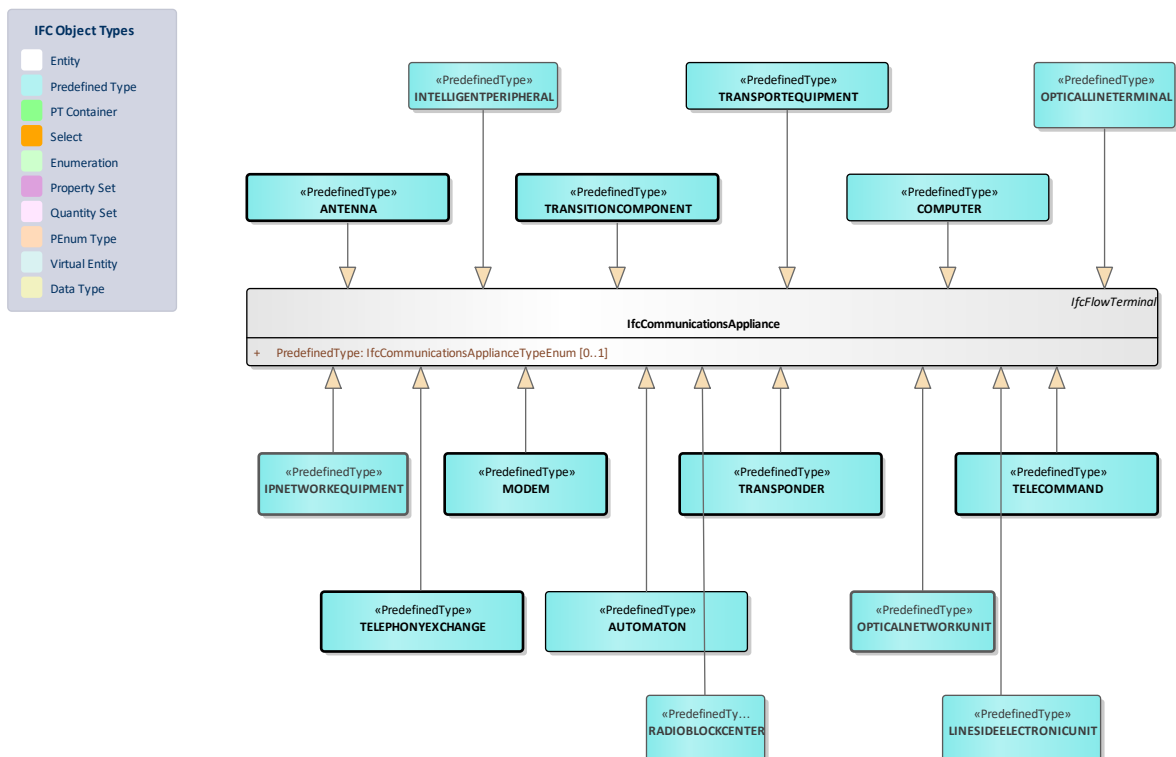
Figure 20: new2_IfcCommunicationsAppliance

RWR_IFC_RAIL_P2_WP4_B

3.4.2.6.1 Predefined Type: ANTENNA

Full Identifier: **IfcCommunicationsAppliance.ANTENNA**

A transducer designed to transmit or receive electromagnetic waves.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.6.2 Predefined Type: AUTOMATON

Full Identifier: **IfcCommunicationsAppliance.AUTOMATON**

A self-acting artificial device, the behaviour of which is governed either in a stepwise manner by given decision rules or continuously in time by defined relationships, while the output variables of which are created from its input and state variables.

Note: definition from IEC 60050-351-42-32.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.6.3 Predefined Type: COMPUTER

Full Identifier: **IfcCommunicationsAppliance.COMPUTER**

A desktop, laptop, tablet, or other type of computer that can be moved from one place to another and connected to an electrical supply via a plugged outlet.

Status: Proposed

Package: IfcElectricalDomain

RWR_IFC_RAIL_P2_WP4_B

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.6.4   Predefined Type: INTELLIGENTPERIPHERAL

Full Identifier: **IfcCommunicationsAppliance.INTELLIGENTPERIPHERAL**

An intelligent peripheral is a device that offers a variety of specialized resources according to the corresponding service logical program under the control of SCP. These resources contain the receiver of DTMF (Dual-Tone Multi-Frequency, signal generator, record notice, etc.). An intelligent peripheral provides dedicated resource functions in the intelligent network, allocates, controls and manages various dedicated resources, communicates with other entities in the network, and completes SRF resource functions as well as the maintenance, management and statistics functions of resources.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.6.5   Predefined Type: IPNETWORKEQUIPMENT

Full Identifier: **IfcCommunicationsAppliance.IPNETWORKEQUIPMENT**

An IP network equipment is a device that provides IP data transmission channel for telecom subsystems or other subsystems e.g., routers, network switches or firewalls.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

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3.4.2.6.6　Predefined Type: LINESIDEELECTRONICUNIT

Full Identifier: **IfcCommunicationsAppliance.LINESIDEELECTRONICUNIT**

The lineside electronic unit (LEU) is the interface between the balise and interlocking in railway. The LEU acquires the information from the interlocking, and sends the appropriate information to the balises in concordance with the lineside signalling (if available).

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.6.7　Predefined Type: MODEM

Full Identifier: **IfcCommunicationsAppliance.MODEM**

A modem (from modulator-demodulator) is a device that modulates an analog carrier signal to encode digital information, and also demodulates such a carrier signal to decode the transmitted information.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.6.8　Predefined Type: OPTICALLINETERMINAL

Full Identifier: **IfcCommunicationsAppliance.OPTICALLINETERMINAL**

An optical line terminal is a service provider endpoint of a passive or active optical network. It is the terminal equipment for connecting fiber optic trunks.

Status: Proposed

Package: IfcElectricalDomain

　　　　RWR_IFC_RAIL_P2_WP4_B

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.6.9   Predefined Type: OPTICALNETWORKUNIT

Full Identifier: **IfcCommunicationsAppliance.OPTICALNETWORKUNIT**

An optical network unit is a kind of optical transmission network connection equipment which is installed at user side.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.6.10 Predefined Type: RADIOBLOCKCENTER

Full Identifier: **IfcCommunicationsAppliance.RADIOBLOCKCENTER**

A radio block center is a specialised computing device in railway with specification for generating Movement Authorities (MA) and transmitting it to trains. It gets information from signalling control and from the trains in its section.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.6.11 Predefined Type: TELECOMMAND

Full Identifier: **IfcCommunicationsAppliance.TELECOMMAND**

A system sending command to control and monitor the switches and circuit breakers or systems directly or not connected (e.g. via wires) within the traction power system remotely.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.6.12 Predefined Type: TELEPHONYEXCHANGE

Full Identifier: **IfcCommunicationsAppliance.TELEPHONYEXCHANGE**

A telephony exchange is a device that ensures the routing of telephone calls and communications.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.6.13 Predefined Type: TRANSITIONCOMPONENT

Full Identifier: **IfcCommunicationsAppliance.TRANSITIONCOMPONENT**

A transition component is a minor active device that converts electric signals to optical signals at the sender, and converts optical signals to electric signals at the receiver.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

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3.4.2.6.14 Predefined Type: TRANSPONDER

Full Identifier: **IfcCommunicationsAppliance.TRANSPONDER**

A transponder is a communication, monitoring, or control device that, upon receiving a signal, emits a different signal in response. Transponders can be either passive or active (e.g., electronic beacon, balise).

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.6.15 Predefined Type: TRANSPORTEQUIPMENT

Full Identifier: **IfcCommunicationsAppliance.TRANSPORTEQUIPMENT**

A transport equipment is a network element responsible for providing functionality of transport, multiplexing, switching, management and supervision of transmission channels between different hosts. The data transport service uses three specific metrics: the bandwidth, the jitter, and the packet loss rate.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.7   Package: IfcController
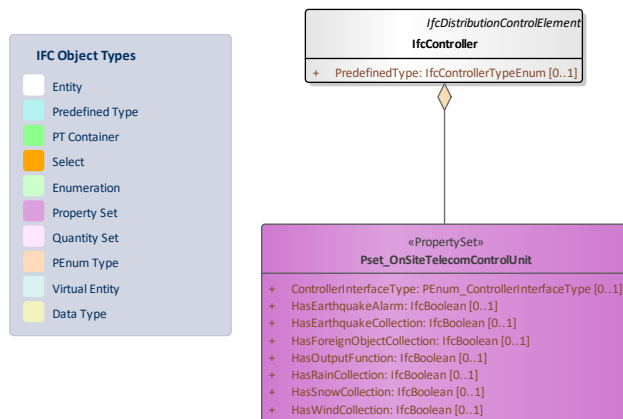
RWR_IFC_RAIL_P2_WP4_B

Figure 21: new2_IfcController

3.4.2.8   Package: IfcDistributionBoard
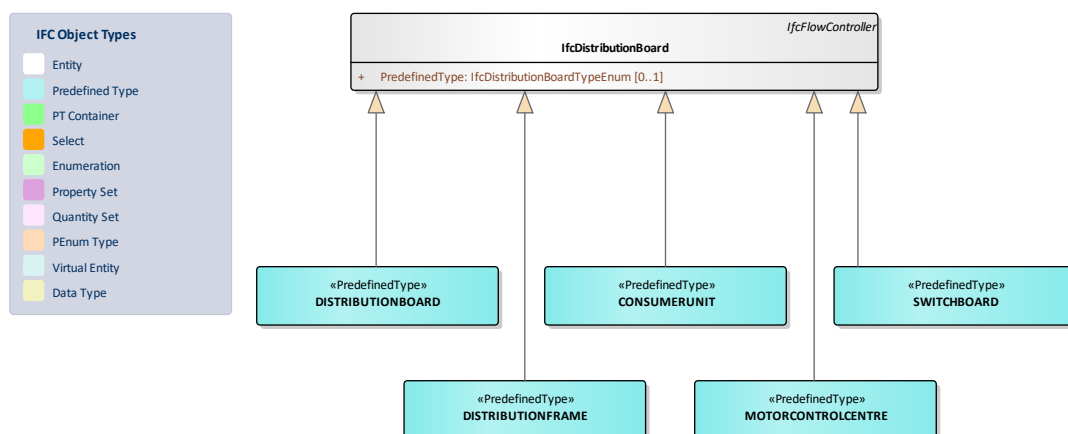
Figure 22: new2_IfcDistributionBoard

3.4.2.9   Package: IfcElectricAppliance

RWR_IFC_RAIL_P2_WP4_B
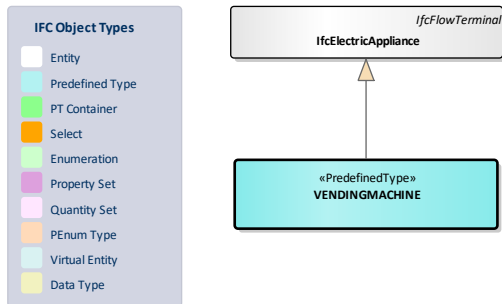
Figure 23: new2_IfcElectricAppliance

3.4.2.9.1   Predefined Type: VENDINGMACHINE

Full Identifier: **IfcElectricAppliance.VENDINGMACHINE**

An appliance that stores and vends goods including food, drink, tickets, and goods of various types.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.10   Package: IfcElectricFlowStorageDevice
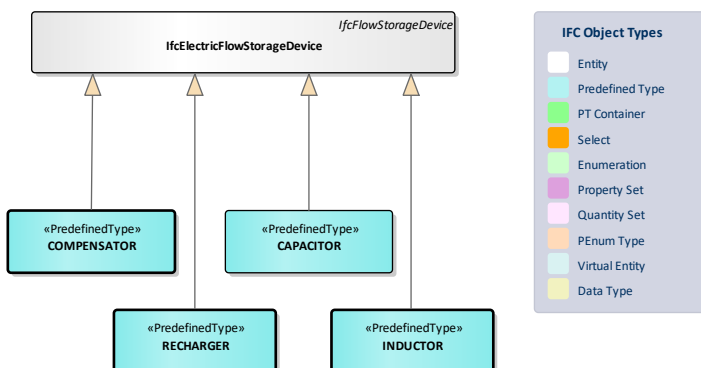
Figure 24: new2_IfcElectricFlowStorageDevice

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3.4.2.10.1 Predefined Type: CAPACITOR

Full Identifier: **IfcElectricFlowStorageDevice.CAPACITOR**

A device that stores electric charge when an external power supply is present using the electrical property of capacitance. Two-terminal device characterized essentially by its capacitance.

Note: definition from IEC 60050 151-13-28.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.10.2 Predefined Type: COMPENSATOR

Full Identifier: **IfcElectricFlowStorageDevice.COMPENSATOR**

A device that is used to fix or adjust the parameter of electric energy, such as voltage loss, power factor and so on.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.10.3 Predefined Type: INDUCTOR

Full Identifier: **IfcElectricFlowStorageDevice.INDUCTOR**

A device used in circuits or power systems due to their inductance, acting as a component of electric storage device.

Status: Proposed

Package: IfcElectricalDomain

RWR_IFC_RAIL_P2_WP4_B

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.10.4 Predefined Type: RECHARGER

Full Identifier: **IfcElectricFlowStorageDevice.RECHARGER**

A recharger or battery charger is a device used to put energy into a secondary cell or rechargeable battery by forcing an electric current through it.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

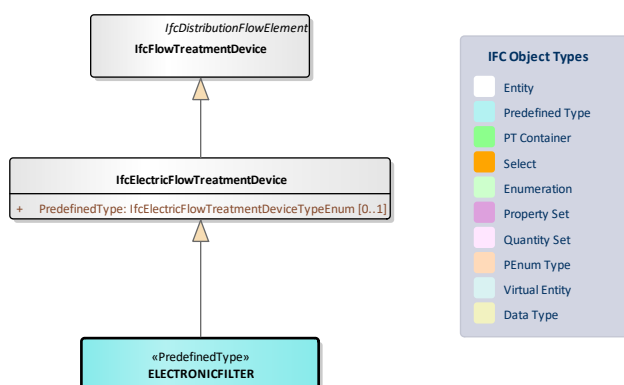### *3.4.2.11   Package: IfcElectricFlowTreatmentDevice*

Figure 25: new2_IfcElectricFlowTreatmentDevice

3.4.2.11.1 Class: IfcElectricFlowTreatmentDevice

An electric flow treatment device is used to remove unwanted matter from an electric or electronic signal in a flow distribution system.

RWR_IFC_RAIL_P2_WP4_B

Status: Proposed

Package: IfcElectricalDomain

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcFlowTreatmentDevice	
Subtypes	EXISTING	PROPOSED
		IfcElectricFlowTreatmentDevice.ELECTRONICFILTER

Class Attributes

Name	Type	Multiplicity	Definition
PredefinedType	IfcElectricFlowTreatmentDeviceTypeEnum	[0..1]	

3.4.2.11.2 Predefined Type: ELECTRONICFILTER

Full Identifier: **IfcElectricFlowTreatmentDevice.ELECTRONICFILTER**

Linear two-port device designed to transmit spectral components of the input quantity according to a specified law, generally in order to pass the components in certain frequency bands and to attenuate those in other bands

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.12 Package: IfcFlowInstrument

RWR_IFC_RAIL_P2_WP4_B
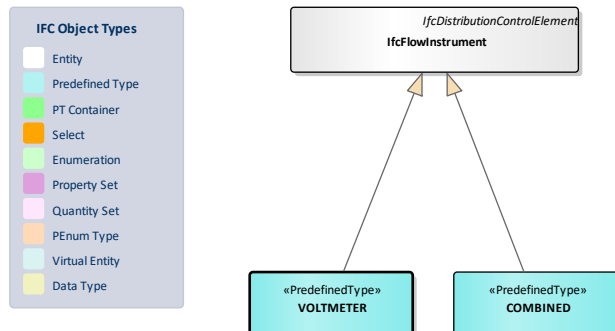
Figure 26: new2_IfcFlowInstrument

3.4.2.12.1 Predefined Type: COMBINED

Full Identifier: **IfcFlowInstrument.COMBINED**

A device that reads and displays the value of multiple properties of a system at a point, or displays the difference in the value of a property between two points.

Status: Proposed

Package: IfcBuildingControlsDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.12.2 Predefined Type: VOLTMETER

Full Identifier: **IfcFlowInstrument.VOLTMETER**

A device that measures and displays the voltage in a circuit.

Status: Proposed

Package: IfcBuildingControlsDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

RWR_IFC_RAIL_P2_WP4_B

3.4.2.13 Package: IfcHeatExchanger
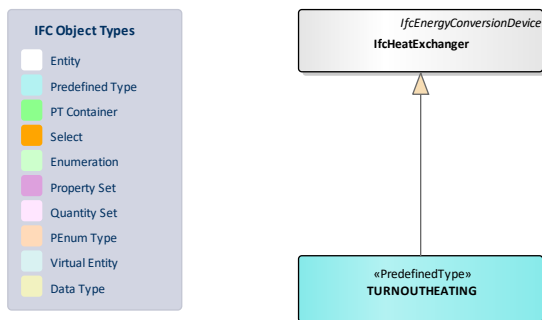
Figure 27: new2_IfcHeatExchanger

3.4.2.13.1 Predefined Type: TURNOUTHEATING

Full Identifier: **IfcHeatExchanger.TURNOUTHEATING**

A device used to remove snow from railways. E.g. electric heating device, gas heater

Status: Proposed

Package: IfcHvacDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.14 Package: IfcMobileTelecommunicationsAppliance

RWR_IFC_RAIL_P2_WP4_B
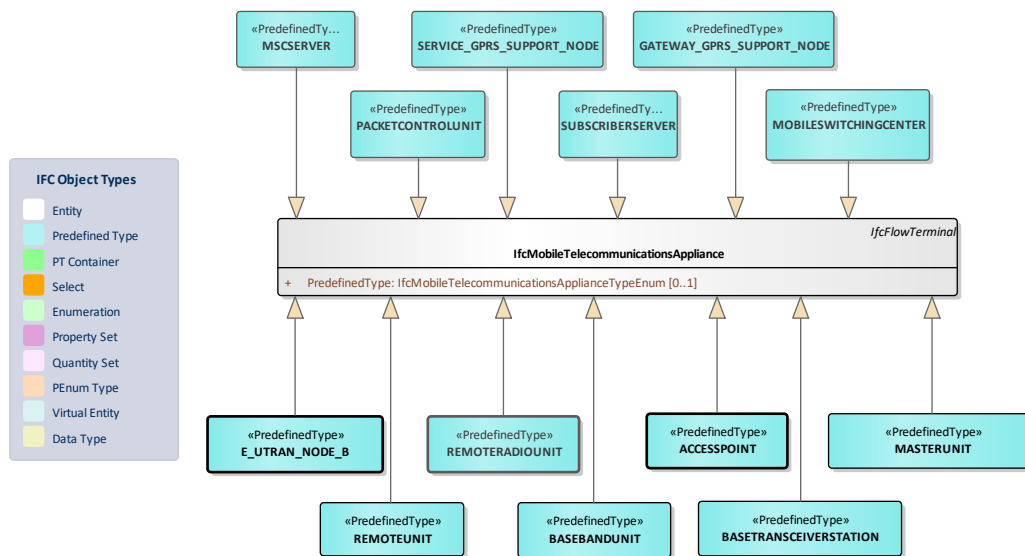
Figure 28: new2_IfcMobileTelecommunicationsAppliance

3.4.2.14.1 Class: IfcMobileTelecommunicationsAppliance

A mobile telecommunications appliance is a device that transmits, converts, amplifies or receives signals used in mobile networks.

Note: This entity is used to define specific appliances used in mobile telecommunication networks. General communications appliances and those used in fixed transmission networks should be instantiated using IfcCommunicationsAppliance.

Status: Proposed

Package: IfcElectricalDomain

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcFlowTerminal	
Subtypes	EXISTING	PROPOSED

RWR_IFC_RAIL_P2_WP4_B

		IfcMobileTelecommunicationsAppliance.MOBILESWITCHINGCENTER
		IfcMobileTelecommunicationsAppliance.MASTERUNIT
		IfcMobileTelecommunicationsAppliance.GATEWAY_GPRS_SUPPORT_NODE
		IfcMobileTelecommunicationsAppliance.E_UTRAN_NODE_B
		IfcMobileTelecommunicationsAppliance.BASETRANSCEIVERSTATION
		IfcMobileTelecommunicationsAppliance.BASEBANDUNIT
		IfcMobileTelecommunicationsAppliance.ACCESSPOINT
		IfcMobileTelecommunicationsAppliance.SUBSCRIBERSERVER
		IfcMobileTelecommunicationsAppliance.SERVICE_GPRS_SUPPORT_NODE
		IfcMobileTelecommunicationsAppliance.REMOTEUNIT
		IfcMobileTelecommunicationsAppliance.REMOTERADIOUNIT
		IfcMobileTelecommunicationsAppliance.PACKETCONTROLUNIT
		IfcMobileTelecommunicationsAppliance.MSCSERVER

Class Attributes

Name	Type	Multiplicity	Definition
PredefinedType	IfcMobileTelecommunicationsApplianceTypeEnum	[0..1]	

3.4.2.14.2 Predefined Type: ACCESSPOINT

Full Identifier: **IfcMobileTelecommunicationsAppliance.ACCESSPOINT**

An access point is a device that allows wireless devices to connect to a wired network.

Status: Proposed

RWR_IFC_RAIL_P2_WP4_B

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.14.3 Predefined Type: BASEBANDUNIT

Full Identifier: **IfcMobileTelecommunicationsAppliance.BASEBANDUNIT**

A baseband unit is a component of a distributed base transceiver station for implementing baseband processing functions.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.14.4 Predefined Type: BASETRANSCEIVERSTATION

Full Identifier: **IfcMobileTelecommunicationsAppliance.BASETRANSCEIVERSTATION**

A base transceiver station (BTS) is a network component which serves one cell. It completes the conversion between base station controller and wireless channel, and realizes the wireless transmission and related control functions between base station controller and mobile switching through the air interface.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

RWR_IFC_RAIL_P2_WP4_B

3.4.2.14.5 Predefined Type: E_UTRAN_NODE_B

Full Identifier: **IfcMobileTelecommunicationsAppliance.E_UTRAN_NODE_B**

An E-utran nodel B is a logical network component which serves one or more E-utran cells. It is the hardware connected to the evolved packet core (EPC), more specifically to the mobility management entity (MME) , which communicates directly with user equipment in wireless way.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.14.6 Predefined Type: GATEWAY_GPRS_SUPPORT_NODE

Full Identifier: **IfcMobileTelecommunicationsAppliance.GATEWAY_GPRS_SUPPORT_NODE**

The gateway GPRS support node is a component of the GPRS core network that extends the GSM to allow packet switching functionalities. This component is responsible for the internetworking between the GPRS network and external packet switched networks (e.g. the internet).

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.14.7 Predefined Type: MASTERUNIT

Full Identifier: **IfcMobileTelecommunicationsAppliance.MASTERUNIT**

A master unit is a component of a repeater for coupling base station signals.

Status: Proposed

Package: IfcElectricalDomain

RWR_IFC_RAIL_P2_WP4_B

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.14.8 Predefined Type: MOBILESWITCHINGCENTER

Full Identifier: **IfcMobileTelecommunicationsAppliance.MOBILESWITCHINGCENTER**

The mobile switching centre (MSC) constitutes the interface between the radio system and the fixed networks. It is an exchange which performs all the switching and signalling functions for mobile station located in a geographical area designated as the MSC area. It consists of a MSC server and a media gateway.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.14.9 Predefined Type: MSCSERVER

Full Identifier: **IfcMobileTelecommunicationsAppliance.MSCSERVER**

The MSC server mainly comprises the call control (CC) and mobility control parts of a mobile switching center (MSC). An MSC server and a media gateway make up the full functionality of an MSC.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

RWR_IFC_RAIL_P2_WP4_B

3.4.2.14.10   Predefined Type: PACKETCONTROLUNIT

Full Identifier: **IfcMobileTelecommunicationsAppliance.PACKETCONTROLUNIT**

A packet control unit performs some of the processing tasks of the base station controller for packet data. It is responsible for data packet, wireless channel management, error sending detection and automatic retransmission.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.14.11   Predefined Type: REMOTERADIOUNIT

Full Identifier: **IfcMobileTelecommunicationsAppliance.REMOTERADIOUNIT**

A remote radio unit is a component of a distributed base transceiver station that converts digital baseband signals into high-frequency (rf) signals and sends high-frequency (rf) signals to the antenna for radiation.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.14.12   Predefined Type: REMOTEUNIT

Full Identifier: **IfcMobileTelecommunicationsAppliance.REMOTEUNIT**

A remote unit is a device used to amplify a base station signal.

Status: Proposed

Package: IfcElectricalDomain

    RWR_IFC_RAIL_P2_WP4_B

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.14.13   Predefined Type: SERVICE_GPRS_SUPPORT_NODE

Full Identifier: **IfcMobileTelecommunicationsAppliance.SERVICE_GPRS_SUPPORT_NODE**

The service GPRS support node (SGSN) is a component of the GPRS core network. It is the GPRS support node of mobile station service, and it can achieve mobility management and packet routing and transfer.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.14.14   Predefined Type: SUBSCRIBERSERVER

Full Identifier: **IfcMobileTelecommunicationsAppliance.SUBSCRIBERSERVER**

It is a database in charge of the management of mobile subscribers. It can be an authentication center (AuC) or a home location register (HLR).

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.15 Package: IfcOutlet
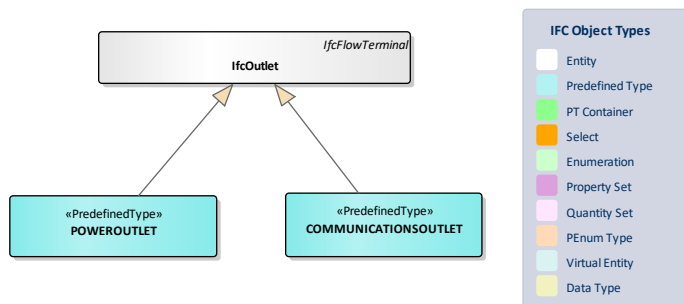
RWR_IFC_RAIL_P2_WP4_B

Figure 29: new2_IfcOutlet

3.4.2.15.1 Predefined Type: COMMUNICATIONSOUTLET

Full Identifier: **IfcOutlet.COMMUNICATIONSOUTLET**

An outlet used for connecting communications equipment.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.15.2 Predefined Type: POWEROUTLET

Full Identifier: **IfcOutlet.POWEROUTLET**

An outlet used for connecting electrical devices requiring power.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

RWR_IFC_RAIL_P2_WP4_B

3.4.2.16   Package: IfcProtectiveDevice
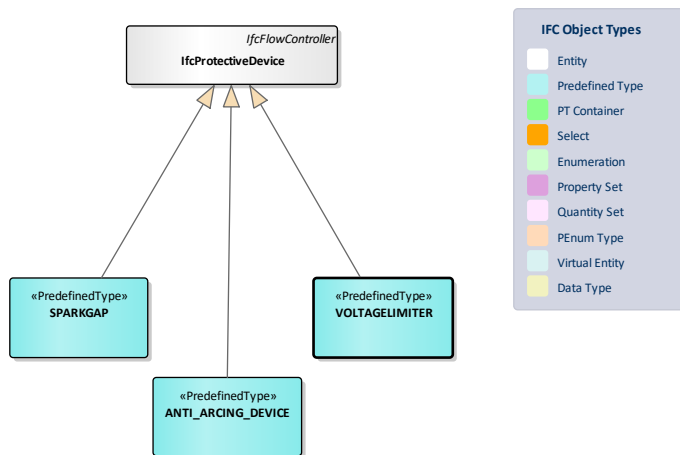
Figure 30: new2_IfcProtectiveDevice

3.4.2.16.1 Predefined Type: ANTI_ARCING_DEVICE

Full Identifier: **IfcProtectiveDevice.ANTI_ARCING_DEVICE**

An anti-arcing device is an equipment that prevents electric arc.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.16.2 Predefined Type: SPARKGAP

Full Identifier: **IfcProtectiveDevice.SPARKGAP**

A spark gap is a device used to connect a circuit to earth in the event of a fault in live circuits.

Status: Proposed

Package: IfcElectricalDomain

RWR_IFC_RAIL_P2_WP4_B

Predefined Type Properties		
Predefined Type Container		**Parent Entity**
Stereotype	«PredefinedType»	
Property sets		

3.4.2.16.3 Predefined Type: VOLTAGELIMITER

Full Identifier: **IfcProtectiveDevice.VOLTAGELIMITER**

a voltage limiter is an equipment that prevents the over voltage.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties		
Predefined Type Container		**Parent Entity**
Stereotype	«PredefinedType»	
Property sets		

3.4.2.17   Package: IfcSensor

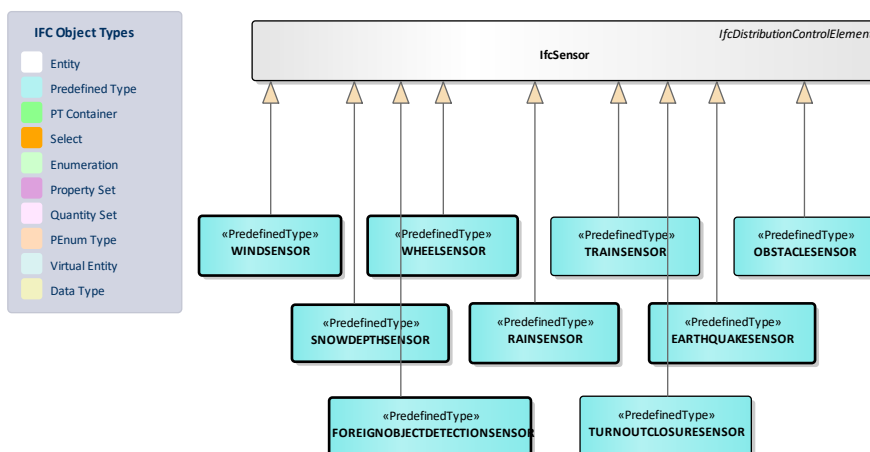*Figure 31: new2_IfcSensor*

3.4.2.17.1 Predefined Type: EARTHQUAKESENSOR

Full Identifier: **IfcSensor.EARTHQUAKESENSOR**

RWR_IFC_RAIL_P2_WP4_B

A device that senses or detects the seismic wave and measures the seismic intensity in case of earthquake.

Status: Proposed

Package: IfcBuildingControlsDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.17.2 Predefined Type: FOREIGNOBJECTDETECTIONSENSOR

Full Identifier: **IfcSensor.FOREIGNOBJECTDETECTIONSENSOR**

A device that senses or detects foreign objects that shock or break the power network. It may alarm when such accidents happen.

Status: Proposed

Package: IfcBuildingControlsDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.17.3 Predefined Type: OBSTACLESENSOR

Full Identifier: **IfcSensor.OBSTACLESENSOR**

A device that senses or detects any obstacles. Examples are: detectors sensing objects falling from a bridge, rock-fall detectors, etc.

Status: Proposed

Package: IfcBuildingControlsDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		

RWR_IFC_RAIL_P2_WP4_B

Property sets	

3.4.2.17.4 Predefined Type: RAINSENSOR

Full Identifier: **IfcSensor.RAINSENSOR**

A device that senses or collects rainfall related information.

Status: Proposed

Package: IfcBuildingControlsDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.17.5 Predefined Type: SNOWDEPTHSENSOR

Full Identifier: **IfcSensor.SNOWDEPTHSENSOR**

A device that senses or measures the depth of snowfall.

Status: Proposed

Package: IfcBuildingControlsDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.17.6 Predefined Type: TRAINSENSOR

Full Identifier: **IfcSensor.TRAINSENSOR**

A device, usually attached to the rear end of the last vehicle of a train, acting on a fixed equipment to give an indication that the train is complete.

Status: Proposed

Package: IfcBuildingControlsDomain

RWR_IFC_RAIL_P2_WP4_B

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.17.7 Predefined Type: TURNOUTCLOSURESENSOR

Full Identifier: **IfcSensor.TURNOUTCLOSURESENSOR**

A device that senses or detects the position of a blade of a turnout.

Status: Proposed

Package: IfcBuildingControlsDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.17.8 Predefined Type: WHEELSENSOR

Full Identifier: **IfcSensor.WHEELSENSOR**

A device that senses or detects the passage of a wheel.

Status: Proposed

Package: IfcBuildingControlsDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.17.9 Predefined Type: WINDSENSOR

Full Identifier: **IfcSensor.WINDSENSOR**

A device that senses or detects airflow speed and direction.

RWR_IFC_RAIL_P2_WP4_B

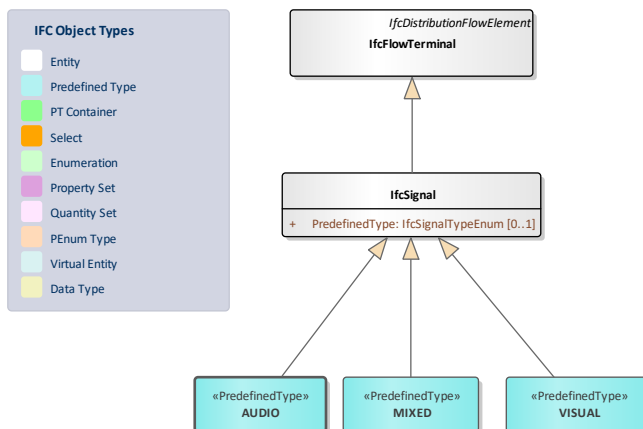| Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.18   Package: IfcSignal

Figure 32: new2_IfcSignal

3.4.2.18.1 Class: IfcSignal

A signal is an active device that conveys information or instructions to users, by means of an audio, visual signal or a combination of both.

The primary distinction from an _IfcSign_ is that a signal is active and therefore a subtype of _IfcFlowTerminal_ usually requiring power and data connections for its operation.

An instance of _IfcSignal_ represents a singular signalling device in a larger assembled unit or connected system, such as an individual frame within a railway signal, a single light unit in a traffic light system or an audio signal or light mounted on a navigational buoy.

Signals can be physically aggregated together into an assembly which can include multiple signal instances (and also sign instances) and the associated supporting structural elements such as a simple pole or a rigid frame gantry (see Signal Assembly for examples).

RWR_IFC_RAIL_P2_WP4_B

Signals can be logically (functionally) grouped together into a signalling system (a type of distribution system) to represent a connected group of signals for example a group of traffic lights controlling an road intersection.

Status: Proposed

Package: IfcSharedInfrastructureElements

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcFlowTerminal	
Subtypes	EXISTING	PROPOSED
		IfcSignal.VISUAL
		IfcSignal.MIXED
		IfcSignal.AUDIO

Class Attributes

Name	Type	Multiplicity	Definition
PredefinedType	IfcSignalTypeEnum	[0..1]	Identifies the predefined type of a signal. This type may associate additional specific property sets. NOTE The PredefinedType shall only be used, if no IfcSignalType is assigned, providing its own IfcSignType .PredefinedType.

3.4.2.18.2 Predefined Type: AUDIO

Full Identifier: **IfcSignal.AUDIO**

A signal type formed of an active device conveying information by emitting an audio signal such as a beep, ring, horn or explosive sound.

Status: Proposed

Package: IfcSharedInfrastructureElements

RWR_IFC_RAIL_P2_WP4_B

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.18.3 Predefined Type: MIXED

Full Identifier: **IfcSignal.MIXED**

A signal type formed of an active device conveying information in both a visual and audio manner.

Status: Proposed

Package: IfcSharedInfrastructureElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.18.4 Predefined Type: VISUAL

Full Identifier: **IfcSignal.VISUAL**

A signal type formed of an active device conveying information in a visual manner such as a light, cluster of lights, or mechanical moving shapes.

Status: Proposed

Package: IfcSharedInfrastructureElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.19 Package: IfcSwitchingDevice
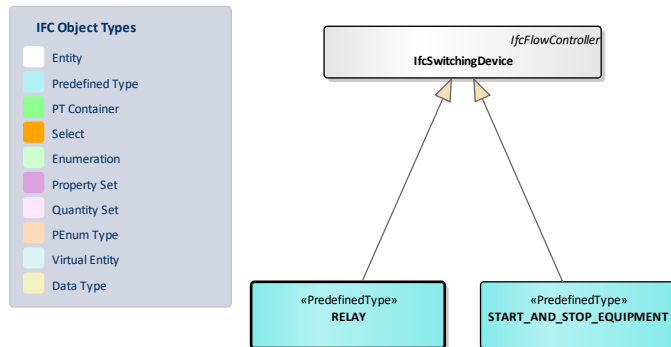
RWR_IFC_RAIL_P2_WP4_B

Figure 33: new2_IfcSwitchingDevice

3.4.2.19.1 Predefined Type: RELAY

Full Identifier: **IfcSwitchingDevice.RELAY**

A device designed to produce sudden predetermined changes in one or more electric output circuits, when certain conditions are fulfilled in the electric input circuits controlling the device.

Note: definition from IEC 60050 151-13-31.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.19.2 Predefined Type: START_AND_STOP_EQUIPMENT

Full Identifier: **IfcSwitchingDevice.START_AND_STOP_EQUIPMENT**

A switch for alternatively closing and opening one or more electric circuits.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

RWR_IFC_RAIL_P2_WP4_B

3.4.2.20 Package: IfcTank
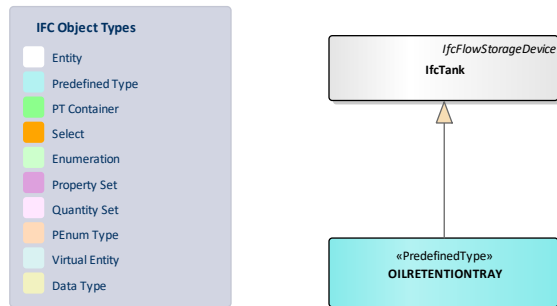
Figure 34: new2_IfcTank

3.4.2.20.1 Predefined Type: OILRETENTIONTRAY

Full Identifier: **IfcTank.OILRETENTIONTRAY**

An open container for environmental protection and storage of chemical products.

Status: Proposed

Package: IfcHvacDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.21 Package: IfcTransformer

RWR_IFC_RAIL_P2_WP4_B

Figure 35: new2_IfcTransformer

3.4.2.21.1 Predefined Type: CHOPPER

Full Identifier: **IfcTransformer.CHOPPER**

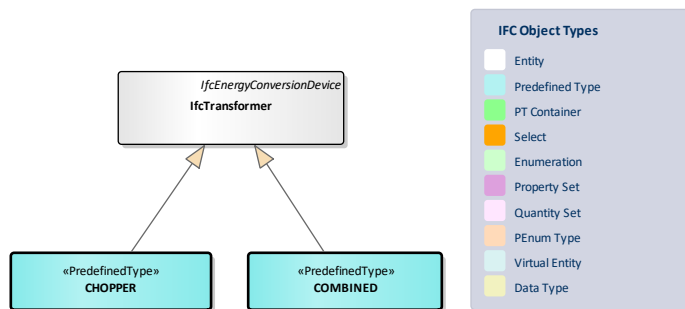A chopper is an electronic power DC convertor without an intermediate AC link giving a variable output voltage by varying the periods of conduction and non-conduction in an adjustable ratio.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.21.2 Predefined Type: COMBINED

Full Identifier: **IfcTransformer.COMBINED**

A transformer that changes different quantities between circuits.

Status: Proposed

Package: IfcElectricalDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

RWR_IFC_RAIL_P2_WP4_B

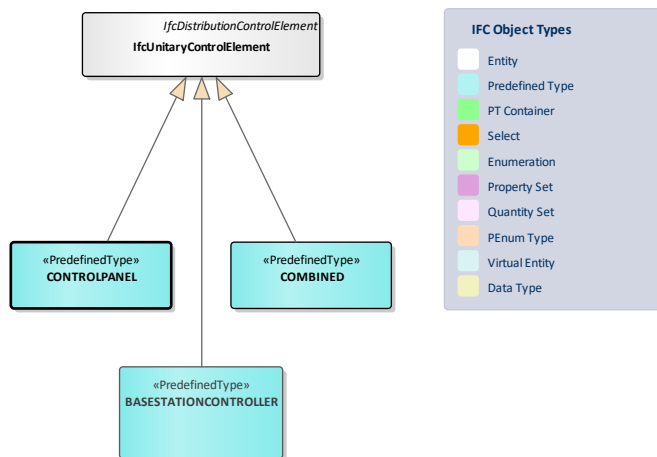## 3.4.2.22   Package: IfcUnitaryControlElement

Figure 36: new2_IfcUnitaryControlElement

3.4.2.22.1 Predefined Type: BASESTATIONCONTROLLER

Full Identifier: **IfcUnitaryControlElement.BASESTATIONCONTROLLER**

A base station controller (BSC) is a network component with the functions for controlling one or more base transceiver stations. BSC is responsible for the management of various interfaces, wireless resources and parameters, the signalling processing of call establishment and the channel allocation in the cell.

Status: Proposed

Package: IfcBuildingControlsDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

1.1.1.1.3 Predefined Type: COMBINED

Full Identifier: **IfcUnitaryControlElement.COMBINED**

Combination of at least two predefined types of unitary control element.

Status: Proposed

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.2.22.2 Predefined Type: CONTROLPANEL

Full Identifier: **IfcUnitaryControlElement.CONTROLPANEL**

A control element at which devices that control or monitor the operation of a site, building or part of a building are located

Status: Proposed

Package: IfcBuildingControlsDomain

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.3 Package: Element Assembly

RWR_IFC_RAIL_P2_WP4_B
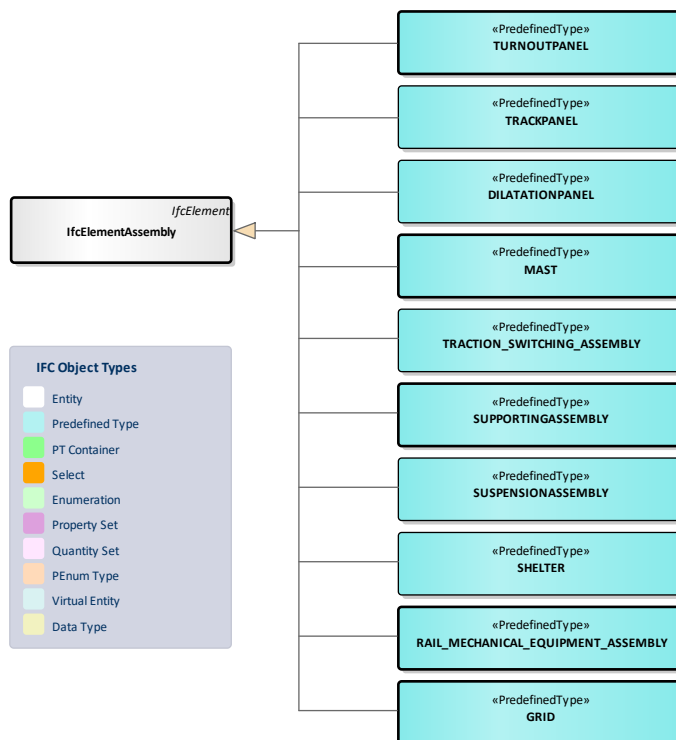
Figure 37: new2_IfcElementAssembly

3.4.3.1   Predefined Type: DILATATIONPANEL

Full Identifier: **IfcElementAssembly.DILATATIONPANEL**

Device which permits longitudinal relative rail movement of two adjacent rails, while maintaining correct guidance and support.

Note: definition from NF EN 13232-1-2004.

Status: Proposed

Package: IfcProductExtension

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.3.2   Predefined Type: GRID

Full Identifier: **IfcElementAssembly.GRID**

RWR_IFC_RAIL_P2_WP4_B

A framework of spaced cables or bars that are parallel to or cross each other.

Status: Proposed

Package: IfcProductExtension

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.3.3   Predefined Type: MAST

Full Identifier: **IfcElementAssembly.MAST**

An assembly of plates, members, cables or fasteners that form a vertical structure for the support or mounting of other equipment such as lights, sonar or wireless transmitters.

Status: Proposed

Package: IfcProductExtension

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.3.4   Predefined Type: RAIL_MECHANICAL_EQUIPMENT_ASSEMBLY

Full Identifier: **IfcElementAssembly.RAIL_MECHANICAL_EQUIPMENT_ASSEMBLY**

A complex assembly made up of several components like blocking device, speed regulator, bias loaded inspector, track scale or controllable retarder.

Status: Proposed

Package: IfcProductExtension

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

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3.4.3.5   Predefined Type: SHELTER

Full Identifier: **IfcElementAssembly.SHELTER**

A structure, fairly quick to setup, move or dismantle, used to give protection, especially from the weather or intrusion.

Status: Proposed

Package: IfcProductExtension

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.3.6   Predefined Type: SUPPORTINGASSEMBLY

Full Identifier: **IfcElementAssembly.SUPPORTINGASSEMBLY**

An assembly intends to support Overhead Contact Line System. It includes foundation, supporting elements and suspension assembly.

Status: Proposed

Package: IfcProductExtension

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.3.7   Predefined Type: SUSPENSIONASSEMBLY

Full Identifier: **IfcElementAssembly.SUSPENSIONASSEMBLY**

A complex assembly of components used to suspend elements or cable segments.

Status: Proposed

Package: IfcProductExtension

RWR_IFC_RAIL_P2_WP4_B

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.3.8   Predefined Type: TRACKPANEL

Full Identifier: **IfcElementAssembly.TRACKPANEL**

Trackwork ensuring the support and guidance of a vehicle along a route. It consists of assembly of rail, sleepers and fastenings.

Status: Proposed

Package: IfcProductExtension

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.3.9   Predefined Type: TRACTION_SWITCHING_ASSEMBLY

Full Identifier: **IfcElementAssembly.TRACTION_SWITCHING_ASSEMBLY**

A common assembly used to insure the switching function. It is composed of switches, control instruments and other components.

Status: Proposed

Package: IfcProductExtension

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.3.10   Predefined Type: TURNOUTPANEL

Full Identifier: **IfcElementAssembly.TURNOUTPANEL**

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Trackwork ensuring the support and guidance of a vehicle along any given route among various diverging or intersecting tracks.

Note: definition from NF EN 13232-1-2004.

Status: Proposed

Package: IfcProductExtension

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.4 Package: Element Component

3.4.4.1 Package: IfcDiscreteAccessory
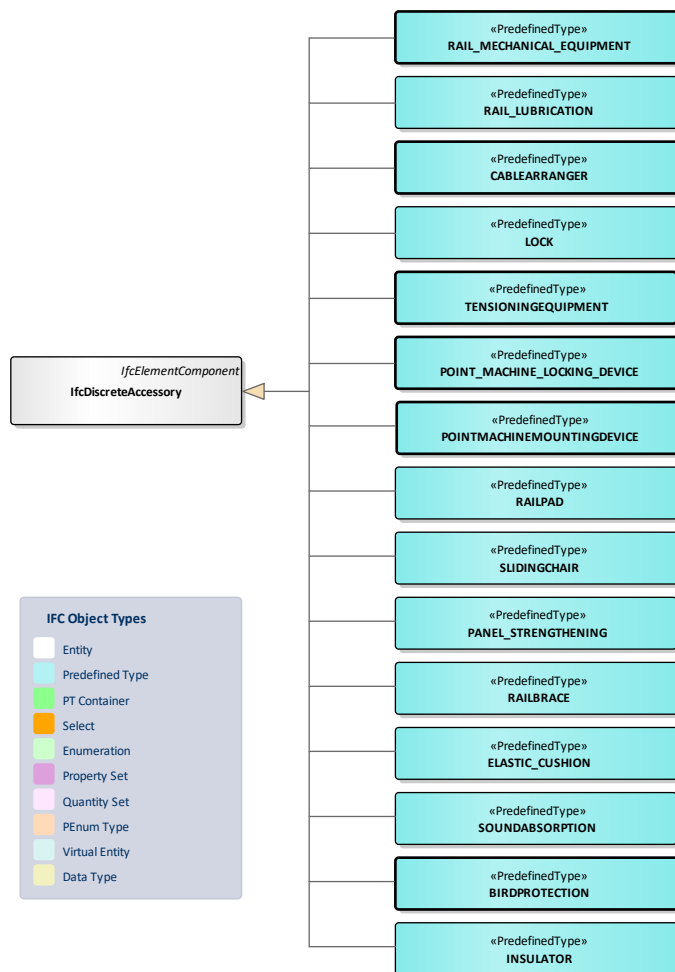
Figure 38: new2_IfcDiscreteAccessory

3.4.4.1.1 Predefined Type: BIRDPROTECTION

Full Identifier: **IfcDiscreteAccessory.BIRDPROTECTION**

A device that prevents a sitting down of birds at electrically critical points and thus birds are protected against electrical shocks and disturbances by short circuit are avoided.

Status: Proposed

Package: IfcSharedComponentElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

RWR_IFC_RAIL_P2_WP4_B

3.4.4.1.2 Predefined Type: CABLEARRANGER

Full Identifier: **IfcDiscreteAccessory.CABLEARRANGER**

A cable arranger is a flexible accessory or a part of a component placed around cables to arrange and minimize flexing of them at the point where it is placed.

Status: Proposed

Package: IfcSharedComponentElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.4.1.3 Predefined Type: ELASTIC_CUSHION

Full Identifier: **IfcDiscreteAccessory.ELASTIC_CUSHION**

A track elastic cushion is a kind of layer set on grooved sides of a concrete base, which is used for mitigating the impact of longitudinal and lateral load on track structures. A track elastic cushion shall only appear in ballastless track structures.

Status: Proposed

Package: IfcSharedComponentElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.4.1.4 Predefined Type: INSULATOR

Full Identifier: **IfcDiscreteAccessory.INSULATOR**

A device designed to support and insulate a conductive element.

Note: definition from IEC 151-15-39.

Status: Proposed

Package: IfcSharedComponentElements

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Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.4.1.5   Predefined Type: LOCK

Full Identifier: **IfcDiscreteAccessory.LOCK**

A lock is a mechanical or electronic fastening device that is released either by a physical object (e.g., key, fingerprint, RFID card, security token etc.), by supplying secret information (e.g., number permutation, password), or by a combination thereof.

Status: Proposed

Package: IfcSharedComponentElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.4.1.6   Predefined Type: PANEL_STRENGTHENING

Full Identifier: **IfcDiscreteAccessory.PANEL_STRENGTHENING**

A component that minimizes pump effects of the substructure.

Status: Proposed

Package: IfcSharedComponentElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.4.1.7   Predefined Type: POINT_MACHINE_LOCKING_DEVICE

Full Identifier: **IfcDiscreteAccessory.POINT_MACHINE_LOCKING_DEVICE**

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Automatically generated by IFC-ModelSearch.TranslatePredefinedType 2022-03-09

<div align="right">Status: Proposed</div>

<div align="right">Package: IfcSharedComponentElements</div>

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.4.1.8   Predefined Type: POINTMACHINEMOUNTINGDEVICE

Full Identifier: **IfcDiscreteAccessory.POINTMACHINEMOUNTINGDEVICE**

Automatically generated by IFC-ModelSearch.TranslatePredefinedType 2022-03-09

<div align="right">Status: Proposed</div>

<div align="right">Package: IfcSharedComponentElements</div>

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.4.1.9   Predefined Type: RAIL_LUBRICATION

Full Identifier: **IfcDiscreteAccessory.RAIL_LUBRICATION**

A device that prevents wearing of the rails throughout the flange of wheel to reduce noise emissions. It is often located at inner side of the outer rail in a curve or near turnouts (depends on function wearing or noise reduction).

<div align="right">Status: Proposed</div>

<div align="right">Package: IfcSharedComponentElements</div>

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

RWR_IFC_RAIL_P2_WP4_B

3.4.4.1.10 Predefined Type: RAIL_MECHANICAL_EQUIPMENT

Full Identifier: **IfcDiscreteAccessory.RAIL_MECHANICAL_EQUIPMENT**

A rail mechanical equipment is a mechnical equipment installed at railside, like blocking device, speed regulator, bias loaded inspector, track scale or controllable retarder.

.

Status: Proposed

Package: IfcSharedComponentElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.4.1.11 Predefined Type: RAILBRACE

Full Identifier: **IfcDiscreteAccessory.RAILBRACE**

A rail component that prevents rails from tipping and twisting.

Status: Proposed

Package: IfcSharedComponentElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.4.1.12 Predefined Type: RAILPAD

Full Identifier: **IfcDiscreteAccessory.RAILPAD**

A non-metallic pad placed between rail and baseplate or rail and sleeper, bearer or slab.

Note: definition from EN 13481-1.

Status: Proposed

RWR_IFC_RAIL_P2_WP4_B

Package: IfcSharedComponentElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.4.1.13 Predefined Type: SLIDINGCHAIR

Full Identifier: **IfcDiscreteAccessory.SLIDINGCHAIR**

A component which supports and retains the stock rail and a flat surface upon which the foot of the switch rail slides.

Status: Proposed

Package: IfcSharedComponentElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.4.1.14 Predefined Type: SOUNDABSORPTION

Full Identifier: **IfcDiscreteAccessory.SOUNDABSORPTION**

A component in the track for sound absorption and may also absorb vibrations. It is often used in combination with slab tracks.

Status: Proposed

Package: IfcSharedComponentElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

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3.4.4.1.15 Predefined Type: TENSIONINGEQUIPMENT

Full Identifier: **IfcDiscreteAccessory.TENSIONINGEQUIPMENT**

An equipment used to maintain the tension of conductors or cables.

Status: Proposed

Package: IfcSharedComponentElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.4.2   Package: IfcFastener

Figure 39: new2_IfcFastener

3.4.4.2.1   Predefined Type: WELD

Full Identifier: **IfcFastener.WELD**

A weld seam between parts of metallic material or other suitable materials.

Status: Proposed

Package: IfcSharedComponentElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		

RWR_IFC_RAIL_P2_WP4_B

Property sets	

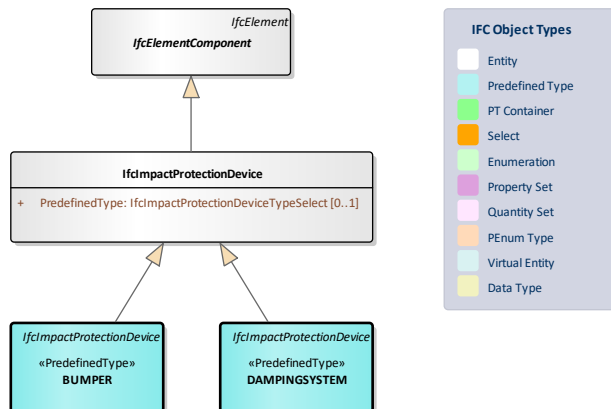*3.4.4.3   Package: IfcImpactProtectionDevice*

Figure 40: new2_IfcImpactProtectionDevice

3.4.4.3.1   Predefined Type: BUMPER

Full Identifier: **IfcImpactProtectionDevice.BUMPER**

Automatically generated by IFC-ModelSearch.TranslatePredefinedType 2022-02-19

Status: Proposed

Package: IfcSharedInfrastructureElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.4.3.2   Predefined Type: DAMPINGSYSTEM

Full Identifier: **IfcImpactProtectionDevice.DAMPINGSYSTEM**

Automatically generated by IFC-ModelSearch.TranslatePredefinedType 2022-02-19

Status: Proposed

Package: IfcSharedInfrastructureElements

RWR_IFC_RAIL_P2_WP4_B

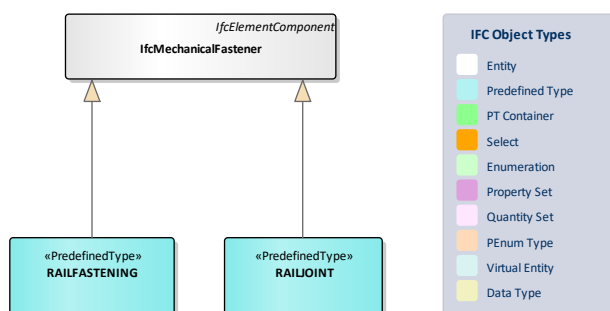| Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.4.4   Package: IfcMechanicalFastener

Figure 41: new2_IfcMechanicalFastener

3.4.4.4.1   Predefined Type: RAILFASTENING

Full Identifier: **IfcMechanicalFastener.RAILFASTENING**

An assembly of components which secures a rail to the supporting structure and retains it in the required position whilst permitting any necessary vertical, lateral and longitudinal movement.

Note: definition from EN 13481-1.

Status: Proposed

Package: IfcSharedComponentElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.4.4.2   Predefined Type: RAILJOINT

Full Identifier: **IfcMechanicalFastener.RAILJOINT**

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A mechanical assembly with e.g. fishplates to join two rail ends with optional functions (insulation or expansion capacity).

Status: Proposed

Package: IfcSharedComponentElements

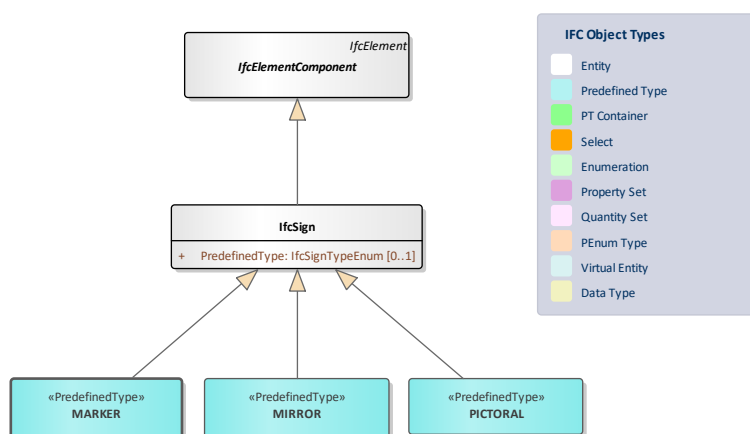| Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.4.5   Package: IfcSign

Figure 42: new2_IfcSign

3.4.4.5.1   Class: IfcSign

A sign is a notice on display that gives information or instructions in a written, symbolic or other form. Signs are passive with the most common form of a pictorial panel. An instance of _IfcSign_ refers to the occurrence of an individual panel which can be applied to a surface such as a wall or be aggregated within a Signal Assembly which can include multiple sign occurrences and the associated supporting structural elements (see Signal Assembly for examples).

Status: Proposed

Package: IfcSharedInfrastructureElements

Class Properties

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Status	Proposed	Is Abstract	
Property sets			

Inheritance Statement		
Subtype Of	IfcElementComponent	
	EXISTING	PROPOSED
Subtypes		IfcSign.PICTORAL IfcSign.MIRROR IfcSign.MARKER

Class Attributes

Name	Type	Multiplicity	Definition
PredefinedType	IfcSignTypeEnum	[0..1]	Identifies the predefined type of a signs. This type may associate additional specific property sets. NOTE The PredefinedType shall only be used, if no IfcSignType is assigned, providing its own IfcSignType .PredefinedType.

3.4.4.5.2   Predefined Type: MARKER

Full Identifier: **IfcSign.MARKER**

A Sign type formed of a vertical post (possibly with some lettering or symbols) usually used to delimitate distance or the location of some equipment.

Status: Proposed

Package: IfcSharedInfrastructureElements

Predefined Type Properties			
Predefined Type Container		Parent Entity	
Stereotype	«PredefinedType»		
Property sets			

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3.4.4.5.3　Predefined Type: MIRROR

Full Identifier: **IfcSign.MIRROR**

A sign type that provides information via a reflective mirror surface.

Status: Proposed

Package: IfcSharedInfrastructureElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.4.5.4　Predefined Type: PICTORAL

Full Identifier: **IfcSign.PICTORAL**

A sign type formed of a flat plate with some written or symbolic images on it.

Status: Proposed

Package: IfcSharedInfrastructureElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.5　Package: Furnishing Element

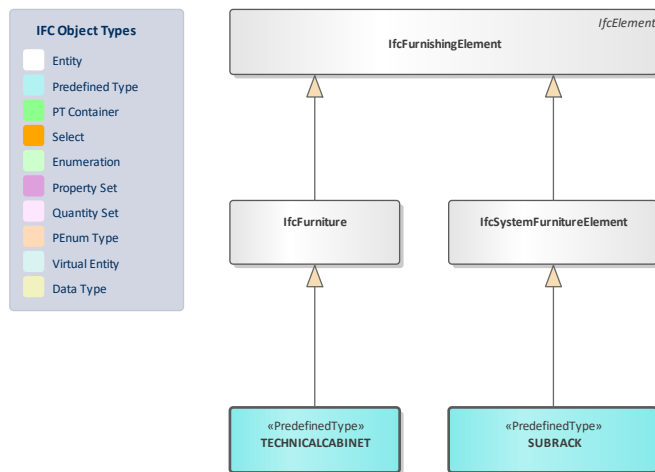### *3.4.5.1　Package: IfcFurnishingElement*

Figure 43: new2_IfcFurnishingElement

3.4.5.1.1   Predefined Type: TECHNICALCABINET

Full Identifier: **IfcFurniture.TECHNICALCABINET**

A technical cabinet is a piece of furniture for holding, displaying and protecting technical appliances, usually organized in shelves, drawers or racks.

Status: Proposed

Package: IfcSharedFacilitiesElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.4.5.1.2   Predefined Type: SUBRACK

Full Identifier: **IfcSystemFurnitureElement.SUBRACK**

A subrack is a part of technical cabinet which is used to store and mount pluggable electric subunits.

Status: Proposed

Package: IfcSharedFacilitiesElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		

RWR_IFC_RAIL_P2_WP4_B

Property sets	

3.5   Package: Positioning Elements

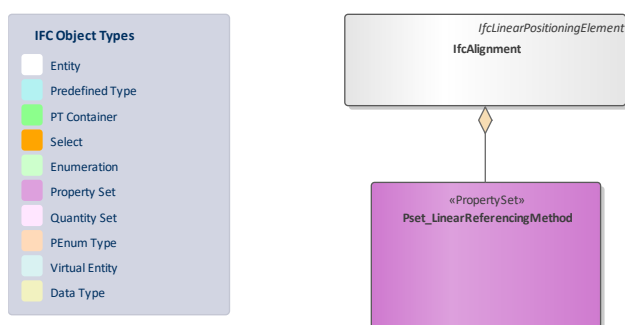### 3.5.1   Package: IfcAlignment

Figure 44: new2_IfcAlignment

3.5.1.1 Class: IfcAlignment

For the purposes of IFC the English term "alignment" defines three essentially separate but closely interconnected concepts.

1. defintion of a reference system for linear positioning

2. safeguarding and optimization of the movement of vehicles - kinematic perspective

3. geometric construction of roads, railway tracks or other linear infrastructure

Reference system for linear positioning

An alignment is used to define a reference system to position elements mainly for linear construction works, such as roads, rails, bridges, and others. The relative positioning along the alignment is defined by the linear referencing methodology.

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> NOTE See ISO 19148 Geographic information – Linear referencing for general definitions about linear referencing.

Kinematic perspective

In the kinematic perspective focus is on the safe and optimized movement of a vehicle under the constraints induced by changes in the direction of the horizontal and the vertical layout.

Geometric perspective

In the geometric perspective the focus is on the proper placement of horizontal and vertical segments to connect certain points along a proposed path. A huge body of knowledge has been developed over a long period of time, in many aspects predating the availability of modern computers and their software.

State of the art in contemporary engineering

1. Contemporary engineering usually establishes first a horizontal layout in a properly projected plane.

2. In a second step the vertical profile (i.e. sequence of segments with constant gradients together with smoothing segments showing a variation in gradient) is added.

3. In the rail domain in most cases a cant layout is added to the horizontal layout to compensate a part of the unwanted lateral acceleration.

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4. In a final step the proposed layout is checked against a defined set of rules, formulas and thresholds to guarantee the conformance against the regulation.

The sequence of steps might change from case to case and might be repeated one or more times to achieve the economic objectives and fulfill regulatory safety requirements.

Contemporary alignment design almost always implements a 2.5 dimension approach.

The resulting and documented geometry might be very precise or just good enough to meet safety thresholds. This depends on factors like priorities of the management, date of the design - existing alignments might have been designed more then 50 years ago - or software tools used. Working with legacy data in a high precision BIM model requires a good understanding of these factors.

Distinction between business modeling and IFC core geometry

According to IFC modeling principles alignment entities are organised in two large parts. The two parts work together, but they can also be used independently from each other

1. Business aspects of alignment

2. Representation with the IFC geometry resources

Business aspects of alignment: Here the focus is a on a schema structure as close to business terminology as possible. It is possible to have a very detailed segment structure with many domain specific properties attached. Examples for domain specific properties are design speed or cant deficiency.

Representation with IFC geometry resources: Here the focus is on using as much of the established IFC geometry entities as possible. A mapping between Business aspects and IFC geometry is proposed.

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IFC modelling

In IFC a single alignment must have:

* a horizontal alignment defined in the x/y plane of the engineering coordinate system

A single alignment may have:

* an accompanying vertical alignment, defined along the horizontal alignment in the distance along / z coordinate space

* a relative alignment, defined as a span within another alignment and/or at constant or variable offsets

* a 3D alignment, either computed from the horizontal and vertical alignment, or extracted from geospatial data.

Alignments may be aggregated into referents (_IfcReferent_) or derivative alignments. Derivative alignments may be used to indicate dependent alignments, such as an alignment for a bridge that is relative to a parent alignment for a road, where the child _IfcAlignment_ may have its shape representation set to _IfcOffsetCurveByDistances_ that starts and ends at a span within the extent of the shape representation of the parent _IfcAlignment_.

Alignments may be assigned to groups using _IfcRelAssignsToGroup_, where _IfcGroup_ or subtypes may capture information common to multiple alignments.

Supported shape representations of IfcAlignment are:

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* _IfcGradientCurve_ as a 3D horizontal and vertical alignment (represented by their alignment segments)

* _IfcCompositeCurve_ as a 2D horizontal alignment (represented by its horizontal alignment segments) without a vertical alignment

* _IfcOffsetCurveByDistances_ as a 2D or 3D curve defined relative to an _IfcAlignmentCurve_ or another _IfcOffsetCurveByDistances_

* _IfcSegmentedReferenceCurve_ as a 3D curve defined relative to an _IfcGradientCurve_ to incorporate the application of cant

* _IfcPolyline_ as a 3D alignment by a 3D polyline representation (such as coming from a survey)

* _IfcPolyline_ as a 2D horizontal alignment by a 2D polyline representation (such as in very early planning phases or as a map representation)

The _RepresentationIdentifier_ shall always be set to ''Axis'' and the _RepresentationType_ shall be set to either ''Curve2D'' or ''Curve3D'' depending on if the referenced curve is 2- or 3-dimensional

> NOTE Derivative specifications (Model View Definitions) may expand the above set to include additional supported curve types.

Status: Proposed

Package: IfcProductExtension

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcLinearPositioningElement	
Subtypes	**EXISTING**	**PROPOSED**

Class Attributes

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Name	Type	Multiplicity	Definition
PredefinedType	IfcAlignmentTypeEnum	[0..1]	

3.5.1.2 Property Set: Pset_LinearReferencingMethod

Describes the manner in which measurements are made along (and optionally offset from) a linear element.

> NOTE Definition according to ISO 19148:2021

<div align="right">

Status: Proposed

</div>

Set Properties			
Applicable Entities		**stereotype**	«PropertySet»

Properties

Name	Type	Multiplicity	Definition
LRMConstraint	IfcLabel	[0..1]	Allows for the specification of constraints imposed by this Linear Referencing Method. For example, a Reference Post Linear Referencing Method may specify that referents be of type \X2\201C\X0\reference marker\X2\201D\X0\. > NOTEdefinition according to ISO 19148:2021
LRMName	IfcLabel	[0..1]	Gives the name of this Linear Referencing Method, such as \X2\201C\X0\kilometre-point\X2\201D\X0\. > NOTEDefinition according to ISO 19148:2021. > > NOTENames of commonly used Linear Referencing Methods are included in ISO 19148, Annex C, along with recognized name aliases.
LRMType	PEnum_LRMType	[0..1]	Gives the type of this Linear Referencing Method. > NOTEDefinition according to ISO 19148:2021, LRMType. > NOTESince the definition in ISO 19148:2021, LRMType is stereotyped as a CodeList it is open for user defined extensions. In this Pset this is

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|			handled by adding the enumeration constant _LRM_USERDEFINED_ and the additional property _UserDefinedLRMType_
LRMUnit	IfcLabel	[0..1]	Specifies the units of measure used by this Linear Referencing Method for measures along the linear element being measured. > NOTEDefinition according to ISO 19148:2021.
UserDefinedLRMType	IfcLabel	[0..1]	Gives the user defined type of this Linear Referencing Method when property _LRMType_ is _LRM_USERDEFINED_.

3.5.2   Package: IfcReferent
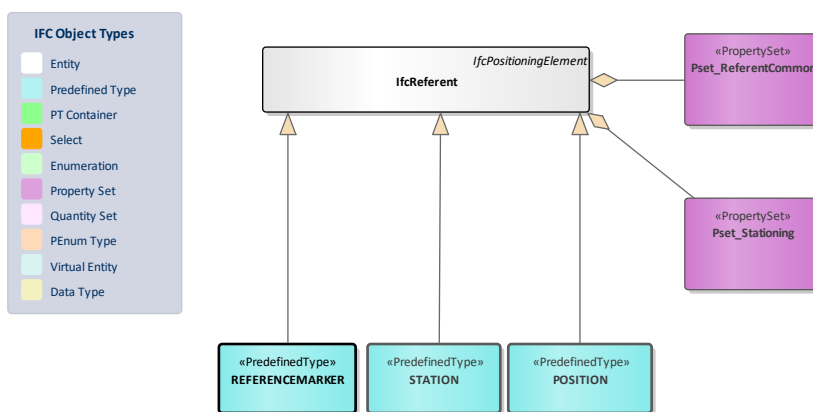
Figure 45: new2_IfcReferent

3.5.2.1 Class: IfcReferent

IfcReferent defines a position at a particular offset along an alignment curve.

Referents may be used for several scenarios:

* positioning physical elements at common locations along an alignment curve (e.g. bridge piers)

* indicating transitions for cross-sections (e.g. beginning of curvature where road is relatively flat, maximum curvature having super-elevated cross-slope to accomodate design speed)

* indicating broken chainage where distance measurements reset or reverse directions

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* indicating domain-specific design parameters (via property sets) at locations along an alignment curve

Status: Proposed

Package: IfcProductExtension

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcPositioningElement	
Subtypes	**EXISTING**	**PROPOSED**
	IfcReferent.LANDMARK	IfcReferent.STATION
	IfcReferent.INTERSECTION	IfcReferent.REFERENCEMARKER
	IfcReferent.BOUNDARY	IfcReferent.POSITION

Class Attributes

Name	Type	Multiplicity	Definition
PredefinedType	IfcReferentTypeEnum	[0..1]	Predefined types to define the particular type of the referent.

3.5.2.2 Predefined Type: POSITION

Full Identifier: **IfcReferent.POSITION**

Used to fully represent and describe a fixed location, relative to which other elements can be positioned using _IfcRelPositions_.

Status: Proposed

Package: IfcProductExtension

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

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3.5.2.3 Predefined Type: REFERENCEMARKER

Full Identifier: **IfcReferent.REFERENCEMARKER**

The reference marker is a notation referent, typically located in the right of way of the road, rail or other transportation system. Usually reference markers are initially spaced at a uniform distance along the linear element being measured, though subsequent re-alignments can result in uneven spacing between the markers.

>NOTEdefinition from ISO 19148:2021

>NOTEThe physical manifestation of the IfcReferent.REFERENCEMARKER can be an IfcSign.MARKER (e.g., a bolt fixed on a post)

Status: Proposed

Package: IfcProductExtension

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.5.2.4 Predefined Type: STATION

Full Identifier: **IfcReferent.STATION**

Represents a linearly measured location along the linear positioning element into which the _IfcReferent_ is nested. The location is described by a station value or a station equation using _Pset_Stationing_ and optionally the method of measurement (_Pset_LinearReferencingMethod_). If a linear referencing method is specified for the STATION referent, it overrides any linear referencing method specified for the alignment.

Status: Proposed

Package: IfcProductExtension

Predefined Type Properties

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Predefined Type Container		Parent Entity	
Stereotype	«PredefinedType»		
Property sets			

3.5.2.5 Property Set: Pset_ReferentCommon

Specifies common properties for _IfcReferent_

Status: Proposed

Set Properties			
Applicable Entities		stereotype	«PropertySet»

Properties

Name	Type	Multiplicity	Definition
NameFormat	IfcLabel	[0..1]	Specifies a reference to or description of the formatting or encoding of the Name attribute of the _IfcReferent_ occurence.

1.1.1.2 Property Set: Pset_Stationing

Specifies stationing parameters for _IfcReferent_.

Status: Proposed

Set Properties			
Applicable Entities		stereotype	«PropertySet»

Properties

Name	Type	Multiplicity	Definition
IncomingStation	IfcLengthMeasure	[0..1]	The optional station value of the incoming segment that ends at this location. This value needs to be set if the intention is to specify a station equation, i.e. a location where stationing changes.
Station	IfcLengthMeasure	[0..1]	The station value at this location.

3.6 Package: Spatial Elements

3.6.1 Package: Spatial Zones
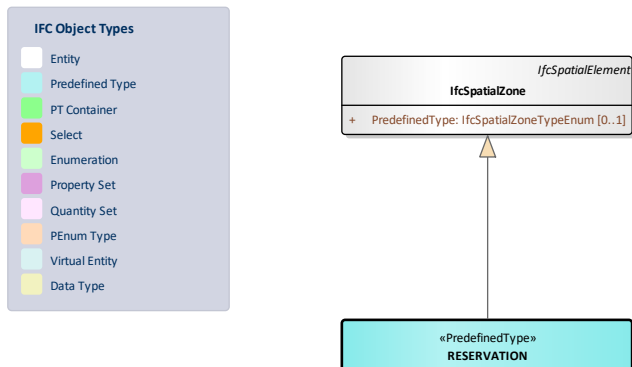
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Figure 46: new2_Spatial Zone

3.6.1.1 Predefined Type: RESERVATION

Full Identifier: **IfcSpatialZone.RESERVATION**

A spatial zone that marks some sort of reservation within the project extent.

Status: Proposed

Package: IfcProductExtension

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.6.2 Package: Spatial Structures

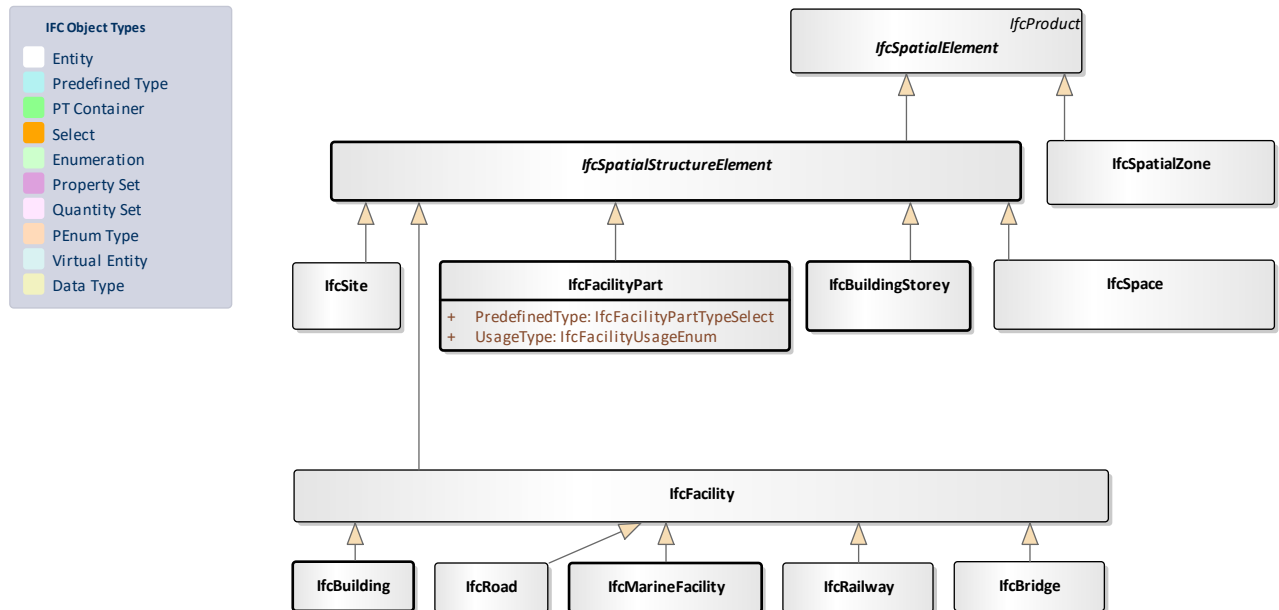### 3.6.2.1 Package: Railway

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Figure 47: new2_Railway

3.6.2.1.1 Class: IfcRailway

An IfcRailway is a spatial structure element as a route from one location to another for guided passage of wheeled vehicles on rails. An IfcRailway acts as a basic spatial structure element that supports to break down a railway project into manageable parts.

Note: Definition according to ISO 6706: 2017: national or regional transport system for guided passage of wheeled vehicles on rails.

Status: Proposed

Package: IfcRailDomain

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement		
Subtype Of	IfcFacility	
Subtypes	EXISTING	PROPOSED

Class Attributes

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Name	Type	Multiplicity	Definition
PredefinedType	IfcRailwayTypeEnum	[0..1]	$

3.6.2.2 Package: Railway Part
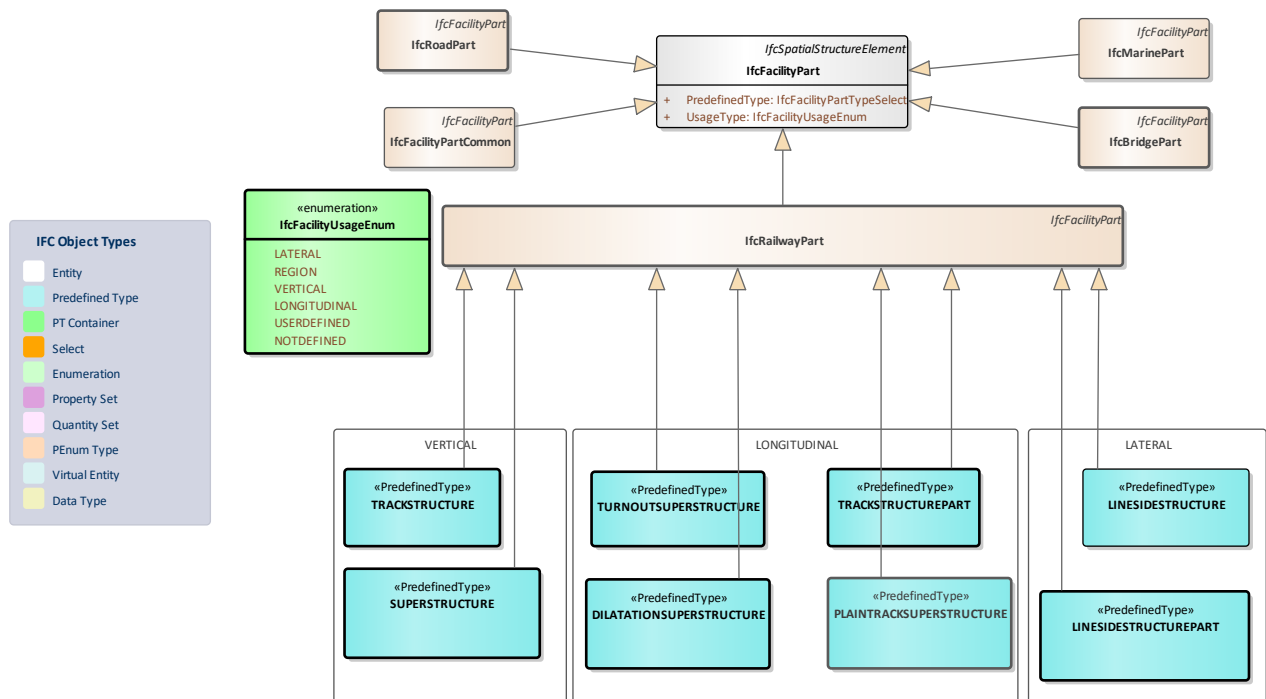

Figure 48: new2_Railway Part

3.6.2.2.1   Class: IfcRailwayPart

Automatically generated by IFC-ModelSearch.TranslatePredefinedType 2022-02-19

Status: Proposed

Package: IfcProductExtension

Class Properties			
Status	Proposed	**Is Abstract**	
Property sets			

Inheritance Statement

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Subtype Of	IfcFacilityPart		
	IfcFacilityPart		
	EXISTING		**PROPOSED**
Subtypes			IfcRailwayPart.TURNOUTSUPERSTRUCTURE
			IfcRailwayPart.TRACKSTRUCTUREPART
			IfcRailwayPart.TRACKSTRUCTURE
			IfcRailwayPart.SUPERSTRUCTURE
			IfcRailwayPart.PLAINTRACKSUPERSTRUCTURE
			IfcRailwayPart.LINESIDESTRUCTUREPART
			IfcRailwayPart.LINESIDESTRUCTURE
			IfcRailwayPart.DILATATIONSUPERSTRUCTURE

3.6.2.2.2   Predefined Type: DILATATIONSUPERSTRUCTURE

Full Identifier: **IfcRailwayPart.DILATATIONSUPERSTRUCTURE**

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Status: Proposed

Package: IfcProductExtension

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.6.2.2.3   Predefined Type: LINESIDESTRUCTURE

Full Identifier: **IfcRailwayPart.LINESIDESTRUCTURE**

Automatically generated by IFC-ModelSearch.TranslatePredefinedType 2022-02-19

Status: Proposed

Package: IfcProductExtension

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.6.2.2.4 Predefined Type: LINESIDESTRUCTUREPART

Full Identifier: **IfcRailwayPart.LINESIDESTRUCTUREPART**

Automatically generated by IFC-ModelSearch.TranslatePredefinedType 2022-02-19

Status: Proposed

Package: IfcProductExtension

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.6.2.2.5 Predefined Type: PLAINTRACKSUPERSTRUCTURE

Full Identifier: **IfcRailwayPart.PLAINTRACKSUPERSTRUCTURE**

Automatically generated by IFC-ModelSearch.TranslatePredefinedType 2022-02-19

Status: Proposed

Package: IfcProductExtension

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.6.2.2.6 Predefined Type: SUPERSTRUCTURE

Full Identifier: **IfcRailwayPart.SUPERSTRUCTURE**

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Status: Proposed

Package: IfcProductExtension

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.6.2.2.7   Predefined Type: TRACKSTRUCTURE

Full Identifier: **IfcRailwayPart.TRACKSTRUCTURE**

Automatically generated by IFC-ModelSearch.TranslatePredefinedType 2022-02-19

Status: Proposed

Package: IfcProductExtension

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.6.2.2.8   Predefined Type: TRACKSTRUCTUREPART

Full Identifier: **IfcRailwayPart.TRACKSTRUCTUREPART**

Automatically generated by IFC-ModelSearch.TranslatePredefinedType 2022-02-19

Status: Proposed

Package: IfcProductExtension

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

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3.6.2.2.9 Predefined Type: TURNOUTSUPERSTRUCTURE

Full Identifier: **IfcRailwayPart.TURNOUTSUPERSTRUCTURE**

Automatically generated by IFC-ModelSearch.TranslatePredefinedType 2022-02-19

Status: Proposed

Package: IfcProductExtension

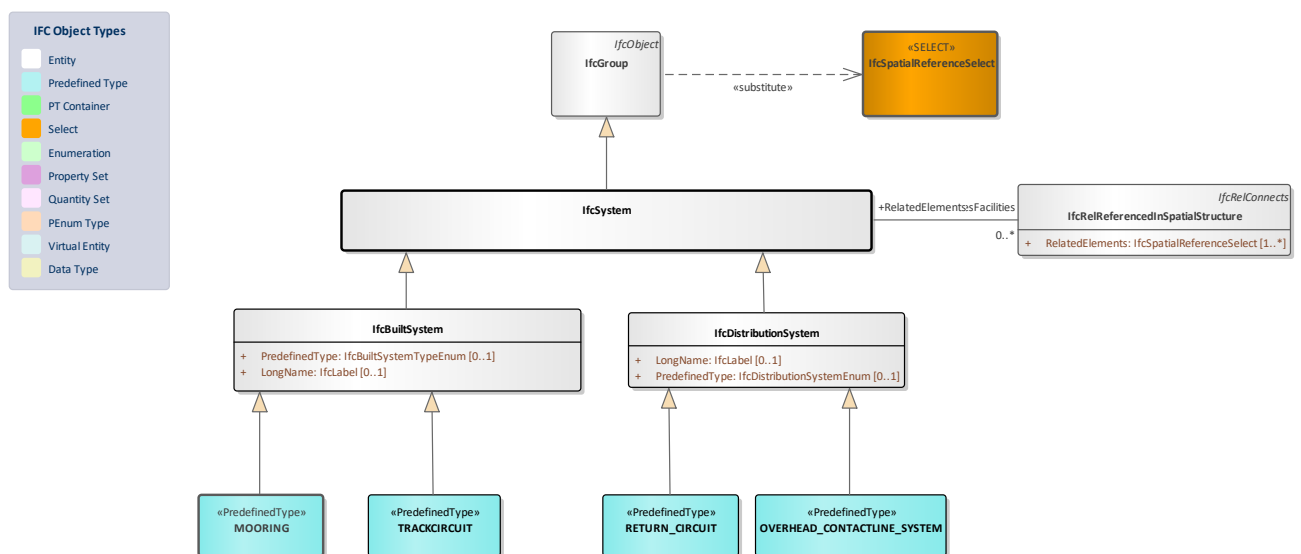| Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.7 Package: Systems

Figure 49: new2_IfcSystem

3.7.1 Predefined Type: MOORING

Full Identifier: **IfcBuiltSystem.MOORING**

System of components and elements responsible for keeping or holding an element (a vessel, platform or set of catenary lines) in a desired position.

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Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.7.2 Predefined Type: TRACKCIRCUIT

Full Identifier: **IfcBuiltSystem.TRACKCIRCUIT**

A track circuit is an electric circuit of which the rails of a track section form a part, with usually a source of current connected at one end and a detection device at the other end for detecting whether this track section is clear or occupied by a vehicle. In a continuous signalling system, the track circuit can be used to transmit information between the ground and the train.

Note: definition from IEC 60050-82.

Status: Proposed

Package: IfcProductExtension

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

3.7.3 Predefined Type: OVERHEAD_CONTACTLINE_SYSTEM

Full Identifier: **IfcDistributionSystem.OVERHEAD_CONTACTLINE_SYSTEM**

An overhead contact line system above the upper limit of the train using an overhead contact line and a catenary system to supply current to traction units.

Status: Proposed

Package: IfcSharedBldgServiceElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	

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Stereotype	«PredefinedType»		
Property sets			

3.7.4 Predefined Type: RETURN_CIRCUIT

Full Identifier: **IfcDistributionSystem.RETURN_CIRCUIT**

A distribution system which forms the intended path for the traction return current and the current under fault conditions.

Status: Proposed

Package: IfcSharedBldgServiceElements

Predefined Type Properties			
Predefined Type Container		**Parent Entity**	
Stereotype	«PredefinedType»		
Property sets			

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