Railway BIM Data Standard

(Version 1.0)

Issued on: 2015-12-29    Implemented on: 2016-01-01

China Railway BIM Alliance
Foreword

In order to share information in different application platforms, different participants and different engineering stages, and to deliver open-format based BIM outcomes to the owners and industry regulators, this standard is developed. This standard is an extension of IFC4x1 in railway engineering domain.

This standard covers the following disciplines in railway engineering: alignment, track, subgrade, bridge, tunnel, station, drainage and geology.

The China Railway BIM Alliance is responsible for the interpretation of this standard. Any feedback of modification and supplement requirements is welcomed by the China Railway BIM Alliance.

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Railway BIM Data Standard  

(Version 1.0)

1. Introduction

1.1 Principle

The development of the standard follows the following principles:

1) "Compatible principle". To achieve the highest compatibility with existing buildingSMART IFC (Industry Foundation Classes) standards and its ongoing extension work.

2) "Portable principle". The proposed standard only stipulates the basic data model of the railway domain. The elements in the model can be used in a variety of technical platforms with multiple coding ways.

3) "Abstract principle". To define the minimum entity set which are most widely understood and used.

4) "Extendable principle". The specific information about the railway engineering can be defined in various information classification standard of different country, regions respectively.

5) "Selectivity principle". Any element defined in this standard is optional to be used in information exchange and storage.

6) "Repeatable principle". Any element defined in this standard is repeatable to be used in data exchange and storage.

7) "Usability principle". The proposed standard is usable for both the human readability and machine readability to achieve the interoperability between software tools.

1.2 Scope

This standard currently covers the following disciplines in railway engineering: alignment, track, subgrade, bridge, tunnel, station, drainage and geology.

1.3 Purpose

This standard applies to the development of Railway BIM Implementation Standard, the development of Railway BIM software and related Railway BIM research.

1.4 Normative References

The following referenced documents are indispensable for the application of this document.


3) GB/T 16656.21-2008, Industrial automation systems and integration - Product data

4) GB/T 25507-2010, Industry foundation classes platform. (ISO 16739: 2013)
5) buildingSMART Industry Foundation Classes IFC4x1
6) buildingSMART Industry Foundation Classes IFC4x1 Alignment Extension

2. Terms, definitions and abbreviations

2.1 Terms and definitions

Entity: class of information defined by common attributes and constraints
Attribute: unit of information within an entity, defined by a particular type or reference to a particular entity
Direct attribute: unit of information directly describing entity characteristics
Inverse attribute: unit of information defining queries for obtaining related data and enforcing referential integrity
Derived attribute: unit of information computed from other values using an expression defined in this schema
Property set: unit of information containing a set of properties
Schema: the definition of the structure to organize data for storage, exchange and sharing, using a formal language
Information model: an abstract semantic representation of concepts and relationships in a certain domain
Spatial structure element: the generalization of all spatial elements that might be used to define a spatial structure
Spatial composition: the composition relationship between the part and the whole of the spatial structure elements
Spatial decomposition: the decomposition relationship between the whole and the parts of the spatial structure elements
Spatial containment: the relationship of a spatial structure element containing the physical elements
Contained in spatial structure: the relationship of physical elements being contained within a spatial structure element.
Entity composition: an aggregation relationship where the element is part of another composite element

EXPRESS-G: a graphical modeling notation, used to identify classes, the data attributes of classes and the relationships that exist between classes

2.2 Abbreviations

AEC/FM  Architecture, Engineering, Construction and Facilities Management
BIM  Building Information Modeling
IFC  Industry Foundation Classes
HVAC  Heating, Ventilation and Air Conditioning
XML  Extensible Markup Language
3.1 Architecture

The architecture of railway engineering information model is based on the IFC standard, and is extended according to the requirements of railway engineering, as shown in Figure 3.1. In the Resource Layer, necessary entities about the alignment model is defined within the geometric resources. In the Product Extension module of the Core Layer, the IfcAlignment entity is defined to represent the alignment of the railway. The module of Shared Railway Elements, which includes the common types, the common spatial structures, the common components and the shared property sets, is added in the Interop Layer. Currently, eight disciplines including Alignment, Geology, Subgrade, Bridge, Tunnel, Drainage, Track and Station are extended in the Domain Layer.

![Figure 3.1 Railway engineering information model architecture](image)

3.2 Railway Engineering Spatial Composition

The spatial structure of railway engineering is illustrated in Figure 3.2. The railway project (IfcProject) may contain one or more railways (IfcRailway) and one or more railway terminals (IfcRailwayTerminal). IfcRailway may consist of one or more alignments (IfcAlignment), one or more tracks (IfcTrack), and one or more sites of tunnel (IfcTunnel), subgrade (IfcSubgrade), bridge
(IfcBridge), station (IfcRailwayStation) and building (IfcBuilding). A railway terminal (IfcRailwayTerminal) may also consist of a series of railways (IfcRailway) and stations (IfcRailwayStation).

Figure 3.2 Railway engineering spatial composition

4. Shared Railway Element Schemas

4.1 Shared Types

4.1.1 IfcGeoElementComponentTypeEnum

This enumeration defines the different predefined types of an IfcGeoElementComponent object.

Enumerated Item Definitions:
ANCHOREDBOLT;
STEELFRAMEUNIT;
GEOTEXTILES;
COMPOSITEGEOMEMBRANE;
GEGRID;
GEOMAT;
PERMEABLEHOSE;
PRESTRESSEDMETALCORRUGATEDPIPE;
SOILNAILING;
USERDEFINED;
NOTDEFINED.
EXPRESS Specification:

TYPE IfcGeoElementComponentTypeEnum = ENUMERATION OF
    (ANCHOREDBOLT,
    STEELFRAMEUNIT,
    GEOTEXTILES,
    COMPOSITEGEOMEMBRANE,
    GEOGRID,
    GEOMAT,
    PERMEABLEHOSE,
    PRESTRESSEDMETALCORRUGATEDPIPE,
    SOILNAILING,
    USERDEFINED,
    NOTDEFINED);
END_TYPE;

4.2 Shared Spatial Structure Elements

Shared spatial structure elements include IfcCivilStructureElement, IfcRailwayStructureElement and IfcRailway. Figure 4.1 shows the inheritance and derived relationships between each other.

Figure 4.1 EXPRESS-G diagram for shared spatial structure elements

4.2.1 IfcCivilStructureElement

IfcCivilStructureElement is inherited from IfcSpatialStructureElement in IFC4 and is the supertype of IfcRailwayStructureElement, IfcSubgradeStructureElement, IfcBridgeStructureElement and IfcTunnelStructureElement.
EXPRESS Specification:

ENTITY IfcCivilStructureElement
SUPERTYPE OF (ONEOF
  (IfcRailwayStructureElement,
   IfcSubgradeStructureElement,
   IfcBridgeStructureElement,
   IfcTunnelStructureElement))
SUBTYPE OF (IfcSpatialStructureElement);
END_ENTITY;

4.2.2 IfcRailwayStructureElement

IfcRailwayStructureElement is inherited from IfcCivilStructureElement and is the supertype of IfcRailway, IfcTrack, IfcTrackPart, IfcRailwayTerminal, IfcRailwayStation and IfcRailwayPlatform.

EXPRESS Specification:

ENTITY IfcRailwayStructureElement
SUPERTYPE OF (ONEOF
  (IfcRailway, IfcTrack, IfcTrackPart, IfcRailwayTerminal, IfcRailwayStation, IfcRailwayPlatform))
SUBTYPE OF (IfcCivilStructureElement);
END_ENTITY;

4.2.3 IfcRailway

IfcRailway is used to define one railway line. Usually, the railway line, which is named independently, non-parallel and requires independent engineering quantity statistics, is appropriate to be defined as an IfcRailway object. An IfcRailway object may contain one, two or more center lines of railway and multiple IfcTrack objects, IfcSubgrade objects, IfcBridge objects, IfcTunnel objects, IfcRailwayStation objects and IfcBuilding objects.

Table 4.1 IfcRailway spatial decomposition

<table>
<thead>
<tr>
<th>Spatial Parts</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTrack</td>
<td>An IfcRailway object may contain multiple IfcTrack objects.</td>
</tr>
<tr>
<td>IfcSubgrade</td>
<td>An IfcRailway object may contain multiple IfcSubgrade objects.</td>
</tr>
<tr>
<td>IfcBridge</td>
<td>An IfcRailway object may contain multiple IfcBridge objects.</td>
</tr>
<tr>
<td>IfcTunnel</td>
<td>An IfcRailway object may contain multiple IfcTunnel objects.</td>
</tr>
<tr>
<td>IfcRailwayStation</td>
<td>An IfcRailway object may contain multiple IfcRailwayStation objects.</td>
</tr>
<tr>
<td>IfcBuilding</td>
<td>An IfcRailway object may contain multiple IfcBuilding objects.</td>
</tr>
</tbody>
</table>

Table 4.2 IfcRailway spatial containment

<table>
<thead>
<tr>
<th>Contained Entities</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcElement</td>
<td>Physical elements can be contained in IfcRailway, but generally should be firstly contained in spatial structure such as IfcBuilding, IfcBridge.</td>
</tr>
</tbody>
</table>
An IfcRailway object may contain multiple IfcAlignment objects.

Table 4.3 Property sets for IfcRailway

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_RailwayProject</td>
</tr>
<tr>
<td></td>
<td>Pset_MainTechnicalStandardOfRailway</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcRailway

  SUBTYPE OF (IfcRailwayStructureElement);

END_ENTITY;

4.3 Shared Components

Shared components include IfcCivilElementComponent, IfcRailwayElementComponent and IfcGeoElementComponent. IfcCivilElementComponent is inherited from IfcElementComponent. IfcRailwayElementComponent and IfcGeoElementComponent are inherited from IfcCivilElementComponent, as shown in Figure 4.2.

![Figure 4.2 EXPRESS-G diagram for shared components](image)

4.3.1 IfcCivilElementComponent

IfcCivilElementComponent is the supertype of all the components in civil engineering.

**EXPRESS Specification:**

ENTITY IfcCivilElementComponent

  SUPERTYPE OF (ONEOF

  (IfcRailwayElementComponent,
   IfcGeoElementComponent))

  SUBTYPE OF (IfcElementComponent);

END_ENTITY;

4.3.2 IfcRailwayElementComponent

IfcRailwayElementComponent is the supertype of all the components in railway engineering. Currently, IfcRailwayElementComponent is the supertype of IfcTrackElementComponent and IfcEarthingTerminal.
EXPRESS Specification:
ENTITY IfcRailwayElementComponent
SUPERTYPE OF (ONEOF
   (IfcTrackElementComponent,
   IfcEarthingTerminal))
SUBTYPE OF (IfcCivilElementComponent);
END_ENTITY;

4.3.3 IfcGeoElementComponent

IfcGeoElementComponent defines components relating to geotechnical engineering such as anchor bolts, geotextiles and soil nailing. Specific types of IfcGeoElementComponent are defined by IfcGeoElementComponentTypeEnum.

Table 4.4 Property sets for IfcGeoElementComponent

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANCHOREDBOLT</td>
<td>Pset_ANCHOREDBOLT</td>
</tr>
</tbody>
</table>

EXPRESS Specification:
ENTITY IfcGeoElementComponent
SUPERTYPE OF (IfcCivilElementComponent);
PredefinedType: IfcGeoElementComponentTypeEnum;
END_ENTITY;

Attribute definitions:
PredefinedType: IfcGeoElementComponent is subdivided into anchored bolt, steel frame unit, geotextile, composite geomembrane, geogrid, geomat, permeable hose, prestressed metal corrugated pipe, soil nailing, etc.

4.4 Shared Property Sets

4.4.1 Pset_RailwayProject

Name: Pset_RailwayProject
Applicable Entities: IfcRailway
Description: Properties common to all occurrences of IfcRailway.
Property Definitions: See Table 4.5.

Table 4.5 Property definitions of Pset_RailwayProject

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DesignedPeriod</td>
<td>TypePropertySingleValue/IfcInteger/Year</td>
<td>Designed period. Indicates the period designed to forecast traffic volume and determine equipment scale.</td>
</tr>
<tr>
<td>TargetSpeed</td>
<td>TypePropertySingleValue/IfcInteger/(Km/h)</td>
<td>The maximum target speed.</td>
</tr>
</tbody>
</table>
### 4.4.2 Pset_MainTechnicalStandardOfRailway

**Name:** Pset_MainTechnicalStandardOfRailway

**Applicable Entities:** IfcRailway

**Description:** Properties related to main technical standard of railways.

**Property Definitions:** See Table 4.6.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NumberOfTrack</strong></td>
<td>TypePropertyEnumeratedValue/PEnum_NumberOfTrack:SingleTrackRailway,DoubleTrackRailway</td>
<td>Number of tracks.</td>
</tr>
<tr>
<td><strong>ModeOfTraction</strong></td>
<td>TypePropertyEnumeratedValue/PEnum_ModeOfTraction:Electric Locomotive,InternalCombustion,StreamLocomotive</td>
<td>Mode of traction.</td>
</tr>
<tr>
<td><strong>BlockSystem</strong></td>
<td>TypePropertyEnumeratedValue/PEnum_BlockSystem:AutomaticBlock,SemiAutomaticBlock,AutomaticInterStationblock</td>
<td>Type of section block.</td>
</tr>
<tr>
<td><strong>RulingGrade</strong></td>
<td>TypePropertySingleValue/IfcReal</td>
<td>Ruling grade.</td>
</tr>
<tr>
<td><strong>TractionMass</strong></td>
<td>TypePropertySingleValue/IfcReal/t</td>
<td>Traction mass.</td>
</tr>
<tr>
<td><strong>MinimumRadiusOfCurveNormal</strong></td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The minimum radius of curve in normal condition.</td>
</tr>
<tr>
<td>Property</td>
<td>Type</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------------------------------</td>
<td>---------------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>MinimumRadiusOfCurveDifficult</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The minimum radius of curve in difficult condition.</td>
</tr>
<tr>
<td>EffectiveLengthOfReceivingDepatureTrack</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Effective length of receiving-depature track.</td>
</tr>
<tr>
<td>MinimumRadiusOfVerticalCurve</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The minimum radius of vertical curve.</td>
</tr>
<tr>
<td>MinimumSlopeLength</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The minimum slope length.</td>
</tr>
<tr>
<td>MaximumGradientDifference</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The maximum gradient difference.</td>
</tr>
<tr>
<td>MinimumClipStraightLine</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The minimum clip straight line.</td>
</tr>
<tr>
<td>MinimumGradientDifferenceToSetVerticalCurve</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The minimum gradient difference to set vertical curve.</td>
</tr>
</tbody>
</table>

4.4.3 Pset_ConcreteElementGeneral

Name: Pset_ConcreteElementGeneral


Description: Properties common to all occurrences of concrete elements.

Property Definitions: See Table 4.7.

Table 4.7 Property definitions of Pset_ConcreteElementGeneral

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ConstructionMethod</td>
<td>TypePropertyEnumeratedValue/PEnum_ConstructionMethod:In-Situ,Precast</td>
<td>Indicates whether the concrete element is constructed on site or prefabricated. Allowed values are: 'In-Situ' vs 'Precast'.</td>
</tr>
<tr>
<td>StructuralClass</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The structural class defined for the concrete structure.</td>
</tr>
<tr>
<td>StrengthClass</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Classification of the concrete strength.</td>
</tr>
<tr>
<td>ExposureClass</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Classification of exposure to environmental conditions.</td>
</tr>
<tr>
<td>ReinforcementVolumeRatio</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The required ratio of the effective mass of the reinforcement to the effective volume of the concrete of a</td>
</tr>
<tr>
<td>Property</td>
<td>Type</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>ReinforcementAreaRatio</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The required ratio of the effective area of the reinforcement to the effective area of the concrete. At any section of a reinforced concrete structural element.</td>
</tr>
<tr>
<td>DimensionalAccuracyClass</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Classification designation of the dimensional accuracy requirement according to local standards.</td>
</tr>
<tr>
<td>ConcreteCover</td>
<td>TypePropertySingleValue/IfcLength/m</td>
<td>The protective concrete cover at the reinforcing bars according to local building regulations.</td>
</tr>
<tr>
<td>ConcreteCoverAtMainBars</td>
<td>TypePropertySingleValue/IfcLength/m</td>
<td>The protective concrete cover at the main reinforcing bars according to local building regulations.</td>
</tr>
<tr>
<td>ConcreteCoverAtLinks</td>
<td>TypePropertySingleValue/IfcLength/m</td>
<td>The protective concrete cover at the reinforcement links according to local building regulations.</td>
</tr>
<tr>
<td>ReinforcementStrengthClass</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Classification of the reinforcement strength.</td>
</tr>
<tr>
<td>ConcreteAge</td>
<td>TypePropertySingleValue/IfcTime/td</td>
<td>Age of the concrete.</td>
</tr>
<tr>
<td>CrackWidth</td>
<td>TypePropertySingleValue/IfcLength/m</td>
<td>Width of the crack.</td>
</tr>
<tr>
<td>NetConcreteCover</td>
<td>TypePropertySingleValue/IfcLength/m</td>
<td>Net concrete cover.</td>
</tr>
<tr>
<td>Degree of prestressing</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Degree of prestressing.</td>
</tr>
<tr>
<td>Effective prestress</td>
<td>TypePropertySingleValue/IfcPressure/Pa</td>
<td>Effective prestress.</td>
</tr>
</tbody>
</table>

4.4.4 Pset_PrecastConcreteElementFabrication

Name: Pset_PrecastConcreteElementFabrication

Applicable Entities: IfcBridgePart, IfcTrackSleeper, IfcTrackSlab

Description: Properties related to precast concrete fabrication.
Property Definitions: See Table 4.8.

**Table 4.8 Property definitions of Pset_PrecastConcreteElementFabrication**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TypeDesignator</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Type designator for the precast concrete element.</td>
</tr>
<tr>
<td>ProductionLotId</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The manufacturer's production lot identifier.</td>
</tr>
<tr>
<td>SerialNumber</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The manufacturer's serial number for the precast concrete element.</td>
</tr>
<tr>
<td>PieceMark</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Defines a unique piece for production purposes.</td>
</tr>
<tr>
<td>AsBuiltLocationNumber</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Defines a unique location within a structure, the ‘slot’ into which the piece was installed.</td>
</tr>
<tr>
<td>ActualProductionDate</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Production date.</td>
</tr>
<tr>
<td>ActualErectionDate</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Date erected.</td>
</tr>
</tbody>
</table>

**4.4.5 Pset_PrecastConcreteElementGeneral**

Name: Pset_PrecastConcreteElementGeneral

Applicable Entities: IfcBridgePart, IfcTrackSleeper, IfcTrackSlab

Description: Properties common to all occurrences of precast concrete elements.

Property Definitions: See Table 4.9.

**Table 4.9 Property definitions of Pset_PrecastConcreteElementGeneral**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TypeDesignator</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Type designator for the precast concrete element.</td>
</tr>
<tr>
<td>CornerChamfer</td>
<td>TypePropertySingleValue/IfcPositiveLengthMeasure/m</td>
<td>The chamfer in the corners of the precast element.</td>
</tr>
<tr>
<td>ManufacturingToleranceClass</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Classification designation of the manufacturing tolerances.</td>
</tr>
<tr>
<td>FormStrippingStrength</td>
<td>TypePropertySingleValue/IfcPressureMeasure/Pa</td>
<td>The minimum required compressive strength of the concrete at form stripping time.</td>
</tr>
<tr>
<td>FreezingResistanceStrength</td>
<td>TypePropertySingleValue/IfcPressureMeasure/Pa</td>
<td>Freezing resistance strength.</td>
</tr>
<tr>
<td>Property</td>
<td>Type</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>-------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>LiftingStrength</td>
<td>TypePropertySingleValue/IfcPressureMeasure/Pa</td>
<td>The minimum required compressive strength of the concrete when the concrete element is lifted.</td>
</tr>
<tr>
<td>ReleaseStrength</td>
<td>TypePropertySingleValue/IfcPressureMeasure/Pa</td>
<td>The minimum required compressive strength of the concrete when the tendon stress is released.</td>
</tr>
<tr>
<td>MinimumAllowableSupportLength</td>
<td>TypePropertySingleValue/IfcPositiveLengthMeasure/m</td>
<td>The minimum allowable support length.</td>
</tr>
<tr>
<td>InitialTension</td>
<td>TypePropertySingleValue/IfcPressureMeasure/Pa</td>
<td>The initial stress of the tendon.</td>
</tr>
<tr>
<td>TendonRelaxation</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The minimum required compressive strength of the concrete required for transportation.</td>
</tr>
<tr>
<td>TransportationStrength</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Textual description of how the concrete element is supported during transportation.</td>
</tr>
<tr>
<td>SupportDuringTransportDescription</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Reference to an external document defining how the concrete element is supported during transportation.</td>
</tr>
<tr>
<td>SupportDuringTransportDocReference</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>A descriptive label for how the hollow core ends are treated.</td>
</tr>
<tr>
<td>HollowCorePlugging</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The camber deflection, measured from the midpoint of a cambered face of a piece to the midpoint of the chord joining the ends of the same face.</td>
</tr>
<tr>
<td>CamberAtMidspan</td>
<td>TypePropertySingleValue/IfcPositiveLengthMeasure/m</td>
<td>The angle, in radians, by which the formwork at the starting face of a piece is to be rotated from the vertical in order to compensate for the</td>
</tr>
<tr>
<td>BatterAtStart</td>
<td>TypePropertySingleValue/IfcCurvatureMeasure/(rad/m)</td>
<td></td>
</tr>
</tbody>
</table>
rotation of the face that will occur once the piece is stripped from its form, inducing camber due to eccentric prestressing.

<table>
<thead>
<tr>
<th>Property</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BatterAtEnd</td>
<td>TypePropertySingleValue/IfcCurvature Measure/(rad/m)</td>
<td>The angle, in radians, by which the formwork at the ending face of a piece is to be rotated from the vertical in order to compensate for the rotation of the face that will occur once the piece is stripped from its form, inducing camber due to eccentric prestressing.</td>
</tr>
<tr>
<td>Twisting</td>
<td>TypePropertySingleValue/IfcCurvature Measure/(rad/m)</td>
<td>The angle, in radians, through which the end face of a precast piece is rotated with respect to its starting face, along its longitudinal axis, as a result of non-aligned supports.</td>
</tr>
<tr>
<td>Shortening</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The ratio of the distance by which a precast piece is shortened after release from its form to its original length.</td>
</tr>
<tr>
<td>PieceMark</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>A unique piece for production purposes.</td>
</tr>
<tr>
<td>DesignLocationNumber</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>A unique location within a structure.</td>
</tr>
</tbody>
</table>

4.4.6 Pset_GeologicalCondition

Name: Pset_GeologicalCondition

Applicable Entities: IfcBridge, IfcTunnel, IfcBridgePart

Description: Properties related to geological condition.

Property Definitions: See Table 4.10.

Table 4.10 Property definitions of Pset_GeologicalCondition

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BasicSeismicIntensity</td>
<td>TypePropertyEnumeratedValue/PEnum_BasicSeismicIntensity: level6, level7, level8, level9</td>
<td>Basic seismic intensity.</td>
</tr>
</tbody>
</table>
SeismicPeakGroundAcceleration  | TypePropertySingleValue/IfcAccelerationMeasure/(m/s²) | Seismic peak ground acceleration.  
SeismicGroundMotionParameterZonation  | TypePropertyEnumeratedValue/PEnum_SeismicGroundMotionParameterZonation:Region1, Region2, Region3 | Seismic ground motion parameter zonation.  
CharacteristicPeriodOfTheSeismicResponseSpectrum  | TypePropertyEnumeratedValue/PEnum_CharacteristicPeriodOfTheSeismicResponseSpectrum: 0.25, 0.3, 0.35, 0.4, 0.45, 0.55, 0.65, 0.75, 0.9 | Characteristic period of the seismic response spectrum.  
SiteCategory  | TypePropertyEnumeratedValue/PEnum_SiteCategory: I, II, III, IV | Site category.  
Classification of Surrounding Rock  | TypePropertyEnumeratedValue/PEnum_Classificationofsurroundingrock: II, III,IV, V, VI | Classification of surrounding rock.  
GroundwaterCorrosion  | TypePropertySingleValue/IfcLabel | Groundwater corrosion.  
Coldest Month of The Average Temperature  | TypePropertySingleValue/IfcThermodynamicTemperatureMeasure/ºC | The coldest month of the average temperature.  
Frozen Depth of Soil  | TypePropertySingleValue/IfcLengthMeasure/m | The frozen depth of soil.  

### 4.4.7 Pset_StandardDrawingNumber

**Name:** Pset_StandardDrawingNumber  
**Applicable Entities:** IfcBridge, IfcBridgePart, IfcBridgeBearing, IfcExpansionInstallation, IfcPipe  
**Description:** The number of standard drawing.  
**Property Definitions:** See Table 4.11.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>StandardDrawingNumberType</td>
<td>TypePropertyEnumeratedValue/IfcLabel/PEnum_StandardDrawingNumberType:MinisterialLevelStandardDrawing,EnterpriseLevelStandardDrawing,ProjectLevelStandardDrawing,Others</td>
<td>Type of the standard drawing.</td>
</tr>
<tr>
<td>StandardDrawingNumber</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Number of the standard drawing.</td>
</tr>
</tbody>
</table>

### 4.4.8 Pset_RailwayElementCommon

**Name:** Pset_RailwayElementCommon  
**Applicable Entities:** IfcCivilElement, IfcCivilStructureElement, IfcPipeSegment  
**Description:** Common properties of all occurrences of railway.  
**Property Definitions:** See Table 4.12.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference</td>
<td>TypePropertySingleValue/IfcIdentifier</td>
<td>Reference.</td>
</tr>
<tr>
<td>Status</td>
<td>TypePropertyEnumeratedValue/IfcLabel/PEnum_RailwayElementStatus:NEW,EXISTING,DEM</td>
<td>The status of railway elements.</td>
</tr>
</tbody>
</table>
4.4.9 Pset_ANCHOREDBOLT

Name: Pset_ANCHOREDBOLT

Applicable Entities: IfcGeoElementComponent/ ANCHOREDBOLT

Description: Properties common to different types of anchored bolts.

Property Definitions: See Table 4.13.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>anchorholediameter</td>
<td>TypePropertySingleValue /IfcLengthMeasure/m</td>
<td>Diameter of anchor hole</td>
</tr>
<tr>
<td>boltdiameter</td>
<td>TypePropertySingleValue /IfcLengthMeasure/m</td>
<td>Diameter of bolt</td>
</tr>
<tr>
<td>anchorlength</td>
<td>TypePropertySingleValue /IfcLengthMeasure/m</td>
<td>Length of anchor</td>
</tr>
</tbody>
</table>

5. Alignment Schema

This schema refers to IFC4x1 Alignment Extension which is released by buildingSMART in 2015. We seek to keep consistent with existed buildingSMART standards as much as possible.

In IFC4x1 Alignment Extension, linear reference is used to position elements. In this schema, chainage system is introduced to adapt to China railway engineering.

In IFC4x1 Alignment Extension, IfcClothoidalArcSegment2D is defined as transition curve. In this schema, IfcTransitionCurve2D is defined to represent universal transition curves.

5.1 Schema Definition

All the entities defined in the alignment schema are shown in Table 5.1.

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IfcAlignment</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>IfcAlignment2DHorizontal</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>IfcAlignment2DVertical</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>IfcAlignment2DSegment</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>IfcAlignment2DHorizontalSegment</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>IfcAlignment2DVerticalSegment</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>IfcCurveSegment2D</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>IfcLineSegment2D</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>IfcCircularArcSegment2D</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>IfcTransitionCurve2D</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>IfcAlignment2DVerSegLine</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>IfcAlignment2DVerSegCircularArc</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>IfcAlignment2DVerSegParabolicArc</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>IfcChainageSystem</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>IfcChainageSystemSegment</td>
<td></td>
</tr>
</tbody>
</table>
IfcAlignment is used to define a reference system to position elements mainly for linear construction works, such as roads, rails, etc. IfcAlignment is composed of IfcAlignment2DHorizontal, IfcAlignment2DVertical and IfcChainageSystem. The alignment in 3D space is combined by IfcAlignment2DHorizontal and IfcAlignment2DVertical.

An IfcAlignment2DHorizontal is a linear reference projected onto the horizontal x/y plane, which is composed of a group of consecutively connected IfcAlignment2DHorizontalSegments. Each IfcAlignment2DHorizontalSegment has an IfcCurveSegment2D. IfcCurveSegment2D can be divided into IfcLineSegment2D, IfcCircularArcSegment2D and IfcTransitionCurve2D. The adjacent IfcAlignment2DHorizontalSegments may have tangential continuity or point continuity.

An IfcAlignment2DVertical is an elevation profile along the horizontal alignment, which is composed of a group of consecutively connected IfcAlignment2DVerticalSegments. IfcAlignment2DVertical can be divided into IfcAlignment2DVerSegLine, IfcAlignment2DVerSegCircularArc and IfcAlignment2DVerSegParabolicArc. The adjacent IfcAlignment2DVerticalSegments may have tangential continuity or point continuity.

IfcChainageSystem is defined by a group of consecutively connected IfcChainageSystemSegments.

Figure 5.1 shows the relationships of all the classes in this alignment schema.
Figure 5.1 EXPRESS-G diagram for alignment
5.2 Type Definition

5.2.1 IfcAlignmentTypeEnum
IfcAlignmentTypeEnum defines the different types of reference methods to locate by referencing this alignment.

Enumerated Item Definitions:

ABSOLUTE;
CHAINAGESYSTEM;
USERDEFINED;
NOTDEFINED.

EXPRESSION Specification:

TYPE IfcAlignmentTypeEnum =ENUMERATION OF
  (ABSOLUTE
   ,CHAINAGESYSTEM
   ,USERDEFINED
   ,NOTDEFINED
  );

5.2.2 IfcTransitionCurveTypeEnum
IfcTransitionCurveTypeEnum defines the different types of transition curves.

Enumerated Item Definitions:

BLOSSCURVE;
CLOTHOIDCURVE;
SINUSOIDALCURVE;
COSINSOIDALCURVE;
CUBICPARABOLAS;
USERDEFINED;
NOTDEFINED.

EXPRESSION Specification:

TYPE IfcTransitionCurveTypeEnum =ENUMERATION OF
  (BLOSSCURVE
   ,CLOTHOIDCURVE
   ,SINUSOIDALCURVE
   ,COSINSOIDALCURVE
   ,CUBICPARABOLAS
   ,USERDEFINED
   ,NOTDEFINED
  );
5.3 Entity Definition

5.3.1 IfcAlignment

5.3.1.1 Entity definition

IfcAlignment is used to define a reference system to position elements mainly for linear construction works, such as roads, rails, etc. IfcAlignment is a subtype of IfcPositioningElement, which is composed of IfcAlignment2DHorizontal, IfcAlignment2DVertical and IfcChainageSystem. Usually, the alignment in 3D space is combined by the horizontal and vertical alignment. An IfcAlignment2DHorizontal is a linear reference projected onto the horizontal x/y plane. An IfcAlignment2DVertical is an elevation profile along the horizontal alignment. The horizontal alignment can be shared by several alignments with its own vertical alignments.

Valid representations of IfcAlignment include:

(1) a complete definition including a single horizontal, vertical (represented by their alignment segments) and a 3D alignment;
(2) a definition including a single horizontal and vertical alignment (represented by their alignment segments) without a generated 3D alignment;
(3) a definition only including a horizontal alignment (represented by its horizontal alignment segments) without a vertical and 3D alignment;
(4) a definition only including a horizontal alignment by a simple 2D line representation without alignment segments (such as in very early planning phases or as a map representation);
(5) a definition only including a 3D alignment (such as coming from a survey) without horizontal and vertical alignment segments.

An IfcGroup entity can aggregate corresponding alignments to form an alignment system.

5.3.1.2 Attribute definitions

<table>
<thead>
<tr>
<th>#</th>
<th>Attribute</th>
<th>Type</th>
<th>Cardinality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PredefinedType</td>
<td>IfcAlignmentTypeEnum</td>
<td>[0:1]</td>
<td>Reference methods, see definition in 5.2.1.</td>
</tr>
<tr>
<td>2</td>
<td>Horizontal</td>
<td>IfcAlignment2DHorizontal</td>
<td>[0:1]</td>
<td>Horizontal alignment</td>
</tr>
<tr>
<td>3</td>
<td>Vertical</td>
<td>IfcAlignment2DVertical</td>
<td>[0:1]</td>
<td>Vertical alignment</td>
</tr>
<tr>
<td>4</td>
<td>LinearRefMethod</td>
<td>IfcLabel</td>
<td>[0:1]</td>
<td>Descriptive names for the Linear Referencing Method used to position items along the alignment.</td>
</tr>
</tbody>
</table>

5.3.1.3 EXPRESS specification

ENTITY IfcAlignment
SUBTYPE OF (IfcPositioningElement);
PredefinedType: OPTIONAL IfcAlignmentTypeEnum;
Horizontal: OPTIONAL IfcAlignment2DHorizontal;
Vertical: OPTIONAL IfcAlignment2DVertical;
LinearRefMethod: OPTIONAL IfcLabel;
WHERE ValidCombination: (EXISTS(Horizontal) AND EXISTS(Vertical)) OR (EXISTS(Horizontal) AND NOT(EXISTS(Vertical))) OR (NOT(EXISTS(Horizontal)) AND NOT(EXISTS(Vertical))); END_ENTITY;

5.3.2 IfcAlignment2DHorizontal

5.3.2.1 Entity definition

An IfcAlignment2DHorizontal is a linear reference projected onto the horizontal x/y plane. The horizontal alignment is defined by segments (IfcAlignment2DHorizontalSegment) that are consecutively connected. Each IfcAlignment2DHorizontalSegment contains an IfcCurveSegment2D. By default, the tangential continuity is used between adjacent IfcAlignment2DHorizontalSegments, but a point continuity is also allowed.

5.3.2.2 Attribute definitions

<table>
<thead>
<tr>
<th>#</th>
<th>Attribute</th>
<th>Type</th>
<th>Cardinality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>StartDistAlong</td>
<td>IfcLengthMeasure</td>
<td>[0:1]</td>
<td>The value of the distance along the start of the horizontal alignment. If omitted (standard) it is set to zero.</td>
</tr>
<tr>
<td>2</td>
<td>Segments</td>
<td>IfcAlignment2DHorizontalSegment</td>
<td>L[1:?]</td>
<td>An ordered list of unique horizontal alignment segments, each (but the last) are connected end to start.</td>
</tr>
<tr>
<td>3</td>
<td>ChainageSystem</td>
<td>IfcChainageSystem</td>
<td>[0:1]</td>
<td>Chainage System. If omitted, the chainage value at the start point is 0, and the value at the end point is the value of length of the alignment.</td>
</tr>
<tr>
<td>4</td>
<td>ToAlignment</td>
<td>IfcAlignment@Horizontal</td>
<td>S[1:?]</td>
<td>Link to the IfcAlignment for which it defines the horizontal alignment. More than one IfcAlignment can be linked – in this case, the horizontal alignment is shared by several alignments with its own vertical alignments.</td>
</tr>
</tbody>
</table>
5.3.2.3 EXPRESS specification

ENTITY IfcAlignment2DHorizontal;
  StartDistAlong: OPTIONAL IfcLengthMeasure;
  Segments: LIST [1:?] OF IfcAlignment2DHorizontalSegment;
  ChainageSystem: OPTIONAL IfcChainageSystem;
  INVERSE
  ToAlignment: SET [1:?] OF IfcAlignment FOR Horizontal;
END_ENTITY;

5.3.3 IfcAlignment2DVertical

5.3.3.1 Entity definition

An IfcAlignment2DVertical is an elevation profile along the horizontal alignment. The vertical alignment is defined by segments (IfcAlignment2DVerticalSegment) that are connected end-to-start. The transition at the segment connection is tangential continuity by default, but a point continuity is also allowed.

5.3.3.2 Attribute definitions

<table>
<thead>
<tr>
<th>#</th>
<th>Attribute</th>
<th>Type</th>
<th>Cardinality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Segments</td>
<td>IfcAlignment2DVerticalSeg</td>
<td>L[1:?]</td>
<td>An ordered list of unique vertical alignment segments, each (but the last) are joined end-to-start</td>
</tr>
<tr>
<td>2</td>
<td>ToAlignment</td>
<td>IfcAlignment@Vertical</td>
<td>S[1:1]</td>
<td>Link to the IfcAlignment for which it defines the vertical alignment. Only one IfcAlignment can be linked, a vertical alignment can not be shared by several alignments.</td>
</tr>
</tbody>
</table>

5.3.3.3 EXPRESS specification

ENTITY IfcAlignment2DVertical;
  Segments: LIST [1:?] OF IfcAlignment2DVerticalSegment;
  INVERSE
  ToAlignment: SET[1:1] OF IfcAlignment FOR Vertical;
END_ENTITY;

5.3.4 IfcAlignment2DSegment

5.3.4.1 Entity definition

IfcAlignment2DSegment is an abstract entity defining common information about horizontal and vertical alignment segments, which is the supertype of
IfcAlignment2DHorizontalSegment and IfcAlignment2DVerticalSegment. It is an abstract class which means it cannot be instantiated.

5.3.4.2 Attribute definitions

<table>
<thead>
<tr>
<th>#</th>
<th>Attribute</th>
<th>Type</th>
<th>Cardinality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TangentialContinuity</td>
<td>IfcBoolean</td>
<td>[0:1]</td>
<td>Connectivity between the continuous segments is not enforced to be tangential. Setting &quot;TangentialContinuity&quot; to True means that the current segment shall continue with tangential continuity to the previous one.</td>
</tr>
<tr>
<td>2</td>
<td>StartTag</td>
<td>IfcLabel</td>
<td>[0:1]</td>
<td>Tag to annotate the start point of the alignment segment.</td>
</tr>
<tr>
<td>3</td>
<td>EndTag</td>
<td>IfcLabel</td>
<td>[0:1]</td>
<td>Tag to annotate the end point of the alignment segment.</td>
</tr>
</tbody>
</table>

5.3.4.3 EXPRESS specification

ENTITY IfcAlignment2DSegment

ABSTRACT SUPERTYPE OF (ONEOF(IfcAlignment2DHorizontalSegment, IfcAlignment2DVerticalSegment));

   TangentialContinuity: OPTIONAL IfcBoolean;
   StartTag: OPTIONAL IfcLabel;
   EndTag: OPTIONAL IfcLabel;

END_ENTITY;

5.3.5 IfcAlignment2DHorizontalSegment

5.3.5.1 Entity definition

IfcAlignment2DHorizontal is composed of a list of IfcAlignment2DHorizontalSegments. IfcAlignment2DHorizontalSegment is a subtype of IfcAlignment2DSegment, defined in the x/y coordinate space. An IfcAlignment2DHorizontalSegment contains an IfcCurveSegment2D to represent its geometrical information.

5.3.5.2 Attribute definitions

<table>
<thead>
<tr>
<th>#</th>
<th>Attribute</th>
<th>Type</th>
<th>Cardinality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CurveGeometry</td>
<td>IfcCurveSegment2D</td>
<td>[1:1]</td>
<td>Geometric representation of the horizontal alignment within the 2D X/Y coordinate space.</td>
</tr>
<tr>
<td>2</td>
<td>ToHorizontal</td>
<td>IfcAlignment2DHorizontal@Segments</td>
<td>S[1:1]</td>
<td>Link to the IfcAlignment2DHorizontal to which this horizontal segment belongs.</td>
</tr>
</tbody>
</table>
### 5.3.5.3 EXPRESS specification

ENTITY IfcAlignment2DHorizontalSegment
  SUBTYPE OF (IfcAlignment2DSegment);
  CurveGeometry: IfcCurveSegment2D;
  INVERSE
  ToHorizontal: SET[1:1] OF IfcAlignment2DHorizontal FOR Segments;
END_ENTITY;

### 5.3.6 IfcAlignment2DVerticalSegment

#### 5.3.6.1 Entity definition

An IfcAlignment2DVertical is composed of a set of IfcAlignment2DVerticalSegments. As an abstract class, IfcAlignment2DVerticalSegment is the supertype of IfcAlignment2DVerSegLine and IfcAlignment2DVerSegCircularArc, defining some common information.

#### 5.3.6.2 Attribute definitions

<table>
<thead>
<tr>
<th>#</th>
<th>Attribute</th>
<th>Type</th>
<th>Cardinality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>StartDistAlong</td>
<td>IfcLengthMeasure</td>
<td>[1:1]</td>
<td>Distance from the start point of the alignment, along the horizontal alignment.</td>
</tr>
<tr>
<td>2</td>
<td>HorizontalLength</td>
<td>IfcPositiveLengthMeasure</td>
<td>[1:1]</td>
<td>Length measured as distance along the horizontal alignment of the segment.</td>
</tr>
<tr>
<td>3</td>
<td>StartHeight</td>
<td>IfcLengthMeasure</td>
<td>[1:1]</td>
<td>Elevation in Z of the start point relative to the IfcAlignment coordinate system.</td>
</tr>
<tr>
<td>4</td>
<td>StartGradient</td>
<td>IfcRatioMeasure</td>
<td>[1:1]</td>
<td>Gradient of the tangent of the vertical segment at the start point. It is provided as a ratio measure.</td>
</tr>
<tr>
<td>5</td>
<td>ToVertical</td>
<td>IfcAlignment2DVertical@Segments</td>
<td>S[1:1]</td>
<td>Link to the IfcAlignment2DVertical to which this vertical segment belongs.</td>
</tr>
</tbody>
</table>

#### 5.3.6.3 EXPRESS specification

ENTITY IfcAlignment2DVerticalSegment
  ABSTRACT SUPERTYPE OF (ONEOF(IfcAlignment2DVerSegCircularArc, IfcAlignment2DVerSegLine, IfcAlignment2DVerSegParabolicArc));
  SUBTYPE OF (IfcAlignment2DSegment);
  StartDistAlong: IfcLengthMeasure;
  HorizontalLength: IfcPositiveLengthMeasure;
  StartHeight: IfcLengthMeasure;
  StartGradient: IfcRatioMeasure;
  INVERSE
  ToVertical: SET[1:1] OF IfcAlignment2DVertical FOR Segments;
END_ENTITY;
5.3.7 IfcCurveSegment2D

5.3.7.1 Entity definition

IfcCurveSegment2D is an abstract class, which is the supertype of IfcLineSegment2D, IfcCircularArcSegment2D and IfcTransitionCurve2D. It defines some common geometric attributes.

5.3.7.2 Attribute definitions

<table>
<thead>
<tr>
<th>#</th>
<th>Attribute</th>
<th>Type</th>
<th>Cardinality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>StartPoint</td>
<td>IfcCartesianPoint</td>
<td>[1:1]</td>
<td>The x/y coordinates of the start point of the 2D curve, defined by a 2D Cartesian point.</td>
</tr>
<tr>
<td>2</td>
<td>StartDirection</td>
<td>IfcPlaneAngleMeasure</td>
<td>[1:1]</td>
<td>The direction of the tangent at the start point. Direction value 0.0 indicates a curve with a start tangent along the positive x-axis. Values increase counter-clockwise, and decrease clockwise. Values larger than a full circle (&gt;360° or &gt;2 π) shall not be used.</td>
</tr>
<tr>
<td>3</td>
<td>SegmentLength</td>
<td>IfcPositiveLengthMeasure</td>
<td>[1:1]</td>
<td>The length along the curve</td>
</tr>
</tbody>
</table>

5.3.7.3 EXPRESS specification

ENTITY IfcCurveSegment2D

ABSTRACT SUPERTYPE OF (ONEOF(IfcCircularArcSegment2D, IfcTransitionCurve2D, IfcLineSegment2D))

SUBTYPE OF (IfcBoundedCurve);

StartPoint: IfcCartesianPoint;
StartDirection: IfcPlaneAngleMeasure;
SegmentLength: IfcPositiveLengthMeasure;

END_ENTITY;

5.3.8 IfcLineSegment2D

5.3.8.1 Entity definition

The line segment is defined using the inherited start point, start distance and segment length parameter. IfcLineSegment2D is a subtype of IfcCurveSegment2D.

5.3.8.2 Attribute definitions

All attributes are inherited from IfcCurveSegment2D.

5.3.8.3 EXPRESS specification

ENTITY IfcLineSegment2D

SUBTYPE OF (IfcCurveSegment2D);
5.3.9 IfcCircularArcSegment2D

5.3.9.1 Entity definition

IfcCircularArcSegment2D defines a circular arc segment in 2D space, which is a subtype of IfcCurveSegment2D.

5.3.9.2 Attribute definitions

<table>
<thead>
<tr>
<th>#</th>
<th>Attribute</th>
<th>Type</th>
<th>Cardinality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Radius</td>
<td>IfcPositiveLengthMeasure</td>
<td>[1:1]</td>
<td>The radius of the circular arc.</td>
</tr>
<tr>
<td>2</td>
<td>IsCCW</td>
<td>IfcBoolean</td>
<td>[1:1]</td>
<td>Indicates the deflecting orientation of the circular arc. Boolean=&quot;true&quot; means counter-clockwise or &quot;to the left&quot;, and Boolean=&quot;false&quot; means clockwise or &quot;to the right&quot;.</td>
</tr>
</tbody>
</table>

5.3.9.3 EXPRESS specification

ENTITY IfcCircularArcSegment2D
  SUBTYPE OF (IfcCurveSegment2D);
  Radius: IfcPositiveLengthMeasure;
  IsCCW: IfcBoolean;
END_ENTITY;

5.3.10 IfcTransitionCurve2D

5.3.10.1 Entity definition

IfcTransitionCurve2D defines a bounded 2D curve transiting two 2D curves with continuous curvature, which is a subtype of IfcCurveSegment2D.

5.3.10.2 Attribute definitions

<table>
<thead>
<tr>
<th>#</th>
<th>Attribute</th>
<th>Type</th>
<th>Cardinality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>StartRadius</td>
<td>IfcPositiveLengthMeasure</td>
<td>[1:1]</td>
<td>The radius of the transition curve at the start point. If the radius is not provided by a value, i.e. being “NIL” it is interpreted as INFINITE – the startPoint is at the point, where the curve does not have a curvature.</td>
</tr>
<tr>
<td>2</td>
<td>IsCCW</td>
<td>IfcBoolean</td>
<td>[1:1]</td>
<td>Indicates whether the transition curve goes counter-clockwise as seen from the start point and start direction.</td>
</tr>
</tbody>
</table>
The radius of the transition curve at the end point.

The type of the transition curve. For detail, see 5.2.2.

### 5.3.10.3 EXPRESS specification

```plaintext
ENTITY IfcTransitionCurve2D
  SUBTYPE OF (IfcCurveSegment2D);
  StartRadius: IfcPositiveLengthMeasure;
  IsCCW: IfcBoolean;
  EndRadius: IfcPositiveLengthMeasure;
  TransitionCurveType: IfcTransitionCurveTypeEnum;
END_ENTITY;
```

### 5.3.11 IfcAlignment2DVerSegLine

#### 5.3.11.1 Entity definition

The vertical straight segment is defined as a line using the inherited attributes from IfcAlignment2DVerticalSegment.

#### 5.3.11.2 Attribute definitions

The attributes are inherited from IfcAlignment2DVerticalSegment.

### 5.3.11.3 EXPRESS specification

```plaintext
ENTITY IfcAlignment2DVerSegLine
  SUBTYPE OF (IfcAlignment2DVerticalSegment);
END_ENTITY;
```

### 5.3.12 IfcAlignment2DVerSegCircularArc

#### 5.3.12.1 Entity definition

The vertical circular arc segment is defined as an arc using the inherited attributes from IfcAlignment2DVerticalSegment. IfcAlignment2DVerSegCircularArc is a subtype of IfcAlignment2DVerticalSegment.

#### 5.3.12.2 Attribute definitions

<table>
<thead>
<tr>
<th>#</th>
<th>Attribute</th>
<th>Type</th>
<th>Cardinality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Radius</td>
<td>IfcPositiveLengthMeasure</td>
<td>[1:1]</td>
<td>The radius of the circular arc.</td>
</tr>
<tr>
<td>2</td>
<td>IsConvex</td>
<td>IfcBoolean</td>
<td>[1:1]</td>
<td>The orientation of the circular arc, convex (Boolean=&quot;true&quot;) means decreasing gradient along the arc at the beginning, concave (Boolean=&quot;false&quot;) means increasing gradient along the arc at the beginning.</td>
</tr>
</tbody>
</table>

### 5.3.12.3 EXPRESS specification
ENTITY IfcAlignment2DVerSegCircularArc
SUBTYPE OF (IfcAlignment2DVerticalSegment);
    Radius: IfcPositiveLengthMeasure;
    IsConvex: IfcBoolean;
END_ENTITY;

5.3.13 IfcAlignment2DVerSegParabolicArc

5.3.13.1 Entity definition

The vertical parabolic segment is defined as a parabola using the inherited attributes from IfcAlignment2DVerticalSegment.

5.3.13.2 Attribute definitions

<table>
<thead>
<tr>
<th>#</th>
<th>Attribute</th>
<th>Type</th>
<th>Cardinality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ParabolaConstant</td>
<td>IfcPositiveLengthMeasure</td>
<td>[1:1]</td>
<td>The parabola constant is provided by the “minimum parabola radius”, the true radius of a parabola at its vertical axis (the zero-gradient point of the parabola).</td>
</tr>
<tr>
<td>2</td>
<td>IsConvex</td>
<td>IfcBoolean</td>
<td>[1:1]</td>
<td>Orientation of the parabolic arc, convex (Boolean=”true”) means that the minimum radius is the distance between the vertex and the center point along the positive direction of the vertical axis, and concave (Boolean=”false”) means along the negative direction of the vertical axis.</td>
</tr>
</tbody>
</table>

5.3.13.3 EXPRESS specification

ENTITY IfcAlignment2DVerSegParabolicArc
SUBTYPE OF (IfcAlignment2DVerticalSegment);
    ParabolaConstant: IfcPositiveLengthMeasure;
    IsConvex: IfcBoolean;
END_ENTITY;

5.3.14 IfcChainageSystem

The IfcAlignment published by buildingSMART recommends to use LRM (Linear Referencing Method System) in ISO19148 to specify a linearly referenced location. The positioning expression must have Linear Element, Linear Referencing Method and Distance Expression. LRM specifies whether the measurement is absolute, relative or interpolative. The absolute type is the simplest method of LRM.

In China, the alignment might be modified with various reasons during railway design, resulting in discontinuous chainage values in the same alignment. It is not convenient for
participants to communicate with each other using absolute linear referencing, because the distance expression at the same position will be changed when the alignment is locally modified. Hence, a mechanism named chainage system is added to minimize the impact of alignment changes. We add CHAINAGESYSTEM to the IfcAlignment predefined types. With the help of the chainage system, it is possible to set the "broken chainage", where the chainage value before a point and the value after the point are discontinuous to achieve the stability of chainage of a railway.

5.3.14.1 Entity definition

IfcChainageSystem is composed of a set of IfcChainageSystemSegments connected end-to-start. The chainage is continuous in an IfcChainageSystemSegment. The chainage values at connection points may be different in different chainage segments, as shown in Figure 5.2.

Figure 5.2 Schematic diagram of IfcChainageSystem

5.3.14.2 Attribute definitions

<table>
<thead>
<tr>
<th>#</th>
<th>Attribute</th>
<th>Type</th>
<th>Cardinality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Segments</td>
<td>IfcChainageSystemSegment</td>
<td>L[1:?]</td>
<td>An ordered list of unique chainage system segments, each are jointed end-to-start.</td>
</tr>
<tr>
<td>2</td>
<td>ToHorizontal</td>
<td>IfcAlignment2DHorizontal</td>
<td>S[1:1]</td>
<td>Link to the horizontal alignment.</td>
</tr>
</tbody>
</table>

5.3.14.3 EXPRESS specification

ENTITY IfcChainageSystem
  Segments: LIST [1:?] OF IfcChainageSystemSegment;
  INVERSE
  ToHorizontal: SET [1:1] OF IfcAlignment2DHorizontal FOR ChainageSystem;
END_ENTITY;

5.3.15 IfcChainageSystemSegment

5.3.15.1 Entity definition

IfcChainageSystemSegment defines a continuous segment in IfcChainageSystem, in which the chainage value is continuous. IfcChainageSystemSegment is described by (see Figure 5.3)

1) StartDistAlong: The distance to the start point of the alignment along the horizontal alignment.
2) Length: Horizontal length.
3) StartChainageNominal: The nominal chainage value of the start of the chainage segment.
4) IsChainageNominalIncrease: Whether the chainage value is increased along the direction of the alignment.
5) Prefix: The prefix string before the chainage value.

![Figure 5.3 Schematic diagram of IfcChainageSystemSegment](image)

5.3.15.2 Attribute definitions

<table>
<thead>
<tr>
<th>#</th>
<th>Attribute</th>
<th>Type</th>
<th>Cardinality</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>StartDistAlong</td>
<td>IfcLengthMeasure</td>
<td>[1:1]</td>
<td>The distance to the start of the alignment along the horizontal alignment.</td>
</tr>
<tr>
<td>3</td>
<td>StartChainageNominal</td>
<td>IfcReal</td>
<td>[1:1]</td>
<td>The nominal chainage value at the start point of the chainage segment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>The value of the end point is calculated by StartChainageNominal + Length if</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>IsChainageNominalIncrease is True, or –Length.</td>
</tr>
<tr>
<td>4</td>
<td>IsChainageNominalIncrease</td>
<td>IfcBoolean</td>
<td>[1:1]</td>
<td>Whether the chainage is increased along the direction of alignment.</td>
</tr>
<tr>
<td>5</td>
<td>Prefix</td>
<td>IfcLabel</td>
<td>[1:1]</td>
<td>The prefix string before the chainage value.</td>
</tr>
<tr>
<td>6</td>
<td>ToChainageSystem</td>
<td>IfcChainageSystem</td>
<td>S[1:1]</td>
<td>Link to the chainage system.</td>
</tr>
</tbody>
</table>

5.3.15.3 EXPRESS specification

ENTITY IfcChainageSystemSegment
StartDistAlong: IfcLengthMeasure;
Length: IfcLengthMeasure;
StartChainageNominal: IfcReal;
IsChainageNominalIncrease: IfcBoolean;
Prefix: IfcLabel;
INVERSE
ToChainageSystem: SET [1:1] OF IfcChainageSystem FOR Segments;
END_ENTITY;

5.4 Property Set Definition

5.4.1 Pset_Alignment

Name: Pset_Alignment
Applicable Entities: IfcAlignment
Description: Property set for alignment.
Property Definitions: See Table 5.15.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AlignWhich</td>
<td>TypePropertyEnumeratedValue/Enum_AlignWhich:AlignCenterOfTrack,AlignCenterOfRailway</td>
<td>Indicates whether the alignment is the centerline of a single track or of a railway.</td>
</tr>
<tr>
<td>StandardForDesign</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Standards observed in design.</td>
</tr>
<tr>
<td>AlignmentName</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Alignment name.</td>
</tr>
<tr>
<td>Length</td>
<td>TypePropertySingleValue/IfcLength Measure</td>
<td>The whole length of an alignment.</td>
</tr>
<tr>
<td>MinimumRadiusOfCurve</td>
<td>TypePropertySingleValue/IfcLength Measure</td>
<td>The minimum radius of curves used in the alignment.</td>
</tr>
<tr>
<td>NumberOfCurve</td>
<td>TypePropertySingleValue/IfcNumber</td>
<td>Curve number in the alignment.</td>
</tr>
<tr>
<td>TotalLengthOfCurves</td>
<td>TypePropertySingleValue/IfcLength Measure</td>
<td>Total length of all curves.</td>
</tr>
<tr>
<td>NumberOfSlope</td>
<td>TypePropertySingleValue/IfcNumber</td>
<td>The number of slope in the alignment</td>
</tr>
<tr>
<td>LiftingHeightForward</td>
<td>TypePropertySingleValue/IfcReal</td>
<td>Lifting height in the forward direction.</td>
</tr>
<tr>
<td>LiftingHeightBackward</td>
<td>TypePropertySingleValue/IfcReal</td>
<td>Lifting height in the backward direction.</td>
</tr>
</tbody>
</table>

6. Terrain Schema

Not available.

7. Geology Schema

7.1 Schema Definition

The data model structure of railway geology is composed of IfcGeologyPart and IfcGeologyElement. IfcGeologyPart could be taken as the basic element of railway geology engineering.
IfcGeologyElement mainly contains IfcRockSoilMass, IfcDrillHole and IfcDrillHoleLayer. Figure 7.1 shows the relationship between IfcGeologyPart and IfcGeologyElement.

**Figure 7.1 Geology composition**

7.1.1 Spatial Structure Elements of Geology

IfcGeologyPart derived from IfcCivilStructureElement is the supertype of all the spatial structure elements in geology engineering. IfcGeologyPart can be divided into FORBRIDGE, FORSUBGRADE, FORTUNNEL and FORBUILDING by IfcGeologyPartTypeEnum. Figure 7.2 shows the inheritance relationship of IfcGeologyPart.

**Figure 7.2 EXPRESS-G diagram for IfcGeologyPart**

7.1.2 Physical Elements of Geology
Figure 7.3 shows the inheritance relationships of physical elements in geology engineering.

![Figure 7.3 EXPRESS-G diagram for physical elements of geology](image)

IfcGeologyElement is the supertype of all geology elements.

IfcRockSoilMass is the product of geological processes which can be distinguished by attribute and occupies a certain space. It is a basic element of a geology layer. IfcRockSoilMass can be divided into SOILAGGREGATE, SANDYSOIL, MUDDYSOIL, CLAYEDSOIL and ROCK by IfcGeologyTypeEnum. IfcRockSoilMass can be divided into GENERALGEOLoGY, COLLAPSIABLESOIL, EXPANSIVESOIL, FROST, REDCLAYEDSOIL, YIELDINGSOIL, MIXEDSOIL, BANKING, HALOMORPHICSOIL, RESIDUALSOIL and POLLUTIONSOIL by IfcSpecialGeologyTypeEnum. IfcRockSoilMass can be divided into GENERAL, LANDSLIDE, DEBRISFLOW, KARST, GOB, RADIOACTIVE, EARTHQUAKELIQ and SANDSTORM by IfcGeologyDisasterTypeEnum.

IfcDrillHole refers to a geological layer set in a certain radius and depth of the exploration point.

IfcDrillHoleLayer is derived from IfcRockSoilMass, which has accurate geological parameters.

7.2 Type Definition

7.2.1 IfcGeologyPartTypeEnum

This enumeration defines the different predefined types of geological sites.

**Enumerated Item Definitions:**

- FORBRIDGE;
- FORSUBGRADE;
- FORTUNNEL;
- FORBUILDING;
- USERDEFINED;
- NOTDEFINED.

**EXPRESS Specification:**
7.2 IfcGeologyPartTypeEnum

This enumeration defines the different predefined types of geology.

Enumerated Item Definitions:

SOILAGGREGATE;
SANDYSOIL;
MUDDYSOIL;
CLAYEDSOIL;
ROCK;
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:

TYPE IfcGeologyPartTypeEnum= ENUMERATION OF
    (FORBRIDGE
        , FORSUBGRADE
        , FORTUNNEL
        , FORBUILDING
        , USERDEFINED
        , NOTDEFINED
    );
END_TYPE;

7.2.2 IfcGeologyTypeEnum

This enumeration defines the different predefined types of geology.

Enumerated Item Definitions:

SOILAGGREGATE;
SANDYSOIL;
MUDDYSOIL;
CLAYEDSOIL;
ROCK;
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:

TYPE IfcGeologyTypeEnum= ENUMERATION OF
    (SOILAGGREGATE
        , SANDYSOIL
        , MUDDYSOIL
        , CLAYEDSOIL
        , ROCK
        , USERDEFINED
        , NOTDEFINED
    );
END_TYPE;

7.2.3 IfcSpecialGeologyTypeEnum

This enumeration defines the different types of special geology.

Enumerated Item Definitions:

GENERALGEOLOGY;
COLLAPSIBLESOIL;
EXPANSIVESOIL;
FROST;
REDCLAYEDSOIL;
YIELDINGSOIL;
MIXEDSOIL;
BANKING;
HALOMORPHICSOIL;
RESIDUALSOIL;
POLLUTIONSOIL;
USERDEFINED;
NOTDEFINED.

**EXPRESS Specification:**

```plaintext
TYPE IfcSpecialGeologyTypeEnum= ENUMERATION OF
  (GENERALGEOLOGY
  , COLLAPSIBLESOIL
  , EXPANSIVESOIL
  , FROST
  , REDCLAYEDSOIL
  , YIELDINGSOIL
  , MIXEDSOIL
  , BANKING
  , HALOMORPHICSOIL
  ,RESIDUALSOIL
  ,POLLUTIONSOIL
  ,USERDEFINED
  , NOTDEFINED
);
END_TYPE;
```

### 7.2.4 IfcGeologyDisasterTypeEnum

This enumeration defines the different types of geology disaster.

**Enumerated Item Definitions:**

- GENERAL;
- LANDSLIDE;
- DEBRISFLOW;
- KARST;
- GOB;
- RADIOACTIVE;
- EARTHQUAKELIQ;
- SANDSTORM;
- USERDEFINED;
- NOTDEFINED.
EXPRESS Specification:

TYPE IfcGeologyDisasterTypeEnum= ENUMERATION OF
   (GENERAL,
       LANDSLIDE,
       DEBRISFLOW,
       KARST,
       GOB,
       RADIOACTIVE,
       EARTHQUAKE,LIQ,
       SANDSTORM,
       USERDEFINED,
       NOTDEFINED);
END_TYPE;

7.3 Entity Definition

7.3.1 IfcGeologyPart

IfcGeologyPart is a basic geological engineering unit.

EXPRESS Specification:

ENTITY IfcGeologyPart
   SUBTYPE OF (IfcCivilStructureElement);
   PredefinedType: IfcGeologyPartTypeEnum;
END_ENTITY;

7.3.2 IfcGeologyElement

IfcGeologyElement is the supertype of all the physical elements in geology engineering.

EXPRESS Specification:

ENTITY IfcGeologyElement
   SUPERTYPE OF (ONEOF (IfcRockSoilMass, IfcDrillHole));
   SUBTYPE OF (IfcCivilElement);
END_ENTITY;

7.3.3 IfcRockSoilMass

IfcRockSoilMass is defined as a basic element of a geological body. Some rock soil mass compose the geology of an area.

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pset_RockSoilMassCommon</td>
<td></td>
</tr>
<tr>
<td>Pset_RockSoilMassProperty</td>
<td></td>
</tr>
</tbody>
</table>

Table 7.1 Property sets for IfcRockSoilMass
COLLAPSIBLESOIL  | Pset_SpecialGeology_COLLAPSIBLESOIL  
EXPANSIVESOIL  | Pset_SpecialGeology_EXPANSIVESOIL  
FROST  | Pset_SpecialGeology_FROST  
HALOMORPHICSOIL  | Pset_SpecialGeology_HALOMORPHICSOIL  
POLLUTIONSOIL  | Pset_SpecialGeology_POLLUTIONSOIL  

Table 7.3 Property sets for IfcRockSoilMass

<table>
<thead>
<tr>
<th>GeologyDisasterType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>LANDSLIDE</td>
<td>Pset_GeologyDisaster_LANDSLIDE</td>
</tr>
<tr>
<td>DEBRISFLOW</td>
<td>Pset_GeologyDisaster_DEBRISFLOW</td>
</tr>
<tr>
<td>KARST</td>
<td>Pset_GeologyDisaster_KARST</td>
</tr>
<tr>
<td>GOB</td>
<td>Pset_GeologyDisaster_GOB</td>
</tr>
<tr>
<td>RADIOACTIVE</td>
<td>Pset_GeologyDisaster_RADIOACTIVE</td>
</tr>
<tr>
<td>SANDSTORM</td>
<td>Pset_GeologyDisaster_SANDSTORM</td>
</tr>
</tbody>
</table>

EXPRESS Specification:

ENTITY IfcRockSoilMass

SUBTYPE OF (IfcGeologyElement);

PredefinedType: IfcGeologyTypeEnum;

SpecialGeologyType: IfcSpecialGeologyTypeEnum;

GeologyDisasterType: IfcGeologyDisasterTypeEnum;

END_ENTITY;

Attribute definitions:

PreDefinedType: It contains Soilaggregate, Sandysoil, Muddysoil, Clayedsoil and Rock.

SpecialGeologyType: It contains General Geology, Collapsible Soil, Expansive Soil, Frost, Red Clayed Soil, Yielding Soil, Mixed Soil, Banking, Halomorphic Soil, Residual Soil and Pollution Soil.

GeologyDisasterType: It contains General, Landslide, Debris Flow, Karst, Gob, Radioactive, Earthquake Liquid and Sand Storm.

7.3.4 IfcDrillHole

IfcDrillHole is defined as a geological layer set in a certain radius and depth of the exploration point.

Table 7.4 Property sets for IfcDrillHole

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_DrillHole</td>
</tr>
</tbody>
</table>

EXPRESS Specification:

ENTITY IfcDrillHole

SUBTYPE OF (IfcGeologyElement);

DrillHoleLayers: LIST [1:?] OF IfcDrillHoleLayer;

END_ENTITY;

7.3.5 IfcDrillHoleLayer

IfcDrillHoleLayer is a geological layer in a certain radius and depth of the exploration point.
**Table 7.5 Property sets for IfcDrillHoleLayer**

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_TestParameter</td>
</tr>
</tbody>
</table>

**EXPRESSION Specification:**

ENTITY IfcDrillHoleLayer  
SUBTYPE OF (IfcRockSoilMass);  
INVERSE  
ToDrillHole: SET [1:1] OF IfcDrillHole FOR DrillHoleLayers;  
END_ENTITY;

### 7.4 Property Set Definition

#### 7.4.1 Pset_GeologyPart

**Name:** Pset_GeologyPart  
**Applicable Entities:** IfcGeologyPart  
**Description:** Common information of IfcGeologyPart.  
**Property Definitions:** See Table 7.6.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GeologyPartName</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Geology part name.</td>
</tr>
<tr>
<td>TerrainFeature</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Terrain feature.</td>
</tr>
<tr>
<td>EngineerType</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Engineer type.</td>
</tr>
<tr>
<td>Mileage</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Mileage.</td>
</tr>
<tr>
<td>SiteClassification</td>
<td>TypePropertyEnumeratedValue/IfcLabel: Hard, Medium-hard, Medium-soft, Soft</td>
<td>Site classification.</td>
</tr>
<tr>
<td>PeakGroundAcceleration</td>
<td>TypePropertySingleValue/IfcAccelerationMeasure/m/s²</td>
<td>Peak ground acceleration.</td>
</tr>
<tr>
<td>MaximumFreezingDepth</td>
<td>TypePropertySingleValue/IfcLengthMeasure</td>
<td>Maximum freezing depth.</td>
</tr>
</tbody>
</table>

#### 7.4.2 Pset_RockSoilMassCommon

**Name:** Pset_RockSoilMassCommon  
**Applicable Entities:** IfcRockSoilMass  
**Description:** Common information of IfcRockSoilMass.  
**Property Definitions:** See Table 7.7.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GeotechnicalName</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Geotechnical name.</td>
</tr>
<tr>
<td>BasicCapacity</td>
<td>TypePropertySingleValue/IfcPressureMeasure/N/m²</td>
<td>Basic capacity.</td>
</tr>
<tr>
<td>OperationLevel</td>
<td>TypePropertyEnumeratedValue/IfcLabel: I , II,III,IV, V ,VI</td>
<td>Operation level.</td>
</tr>
<tr>
<td>MainSubLayerNum</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Main sublayer number.</td>
</tr>
</tbody>
</table>
AgeAndGenesis | TypePropertySingleValue/IfcLabel | Age and genesis.

### 7.4.3 Pset_DrillHole

**Name:** Pset_DrillHole  
**Applicable Entities:** IfcDrillHole  
**Description:** Common information of IfcDrillHole.  
**Property Definitions:** See Table 7.8.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HoleNum</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Hole number.</td>
</tr>
<tr>
<td>HoleTime</td>
<td>TypePropertySingleValue/IfcTime</td>
<td>Hole time.</td>
</tr>
<tr>
<td>FirstLevel</td>
<td>TypePropertySingleValue/IfcLengthMeasure</td>
<td>First level.</td>
</tr>
<tr>
<td>StandingLevel</td>
<td>TypePropertySingleValue/IfcLengthMeasure</td>
<td>Standing level.</td>
</tr>
<tr>
<td>OrificeElevation</td>
<td>TypePropertySingleValue/IfcLengthMeasure</td>
<td>Orifice elevation.</td>
</tr>
<tr>
<td>Depth</td>
<td>TypePropertySingleValue/IfcLengthMeasure</td>
<td>Depth.</td>
</tr>
</tbody>
</table>

### 7.4.4 Pset_RockSoilMassProperty

**Name:** Pset_RockSoilMassProperty  
**Applicable Entities:** IfcRockSoilMass  
**Description:** Property set of IfcRockSoilMass.  
**Property Definitions:** See Table 7.9.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WeatheringDegree</td>
<td>TypePropertyEnumeratedValue/IfcLabel: Not weathered, Weak weathered, Moderate weathered, Intense weathered, Fully weathered</td>
<td>Weathering degree</td>
</tr>
<tr>
<td>Humidity</td>
<td>TypePropertyEnumeratedValue/IfcLabel: Slightly Wet, Wet, Saturated</td>
<td>Humidity</td>
</tr>
<tr>
<td>Compactness</td>
<td>TypePropertyEnumeratedValue/IfcLabel: Loose, Slightly dense, Medium dense, Dense</td>
<td>Compactness</td>
</tr>
<tr>
<td>PlasticState</td>
<td>TypePropertyEnumeratedValue/IfcLabel: Hard, Hard plasticity, Soft plasticity, Flow plasticity</td>
<td>Plastic state</td>
</tr>
<tr>
<td>RockType</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Rock type</td>
</tr>
</tbody>
</table>

### 7.4.5 Pset_SpecialGeology_COLLAPSIBLESOIL

**Name:** Pset_SpecialGeology_COLLAPSIBLESOIL  
**Applicable Entities:** IfcRockSoilMass/COLLAPSIBLESOIL  
**Description:** Property set of Collapsible Soil derived from IfcRockSoilMass.  
**Property Definitions:** See Table 7.10.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CollapsibleLevel</td>
<td>TypePropertyEnumeratedValue/IfcLabel</td>
<td>Collapsible level</td>
</tr>
</tbody>
</table>
### 7.4.6 Pset_SpecialGeology_EXPANSIVESOIL

**Name:** Pset_SpecialGeology_EXPANSIVESOIL  
**Applicable Entities:** IfcRockSoilMass/EXPANSIVESOIL  
**Description:** Property set of Expansive Soil derived from IfcRockSoilMass.  
**Property Definitions:** See Table 7.11.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ExpansiveLevel</td>
<td>TypePropertyEnumeratedValue/IfcLabel:Weak,Medium,Hard</td>
<td>Expansive level</td>
</tr>
<tr>
<td>FreeSwellingRate</td>
<td>TypePropertySingleValue/IfcRatioMeasure</td>
<td>Free swelling rate</td>
</tr>
<tr>
<td>MontmorContent</td>
<td>TypePropertySingleValue/IfcRatioMeasure</td>
<td>Montmorillonite content</td>
</tr>
<tr>
<td>CationExchangeCapacity</td>
<td>TypePropertySingleValue/IfcLengthMeasure</td>
<td>Cation exchange capacity</td>
</tr>
<tr>
<td>Expansibility</td>
<td>TypePropertySingleValue/IfcPressureMeasure</td>
<td>Expansibility</td>
</tr>
</tbody>
</table>

### 7.4.7 Pset_SpecialGeology_FROST

**Name:** Pset_SpecialGeology_FROST  
**Applicable Entities:** IfcRockSoilMass/FROST  
**Description:** Property set of Frost derived from IfcRockSoilMass.  
**Property Definitions:** See Table 7.12.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ThawCollapseLevel</td>
<td>TypePropertyEnumeratedValue/IfcLabel:Ⅰ,Ⅱ,Ⅲ,Ⅳ,Ⅴ,Ⅵ</td>
<td>Thaw collapse level</td>
</tr>
</tbody>
</table>

### 7.4.8 Pset_SpecialGeology_HALOMORPHICSOIL

**Name:** Pset_SpecialGeology_HALOMORPHICSOIL  
**Applicable Entities:** IfcRockSoilMass/HALOMORPHICSOIL  
**Description:** Property set of Halomorphic Soil derived from IfcRockSoilMass.  
**Property Definitions:** See Table 7.13.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HalomoSoilDegree</td>
<td>TypePropertyEnumeratedValue/IfcLabel:Halomorphic soil</td>
<td>Halomorphic soil</td>
</tr>
</tbody>
</table>
Weak, Medium, Hard, Super degree

7.4.9 Pset_SpecialGeology_POLLUTIONSOIL

Name: Pset_SpecialGeology_POLLUTIONSOIL
Applicable Entities: IfcRockSoilMass/POLLUTIONSOIL
Description: Property set of Pollution Soil derived from IfcRockSoilMass.
Property Definitions: See Table 7.14.

Table 7.14 Property definitions of Pset_SpecialGeology_POLLUTIONSOIL

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ImpactLevel</td>
<td>TypePropertyEnumeratedValue/IfcLabel</td>
<td>Impact level.</td>
</tr>
</tbody>
</table>

7.4.10 Pset_GeologyDisaster_LANDSLIDE

Name: Pset_GeologyDisaster_LANDSLIDE
Applicable Entities: IfcRockSoilMass/LANDSLIDE
Description: Property set of Landslide derived from IfcRockSoilMass.
Property Definitions: See Table 7.15.

Table 7.15 Property definitions of Pset_GeologyDisaster_LANDSLIDE

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LandslideScale</td>
<td>TypePropertyEnumeratedValue/IfcLabel: Small Scale, Medium Scale, Big Scale, Super Scale</td>
<td>Landslide scale.</td>
</tr>
</tbody>
</table>

7.4.11 Pset_GeologyDisaster_DEBRISFLOW

Name: Pset_GeologyDisaster_DEBRISFLOW
Applicable Entities: IfcRockSoilMass/DEBRISFLOW
Description: Property set of debris flow derived from IfcRockSoilMass.
Property Definitions: See Table 7.16.

Table 7.16 Property definitions of Pset_GeologyDisaster_DEBRISFLOW

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DebrisFlowScale</td>
<td>TypePropertyEnumeratedValue/IfcLabel: Small Scale, Medium Scale, Big Scale, Super Scale</td>
<td>Debrisflow scale.</td>
</tr>
</tbody>
</table>

7.4.12 Pset_GeologyDisaster_KARST

Name: Pset_GeologyDisaster_KARST
Applicable Entities: IfcRockSoilMass/KARST
Description: Property set of karst derived from IfcRockSoilMass.
Property Definitions: See Table 7.17.

Table 7.17 Property definitions of Pset_GeologyDisaster_KARST

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>KarstLevel</td>
<td>TypePropertyEnumeratedValue/IfcLabel: Strong Development, Medium Development, Weak Development, Tiny Development</td>
<td>Karst level.</td>
</tr>
</tbody>
</table>

7.4.13 Pset_GeologyDisaster_GOB

Name: Pset_GeologyDisaster_GOB
Applicable Entities: IfcRockSoilMass/GOB

Description: Property set of gob derived from IfcRockSoilMass.

Property Definitions: See Table 7.18.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GobScale</td>
<td>TypePropertySingleValue/IfcAreaMeasure</td>
<td>Gob scale.</td>
</tr>
</tbody>
</table>

7.4.14 Pset_GeologyDisaster_RADIOACTIVE

Name: Pset_GeologyDisaster_RADIOACTIVE
Applicable Entities: IfcRockSoilMass/RADIOACTIVE

Description: Property set of radioactive material derived from IfcRockSoilMass.

Property Definitions: See Table 7.19.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radioactive</td>
<td>TypePropertyEnumeratedValue/IfcLabel</td>
<td>Radioactive type.</td>
</tr>
</tbody>
</table>

7.4.15 Pset_GeologyDisaster_SANDSTORM

Name: Pset_GeologyDisaster_SANDSTORM
Applicable Entities: IfcRockSoilMass/SANDSTORM

Description: Property set of sand storm derived from IfcRockSoilMass.

Property Definitions: See Table 7.20.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SandStormDegree</td>
<td>TypePropertyEnumeratedValue/IfcLabel: Strong, Medium, Weak</td>
<td>Sandstorm degree.</td>
</tr>
</tbody>
</table>

7.4.16 Pset_TestParameter

Name: Pset_TestParameter
Applicable Entities: IfcDrillHoleLayer

Description: Property set of rock soil test derived from IfcDrillHoleLayer.

Property Definitions: See Table 7.21.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WaterRatio</td>
<td>TypePropertySingleValue/IfcRatioMeasure</td>
<td>Water ratio</td>
</tr>
<tr>
<td>Density</td>
<td>TypePropertySingleValue/IfcMassDensityMeasure</td>
<td>Density</td>
</tr>
<tr>
<td>GrainDensity</td>
<td>TypePropertySingleValue/IfcMassDensityMeasure</td>
<td>Grain density</td>
</tr>
<tr>
<td>VoidRatio</td>
<td>TypePropertySingleValue/IfcRatioMeasure</td>
<td>Void ratio</td>
</tr>
<tr>
<td>Saturation</td>
<td>TypePropertySingleValue/IfcRatioMeasure</td>
<td>Saturation</td>
</tr>
<tr>
<td>LiqBoundary</td>
<td>TypePropertySingleValue/IfcRatioMeasure</td>
<td>Liquid boundary</td>
</tr>
<tr>
<td>PlaBoundary</td>
<td>TypePropertySingleValue/IfcRatioMeasure</td>
<td>Plastic boundary</td>
</tr>
<tr>
<td>LiqIndex</td>
<td>TypePropertySingleValue/IfcRatioMeasure</td>
<td>Liquid index</td>
</tr>
<tr>
<td>Property</td>
<td>Type</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td>Plastic index</td>
<td>TypePropertySingleValue/IfcRatioMeasure</td>
<td>Plastic index</td>
</tr>
<tr>
<td>CompreCoefficient</td>
<td>TypePropertySingleValue/IfcLengthMeasure</td>
<td>Coefficient of compressibility</td>
</tr>
<tr>
<td>PreModulus</td>
<td>TypePropertySingleValue/IfcPressureMeasure</td>
<td>Compression modulus</td>
</tr>
<tr>
<td>InterFricAngle</td>
<td>TypePropertySingleValue/IfcPlaneAngleMeasure</td>
<td>Interfriction Angle</td>
</tr>
<tr>
<td>Cohesion</td>
<td>TypePropertySingleValue/IfcPressureMeasure</td>
<td>Cohesion</td>
</tr>
<tr>
<td>AntiPressStren</td>
<td>TypePropertySingleValue/IfcPressureMeasure</td>
<td>Anti press strength</td>
</tr>
</tbody>
</table>

8. Subgrade Schema
8.1 Schema Definition

The data model architecture of railway subgrade is composed of IfcSubgradeStructureElement, IfcSubgradeElementAssembly and IfcSubgradeElement.


IfcSubgradeElementAssembly mainly includes IfcSubgradeRetainingStructureSectionAssembly and IfcSubgradeSubsoilReinforcementPileAssembly.

IfcSubgradeElement mainly includes IfcSubgradeRetainingElement, IfcSubgradeFillingWorks, IfcSubgradeSlopeProtectionSectionElement, IfcSubgradeSubsoilReinforcementPileElement, IfcOriginalSubgradeSubsoilReinforcement and IfcSubgradeTransitionSectionElement.

Figure 8.1 shows the relationship between IfcSubgradeStructureElement, IfcSubgradeElementAssembly and IfcSubgradeElement.
Figure 8.1 Relationship between IfcSubgradeStructureElement, IfcSubgradeElementAssembly and IfcSubgradeElement
8.1.1 Spatial Structure Elements of Subgrade

IfcCivilStructureElement is defined in IFC4. IfcSubgradeStructureElement derived from IfcCivilStructureElement is the supertype of all the spatial structure elements in subgrade engineering. IfcSubgradeStructureElement further derives IfcSubgrade, IfcSubgradeStructurePartElement, IfcSubgradeSlopeProtectionElement, IfcSubgradeRetainingStructureElement, IfcSubgradeSubsoilTreatmentElement and IfcSubgradeTransitionSectionStructureElement. Figure 8.2 shows the inheritance relationship between all the spatial structure elements in subgrade engineering.

![Figure 8.2 EXPRESS-G diagram for spatial structure elements in subgrade engineering](image)

IfcSubgradeStructureElement is the supertype of all the spatial structure elements in subgrade engineering.

IfcSubgrade defines a segment of subgrade, or a work site for subgrade. IfcSubgrade can be further decomposed into IfcSubgradeStructurePartElement, IfcSubgradeSlopeProtectionElement, IfcSubgradeSubsoilTreatmentElement, IfcSubgradeRetainingStructureElement and IfcSubgradeTransitionSectionStructureElement from the perspective of spatial structure. IfcSubgrade can be decomposed into EMBANKMENT, CUTTING and CUTANDFILLSUBGRADE by predefined types. IfcSubgrade can be decomposed into RAILWAYSUBGRADE, HIGHWAYSUBGRADE and ROADSUBGRADE by functional types.

IfcSubgradeStructurePartElement defines the main body of subgrade structure. An IfcSubgradeStructurePartElement is composed of one or more IfcSubgradeFillingWorks. An IfcSubgrade may contain one or more IfcSubgradeStructurePartElement.

IfcSubgradeSlopeProtectionElement is used to define block-based subgrade slope protection. An IfcSubgrade may contain one or more IfcSubgradeSlopeProtectionElement objects. Generally speaking, the slope protection measures on both sides of the subgrade may be defined as two IfcSubgradeSlopeProtectionElement objects. An IfcSubgradeSlopeProtectionElement is composed of one or more IfcSubgradeSlopeProtectionSectionElement objects.
IfcSubgradeSubsoilTreatmentElement is used to define block-based subgrade subsoil treatment. An IfcSubgrade usually contains an IfcSubgradeSubsoilTreatmentElement. An IfcSubgradeSubsoilTreatmentElement is composed of one or more IfcSubgradeSubsoilReinforcementPileAssembly or IfcOriginalSubgradeSubsoilReinforcement objects.

![Figure 8.3 Subgrade cross section and relevant structures](image)

**Figure 8.3 Subgrade cross section and relevant structures**

IfcSubgradeRetainingStructureElement is used to define the retaining structures in subgrade engineering, such as gravity retaining wall, balance weight retaining wall and cantilever retaining wall. An IfcSubgradeRetainingStructureElement is composed of one or more IfcSubgradeRetainingStructureSectionAssembly objects. In Figure 8.4 (a), the section between two expansion joints is a reinforced earth retaining wall section. Some reinforced earth retaining wall sections compose the reinforced earth retaining wall. In Figure 8.4 (b), section ① and section ② are anchorage pile and retaining plate in IfcSubgradeRetainingElement. The combination of section ① and section ② is reinforced concrete retaining wall section assembly. Some reinforced concrete retaining wall section assembly objects compose reinforced concrete retaining wall.

![Figure 8.4 Retaining structure](image)

(a) Reinforced earth retaining wall          (b) reinforced concrete retaining wall

**Figure 8.4 Retaining structure**

IfcSubgradeTransitionSectionStructureElement is used to define the section requiring special treatment to connect the subgrade and structures, which is composed of IfcSubgradeTransitionSectionElement objects. In Figure 8.5, the "Graded crushed stone mixed with...
3% cement” section indicates a transition cone. The transition cone in vertical-section is a subgrade transition section, whose length is $L$ in Figure 8.5.

![Figure 8.5 Subgrade transition section](image)

**Figure 8.5** Subgrade transition section

8.1.2 Physical Elements of Subgrade

Figure 8.6 shows the EXPRESS-G diagram for physical elements in subgrade engineering.

![Figure 8.6 EXPRESS-G diagram for physical elements of subgrade](image)

**Figure 8.6** EXPRESS-G diagram for physical elements of subgrade

IfcSubgradeElement is the supertype of all the physical elements in subgrade engineering. IfcSubgradeRetainingElement refers to the basic elements of subgrade retaining structure, containing GRARETBODY, BALWEIRETBODY, CANRETBODY, COURETBODY, ANCHORAGEPILE, RETAININGPLATE, RIBBEDCOLUMN, PANEL, REIEARRETBODY, WALLFOUNDATION, PRECABLEBODY, PILEFOUNTRIMMER, DOCKRETBODY, SHORTRELRETBODY, WINDBREAKBODY, SOILNAILRATBODY, ANCHORPLATE, ANCHORPLATEPULLROD, WALLPANEL, ANCHRIBCOLUMN, and so on.

IfcSubgradeFillingWorks refers to the components of subgrade filling, including TOPLAYERSUBBED, BOTTOMLAYERSUBBED, BELOWSUBBED and REPSUBBASE.
IfcSubgradeSlopeProtectionSectionElement refers to the basic elements of subgrade slope protection. Subgrade slope protection is usually composed of several IfcSubgradeSlopeProtectionSectionElements. IfcSubgradeSlopeProtectionSectionElement includes ARCHEDFRAMEWORK, HOLETYPETROWALL, MORTARRUBBLE, ANCHOREDFRAMEBEAM, GRIDFRAME, DIOMONDFRAME, HUMANSHAPEDFRAME, HOLLOWBRICK, SOLIDSLOPEPROTECTION, and so on.

IfcSubgradeSubsoilReinforcementPileElement refers to the pile elements to improve the bearing capacity of foundation composed of soil or rock. IfcSubgradeSubsoilReinforcementPileElement includes PILEBODY and PILECAP.

IfcOriginalSubgradeSubsoilReinforcement refers to the engineer measures to improve the bearing capacity of foundation, such as COMPACTION, RAMMED, GROUTING, SANDWICK and SHEETDRAIN.

IfcSubgradeTransitionSectionElement refers to the basic elements of subgrade transition section, including TRANSITIONCONE, FOUNDATIONBACKFILLINGSOIL, NONSANDCONPERPLATE and REPLACEMENTSOIL.

### 8.1.3 Element Assemblies of Subgrade

Figure 8.7 shows the EXPRESS-G diagram for element assemblies in subgrade engineering.

![EXPRESS-G diagram for IfcSubgradeElementAssembly](image)

**Figure 8.7 EXPRESS-G diagram for IfcSubgradeElementAssembly**

IfcSubgradeElementAssembly is the supertype of all the element assemblies in subgrade engineering.

IfcSubgradeRetainingStructureSectionAssembly is composed of IfcSubgradeRetainingElement. Generally, IfcSubgradeRetainingStructureSectionAssembly is a retaining wall section with expansion joint as the dividing line.

IfcSubgradeSubsoilReinforcementPileAssembly refers to a single pile composed of IfcSubgradeSubsoilReinforcementPileElement.
8.2 Type Definition

8.2.1 IfcSubgradeStructureTypeEnum

This enumeration defines the different predefined types of subgrade from the perspective of form.

**Enumerated Item Definitions:**

- EMBANKMENT;
- CUTTING;
- CUTANDFILLSUBGRADE;
- USERDEFINED;
- NOTDEFINED.

**EXPRESS Specification:**

```
TYPE IfcSubgradeStructureTypeEnum = ENUMERATION OF
  (EMBANKMENT,
   CUTTING,
   CUTANDFILLSUBGRADE,
   USERDEFINED,
   NOTDEFINED);
END_TYPE;
```

8.2.2 IfcSubgradeFunctionTypeEnum

This enumeration defines the different functional types of subgrade.

**Enumerated Item Definitions:**

- RAILWAYSUBGRADE;
- HIGHWAYSUBGRADE;
- ROADSUBGRADE;
- USERDEFINED;
- NOTDEFINED.

**EXPRESS Specification:**

```
TYPE IfcSubgradeFunctionTypeEnum = ENUMERATION OF
  (RAILWAYSUBGRADE,
   HIGHWAYSUBGRADE,
   ROADSUBGRADE,
   USERDEFINED,
   NOTDEFINED);
END_TYPE;
```

8.2.3 IfcSubgradeStructurePartTypeEnum

...
This enumeration defines the different predefined types of an IfcSubgradeStructurePartElement.

**Enumerated Item Definitions:**

USERDEFINED;
NOTDEFINED.

**EXPRESS Specification:**

TYPE IfcSubgradeStructurePartTypeEnum = ENUMERATION OF
  ( USERDEFINED
    , NOTDEFINED
  );
END_TYPE;

8.2.4 IfcSubgradeSlopeProtectionTypeEnum

This enumeration defines the different predefined types of an IfcSubgradeSlopeProtectionElement.

**Enumerated Item Definitions:**

USERDEFINED;
NOTDEFINED.

**EXPRESS Specification:**

TYPE IfcSubgradeSlopeProtectionTypeEnum = ENUMERATION OF
  ( USERDEFINED
    , NOTDEFINED
  );
END_TYPE;

8.2.5 IfcSubgradeRetainingStructureTypeEnum

This enumeration defines the different predefined types of an IfcSubgradeRetainingStructureElement.

**Enumerated Item Definitions:**

GRARETWALL;
BALWEIRETWALL;
CANRETWALL;
COURRETWALL;
REICONRETWALL;
ANCBLTRETWALL;
REIEARRETWALL;
PRECABLE;
EXPRESS Specification:

TYPE IfcSubgradeRetainingStructureTypeEnum = ENUMERATION OF
  (GRARETWALL,
   BALWEIRETWALL,
   CANRETWALL,
   COURETWALL,
   REICONRETWALL,
   ANCBOLTRETWALL,
   REIEARRETWALL,
   PRECABLE,
   PILEFOUNRETWALL,
   DOCKRETWALL,
   SHORTRELRETWALL,
   WINDBREAKWALL,
   SOILNAILRATWALL,
   ANCPLARETWALL,
   USERDEFINED,
   NOTDEFINED);

END_TYPE;

8.2.6 IfcSubgradeSubsoilTreatmentTypeEnum

This enumeration defines the different predefined types of an IfcSubgradeSubsoilTreatmentElement.

Enumerated Item Definitions:

USERDEFINED;

NOTDEFINED.

EXPRESS Specification:

TYPE IfcSubgradeSubsoilTreatmentTypeEnum = ENUMERATION OF
  (USERDEFINED,
   NOTDEFINED
   );
8.2.7 IfcSubgradeTransitionSectionStructureTypeEnum

This enumeration defines the different predefined types of an IfcSubgradeTransitionSectionStructureElement.

**Enumerated Item Definitions:**

- EMBANKMENTABUTMENT;
- MBANKMENTLATERALSTRUCTURE; EMBANKMENTCUTTING;
- CUTTINGABUTMENT;
- CUTTINGTUNNEL;
- USERDEFINED;
- NOTDEFINED.

**EXPRESSION Specification:**

```plaintext
TYPE IfcSubgradeTransitionSectionStructureTypeEnum = ENUMERATION OF
  (EMBANKMENTABUTMENT,
   EMBANKMENTLATERALSTRUCTURE,
   EMBANKMENTCUTTING,
   CUTTINGABUTMENT,
   CUTTINGTUNNEL,
   USERDEFINED,
   NOTDEFINED);
END_TYPE;
```

8.2.8 IfcSubgradeRetainingElementTypeEnum

This enumeration defines the different predefined types of an IfcSubgradeRetainingElement.

**Enumerated Item Definitions:**

- GRARETBODY;
- BALWEIRETBODY;
- CANRETBODY;
- COURRETBODY;
- ANCHORAGEPILE;
- RETAININGPLATE;
- RIBBEDCOLUMN;
- PANEL;
- REIEARRETBODY;
- WALLFOUNDATION;
- PRECABLEBODY;
PILEFOUNTRIMMER;
DOCKRETBODY;
SHORTRELRETBODY;
WINDBREAKBODY;
SOILNAILRATBODY;
ANCHORPLATE;
ANCHORPLATEPULLROD;
WALLPANEL;
ANCHRIBCOLUMN;
USERDEFINED;
NOTDEFINED.

**EXPRESS Specification:**

```plaintext
TYPE IfcSubgradeRetainingElementTypeEnum = ENUMERATION OF
  (GRARETBODY
  ,BALWEIRETBODY
  ,CANRETBODY
  ,COURETBODY
  ,ANCHORAGEPILE
  ,RETAININGPLATE
  ,RIBBEDCOLUMN
  ,PANEL
  ,REIEARRETBODY
  ,WALLFOUNDATION
  ,PRECABLEBODY
  ,PILEFOUNTRIMMER
  ,DOCKRETBODY
  ,SHORTRELRETBODY
  ,WINDBREAKBODY
  ,SOILNAILRATBODY
  ,ANCHORPLATE
  ,ANCHORPLATEPULLROD
  ,WALLPANEL
  ,ANCHRIBCOLUMN
  ,USERDEFINED
  ,NOTDEFINED
);
END_TYPE;
```

8.2.9 **IfcSubgradeFillingWorksTypeEnum**

This enumeration defines the different predefined types of an IfcSubgradeFillingWorks.
Enumerated Item Definitions:
TOPLAYERSUBBED;
BOTTOMLAYERSUBBED;
BELOWSUBBED;
REPSUBBASE;
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:

TYPE IfcSubgradeFillingWorksTypeEnum = ENUMERATION OF
   (TOPLAYERSUBBED
    ,BOTTOMLAYERSUBBED
    ,BELOWSUBBED
    ,REPSUBBASE
    ,USERDEFINED
    , NOTDEFINED
   );
END_TYPE;

8.2.10 IfcSubgradeSlopeProtectionSectionElementTypeEnum

This enumeration defines the different predefined types of an IfcSubgradeSlopeProtectionSectionElement.

Enumerated Item Definitions:
ARCHEDFRAMEWORK;
HOLETYPEPROWALL;
MORTARRUBBLE;
ANCHOREDFRAMEBEAM;
GRIDFRAME;
DIOMONDFRAME;
HUMANSHAPEDFRAME;
HOLLOWBRICK;
SOLIDSLOPEPROTECTION;
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:

TYPE IfcSubgradeSlopeProtectionSectionElementTypeEnum = ENUMERATION OF
   (ARCHEDFRAMEWORK
    ,HOLETYPEPROWALL
   );
8.2.11 IfcSubgradeSubsoilReinforcementPileElementTypeEnum

This enumeration defines the different predefined types of an IfcSubgradeSubsoilReinforcementPileElement.

Enumerated Item Definitions:

- PILECAP;
- PILEBODY;
- USERDEFINED;
- NOTDEFINED.

EXPRESS Specification:

TYPE IfcSubgradeSubsoilReinforcementPileElementTypeEnum = ENUMERATION OF
    (PILECAP
     , PILEBODY
     , USERDEFINED
     , NOTDEFINED
    );
END_TYPE;

8.2.12 IfcSubgradeOriginalSubgradeSubsoilReinforcementTypeEnum

This enumeration defines the different predefined types of an IfcSubgradeOriginalSubgradeSubsoilReinforcement.

Enumerated Item Definitions:

- COMPACTION;
- RAMMED;
- GROUTING;
- SANDWICK;
- SHEETDRAIN;
- USERDEFINED;
- NOTDEFINED.
EXPRESS Specification:

TYPE IfcSubgradeOriginalSubgradeSubsoilReinforcementTypeEnum = ENUMERATION OF
  (COMPACATION,
   RAMMED,
   GROUTING,
   SANDWICK,
   SHEETDRAIN,
   USERDEFINED,
   NOTDEFINED);
END_TYPE;

8.2.13 IfcSubgradeTransitionSectionElementTypeEnum

This enumeration defines the different predefined types of an IfcSubgradeTransitionSectionElement.

Enumerated Item Definitions:
TRANSITIONCONE;
FOUNDATIONBACKFILLINGSOIL;
NONSANDCONPERPLATE;
REPLACEMENTSOIL;
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:

TYPE IfcSubgradeTransitionSectionElementTypeEnum = ENUMERATION OF
  (TRANSITIONCONE,
   FOUNDATIONBACKFILLINGSOIL,
   NONSANDCONPERPLATE,
   REPLACEMENTSOIL,
   USERDEFINED,
   NOTDEFINED);
END_TYPE;

8.2.14 IfcSubgradeRetainingStructureSectionAssemblyTypeEnum

This enumeration defines the different predefined types of an IfcSubgradeRetainingStructureSectionAssembly.

Enumerated Item Definitions:
GRARETSECTION;
BALWEIRETSECTION;
EXPRESS Specification:

```plaintext
TYPE IfcSubgradeRetainingStructureSectionAssemblyTypeEnum = Enumeration
  OF
    GRARETSECTION,
    BALWEIRETSECTION,
    CANRETSECTION,
    COURETSECTION,
    REICONRETSECTION,
    ANCBOLTRETSECTION,
    REIEARRETSECTION,
    PRECABLESECTION,
    PILEFOUNRETSECTION,
    DOCKRETSECTION,
    SHORTRELRETSECTION,
    WINDBREAKSECTION,
    SOILNAILRATSECTION,
    ANCPLARETSECTION,
    USERDEFINED,
    NOTDEFINED;
END_TYPE;
```

8.2.15 IfcSubgradeSubsoilReinforcementPileAssemblyTypeEnum

This enumeration defines the different predefined types of an IfcSubgradeSubsoilReinforcementPileAssembly.

Enumerated Item Definitions:
CEMENTMIXINGPILE;
LIMESOILCOMPILE;
CEMFLYGRAPILE;
CHEMICALCHURNINGPILE;
COLUMNHAMEXPPILE;
CEMSOILCOMPPILE;
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:

TYPE IfcSubgradeSubsoilReinforcementPileAssemblyTypeEnum = ENUMERATION OF
(CEMENTMIXINGPILE,
LIMESOILCOMPILE,
CEMFLYGRAPILE,
CHEMICALCHURNINGPILE,
COLUMNHAMEXPPILE,
CEMSOILCOMPPILE,
USERDEFINED,
NOTDEFINED);

END_TYPE;

8.3 Entity Definition

8.3.1 IfcSubgradeStructureElement

IfcSubgradeStructureElement is the supertype of all the spatial structure elements in subgrade engineering.

EXPRESS Specification:

ENTITY IfcSubgradeStructureElement
  SUPERTYPE OF (ONEOF
  SUBTYPE OF (IfcCivilStructureElement);
END_ENTITY;

8.3.2 IfcSubgrade

IfcSubgrade refers to a segment of subgrade with certain functions, clear start point and end point.

Table 8.1 IfcSubgrade spatial composition

<table>
<thead>
<tr>
<th>Spatial Composite</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcRailway</td>
<td>IfcSubgrade can be a component of IfcRailway.</td>
</tr>
<tr>
<td>IfcRailwayStation</td>
<td>IfcSubgrade can be a component of IfcRailwayStation.</td>
</tr>
</tbody>
</table>
### Table 8.2 IfcSubgrade spatial decomposition

<table>
<thead>
<tr>
<th>Spatial Parts</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcSubgradeStructurePartElement</td>
<td>IfcSubgradeStructurePartElement is a component of IfcSubgrade.</td>
</tr>
<tr>
<td>IfcSubgradeSlopeProtectionElement</td>
<td>IfcSubgradeSlopeProtectionElement is a component of IfcSubgrade.</td>
</tr>
<tr>
<td>IfcSubgradeRetainingStructureElement</td>
<td>IfcSubgradeRetainingStructureElement is a component of IfcSubgrade.</td>
</tr>
<tr>
<td>IfcSubgradeSubsoilTreatmentElement</td>
<td>IfcSubgradeSubsoilTreatmentElement is a component of IfcSubgrade.</td>
</tr>
<tr>
<td>IfcSubgradeTransitionSectionStructureElement</td>
<td>IfcSubgradeTransitionSectionStructureElement is a component of IfcSubgrade.</td>
</tr>
</tbody>
</table>

### EXPRESS Specification:

ENTITY IfcSubgrade

  SUBTYPE OF (IfcSubgradeStructureElement);
  PredefinedType: IfcSubgradeStructureTypeEnum;
  FunctionType: IfcSubgradeFunctionTypeEnum;

END_ENTITY;

Attribute definitions:

PreDefinedType: IfcSubgrade is structurally decomposed into EMBANKMENT, CUTTING and CUTANDFILLSUBGRADE.

FunctionType: To define different function types of subgrade, such as RAILWAYSUBGRADE, HIGHWAYSUBGRADE and ROADSUBGRADE.

#### 8.3.3 IfcSubgradeStructurePartElement

IfcSubgradeStructurePartElement is used to define the main body of subgrade. An IfcSubgradeStructurePartElement is composed of one or more IfcSubgradeFillingWorks. An IfcSubgrade may contain one or more IfcSubgradeStructurePartElement objects.

### Table 8.3 Property sets for IfcSubgradeStructurePartElement

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_SubgradeStructurePartElementCommon</td>
</tr>
</tbody>
</table>

### Table 8.4 IfcSubgradeStructurePartElement spatial composition

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IfcSubgradeStructurePartElement is a component of IfcSubgrade.</td>
</tr>
</tbody>
</table>

### Table 8.5 IfcSubgradeStructurePartElement spatial containment

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Contained Entities</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>IfcSubgradeFillingWorks can be contained in IfcSubgradeStructurePartElement.</td>
</tr>
</tbody>
</table>
EXPRESS Specification:
ENTITY IfcSubgradeSlopeProtectionElement
  SUBTYPE OF (IfcSubgradeStructureElement);
  PredefinedType: IfcSubgradeSlopeProtectionTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType.

8.3.4 IfcSubgradeSlopeProtectionElement

IfcSubgradeSlopeProtectionElement is used to define block-based subgrade slope protection. An IfcSubgrade may be composed of one or more IfcSubgradeSlopeProtectionElement objects. Generally speaking, the slope protection measures on both sides of the subgrade are defined as two IfcSubgradeSlopeProtectionElement objects. An IfcSubgradeSlopeProtectionElement is composed of one or more IfcSubgradeSlopeProtectionSectionElement objects.

Table 8.6 Property sets for IfcSubgradeSlopeProtectionElement

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset__SubgradeSlopeProtectionElementCommon</td>
</tr>
</tbody>
</table>

Table 8.7 IfcSubgradeSlopeProtectionElement spatial composition

<table>
<thead>
<tr>
<th>Spatial Composite</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcSubgrade</td>
<td>IfcSubgradeSlopeProtectionElement is a component of IfcSubgrade.</td>
</tr>
</tbody>
</table>

Table 8.8 IfcSubgradeSlopeProtectionElement spatial containment

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Contained Entities</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IfcSubgradeSlopeProtectionSectionElement</td>
<td>IfcSubgradeSlopeProtectionElement may contain IfcSubgradeSlopeProtectionSectionElement.</td>
</tr>
</tbody>
</table>

EXPRESS Specification:
ENTITY IfcSubgradeRetainingStructureElement
  SUBTYPE OF (IfcSubgradeStructureElement);
  PredefinedType: IfcSubgradeRetainingStructureTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType.

8.3.5 IfcSubgradeRetainingStructureElement

IfcSubgradeRetainingStructureElement is used to define subgrade retaining structures, such as gravity retaining wall, balance weight retaining wall and cantilever retaining wall. An IfcSubgradeRetainingStructureElement is composed of one or more IfcSubgradeRetainingStructureSectionAssembly objects.

Table 8.9 Property sets for IfcSubgradeRetainingStructureElement

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
</table>
### Table 8.10 IfcSubgradeRetainingStructureElement spatial composition

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Contained Entities</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRAETWALL</td>
<td>IfcSubgradeRetainingStructureSectionAssembly/GRAETSECTION</td>
<td>Gravity retaining wall may contain gravity retaining wall section.</td>
</tr>
<tr>
<td>BALWEIRETWALL</td>
<td>IfcSubgradeRetainingStructureSectionAssembly/BALWEIRETSECTION</td>
<td>Balance weight retaining wall may contain balance weight retaining wall section.</td>
</tr>
<tr>
<td>CANRETWALL</td>
<td>IfcSubgradeRetainingStructureSectionAssembly/CANRETSECTION</td>
<td>Cantilever retaining wall may contain cantilever retaining wall section.</td>
</tr>
<tr>
<td>REICONRETWALL</td>
<td>IfcSubgradeRetainingStructureSectionAssembly/REICONRETSECTION</td>
<td>Reinforced concrete retaining wall may contain reinforced concrete retaining wall section.</td>
</tr>
<tr>
<td>ANCBOLTRETWALL</td>
<td>IfcSubgradeRetainingStructureSectionAssembly/ANCBOLTRETSECTION</td>
<td>Anchor bolt retaining wall may contain anchor bolt retaining wall section.</td>
</tr>
<tr>
<td>REIEARRETWALL</td>
<td>IfcSubgradeRetainingStructureSectionAssembly/REIEARRETSECTION</td>
<td>Reinforced earth retaining wall may contain reinforced earth retaining wall section.</td>
</tr>
<tr>
<td>PRECABLE</td>
<td>IfcSubgradeRetainingStructureSectionAssembly/PRECABLESECTION</td>
<td>Prestressed cable may contain prestressed cable section.</td>
</tr>
<tr>
<td>PILEFOUNRETWALL</td>
<td>IfcSubgradeRetainingStructureSectionAssembly/PILEFOUNRETSECTION</td>
<td>Pile foundation retaining wall may contain pile foundation retaining wall section.</td>
</tr>
<tr>
<td>DOCKRETWALL</td>
<td>IfcSubgradeRetainingStructureSectionAssembly/DOCKRETSECTION</td>
<td>Dock retaining wall may contain dock retaining wall section.</td>
</tr>
<tr>
<td>SHORTRELRETWALL</td>
<td>IfcSubgradeRetainingStructureSectionAssembly/SHORTRELRETSECTION</td>
<td>Short relieving slab retaining wall may contain short relieving slab retaining wall section.</td>
</tr>
<tr>
<td>WINDBREAKWALL</td>
<td>IfcSubgradeRetainingStructureSectionAssembly/WINDBREAKSECTION</td>
<td>Wind brake wall may contain wind brake wall section.</td>
</tr>
<tr>
<td>SOILNAILRA TWALL</td>
<td>IfcSubgradeRetainingStructureSection</td>
<td>Soil nail retaining wall may</td>
</tr>
</tbody>
</table>

### Table 8.11 IfcSubgradeRetainingStructureElement spatial containment

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Spatial Composite</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRAETWALL</td>
<td>GRARETWALL</td>
<td>Gravity retaining wall may contain gravity retaining wall section.</td>
</tr>
<tr>
<td>BALWEIRETWALL</td>
<td>BALWEIRETWALL</td>
<td>Balance weight retaining wall may contain balance weight retaining wall section.</td>
</tr>
<tr>
<td>CANRETWALL</td>
<td>CANRETWALL</td>
<td>Cantilever retaining wall may contain cantilever retaining wall section.</td>
</tr>
<tr>
<td>REICONRETWALL</td>
<td>REICONRETWALL</td>
<td>Reinforced concrete retaining wall may contain reinforced concrete retaining wall section.</td>
</tr>
<tr>
<td>ANCBOLTRETWALL</td>
<td>ANCBOLTRETWALL</td>
<td>Anchor bolt retaining wall may contain anchor bolt retaining wall section.</td>
</tr>
<tr>
<td>REIEARRETWALL</td>
<td>REIEARRETWALL</td>
<td>Reinforced earth retaining wall may contain reinforced earth retaining wall section.</td>
</tr>
<tr>
<td>PRECABLE</td>
<td>PRECABLE</td>
<td>Prestressed cable may contain prestressed cable section.</td>
</tr>
<tr>
<td>PILEFOUNRETWALL</td>
<td>PILEFOUNRETWALL</td>
<td>Pile foundation retaining wall may contain pile foundation retaining wall section.</td>
</tr>
<tr>
<td>DOCKRETWALL</td>
<td>DOCKRETWALL</td>
<td>Dock retaining wall may contain dock retaining wall section.</td>
</tr>
<tr>
<td>SHORTRELRETWALL</td>
<td>SHORTRELRETWALL</td>
<td>Short relieving slab retaining wall may contain short relieving slab retaining wall section.</td>
</tr>
<tr>
<td>WINDBREAKWALL</td>
<td>WINDBREAKWALL</td>
<td>Wind brake wall may contain wind brake wall section.</td>
</tr>
<tr>
<td>SOILNAILRA TWALL</td>
<td>SOILNAILRA TWALL</td>
<td>Soil nail retaining wall may</td>
</tr>
<tr>
<td>ANCPLARET_WALL</td>
<td>Assembly/ SOILNAILRATSECTION</td>
<td>IfcSubgradeRetainingStructureSection Assembly/ ANCPLARETSECTION</td>
</tr>
<tr>
<td>---------------</td>
<td>------------------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ancreated plate retaining wall may contain anchored plate retaining wall section.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcSubgradeRetainingStructureElement

SUBTYPE OF (IfcSubgradeStructureElement);

PredefinedType: IfcSubgradeRetainingStructureTypeEnum;

END_ENTITY;

**Attribute definitions:**

PreDefinedType: IfcSubgradeRetainingStructureElement may include gravity retaining wall, balance weight retaining wall, cantilever retaining wall, counterfort retaining wall, reinforced concrete retaining wall, anchor bolt retaining wall, reinforced earth retaining wall, prestressed cable, pile foundation retaining wall, dock retaining wall, short relieving slab retaining wall, wind brake wall, Soil nail retaining wall, anchored plate retaining wall and so on.

8.3.6 IfcSubgradeSubsoilTreatmentElement

IfcSubgradeSubsoilTreatmentElement is used to define block-based subgrade subsoil treatment. An IfcSubgrade usually contains an IfcSubgradeSubsoilTreatmentElement object. An IfcSubgradeSubsoilTreatmentElement is composed of one or more IfcSubgradeSubsoilReinforcementPileAssembly or IfcOriginalSubgradeSubsoilReinforcement objects.

**Table 8.12 Property sets for IfcSubgradeSubsoilTreatmentElement**

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_SubgradeSubsoilTreatmentElementCommon</td>
</tr>
</tbody>
</table>

**Table 8.13 IfcSubgradeSubsoilTreatmentElement spatial composition**

<table>
<thead>
<tr>
<th>Spatial Composite</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcSubgrade</td>
<td>IfcSubgradeSubsoilTreatmentElement is a component of IfcSubgrade.</td>
</tr>
</tbody>
</table>

**Table 8.14 IfcSubgradeSubsoilTreatmentElement spatial containment**

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Contained Entities</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IfcSubgradeSubsoilReinforcementPileAssembly</td>
<td>IfcSubgradeSubsoilTreatmentElement may contain IfcSubgradeSubsoilReinforcementPileAssembly.</td>
</tr>
<tr>
<td>IfcOriginalSubgradeSubsoilReinforcement</td>
<td>IfcSubgradeSubsoilTreatmentElement may contain IfcOriginalSubgradeSubsoilReinforcement.</td>
<td></td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcSubgradeSubsoilTreatmentElement

SUBTYPE OF (IfcSubgradeStructureElement);

PredefinedType: IfcSubgradeSubsoilTreatmentTypeEnum;
8.3.7 IfcSubgradeTransitionSectionStructureElement

IfcSubgradeTransitionSectionStructureElement is used to define the section requiring special treatment to connect the subgrade and structures, which is composed of IfcSubgradeTransitionSectionElement objects.

Table 8.15 Property sets for IfcSubgradeTransitionSectionStructureElement

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMBANKMENTCUTTING</td>
<td>Pset_EMBANKMENTCUTTING</td>
</tr>
</tbody>
</table>

Table 8.16 IfcSubgradeTransitionSectionStructureElement spatial composition

<table>
<thead>
<tr>
<th>Spatial Composite</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcSubgrade</td>
<td>IfcSubgradeTransitionSectionStructureElement is a component of IfcSubgrade.</td>
</tr>
</tbody>
</table>

Table 8.17 IfcSubgradeTransitionSectionStructureElement spatial containment

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Contained Entities</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IfcSubgradeTransitionSectionElement</td>
<td>IfcSubgradeTransitionSectionElement can be included in IfcSubgradeTransitionSectionStructureElement.</td>
</tr>
</tbody>
</table>

EXPRESS Specification:

ENTITY IfcSubgradeTransitionSectionStructureElement
   SUBTYPE OF (IfcSubgradeStructureElement);
      PredefinedType: IfcSubgradeTransitionSectionStructureTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType: It contains embankment and abutment, embankment and lateral structure, embankment and cutting, cutting and abutment, cutting and tunnel, etc.

8.3.8 IfcSubgradeElement

IfcSubgradeElement is the supertype of all the physical elements in subgrade engineering.

EXPRESS Specification:

ENTITY IfcSubgradeElement
   SUPERTYPE OF (ONEOF (IfcSubgradeRetainingElement, IfcSubgradeFillingWorks, IfcSubgradeSlopeProtectionSectionElement, IfcSubgradeSubsoilReinforcementPileElement, IfcOriginalSubgradeSubsoilReinforcement, IfcSubgradeTransitionSectionElement))
   SUBTYPE OF (IfcCivilElement);
END_ENTITY;

8.3.9 IfcSubgradeRetainingElement

IfcSubgradeRetainingElement refers to the basic elements of subgrade retaining structure.
Some IfcSubgradeRetainingElements can compose IfcSubgradeRetainingStructureSectionAssembly.

Table 8.18 Property sets for IfcSubgradeRetainingElement

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRARETBODY</td>
<td>Pset_GRARETBODY</td>
</tr>
<tr>
<td>BALWEIRETBODY</td>
<td>Pset_BALWEIRETBODY</td>
</tr>
<tr>
<td>CANRETBODY</td>
<td>Pset_CANRETBODY</td>
</tr>
<tr>
<td>COURETBODY</td>
<td>Pset_COURETBODY</td>
</tr>
<tr>
<td>ANCHORAGEPILE</td>
<td>Pset_ANCHORAGEPILE</td>
</tr>
<tr>
<td>RETAININGPLATE</td>
<td>Pset_RETAININGPLATE</td>
</tr>
<tr>
<td>RIBBEDCOLUMN</td>
<td>Pset_RIBBEDCOLUMN</td>
</tr>
<tr>
<td>PANEL</td>
<td>Pset_PANEL</td>
</tr>
<tr>
<td>REIEARRETBODY</td>
<td>Pset_REIEARRETBODY</td>
</tr>
<tr>
<td>PRECABLEBODY</td>
<td>Pset_PRECABLEBODY</td>
</tr>
</tbody>
</table>

Table 8.19 IfcSubgradeRetainingElement contained in Assembly

<table>
<thead>
<tr>
<th>Assembly</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcSubgradeRetainingStructureSectionAssembly</td>
<td>IfcSubgradeRetainingElement should be included in IfcSubgradeRetainingStructureSectionAssembly.</td>
</tr>
</tbody>
</table>

**EXPRESSION Specification:**

ENTITY IfcSubgradeRetainingElement
  SUBTYPE OF (IfcSubgradeElement);
  PredefinedType: IfcSubgradeRetainingElementTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType: It contains gravity retaining wall body, balance weight retaining wall body, cantilever retaining wall body, counterfort retaining wall body, anchorage pile, retaining plate, ribbed column, panel, reinforced earth retaining wall body, wall foundation, prestressed cable body, pile foundation trimmer, dock retaining wall body, short relieving slab retaining wall body, wind brake wall body, Soil nail retaining wall body, anchor plate, anchor plate pullrod, wall panel, anchor ribbed column and so on.

8.3.10 IfcSubgradeFillingWorks

IfcSubgradeFillingWorks refers to the component of subgrade filling, and can compose IfcSubgradeStructurePartElement.

Table 8.20 Property sets for IfcSubgradeFillingWorks

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_SubgradeFillingWorksCommon</td>
</tr>
</tbody>
</table>

Table 8.21 IfcSubgradeFillingWorks contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcSubgradeStructurePartElement</td>
<td>IfcSubgradeFillingWorks can be included in</td>
</tr>
</tbody>
</table>
IfcSubgradeStructurePartElement.

EXPRESS Specification:
ENTITY IfcSubgradeFillingWorks
  SUBTYPE OF (IfcSubgradeElement);
  PredefinedType: IfcSubgradeFillingWorksTypeEnum;
END_ENTITY;

Attribute definitions:
  PreDefinedType: It contains top layer subbed, bottom layer subbed, below subbed, replace subbed base and so on.

8.3.11 IfcSubgradeSlopeProtectionSectionElement
  IfcSubgradeSlopeProtectionSectionElement refers to the basic elements of subgrade slope protection, and can compose IfcSubgradeSlopeProtectionElement.

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_SubgradeSlopeProtectionSectionElementCommon</td>
</tr>
</tbody>
</table>

Table 8.22 Property sets for IfcSubgradeSlopeProtectionSectionElement

EXPRESS Specification:
ENTITY IfcSubgradeSlopeProtectionSectionElement
  SUBTYPE OF (IfcSubgradeElement);
  PredefinedType: IfcSubgradeSlopeProtectionSectionElementTypeEnum;
END_ENTITY;

Attribute definitions:
  PreDefinedType: It contains arch framework, hole type protective wall, mortar rubble, anchored frame beam, grid frame, diamond frame, human shaped frame, hollow brick, solid slope protection, and so on.

8.3.12 IfcSubgradeSubsoilReinforcementPileElement
  IfcSubgradeSubsoilReinforcementPileElement refers to the pile foundation to improve the bearing capacity of foundation composed of soil or rock. IfcSubgradeSubsoilReinforcementPileElement can compose IfcSubgradeSubsoilReinforcementPileAssembly.

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_SubgradeSubsoilReinforcementPileElementCommon</td>
</tr>
</tbody>
</table>

Table 8.24 Property sets for IfcSubgradeSubsoilReinforcementPileElement

Table 8.25 IfcSubgradeSubsoilReinforcementPileElement contained in Assembly

<table>
<thead>
<tr>
<th>Assembly</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcSubgradeSubsoilReinforcement</td>
<td>IfcSubgradeSubsoilReinforcementPileElement should be</td>
</tr>
</tbody>
</table>
ntPileAssembly

EXPRESS Specification:
ENTITY IfcSubgradeSubsoilReinforcementPileElement
  SUBTYPE OF (IfcSubgradeElement);
    PredefinedType: IfcSubgradeSubsoilReinforcementPileElementTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType: It contains pilebody and pilecap, etc.

8.3.13 IfcOriginalSubgradeSubsoilReinforcement

IfcOriginalSubgradeSubsoilReinforcement refers to the engineering measures such as compaction, rammed, and grouting to improve the bearing capacity of foundation. IfcOriginalSubgradeSubsoilReinforcement can compose IfcSubgradeSubsoilTreatmentElement.

Table 8.26 Property sets for IfcOriginalSubgradeSubsoilReinforcement

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pset_OriginalSubgradeSubsoilReinforcementCommon</td>
<td></td>
</tr>
</tbody>
</table>

EXPRESSION Specification:
ENTITY IfcOriginalSubgradeSubsoilReinforcement
  SUBTYPE OF (IfcSubgradeElement);
    PredefinedType: IfcOriginalSubgradeSubsoilReinforcementTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType: It contains compaction, rammed, grouting, sand wick, sheet drain and so on.

8.3.14 IfcSubgradeTransitionSectionElement

IfcSubgradeTransitionSectionElement refers to the basic elements of subgrade transition section. IfcSubgradeTransitionSectionElement can compose IfcSubgradeTransitionSectionStructureElement.

Table 8.27 IfcOriginalSubgradeSubsoilReinforcement contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcSubgradeSubsoilTreatmentElement</td>
<td>IfcOriginalSubgradeSubsoilReinforcement can be included in IfcSubgradeSubsoilTreatmentElement.</td>
</tr>
</tbody>
</table>

Table 8.28 Property sets for IfcSubgradeTransitionSectionElement

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRANSITIONCONE</td>
<td>Pset_TRANSITIONCONE</td>
</tr>
<tr>
<td>FOUNDATIONBACKFILLINGSOIL</td>
<td>Pset_FOUNDATIONBACKFILLINGSOIL</td>
</tr>
<tr>
<td>NONSANDCONPERPLATE</td>
<td>Pset_NONSANDCONPERPLATE</td>
</tr>
<tr>
<td>REPLACEMENTSOIL</td>
<td>Pset_REPLACEMENTSOIL</td>
</tr>
</tbody>
</table>

Table 8.29 IfcSubgradeTransitionSectionElement contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcSubgradeTransitionSectionStruc</td>
<td>IfcSubgradeTransitionSectionElement can be included</td>
</tr>
</tbody>
</table>
EXPRESS Specification:
ENTITY IfcSubgradeTransitionSectionElement
  SUBTYPE OF (IfcSubgradeElement);
    PredefinedType: IfcSubgradeTransitionSectionElementTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType: It contains transition cone, foundation backfilling soil, non-sand concrete permeable plate, replacement soil and so on.

8.3.15 IfcSubgradeElementAssembly
IfcSubgradeElementAssembly is the supertype of all the element assemblies in subgrade engineering.

EXPRESS Specification:
ENTITY IfcSubgradeElementAssembly
  SUPERTYPE OF (ONEOF
    (IfcSubgradeRetainingStructureSectionAssembly, IfcSubgradeSubsoilReinforcementPileAssembly))
  SUBTYPE OF (IfcCivilElementAssembly);
END_ENTITY;

8.3.16 IfcSubgradeRetainingStructureSectionAssembly
IfcSubgradeRetainingStructureSectionAssembly is composed of some IfcSubgradeRetainingElement objects. Some IfcSubgradeRetainingStructureSectionAssembly objects can compose IfcSubgradeRetainingStructureElement.

Table 8.30 IfcSubgradeRetainingStructureSectionAssembly contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcSubgradeRetainingStructureSectionAssembly</td>
<td>IfcSubgradeRetainingStructureSectionAssembly can be included in IfcSubgradeRetainingStructureElement.</td>
</tr>
</tbody>
</table>

Table 8.31 IfcSubgradeRetainingStructureSectionAssembly entity composition

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Contained Entities</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcSubgradeRetainingElement</td>
<td></td>
<td>IfcSubgradeRetainingElement can be included in IfcSubgradeRetainingStructureSectionAssembly.</td>
</tr>
</tbody>
</table>

EXPRESS Specification:
ENTITY IfcSubgradeRetainingStructureSectionAssembly
  SUBTYPE OF (IfcSubgradeElementAssembly);
    PredefinedType: IfcSubgradeRetainingStructureSectionAssemblyTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType: It contains gravity retaining wall section, balance weight retaining wall section, cantilever retaining wall section, counterfort retaining wall section, reinforced concrete
retaining wall section, anchor bolt retaining wall section, reinforced earth retaining wall section, prestressed cable section, pile foundation retaining wall section, dock retaining wall section, short relieving slab retaining wall section, wind brake wall section, Soil nail retaining wall section, anchored plate retaining wall section and so on.

8.3.17 IfcSubgradeSubsoilReinforcementPileAssembly

IfcSubgradeSubsoilReinforcementPileAssembly is composed of IfcSubgradeTransitionSectionElement. Some IfcSubgradeSubsoilReinforcementPileAssembly objects can compose IfcSubgradeSubsoilTreatmentElement.

Table 8.32 IfcSubgradeSubsoilReinforcementPileAssembly contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcSubgradeSubsoilTreatmentElement</td>
<td>IfcSubgradeSubsoilReinforcementPileAssembly can be included in IfcSubgradeSubsoilTreatmentElement.</td>
</tr>
</tbody>
</table>

Table 8.33 IfcSubgradeSubsoilReinforcementPileAssembly entity composition

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Contained Entities</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcSubgradeRetainingElement</td>
<td>IfcSubgradeSubsoilReinforcementPileElement</td>
<td>can be included in IfcSubgradeSubsoilReinforcementPileAssembly.</td>
</tr>
</tbody>
</table>

EXPRESS Specification:

ENTITY IfcSubgradeSubsoilReinforcementPileAssembly

SUBTYPE OF (IfcSubgradeElementAssembly);

PredefinedType: IfcSubgradeSubsoilReinforcementPileAssemblyTypeEnum;

END_ENTITY;

Attribute definitions:

PreDefinedType: It contains cement mixing pile, lime-soil compaction pile, cement fly-ash gravel pile, chemical churning pile, column hammer expansion pile, cement soil compaction pile and so on.

8.4 Property Set Definition

8.4.1 Pset_SubgradeStructurePartElementCommon

Name: Pset_SubgradeStructurePartElementCommon

Applicable Entities: IfcSubgradeStructurePartElement

Description: Properties common to the definition of all occurrences of IfcSubgradeStructurePartElement.

Property Definitions: See Table 8.34.

Table 8.34 Property definitions of Pset_SubgradeStructurePartElementCommon

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>fillingmaximum</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Indicates the maximum</td>
</tr>
<tr>
<td>Property</td>
<td>Type</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>------</td>
<td>-------------</td>
</tr>
<tr>
<td>fillingmaximum</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Indicates the maximum digging depth.</td>
</tr>
</tbody>
</table>

### 8.4.2 Pset_SubgradeSlopeProtectionElementCommon

Name: Pset_SubgradeSlopeProtectionElementCommon

Applicable Entities: IfcSubgradeSlopeProtectionElement

Description: Properties common to the definition of all occurrences of IfcSubgradeSlopeProtectionElement.

Property Definitions: See Table 8.35.

**Table 8.35 Property definitions of Pset_SubgradeSlopeProtectionElementCommon**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>slopeprotectionsectionnumber</td>
<td>TypePropertySingleValue/IfcInteger</td>
<td>Indicates the number of slope protection sections.</td>
</tr>
<tr>
<td>protectiontype</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Protection type.</td>
</tr>
<tr>
<td>protectionarea</td>
<td>TypePropertySingleValue/IfcAreaMeasure/m2</td>
<td>Protection area.</td>
</tr>
<tr>
<td>protectionsectionlength</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Indicates the length of the protection section.</td>
</tr>
</tbody>
</table>

### 8.4.3 Pset_SubgradeRetainingStructureElementCommon

Name: Pset_SubgradeRetainingStructureElementCommon

Applicable Entities: IfcSubgradeRetainingStructureElement

Description: Properties common to the definition of all occurrences of IfcSubgradeRetainingStructureElement.

Property Definitions: See Table 8.36.

**Table 8.36 Property definitions of Pset_SubgradeRetainingStructureElementCommon**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>wallsectionnumber</td>
<td>TypePropertySingleValue/IfcInteger</td>
<td>Indicates the number of wall sections.</td>
</tr>
<tr>
<td>expansionjointspacing</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Expansion joint spacing.</td>
</tr>
<tr>
<td>expansionjointwidth</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Indicates the width of the expansion joint.</td>
</tr>
<tr>
<td>wallsectionlength</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Indicates the length of the wall section.</td>
</tr>
</tbody>
</table>

### 8.4.4 Pset_SubgradeSubsoilTreatmentElementCommon

Name: Pset_SubgradeSubsoilTreatmentElementCommon

Applicable Entities: IfcSubgradeSubsoilTreatmentElement

Description: Properties common to the definition of all occurrences of
IfcSubgradeSubsoilTreatmentElement.

Property Definitions: See Table 8.37.

Table 8.37 Property definitions of Pset_SubgradeSubsoilTreatmentElementCommon

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>treatmentlength</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Treatment length.</td>
</tr>
<tr>
<td>treatmentdepth</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Treatment depth.</td>
</tr>
<tr>
<td>treatmentcapacity</td>
<td>TypePropertySingleValue/IfcPlanarForceMeasure/Pa</td>
<td>Capacity after treatment.</td>
</tr>
<tr>
<td>pilenumber</td>
<td>TypePropertySingleValue/IfcInteger</td>
<td>Pile number.</td>
</tr>
<tr>
<td>leftboundary</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Left boundary.</td>
</tr>
<tr>
<td>rightboundary</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Right boundary.</td>
</tr>
</tbody>
</table>

8.4.5 Pset_REICONRETWALL

Name: Pset_REICONRETWALL

Applicable Entities: IfcSubgradeRetainingStructure/REICONRETWALL

Description: A set of properties of reinforced concrete retaining walls.

Property Definitions: See Table 8.38.

Table 8.38 Property definitions of Pset_REICONRETWALL

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>anchorpilesnumber</td>
<td>TypePropertySingleValue/IfcInteger</td>
<td>The number of anchor piles.</td>
</tr>
<tr>
<td>retainingplatenumber</td>
<td>TypePropertySingleValue/IfcInteger</td>
<td>The number of retaining plates.</td>
</tr>
</tbody>
</table>

8.4.6 Pset_ANCBOLTRETWALL

Name: Pset_ANCBOLTRETWALL

Applicable Entities: IfcSubgradeRetainingStructure/ANCBOLTRETWALL

Description: A set of properties of anchor bolt retaining walls.

Property Definitions: See Table 8.39.

Table 8.39 Property definitions of Pset_ANCBOLTRETWALL

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ribbedcolumnnumber</td>
<td>TypePropertySingleValue/IfcInteger</td>
<td>Ribbed column number.</td>
</tr>
<tr>
<td>panelnumber</td>
<td>TypePropertySingleValue/IfcInteger</td>
<td>Panel number.</td>
</tr>
<tr>
<td>anchoredboltnumber</td>
<td>TypePropertySingleValue/IfcInteger</td>
<td>Anchored bolt number.</td>
</tr>
</tbody>
</table>

8.4.7 Pset_EMBANKMENTCUTTING

Name: Pset_EMBANKMENTCUTTING

Applicable Entities: IfcSubgradeTransitionSectionStructure/EMBANKMENTCUTTING

Description: A set of properties of embankment and cutting.

Property Definitions: See Table 8.40.

Table 8.40 Property definitions of Pset_EMBANKMENTCUTTING

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
</table>
stepheight | TypePropertySingleValue/IfcLengthMeasure/m | Step height.
firststepheight | TypePropertySingleValue/IfcLengthMeasure/m | First step height.
longitudinaldepth | TypePropertySingleValue/IfcLengthMeasure/m | Longitudinal depth.

### 8.4.8 Pset_SubgradeFillingWorksCommon

Name: Pset_SubgradeFillingWorksCommon

Applicable Entities: IfcSubgradeFillingWorks

Description: Properties common to the definition of all occurrences of IfcSubgradeFillingWorks.

Property Definitions: See Table 8.41.

**Table 8.41 Property definitions of Pset_SubgradeFillingWorksCommon**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>fillingheight</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Filling height.</td>
</tr>
<tr>
<td>fillingname</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Filling name.</td>
</tr>
<tr>
<td>fillingvolume</td>
<td>TypePropertySingleValue/IfcVolumeMeasure/m</td>
<td>Filling volume.</td>
</tr>
<tr>
<td>compactiondegree</td>
<td>TypePropertySingleValue/IfcModulusOfSubgradeReacionMeasure</td>
<td>Compaction degree.</td>
</tr>
<tr>
<td>moisturedegree</td>
<td>TypePropertySingleValue/IfcNormalisedRatioMeasure</td>
<td>Moisture degree.</td>
</tr>
</tbody>
</table>

### 8.4.9 Pset_SubgradeSlopeProtectionSectionElementCommon

Name: Pset_SubgradeSlopeProtectionSectionElementCommon

Applicable Entities: IfcSubgradeSlopeProtectionSectionElement

Description: Properties common to the definition of all occurrences of IfcSubgradeSlopeProtectionSectionElement.

Property Definitions: See Table 8.42.

**Table 8.42 Property definitions of Pset_SubgradeSlopeProtectionSectionElementCommon**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>height</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>height</td>
</tr>
<tr>
<td>width</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>width</td>
</tr>
<tr>
<td>mortarrubletype</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>material</td>
</tr>
</tbody>
</table>

### 8.4.10 Pset_SubgradeSubsoilReinforcementPileElementCommon

Name: Pset_SubgradeSubsoilReinforcementPileElementCommon

Applicable Entities: IfcSubgradeSubsoilReinforcementPileElement

Description: Properties common to the definition of all occurrences of IfcSubgradeSubsoilReinforcementPileElement.

Property Definitions: See Table 8.43.

**Table 8.43 Property definitions of Pset_SubgradeSubsoilReinforcementPileElementCommon**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>waterdepth</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Water depth.</td>
</tr>
</tbody>
</table>
8.4.11 Pset_OriginalSubgradeSubsoilReinforcementCommon

Name: Pset_OriginalSubgradeSubsoilReinforcementCommon

Applicable Entities: IfcOriginalSubgradeSubsoilReinforcement

Description: Properties common to the definition of all occurrences of IfcOriginalSubgradeSubsoilReinforcement.

Property Definitions: See Table 8.44.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>reinforcearea</td>
<td>TypePropertySingleValue/IfcAreaMeasure/m²</td>
<td>Reinforcement area.</td>
</tr>
<tr>
<td>engineeringquantity</td>
<td>TypePropertySingleValue/IfcInteger</td>
<td>Engineering quantity.</td>
</tr>
</tbody>
</table>

8.4.12 Pset_GRARETBODY

Name: Pset_GRARETBODY

Applicable Entities: IfcSubgradeRetainingElement/GRARETBODY

Description: A set of properties of gravity retaining wall body.

Property Definitions: See Table 8.45.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>totalheight</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Total height.</td>
</tr>
<tr>
<td>topwidth</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Top width.</td>
</tr>
<tr>
<td>positivesloperatio</td>
<td>TypePropertySingleValue/IfcRatioMeasure</td>
<td>Positive slope ratio.</td>
</tr>
<tr>
<td>backsloperatio</td>
<td>TypePropertySingleValue/IfcRatioMeasure</td>
<td>Back slope ratio.</td>
</tr>
<tr>
<td>bottomratio</td>
<td>TypePropertySingleValue/IfcRatioMeasure</td>
<td>Bottom ratio.</td>
</tr>
</tbody>
</table>

8.4.13 Pset_BALWEIRETBODY

Name: Pset_BALWEIRETBODY

Applicable Entities: IfcSubgradeRetainingElement/BALWEIRETBODY

Description: A set of properties of balance weight retaining wall body.

Property Definitions: See Table 8.46.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>totalheight</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Total height.</td>
</tr>
<tr>
<td>upperwallheight</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Upper wall height.</td>
</tr>
<tr>
<td>topwidth</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Top width.</td>
</tr>
<tr>
<td>platformwidth</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Platform width.</td>
</tr>
<tr>
<td>positivesloperatio</td>
<td>TypePropertySingleValue/IfcRatioMeasure</td>
<td>Positive slope ratio.</td>
</tr>
<tr>
<td>Name</td>
<td>Type</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>upbacksloperatio</td>
<td>TypePropertySingleValue/IfcRatioMeasure</td>
<td>Up back-slope ratio.</td>
</tr>
<tr>
<td>bottombacksloperatio</td>
<td>TypePropertySingleValue/IfcRatioMeasure</td>
<td>Bottom back-slope ratio.</td>
</tr>
</tbody>
</table>

### 8.4.14 Pset_CANRETBODY

Name: Pset_CANRETBODY

Applicable Entities: IfcSubgradeRetainingElement/CANRETBODY

Description: A set of properties of cantilever retaining wall body.

Property Definitions: See Table 8.47.

**Table 8.47 Property definitions of Pset_CANRETBODY**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>totalheight</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Total height.</td>
</tr>
<tr>
<td>topwidth</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Top width.</td>
</tr>
<tr>
<td>positivesloperatio</td>
<td>TypePropertySingleValue/IfcRatioMeasure</td>
<td>Positive slope ratio.</td>
</tr>
<tr>
<td>backslope</td>
<td>TypePropertySingleValue/IfcRatioMeasure</td>
<td>Back slope ratio.</td>
</tr>
</tbody>
</table>

### 8.4.15 Pset_COURETBODY

Name: Pset_COURETBODY

Applicable Entities: IfcSubgradeRetainingElement/COURETBODY

Description: A set of properties of counterfort retaining wall body.

Property Definitions: See Table 8.48.

**Table 8.48 Property definitions of Pset_COURETBODY**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>totalheight</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Total height.</td>
</tr>
<tr>
<td>wallwidth</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Wall width.</td>
</tr>
<tr>
<td>floorheight</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Floor height.</td>
</tr>
<tr>
<td>armsspacing</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Arm spacing.</td>
</tr>
<tr>
<td>armthickness</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Arm thickness.</td>
</tr>
</tbody>
</table>

### 8.4.16 Pset_ANCHORAGEPILE

Name: Pset_ANCHORAGEPILE

Applicable Entities: IfcSubgradeRetainingElement/ANCHORAGEPILE

Description: A collection of properties applicable to anchorage piles for subgrade retaining.

Property Definitions: See Table 8.49.

**Table 8.49 Property definitions of Pset_ANCHORAGEPILE**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pilelength</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Pile length.</td>
</tr>
<tr>
<td>embeddingdepth</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Embedding depth.</td>
</tr>
<tr>
<td>crosssectionshape</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Cross section shape.</td>
</tr>
<tr>
<td>pilespacing</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Pile spacing.</td>
</tr>
</tbody>
</table>

### 8.4.17 Pset_RETAININGPLATE

Name: Pset_RETAININGPLATE
Applicable Entities: IfcSubgradeRetainingElement/RETAININGPLATE

Description: A collection of properties applicable to retaining plates for subgrade retaining.

Property Definitions: See Table 8.50.

### Table 8.50 Property definitions of Pset RETAININGPLATE

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>platethickness</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Plate thickness.</td>
</tr>
<tr>
<td>platewidth</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Plate width.</td>
</tr>
</tbody>
</table>

#### 8.4.18 Pset RIBBEDCOLUMN

Name: Pset_RIBBEDCOLUMN

Applicable Entities: IfcSubgradeRetainingElement/RIBBEDCOLUMN

Description: A collection of properties applicable to ribbed columns for subgrade retaining.

Property Definitions: See Table 8.51.

### Table 8.51 Property definitions of Pset RIBBEDCOLUMN

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>totalheight</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Total height of the wall.</td>
</tr>
<tr>
<td>wallbottomsupportcondition</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Wall bottom support condition.</td>
</tr>
</tbody>
</table>

#### 8.4.19 Pset PANEL

Name: Pset_PANEL

Applicable Entities: IfcSubgradeRetainingElement/PANEL

Description: A collection of properties applicable to panels for subgrade retaining.

Property Definitions: See Table 8.52.

### Table 8.52 Property definitions of Pset PANEL

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>retainingplatewidth</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Indicates the width of the retaining plate.</td>
</tr>
<tr>
<td>retainingplatethickness</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Indicates the thickness of the retaining plate.</td>
</tr>
</tbody>
</table>

#### 8.4.20 Pset REIEARRETBODY

Name: Pset_REIEARRETBODY

Applicable Entities: IfcSubgradeRetainingElement/REIEARRETBODY

Description: A collection of properties applicable to reinforced earth retaining wall body.

Property Definitions: See Table 8.53.

### Table 8.53 Property definitions of Pset REIEARRETBODY

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>totalheight</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Total height of the wall.</td>
</tr>
<tr>
<td>Name</td>
<td>Type</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>bandthickness</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The thickness of the band.</td>
</tr>
<tr>
<td>verticalsegment</td>
<td>TypePropertySingleValue/IfcInteger</td>
<td>The number of vertical segments.</td>
</tr>
</tbody>
</table>

8.4.21 Pset_PRECABLEBODY

Name: Pset_PRECABLEBODY

Applicable Entities: IfcSubgradeRetainingElement/PRECABLEBODY

Description: A collection of properties applicable to prestressed cable body.

Property Definitions: See Table 8.54.

Table 8.54 Property definitions of Pset_PRECABLEBODY

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>steelwirediameter</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The diameter of steel wire.</td>
</tr>
<tr>
<td>steelwirelength</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The length of steel wire.</td>
</tr>
<tr>
<td>boreholelength</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The length of bore hole.</td>
</tr>
</tbody>
</table>

8.4.22 Pset_REPSUBBASE

Name: Pset_REPSUBBASE

Applicable Entities: IfcSubgradeFillingWorks/REPSUBBASE

Description: A collection of properties applicable to subbed bases.

Property Definitions: See Table 8.55.

Table 8.55 Property definitions of Pset_REPSUBBASE

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>filltype</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Filling type.</td>
</tr>
<tr>
<td>fillmaterial</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Filling material.</td>
</tr>
<tr>
<td>diggingbasetype</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Digging base type.</td>
</tr>
</tbody>
</table>

8.4.23 Pset_PILECAP

Name: Pset_PILECAP

Applicable Entities: IfcSubgradeSubsoilReinforcementPileElement/PILECAP

Description: A collection of properties applicable to pile caps.

Property Definitions: See Table 8.56.

Table 8.56 Property definitions of Pset_PILECAP

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>thickness</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>thickness</td>
</tr>
<tr>
<td>diameter</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>diameter</td>
</tr>
<tr>
<td>volume</td>
<td>TypePropertySingleValue/IfcVolumeMeasure/m³</td>
<td>volume</td>
</tr>
</tbody>
</table>

8.4.24 Pset_PILEBODY

Name: Pset_PILEBODY

Applicable Entities: IfcSubgradeSubsoilReinforcementPileElement/PILEBODY

Description: A collection of properties applicable to pile body for subgrade reinforcement piles.
Property Definitions: See Table 8.57.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pile length</td>
<td>TypePropertySingleValue</td>
<td>Pile length.</td>
</tr>
<tr>
<td>diameter</td>
<td>IfcLengthMeasure/m</td>
<td>Diameter.</td>
</tr>
<tr>
<td>volume</td>
<td>IfcVolumeMeasure/m³</td>
<td>Volume.</td>
</tr>
</tbody>
</table>

**8.4.25 Pset_COMPACTION**

Name: Pset_COMPACTION

Applicable Entities: IfcSubgradeOriginalSubgradeSubsoilReinforcement/COMPACTION

Description: A collection of properties applicable to compaction subgrade.

Property Definitions: See Table 8.58.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>compactionarea</td>
<td>TypePropertySingleValue/m²</td>
<td>Compaction area.</td>
</tr>
<tr>
<td>engineeringquantity</td>
<td>TypePropertySingleValue/IfcInteger</td>
<td>Engineering quantity.</td>
</tr>
<tr>
<td>K30</td>
<td>IfcModulusOfSubgradeReacionMeasure/ N/m³</td>
<td>K30 test value.</td>
</tr>
</tbody>
</table>

**8.4.26 Pset_RAMMED**

Name: Pset_RAMMED

Applicable Entities: IfcSubgradeOriginalSubgradeSubsoilReinforcement/RAMMED

Description: A collection of properties applicable to rammed subgrade.

Property Definitions: See Table 8.59.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>rammedarea</td>
<td>TypePropertySingleValue/m²</td>
<td>Rammed area.</td>
</tr>
<tr>
<td>engineeringquantity</td>
<td>TypePropertySingleValue/IfcInteger</td>
<td>Engineering quantity.</td>
</tr>
<tr>
<td>K30</td>
<td>IfcModulusOfSubgradeReacionMeasure/ N/m³</td>
<td>K30 test value.</td>
</tr>
</tbody>
</table>

**8.4.27 Pset_GROUTING**

Name: Pset_GROUTING

Applicable Entities: IfcSubgradeOriginalSubgradeSubsoilReinforcement/GROUTING

Description: A collection of properties applicable to grouting for original subgrade subsoil reinforcement.

Property Definitions: See Table 8.60.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>groutingvolume</td>
<td>TypePropertySingleValue/m³</td>
<td>Grouting volume.</td>
</tr>
<tr>
<td>materialtype</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Material type.</td>
</tr>
</tbody>
</table>
8.4.28 Pset_TRANSITIONCONE

Name: Pset_TRANSITIONCONE

Applicable Entities: IfcSubgradeTransitionSectionElement/TRANSITIONCONE

Description: A collection of properties applicable to transition cone for subgrade transition section.

Property Definitions: See Table 8.61.

Table 8.61 Property definitions of Pset_TRANSITIONCONE

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bottomdepth</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Bottom depth.</td>
</tr>
<tr>
<td>crosssectionsloperatio</td>
<td>TypePropertySingleValue/IfcRatioMeasure</td>
<td>Cross section slope ratio.</td>
</tr>
<tr>
<td>originalthickness</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Original thickness.</td>
</tr>
<tr>
<td>longitudinalsectionsloperatio</td>
<td>TypePropertySingleValue/IfcRatioMeasure</td>
<td>Longitudinal section slope ratio.</td>
</tr>
<tr>
<td>equalthicknessdepth</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Equal thickness depth.</td>
</tr>
<tr>
<td>variousthicknessdepth</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Various thickness depth.</td>
</tr>
</tbody>
</table>

8.4.29 Pset_FOUNDATIONBACKFILLINGSOIL

Name: Pset_FOUNDATIONBACKFILLINGSOIL

Applicable Entities: IfcSubgradeTransitionSectionElement/FOUNDATIONBACKFILLINGSOIL

Description: A set of properties of foundation backfilling soil.

Property Definitions: See Table 8.62.

Table 8.62 Property definitions of Pset_FOUNDATIONBACKFILLINGSOIL

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>backfillmaterial</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Backfill material.</td>
</tr>
<tr>
<td>backfillvolume</td>
<td>TypePropertySingleValue/IfcVolumeMeasure/m³</td>
<td>Backfill volume.</td>
</tr>
</tbody>
</table>

8.4.30 Pset_NONSANDCONPERPLATE

Name: Pset_NONSANDCONPERPLATE

Applicable Entities: IfcSubgradeTransitionSectionElement/NONSANDCONPERPLATE

Description: A set of properties of non-sand concrete permeable plates.

Property Definitions: See Table 8.63.

Table 8.63 Property definitions of Pset_NONSANDCONPERPLATE

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>platethickness</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Plate thickness.</td>
</tr>
<tr>
<td>plateheight</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Plate height.</td>
</tr>
</tbody>
</table>

8.4.31 Pset_REPLACEMENTSOIL

Name: Pset_REPLACEMENTSOIL
Applicable Entities: IfcSubgradeTransitionSectionElement/REPLACEMENTSOIL

Description: A set of properties of replacement soil.

Property Definitions: See Table 8.64.

Table 8.64 Property definitions of Pset_REPLACEMENTSOIL

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>fillthickness</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>Filling thickness.</td>
</tr>
<tr>
<td>fillmaterial</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Filling material.</td>
</tr>
</tbody>
</table>

9. Bridge Schema

9.1 Schema Definition

The information model defined in this schema includes beam bridge, arch bridge, rigid frame bridge, cable-stayed bridge, suspension bridge, frame bridge, culvert and their main components.

The basic data architecture of bridge information model is composed of IfcBridgeStructureElement, IfcBridgeElementAssembly and IfcBridgeElement.

IfcBridgeStructureElement includes IfcBridge and IfcBridgePart.

IfcBridgeElementAssembly includes IfcBridgeTruss, IfcBridgeJoint, IfcBeamFallingPreventionDevice and IfcCrossBrace.

IfcBridgeElement includes IfcBridgeMember, IfcStiffeningRib, IfcBridgeSlab, IfcBridgeGirderSegment, IfcBridgeGearBlocks, IfcBridgeBedstone, IfcBridgePierSegment, IfcBridgeAbutmentSegment, IfcBridgePylon, IfcBridgeArchrib, IfcBridgeArchfoot, IfcBridgeStandColumn, IfcBridgeSuspender, IfcBridgeCable, IfcBridgeSuspendedTendon, IfcBridgeBearing, IfcBridgeExpansionInstallation, IfcBridgeProtectingWall, IfcBridgeFrameSegment, IfcBridgeWingWall, IfcBridgeCulvertSegment, IfcBridgeHatStone, IfcBridgeCoping, IfcBridgeEmbeddedPartsFoundation and IfcBridgeRefugePlatform.

The relationship between all the classes in the bridge domain is shown in Figure 9.1.
Figure 9.1 Bridge composition
9.1.1 Spatial Structure Elements of Bridge

Firstly, the IfcBridgeStructureElement is derived from the IfcCivilStructureElement, and it is the supertype of all the spatial structure elements in bridge engineering. Then IfcBridge and IfcBridgePart are derived from the IfcBridgeStructureElement. The inheritance relationship between the spatial structure elements in bridge domain is shown in Figure 9.2.

Figure 9.2 EXPRESS-G diagram for IfcBridgeStructureElements

IfcBridgeStructureElement inherits from IfcCivilStructureElement, and is the supertype of all the spatial structure elements of bridge.

IfcBridge refers to a bridge which may be a single structure bridge or a composite bridge comprised of one or more single structure bridges and bridge parts.

A single structure bridge is usually comprised of IfcBridgePart such as bridge girder, pier, foundation and abutment, and IfcBridgeElement such as bridge expansion installation, bridge bearing, etc.

A composite bridge is usually comprised of one or more single structure bridges and IfcBridgePart such as bridge girder, pier, foundation and abutment, and IfcBridgeElement such as bridge expansion installation, bridge bearing, etc.

When IfcBridge refers to a single structure bridge, the “CompositionType” property that inherited from the IfcSpatialStructureElement should be ELEMENT. When IfcBridge refers to a composite bridge, the “CompositionType” property that inherited from the IfcSpatialStructureElement should be COMPLEX. As is shown in Figure 9.3.
IfcBridge is further subdivided into GIRDERBRIDGE, ARCHBRIDGE, RIGIDFRAMEBRIDGE, CABLESTAYEDBRIDGE, SUSPENSIONBRIDGE, FRAMEBRIDGE and CULVERT by predefined types.

IfcBridgePart refers to the various parts of the IfcBridge from the perspective of spatial structure. IfcBridgePart is further subdivided into GIRD, ABUTMENT, PIRE, PYLONS, CABLES, ARCH, SUSPENDERS, FOUNDATION, SUSPENDEDTENDONS and BRIDGEFLOORSYSTEM by predefined types. As is shown in Figure 9.4.

9.1.2 Physical Elements of Bridge

IfcBridgeElement is derived from IfcCivilElement, which is the supertype of all the physical elements in bridge engineering. Then IfcBridgeElement derives IfcBridgeMember, IfcStiffeningRib, IfcBridgeSlab, IfcBridgeGirderSegment, IfcBridgeGearBlocks, IfcBridgeBedstone, IfcBridgePierSegment, IfcBridgeAbutmentSegment, IfcBridgePylon, IfcBridgeArchrib, IfcBridgeArchfoot, IfcBridgeStandColumn, IfcBridgeSuspender, IfcBridgeCable, IfcBridgeSuspendedTendon, IfcBridgeBearing, IfcBridgeExpansionInstallation, IfcBridgeProtectingWall, IfcBridgeFrameSegment, IfcBridgeWingWall, IfcBridgeCulvertSegment,
IfcBridgeHatStone, IfcBridgeCoping, IfcBridgeEmbeddedPartsFoundation, and IfcBridgeRefugePlatform.

The inheritance relationship between the physical elements of bridge is shown in Figure 9.5.

![Figure 9.5 EXPRESS-G diagram for IfcBridgeElements](image)

IfcBridgeElement is derived from IfcCivilElement and is the supertype of all the physical elements of bridge.

IfcBridgeMember refers to the components of truss such as chord, longitudinal beam, cross beam, etc. Considering that the bridge members are generally the main bearing components with complex structure, so this schema don’t directly reference the original IfcMember in IFC4 schema.

IfcStiffeningRib refers to stiffening structure such as U-shape rib, plate rib, etc.

IfcBridgeSlab refers to the gusset plate, bridge deck, splice plate, cantilever plate, pavement plate and web plate, and the thickness can be changed. In IFC4, IfcSlab refers to ceiling, floor and
stair board in the building, and IfcPlate mainly refers to the flat plate with a uniform thickness. IfcSlab and IfcPlate can't fully meet the requirements for the bridge slabs, therefore this schema don't directly use IfcSlab or IfcPlate to define the bridge slabs.

IfcBridgeGirderSegment refers to the segment of the main girder of the bridge. Because the main girder is constructed segment by segment and the section size of the main girder is different at different locations, so the main girder is not defined as a physical element.

IfcBridgeGearBlocks refers to the wedge structure of anchorage prestressed steel strand. The gear block is generally designed separately, so it is defined as an entity.

IfcBridgeBedstone refers to the structure placed on the top of the pier or abutment to support the bearing.

IfcBridgePierSegment refers to the pier shaft segment, the top cap or the tray. Because the bridge pier is poured segment by segment in the construction process and the materials of the pier, the top cap and the tray are different, so the bridge pier is not defined as a physical element.

IfcBridgeAbutmentSegment refers to the components of the abutment. Because the bridge abutment is poured segment by segment in the construction process, so the bridge abutment is not defined as a physical element.

IfcBridgePylonsegment refers to the components of the pylon. Because the bridge pylon is poured or assembled segment by segment in the construction process, so the bridge pylon is not defined as a physical element.

IfcBridgeArchfoot refers to the structure used to support the arch rib and connect the foundation or main girder to the arch rib.

IfcBridgeStandColumn refers to the structure on the arch rib to support the main girder.

IfcBridgeSuspender refers to the structure used to connect the suspension cable or the arch rib with the bridge floor system. A bridge suspender comprises a hanger body, sheath, sleeve, bolts, etc.

IfcBridgeCable refers to the structure used to connect the pylon with the bridge floor system. A bridge cable comprises a hanger body, sheath, sleeve, bolts, etc.

IfcBridgeSuspendedTendon refers to the single suspension cable, which comprises steel wire, sheath, etc.

IfcBridgeBearing refers to the structure used to support the main girder and transfer the load from the superstructure to the bridge pier.

IfcBridgeExpansionInstallation refers to the structure installed on between two main girders to facilitate the vehicle smoothly pass the bridge deck and to meet the deformation of the upper
structure of the bridge. It is comprised of rubber and steel parts.

IfcBridgeProtectingWall refers to the structure located on the bridge deck to protect the pedestrians and to retain the ballast. The IfcWall defined in IFC4 mainly refers to the wall of the building. In order to emphasize the specific meaning of the bridge protection wall, IfcWall is not used.

IfcBridgeFrameSegment refers to a segment of a frame bridge. Because the main body of the frame bridge is casted or assembled segment by segment in the construction process, so the frame bridge is not defined as a physical element.

IfcBridgeWingWall refers to the structure at the inlet and outlet of a culvert or a frame bridge to ensure the two sides of the embankment slope stability and to guide the river. The IfcWall defined in IFC4 mainly refers to the wall of the building. To emphasize the specific meaning of the bridge wing wall, IfcWall is not used.

IfcBridgeCulvertSegment refers to a segment of a culvert. Because the culvert body is usually designed and constructed segment by segment in the design and construction process, so the culvert is not defined as a physical element.

IfcBridgeHatStone refers to the structure located on the end of the wing wall of the culvert to support the subgrade filling material.

IfcBridgeCoping refers to the structure set on the top of the frame or the double column pier to support, distribute and transfer the load of the upper structure, also known as cap beam.

IfcBridgeEmbeddedPartsFoundation refers to the joint structure placed on bridge deck or piers to connect other structures.

IfcBridgeRefugePlatform refers to the platform on the bridge for maintenance personnel to avoid the train.

9.1.3 Element Assemblies of Bridge

IfcBridgeElementAssembly is derived from the IfcCivilElementAssembly and is the supertype of all the element assemblies in bridge engineering. Then IfcBridgeElementAssembly derives IfcBridgeTruss, IfcBridgeJoint, IfcBeamFallingPreventionDevice and IfcCrossBrace. The inheritance relationship between the element assemblies of the bridge is shown in Figure 9.6.
IfcBridgeElementAssembly, inherited from IfcCivilElementAssembly, is the supertype of all the element assemblies in bridge engineering. It has 4 subtypes which are IfcBridgeTruss, IfcBridgeJoint, IfcBeamFallingPreventionDevice and IfcCrossBrace.

IfcBridgeTruss refers to a truss structure comprised of members and is a part of a steel truss bridge. In IFC4, there is the definition of truss, but it is only an enumeration value of IfcElementAssembly. The truss structure in the bridge is complex and the original definition in IFC4 can not fully express the concept of truss in the bridge structure, so IfcBridgeTruss is defined.

IfcBridgeJoint refers to the structure to connect the members of the truss. It is constituted by members, plates, stiffening ribs, bolts, etc.

IfcBeamFallingPreventionDevice refers to the structure to prevent the falling of main girder during earthquake. Generally it is composed of shock proof block and retaining structure.

IfcCrossBrace refers to the transverse connection structure of arch rib. It mainly consists of members, plates and stiffening ribs.

9.1.4 Others

1. IfcRailing in IFC4 is used to describe the sidewalk railing, baskets on the pier and the inspection ladder in this schema.

2. IfcReinforcingBar and IfcReinforcingMesh in IFC4 are used to describe the ReinforcingBar and ReinforcingMesh in this schema.

3. IfcPile and IfcFootin in IFC4 are used to describe the pile foundation and footing in this schema.

4. IfcTendon and IfcTendonAnchor in IFC4 are used to describe the prestressed tendon and anchorage in this schema. The description of prestressed bellows is in Section 4 of this document.

5. IfcMechanicalFastenerBOLT and IfcMechanicalFastenerSTUDSHEARCONNECTOR in IFC4 are used to describe bolts and shear studs in this schema.
IfcFastener\WELD in IFC4 is used to describe the weld in this schema.

IfcDiscreteAccessory\ANCHORPLATE in IFC4 is used to describe the anchor plate in this schema.

The definition of cable slot is in Section 14 of this document.

The definition of drainage pipe, chute and flow well is in Section 11 of this document.

9.2 Type Definition

9.2.1 IfcBridgeStructureTypeEnum

IfcBridgeStructureTypeEnum is an enumeration of bridge structure types, to define the different types of bridges from the perspective of the bridge’s structural style.

Enumerated Item Definitions:

- GIRDERBRIDGE;
- ARCHBRIDGE;
- RIGIDFRAMEBRIDGE;
- CABLESTAYEDBRIDGE;
- SUSPENSIONBRIDGE;
- FRAME BRIDGE;
- CULVERT;
- USERDEFINED;
- NOTDEFINED.

EXPRESSION Specification:

TYPE IfcBridgeStructureTypeEnum = ENUMERATION OF
  (GIRDERBRIDGE,
   ARCHBRIDGE,
   RIGIDFRAMEBRIDGE,
   CABLESTAYEDBRIDGE,
   SUSPENSIONBRIDGE,
   FRAME BRIDGE,
   CULVERT,
   USERDEFINED,
   NOTDEFINED);
END_TYPE;

9.2.2 IfcBridgeStructurePartTypeEnum

IfcBridgeStructurePartTypeEnum defines the different types of bridge structure parts.

Enumerated Item Definitions:

- GIRD;
- ABUTMENT;
- PIRE;
PYLONS;
CABLES;
ARCH;
SUSPENDERS;
FOUNDATION;
SUSPENDEDTENDONS;
BRIDGEFLOORSYSTEM;
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:

TYPE IfcBridgeStructurePartTypeEnum = ENUMERATION OF
  (GIRD
   ,ABUTMENT
   ,PIRE
   ,PYLONS
   ,CABLES
   ,ARCH
   ,SUSPENDERS
   ,FOUNDATION
   ,SUSPENDEDTENDONS
   ,BRIDGEFLOORSYSTEM
   ,USERDEFINED
   ,NOTDEFINED);
END_TYPE;

9.2.3 IfcBridgeMemberTypeEnum
IfcBridgeMemberTypeEnum defines the different types of bridge members.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:

TYPE IfcBridgeMemberTypeEnum = ENUMERATION OF
  (USERDEFINED
   ,NOTDEFINED);
END_TYPE;

9.2.4 IfcBridgeStiffeningRibTypeEnum
IfcBridgeStiffeningRibTypeEnum defines the different types of bridge stiffening ribs.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.

**EXPRESS Specification:**

```plaintext
TYPE IfcBridgeStiffeningRibTypeEnum = ENUMERATION OF
  (USERDEFINED
   ,NOTDEFINED);
END_TYPE;
```

#### 9.2.5 IfcBridgeSlabTypeEnum

IfcBridgeSlabTypeEnum defines the different types of bridge slabs.

**Enumerated Item Definitions:**

- GUSSETPLATE;
- SPLICEPLATE;
- DECK;
- FOOTSLABS;
- USERDEFINED;
- NOTDEFINED.

**EXPRESS Specification:**

```plaintext
TYPE IfcBridgeSlabTypeEnum = ENUMERATION OF
  (GUSSETPLATE
   ,SPLICEPLATE
   ,DECK
   ,FOOTSLABS
   ,USERDEFINED
   ,NOTDEFINED);
END_TYPE;
```

#### 9.2.6 IfcBridgeGirderSegmentTypeEnum

IfcBridgeGirderSegmentTypeEnum defines the different types of bridge girder segments.

**Enumerated Item Definitions:**

- USERDEFINED;
- NOTDEFINED.

**EXPRESS Specification:**

```plaintext
TYPE IfcBridgeGirderSegmentTypeEnum = ENUMERATION OF
  (USERDEFINED
   ,NOTDEFINED);
END_TYPE;
```

#### 9.2.7 IfcBridgeGearBlockTypeEnum
IfcBridgeGearBlockTypeEnum defines the different types of bridge gear blocks.

**Enumerated Item Definitions:**

- USERDEFINED;
- NOTDEFINED.

**EXPRESS Specification:**

```express
type IfcBridgeGearBlockTypeEnum = enumeration of (userdefined, notdefined);
end_type;
```

9.2.8 IfcBridgeBedStoneTypeEnum

IfcBridgeBedStoneTypeEnum different the different types of bridge bed stones.

**Enumerated Item Definitions:**

- USERDEFINED;
- NOTDEFINED.

**EXPRESS Specification:**

```express
type IfcBridgeBedStoneTypeEnum = enumeration of (userdefined, notdefined);
end_type;
```

9.2.9 IfcBridgePierSegmentTypeEnum

IfcBridgePierSegmentTypeEnum defines the different types of bridge pier segments.

**Enumerated Item Definitions:**

- TOPCAP;
- PIERBODY;
- TRAY;
- USERDEFINED;
- NOTDEFINED.

**EXPRESS Specification:**

```express
type IfcBridgePierSegmentTypeEnum = enumeration of (topcap, pierbody, tray, userdefined, notdefined);
end_type;
```

9.2.10 IfcBridgeAbutmentSegmentTypeEnum
IfcBridgeAbutmentSegmentTypeEnum defines the different types of bridge abutment segments.

**Enumerated Item Definitions:**

USERDEFINED;

NOTDEFINED.

**EXPRESSION Specification:**

TYPE IfcBridgeAbutmentSegmentTypeEnum= ENUMERATION OF
   (USERDEFINED
    ,NOTDEFINED);
END_TYPE;

9.2.11 IfcBridgePylonSegmentTypeEnum

IfcBridgePylonSegmentTypeEnum defines the different types of bridge pylon segments.

**Enumerated Item Definitions:**

USERDEFINED;

NOTDEFINED.

**EXPRESSION Specification:**

TYPE IfcBridgePylonSegmentTypeEnum= ENUMERATION OF
   (USERDEFINED
    ,NOTDEFINED);
END_TYPE;

9.2.12 IfcBridgeArchSegmentTypeEnum

IfcBridgeArchSegmentTypeEnum defines the different types of bridge arch segments.

**Enumerated Item Definitions:**

STEELPIPECONCRETEARCH;

CONCRETEARCH;

STEELBOXARCH;

USERDEFINED;

NOTDEFINED.

**EXPRESSION Specification:**

TYPE IfcBridgeArchSegmentTypeEnum= ENUMERATION OF
   (STEELPIPECONCRETEARCH
    ,CONCRETEARCH
    ,STEELBOXARCH
    ,USERDEFINED
    ,NOTDEFINED);
END_TYPE;
9.2.13 IfcBridgeArchfootTypeEnum

IfcBridgeArchfootTypeEnum defines the different types of bridge arch feet.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:

```plaintext
TYPE IfcBridgeArchfootTypeEnum = ENUMERATION OF
  ( USERDEFINED
    , NOTDEFINED);
END_TYPE;
```

9.2.14 IfcBridgeColumnTypeEnum

IfcBridgeColumnTypeEnum defines the different types of bridge stand columns.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:

```plaintext
TYPE IfcBridgeColumnTypeEnum = ENUMERATION OF
  ( USERDEFINED
    , NOTDEFINED);
END_TYPE;
```

9.2.15 IfcBridgeSuspenderTypeEnum

IfcBridgeSuspenderTypeEnum defines the different types of bridge suspenders.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:

```plaintext
TYPE IfcBridgeSuspenderTypeEnum = ENUMERATION OF
  ( USERDEFINED
    , NOTDEFINED);
END_TYPE;
```

9.2.16 IfcBridgeCableTypeEnum

IfcBridgeCableTypeEnum defines the different types of bridge cables.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.
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EXPRESS Specification:
TYPE IfcBridgeCableTypeEnum= ENUMERATION OF
  (USERDEFINED,
   NOTDEFINED);
END_TYPE;

9.2.17 IfcBridgeSuspendedTendonTypeEnum
IfcBridgeSuspendedTendonTypeEnum defines the different types of bridge suspended tendons.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:
TYPE IfcBridgeSuspendedTendonTypeEnum= ENUMERATION OF
  (USERDEFINED,
   NOTDEFINED);
END_TYPE;

9.2.18 IfcBridgeBearingTypeEnum
IfcBridgeBearingTypeEnum defines the different types of bridge bearings from the perspective of the bearing’s structural style.

Enumerated Item Definitions:
BASINRUBBERSUPPORT;
LAMINATEDRUBBERBEARING;
STEELBEARING;
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:
TYPE IfcBridgeBearingTypeEnum= ENUMERATION OF
  (BASINRUBBERSUPPORT,
   LAMINATEDRUBBERBEARING,
   STEELBEARING,
   USERDEFINED,
   NOTDEFINED);
END_TYPE;

9.2.19 IfcBridgeExpansionInstallationTypeEnum
IfcBridgeExpansionInstallationTypeEnum defines the different types of bridge expansion installations.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.

**EXPRESSION Specification:**

```
TYPE IfcBridgeExpansionInstallationTypeEnum=ENUMERATION OF
  (USERDEFINED
   ,NOTDEFINED);
END_TYPE;
```

**9.2.20 IfcBridgeProtectingWallTypeEnum**

IfcBridgeProtectingWallTypeEnum defines the different types of bridge protecting walls.

**Enumerated Item Definitions:**

USERDEFINED;
NOTDEFINED.

**EXPRESSION Specification:**

```
TYPE IfcBridgeProtectingWallTypeEnum=ENUMERATION OF
  (USERDEFINED
   ,NOTDEFINED);
END_TYPE;
```

**9.2.21 IfcBridgeFrameSegmentTypeEnum**

IfcBridgeFrameSegmentTypeEnum defines the different types of bridge frame segments.

**Enumerated Item Definitions:**

USERDEFINED;
NOTDEFINED.

**EXPRESSION Specification:**

```
TYPE IfcBridgeFrameSegmentTypeEnum=ENUMERATION OF
  (USERDEFINED
   ,NOTDEFINED);
END_TYPE;
```

**9.2.22 IfcBridgeWingWallTypeEnum**

IfcBridgeWingWallTypeEnum defines the different types of bridge wing walls.

**Enumerated Item Definitions:**

USERDEFINED;
NOTDEFINED.

**EXPRESSION Specification:**

```
TYPE IfcBridgeWingWallTypeEnum=ENUMERATION OF
```
9.2.23 IfcBridgeCulvertSegmentTypeEnum

IfcBridgeCulvertSegmentTypeEnum defines the different types of bridge culvert segments.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:
TYPE IfcBridgeCulvertSegmentTypeEnum= ENUMERATION OF
   (USERDEFINED
   ,NOTDEFINED);
END_TYPE;

9.2.24 IfcBridgeHatStoneTypeEnum

IfcBridgeHatStoneTypeEnum defines the different types of bridge hat stones.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:
TYPE IfcBridgeHatStoneTypeEnum= ENUMERATION OF
   (USERDEFINED
   ,NOTDEFINED);
END_TYPE;

9.2.25 IfcBridgeCopingTypeEnum

IfcBridgeCopingTypeEnum defines the different types of bridge copings.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:
TYPE IfcBridgeCopingTypeEnum= ENUMERATION OF
   (USERDEFINED
   ,NOTDEFINED);
END_TYPE;

9.2.26 IfcBridgeEmbeddedPartsFoundationTypeEnum

IfcBridgeEmbeddedPartsFoundationTypeEnum defines the different types of bridge
embedded parts foundation.

**Enumerated Item Definitions:**

USERDEFINED;

NOTDEFINED.

**EXPRESSION Specification:**

TYPE IfcBridgeEmbeddedPartsFoundationTypeEnum= ENUMERATION OF
  ( USERDEFINED
   ,NOTDEFINED);
END_TYPE;

9.2.27 IfcBridgeRefugePlatformTypeEnum

IfcBridgeRefugePlatformTypeEnum defines the different types of bridge refuge platforms.

**Enumerated Item Definitions:**

USERDEFINED;

NOTDEFINED.

**EXPRESSION Specification:**

TYPE IfcBridgeRefugePlatformTypeEnum = ENUMERATION OF
  (USERDEFINED
   ,NOTDEFINED);
END_TYPE;

9.2.28 IfcBridgeTrussTypeEnum

IfcBridgeTrussTypeEnum defines the different types of bridge trusses from the perspective of

the truss’s form.

**Enumerated Item Definitions:**

N-TRUSS;

TRI-TRUSS;

USERDEFINED;

NOTDEFINED.

**EXPRESSION Specification:**

TYPE IfcBridgeTrussTypeEnum= ENUMERATION OF
  (N-TRUSS
   ,TRI-TRUSS
   ,USERDEFINED
   ,NOTDEFINED);
END_TYPE;

9.2.29 IfcBridgeJointTypeEnum
IfcBridgeJointTypeEnum defines the different types of bridge joints from the perspective of the joint’s assembly method.

**Enumerated Item Definitions:**

INTEGRALJOINT;
DISTRIBUTEDJOINT;
USERDEFINED;
NOTDEFINED.

**EXPRESS Specification:**

```
TYPE IfcBridgeJointTypeEnum= ENUMERATION OF
  (INTEGRALJOINT
   , DISTRIBUTEDJOINT
   ,USERDEFINED
   ,NOTDEFINED);
END_TYPE;
```

9.2.30 IfcBeamFallingPreventionDeviceTypeEnum

IfcBeamFallingPreventionDeviceTypeEnum defines the different types of beam falling prevention device.

**Enumerated Item Definitions:**

USERDEFINED;
NOTDEFINED.

**EXPRESS Specification:**

```
TYPE IfcBeamFallingPreventionDeviceTypeEnum= ENUMERATION OF
  (USERDEFINED
   ,NOTDEFINED);
END_TYPE;
```

9.2.31 IfcCrossBraceTypeEnum

IfcCrossBraceTypeEnum defines the different types of cross braces according to the structural style of the cross brace.

**Enumerated Item Definitions:**

HORIZONTALBRACE;
K-BRACE;
USERDEFINED;
NOTDEFINED.

**EXPRESS Specification:**

```
TYPE IfcCrossBraceTypeEnum= ENUMERATION OF
```

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9.3 Entity Definition

9.3.1 IfcBridgeStructureElement

IfcBridgeStructureElement inherits from IfcCivilStructureElement, which is the supertype of all the spatial structure elements in the bridge domain.

**EXPRESS Specification:**

```express
ENTITY IfcBridgeStructureElement
  ABSTRACT SUPERTYPE OF (ONEOF(IfcBridge, IfcBridgePart))
  SUBTYPE OF (IfcCivilStructureElement);
END_ENTITY;
```

9.3.2 IfcBridge

IfcBridge defines a bridge which can be a single structure bridge or a composite bridge comprised of one or more single structure bridges.

**Table 9.1 IfcBridge spatial composition**

<table>
<thead>
<tr>
<th>Spatial Composite</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcRailway</td>
<td>IfcBridge is part of IfcRailway.</td>
</tr>
<tr>
<td>IfcRailwayStation</td>
<td>IfcBridge is part of IfcRailwayStation.</td>
</tr>
</tbody>
</table>

**Table 9.2 IfcBridge spatial decomposition**

<table>
<thead>
<tr>
<th>Spatial Parts</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgePart</td>
<td>IfcBridge is composed of one or more IfcBridgeParts, but different types of bridges are composed of different types of IfcBridgePart, as shown in Table 9.4.</td>
</tr>
<tr>
<td>IfcBridge</td>
<td>IfcBridge can be composed of one or more IfcBridges.</td>
</tr>
</tbody>
</table>

**Table 9.3 Property sets for IfcBridge**

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pset_BridgeCommon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pset_TechnicalStandard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pset_ArchBridge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pset_RigidBridge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pset_Culvert</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 9.4 IfcBridge spatial decomposition and containment**

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Contained Bridge Parts</th>
<th>Contained Entities</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GIRDERBRIDGE</td>
<td>GIRD</td>
<td></td>
<td>GIRD is a component of GIRDERBRIDGE.</td>
</tr>
<tr>
<td>Component</td>
<td>Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABUTMENT</td>
<td>ABUTMENT is a component of GIRDERBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIRE</td>
<td>PIRE is a component of GIRDERBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FOUNDATION</td>
<td>FOUNDATION is a component of GIRDERBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRIDGEFLOORSYSTEM</td>
<td>BRIDGEFLOORSYSTEM is a component of GIRDERBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARCHBRIDGE</td>
<td>GIRD is a component of ARCHBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRIDGEFLOORSYSTEM</td>
<td>IfcBridgeExpansionInstallation should be contained in GIRDERBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARCHBRIDGE</td>
<td>ABUTMENT is a component of ARCHBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIRE</td>
<td>PIRE is a component of ARCHBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FOUNDATION</td>
<td>FOUNDATION is a component of ARCHBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRIDGEFLOORSYSTEM</td>
<td>IfcBridgeBearing should be contained in GIRDERBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARCH</td>
<td>ARCH is a component of ARCHBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUSPENDERS</td>
<td>SUSPENDERS is a component of ARCHBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IfcBridgeExpansionInstallation</td>
<td>IfcBridgeExpansionInstallation should be contained in ARCHBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IfcBridgeBearing</td>
<td>IfcBridgeBearing should be contained in GIRDERBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IfcBeamFallingPreventionDevice</td>
<td>IfcBeamFallingPreventionDevice should be contained in GIRDERBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Component Type</td>
<td>Component</td>
<td>Containment</td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>-----------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>IfcBridgeBearing</td>
<td>IfcBridgeBearing should be contained in ARCHBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IfcBeamFalling PreventionDevice</td>
<td>IfcBeamFalling PreventionDevice should be contained in ARCHBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IfcBridgeArchfoot</td>
<td>IfcBridgeArchfoot should be contained in ARCHBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RIGIDFRAMEBRIDGE</td>
<td>GIRD</td>
<td>GIRD is a component of RIGIDFRAMEBRIDGE.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ABUTMENT</td>
<td>ABUTMENT is a component of RIGIDFRAMEBRIDGE.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PIRE</td>
<td>PIRE is a component of RIGIDFRAMEBRIDGE.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FOUNDATION</td>
<td>FOUNDATION is a component of RIGIDFRAMEBRIDGE.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BRIDGEFLOORSYSTEM</td>
<td>BRIDGEFLOORSYSTEM is a component of RIGIDFRAMEBRIDGE.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IfcBridgeExpansion Installation</td>
<td>IfcBridgeExpansion Installation should be contained in RIGIDFRAMEBRIDGE.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IfcBridgeBearing</td>
<td>IfcBridgeBearing should be contained in RIGIDFRAMEBRIDGE.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>IfcBeamFalling PreventionDevice</td>
<td>IfcBeamFalling PreventionDevice should be contained in RIGIDFRAMEBRIDGE.</td>
<td></td>
</tr>
<tr>
<td>CABLESTAYEDBRIDGE</td>
<td>GIRD</td>
<td>GIRD is a component of CABLESTAYEDBRIDGE.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ABUTMENT</td>
<td>ABUTMENT is a component of CABLESTAYEDBRIDGE.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PIRE</td>
<td>PIRE is a component of CABLESTAYEDBRIDGE.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FOUNDATION</td>
<td>FOUNDATION is a component of CABLESTAYEDBRIDGE.</td>
<td></td>
</tr>
<tr>
<td>Component</td>
<td>Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRIDGEFLOOR</td>
<td>BRIDGEFLOORSYSTEM is a component of CABLESTAYEDBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PYLONS</td>
<td>PYLONS is a component of CABLESTAYEDBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CABLES</td>
<td>CABLES is a component of CABLESTAYEDBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IfcBridgeExpansionInstallation</td>
<td>IfcBridgeExpansion Installation should be contained in CABLESTAYEDBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IfcBridgeBearing</td>
<td>IfcBridgeBearing should be contained in CABLESTAYEDBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IfcBeamFallingPreventionDevice</td>
<td>IfcBeamFalling PreventionDevice should be contained in CABLESTAYEDBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUSPENSIONBRIDGE</td>
<td>GIRD is a component of SUSPENSIONBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABUTMENT</td>
<td>ABUTMENT is a component of SUSPENSIONBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIRE</td>
<td>PIRE is a component of SUSPENSIONBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FOUNDATION</td>
<td>FOUNDATION is a component of SUSPENSIONBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRIDGEFLOOR</td>
<td>BRIDGEFLOORSYSTEM is a component of SUSPENSIONBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PYLONS</td>
<td>PYLONS is a component of SUSPENSIONBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUSPENDEDTENDONS</td>
<td>SUSPENDEDTENDONS is a component of SUSPENSIONBRIDGE.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IfcBridgeExpansionInstallation</td>
<td>IfcBridgeExpansion Installation should be contained in SUSPENSIONBRIDGE.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
EXPRESS Specification:

ENTITY IfcBridge
  SUBTYPE OF (IfcBridgeStructureElement);
  PreDefinedType: IfcBridgeStructureTypeEnum;
END_ENTITY;

Attribute definitions:

PreDefinedType: IfcBridge is subdivided into girder bridge, arch bridge, rigid frame bridge, cable-stayed bridge, suspension bridge, frame bridge and culvert from the perspective of structural style.

9.3.3 IfcBridgePart

IfcBridgePart refers to the various spatial parts of IfcBridge.

<table>
<thead>
<tr>
<th>Spatial Composite</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridge</td>
<td>IfcBridgePart is a component of IfcBridge.</td>
</tr>
<tr>
<td>PredefinedType</td>
<td>Contained Entities</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>GIRD</td>
<td>IfcBridgeMember</td>
</tr>
<tr>
<td></td>
<td>IfcBridgeStiffeningRib</td>
</tr>
<tr>
<td></td>
<td>IfcBridgeSlab</td>
</tr>
<tr>
<td></td>
<td>IfcBridgeGirderSegment</td>
</tr>
<tr>
<td>ABUTMENT</td>
<td>IfcBridgeAbutmentSegment</td>
</tr>
<tr>
<td>PIRE</td>
<td>IfcBridgePylonSegment</td>
</tr>
<tr>
<td>CABLES</td>
<td>IfcBridgeCable</td>
</tr>
<tr>
<td>ARCH</td>
<td>IfcBridgeArchSegment</td>
</tr>
<tr>
<td></td>
<td>IfcBridgeArchFoot</td>
</tr>
<tr>
<td></td>
<td>IfcCrossBrace</td>
</tr>
<tr>
<td>SUSPENDERS</td>
<td>IfcBridgeSuspender</td>
</tr>
<tr>
<td>FOUNDATION</td>
<td>IfcFooting</td>
</tr>
<tr>
<td></td>
<td>IfcPile</td>
</tr>
<tr>
<td>SUSPENDEDTENDONS</td>
<td>IfcBridgeSuspendedTendon</td>
</tr>
<tr>
<td>BRIDGEFLOORSYSTEM</td>
<td>IfcBridgeMember</td>
</tr>
<tr>
<td></td>
<td>IfcBridgeStiffeningRib</td>
</tr>
<tr>
<td></td>
<td>IfcBridgeSlab</td>
</tr>
<tr>
<td></td>
<td>IfcRailing</td>
</tr>
</tbody>
</table>
IfcBridgeRefugePlatform can be contained in BRIDGEFLOORSYSTEM.

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>GIRD</td>
<td>Pset_TechnicalIndex</td>
</tr>
<tr>
<td>ABUTMENT</td>
<td>Pset_Abutment</td>
</tr>
<tr>
<td>PIRE</td>
<td>Pset_BridgePier</td>
</tr>
</tbody>
</table>

**Table 9.7 Property sets for IfcBridgePart**

**EXPRESSION Specification:**

ENTIITY IfcBridgePart

SUBTYPE OF (IfcBridgeStructureElement);

PreDefinedType: IfcBridgeStructurePartTypeEnum;

END_ENTITY;

**Attribute definitions:**

PreDefinedType: IfcBridgePart includes GIRD, ABUTMENT, PIER, PYLONS, CABLES, ARCH, SUSPENDERS, FOUNDATION, SUSPENDEDTENDONS and BRIDGEFLOORSYSTEM.

**9.3.4 IfcBridgeElement**

IfcBridgeElement is derived from the IfcCivilElement, which is the supertype of all physical elements in bridge engineering.

**Table 9.8 IfcBridgeElement contained in spatial structure**

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridge</td>
<td>IfcBridgeElement is a component of IfcBridge. Some of IfcBridgeElement can be directly contained in IfcBridge.</td>
</tr>
<tr>
<td>IfcBridgePart</td>
<td>IfcBridgeElement is a component of IfcBridgePart. Some of IfcBridgeElement should be contained in IfcBridgePart, but some of IfcBridgeElement can also be directly contained in IfcBridge.</td>
</tr>
</tbody>
</table>

**EXPRESSION Specification:**

ENTIITY IfcBridgeElement

ABSTRACT SUPERTYPE OF(ONEOF(IfcBridgeMember,IfcStiffeningRib,IfcBridgeSlab, IfcBridgeGirdertSegment,IfcBridgeGearBlocks,IfcBridgeBedstone,IfcBridgePierSegment,IfcBridgeAbutmentSegment,IfcBridgePylon,IfcBridgeArchrib,IfcBridgeArchfoot,IfcBridgeStandColumn,IfcBridgeSuspender,IfcBridgeCable,IfcBridgeSuspendedTendon,IfcBridgeBearing,IfcBridgeExpansionInstallation,IfcBridgeProtectingWall,IfcBridgeFrameSegment,IfcBridgeWingWall,IfcBridgeCulvertSegment,IfcBridgeHatStone,IfcBridgeCoping,IfcBridgeEmbeddedPartsFoundation,IfcBridgeRefugePlatform));

END_ENTITY;

**9.3.5 IfcBridgeMember**
IfcBridgeMember mainly refers to the members comprising the structure, such as truss member, longitudinal beam, cross beam, etc.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgePart\GIRD</td>
<td>IfcBridgeMember can be contained in IfcBridgePart\GIRD.</td>
</tr>
<tr>
<td>IfcBridgePart\PYLONS</td>
<td>IfcBridgeMember can be contained in IfcBridgePart\PYLONS.</td>
</tr>
<tr>
<td>IfcBridgePart\ARCH</td>
<td>IfcBridgeMember can be contained in IfcBridgePart\ARCH.</td>
</tr>
<tr>
<td>IfcBridgePart\BRIDGEFLOORSYSTEM</td>
<td>IfcBridgeMember can be contained in IfcBridgePart\BRIDGEFLOORSYSTEM.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcBridgeMember

    SUBTYPE OF (IfcBridgeElement);

    PreDefinedType: IfcBridgeMemberTypeEnum;

END_ENTITY;

**Attribute definitions:**

PreDefinedType: Currently it only includes USERDEFINED and NOTDEFINED.

### 9.3.6 IfcBridgeStiffeningRib

IfcBridgeStiffeningRib mainly refers to U-type rib, plate rib and other stiffening structures.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgePart\GIRD</td>
<td>IfcBridgeStiffeningRib can be contained in IfcBridgePart\GIRD.</td>
</tr>
<tr>
<td>IfcBridgePart\PYLONS</td>
<td>IfcBridgeStiffeningRib can be contained in IfcBridgePart\PYLONS.</td>
</tr>
<tr>
<td>IfcBridgePart\ARCH</td>
<td>IfcBridgeStiffeningRib can be contained in IfcBridgePart\ARCH.</td>
</tr>
<tr>
<td>IfcBridgePart\BRIDGEFLOORSYSTEM</td>
<td>IfcBridgeStiffeningRib can be contained in IfcBridgePart\BRIDGEFLOORSYSTEM.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcBridgeStiffeningRib

    SUBTYPE OF (IfcBridgeElement);

    PreDefinedType: IfcBridgeStiffeningRibTypeEnum;

END_ENTITY;

**Attribute definitions:**

PreDefinedType: Currently it only includes USERDEFINED and NOTDEFINED.

### 9.3.7 IfcBridgeSlab
IfcBridgeSlab mainly refers to gusset plate, bridge deck, splice plate, cantilever plate and pavement slab, and their thickness can be changed.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgePart\GIRD</td>
<td>IfcBridgeSlab can be contained in IfcBridgePart\GIRD.</td>
</tr>
<tr>
<td>IfcBridgePart\PYLONS</td>
<td>IfcBridgeSlab can be contained in IfcBridgePart\PYLONS.</td>
</tr>
<tr>
<td>IfcBridgePart\ARCH</td>
<td>IfcBridgeSlab can be contained in IfcBridgePart\ARCH.</td>
</tr>
<tr>
<td>IfcBridgePart\BRIDGEFLOOR SYSTEM</td>
<td>IfcBridgeSlab can be contained in IfcBridgePart\BRIDGEFLOORSYSTEM.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcBridgeSlab
  SUBTYPE OF (IfcBridgeElement);
  PreDefinedType: IfcBridgeSlabTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType: It currently includes gusset plate, splice plate, bridge deck and pavement slab.

### 9.3.8 IfcBridgeGirderSegment

IfcBridgeGirderSegment is a component of IfcBridgePart\GIRD.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgePart\GIRD</td>
<td>IfcBridgeGirderSegment is a component of IfcBridgePart\GIRD.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcBridgeGirderSegment
  SUBTYPE OF (IfcBridgeElement);
  PreDefinedType: IfcBridgeGirderSegmentTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType: It currently only includes USERDEFINED and NOTDEFINED.

### 9.3.9 IfcBridgeGearBlock

IfcBridgeGearBlock refers to the wedge structure to anchor the prestressed steel strand.
Table 9.14 IfcBridgeGearBlock contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgePart\GIRD</td>
<td>IfcBridgeGearBlock is a component of IfcBridgePart\GIRD.</td>
</tr>
</tbody>
</table>

**EXPRESSION Specification:**

ENTITY IfcBridgeGearBlock  
  SUBTYPE OF (IfcBridgeElement);  
  PreDefinedType: IfcBridgeGearBlockTypeEnum;  
END_ENTITY;

**Attribute definitions:**

PreDefinedType: It currently only includes USERDEFINED and NOTDEFINED.

9.3.10 IfcBridgeBedstone

IfcBridgeBedstone refers to the structure placed on the top of the pier or abutment to support the bearing.

Table 9.15 IfcBridgeBedstone contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgePart\PIRE</td>
<td>IfcBridgeBedstone should be contained in IfcBridgePart\PIRE.</td>
</tr>
<tr>
<td>IfcBridgePart\ABUTMENT</td>
<td>IfcBridgeBedstone should be contained in IfcBridgePart\ABUTMENT.</td>
</tr>
</tbody>
</table>

**EXPRESSION Specification:**

ENTITY IfcBridgeBedstone  
  SUBTYPE OF (IfcBridgeElement);  
  PreDefinedType: IfcBridgeBedstoneTypeEnum;  
END_ENTITY;

**Attribute definitions:**

PreDefinedType: It currently only includes USERDEFINED and NOTDEFINED.

9.3.11 IfcBridgePierSegment

IfcBridgePierSegment refers to the pier shaft segment, the top cap and tray.

Table 9.16 IfcBridgePierSegment contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgePart\PIRE</td>
<td>IfcBridgePierSegment is a component of IfcBridgePart\PIRE.</td>
</tr>
</tbody>
</table>

**EXPRESSION Specification:**

ENTITY IfcBridgePierSegment  
  SUBTYPE OF (IfcBridgeElement);  
  PreDefinedType: IfcBridgePierSegmentTypeEnum;  
END_ENTITY;

**Attribute definitions:**

PreDefinedType: It currently includes the pier shaft segment, the top cap and tray.

9.3.12 IfcBridgeAbutmentSegment
IfcBridgeAbutmentSegment refers to the component of the abutment.

Table 9.17 IfcBridgeAbutmentSegment contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgePart\Abutment</td>
<td>IfcBridgeAbutmentSegment is a component of IfcBridgePart\Abutment.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcBridgeAbutmentSegment
  SUBTYPE OF (IfcBridgeElement);
  PreDefinedType: IfcBridgeAbutmentSegmentTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType: It currently only includes USERDEFINED and NOTDEFINED.

9.3.13 IfcBridgePylonSegment

IfcBridgePylonSegment refers to the component of the pylon.

Table 9.18 IfcBridgePylonSegment contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgePart\PYLONS</td>
<td>IfcBridgePylonSegment is a component of IfcBridgePart\PYLONS.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcBridgePylonSegment
  SUBTYPE OF (IfcBridgeElement);
  PreDefinedType: IfcBridgePylonSegmentTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType: It currently only includes USERDEFINED and NOTDEFINED.

9.3.14 IfcBridgeArchSegment

IfcBridgeArchSegment refers to the component of the bridge arch.

Table 9.19 IfcBridgeArchSegment contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgePart\ARCH</td>
<td>IfcBridgeArchSegment is a component of IfcBridgePart\ARCH.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcBridgeArchSegment
  SUBTYPE OF (IfcBridgeElement);
  PreDefinedType: IfcBridgeArchSegmentTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType: It currently includes STEELPIPECONCRETEARCH, CONCRETEARCH and STEELBOXARCH.

9.3.15 IfcBridgeArchFoot
IfcBridgeArchFoot refers to the structure to support the arch rib and connect the foundation or main girder to the arch rib.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgeArchFoot</td>
<td>IfcBridgeArchFoot is a component of IfcBridge\ARCHBRIDGE.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcBridgeArchFoot
    SUBTYPE OF (IfcBridgeElement);
    PreDefinedType: IfcBridgeArchFootTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType: It currently only includes USERDEFINED and NOTDEFINED.

9.3.16 IfcBridgeStandColumn

IfcBridgeStandColumn refers to the structure on the arch rib to support the main girder.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgeStandColumn</td>
<td>IfcBridgeStandColumn is a component of IfcBridge\ARCHBRIDGE.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcBridgeStandColumn
    SUBTYPE OF (IfcBridgeElement);
    PreDefinedType: IfcBridgeStandColumnTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType: It currently only includes USERDEFINED and NOTDEFINED.

9.3.17 IfcBridgeSuspender

IfcBridgeSuspender: refers to the structure to connect the suspension cable or the arch rib with the bridge floor system.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgeSuspender</td>
<td>IfcBridgeSuspender is a component of IfcBridgePart\SUSPENDERS.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcBridgeSuspender
    SUBTYPE OF (IfcBridgeElement);
    PreDefinedType: IfcBridgeSuspenderTypeEnum;
END_ENTITY;

**Attribute definitions:**
PreDefinedType: It currently includes USERDEFINED and NOTDEFINED.

9.3.18 IfcBridgeCable

IfcBridgeCable refers to the structure to connect the pylon with the bridge floor system.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgePart\CABLES</td>
<td>IfcBridgeCable is a component of IfcBridgePart\CABLES.</td>
</tr>
</tbody>
</table>

Table 9.23 IfcBridgeCable contained in spatial structure

9.3.19 IfcBridgeSuspendedTendon

IfcBridgeSuspendedTendon refers to the single suspension cable, which comprises steel wire, sheath, etc.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgePart\SUSPENDEDTENDONS</td>
<td>IfcBridgeSuspendedTendon is a component of IfcBridgePart\SUSPENDEDTENDONS.</td>
</tr>
</tbody>
</table>

Table 9.25 IfcBridgeSuspendedTendon contained in spatial structure

9.3.20 IfcBridgeBearing

IfcBridgeBearing refers to a structure to support the main girder and transfer the load from the superstructure to the bridge pier.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridge</td>
<td>IfcBridgeBearing is a component of IfcBridge.</td>
</tr>
</tbody>
</table>

Table 9.26 IfcBridgeBearing contained in spatial structure
Table 9.27 Property sets for IfcBridgeBearing

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_BridgeBearing</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcBridgeBearing
    SUBTYPE OF (IfcBridgeElement);
    PreDefinedType: IfcBridgeBearingTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType: IfcBridgeBearing is subdivided into BASINRUBBER, LAMINATEDRUBBER, and STEELBEARING.

9.3.21 IfcBridgeExpansionInstallation

IfcBridgeExpansionInstallation refers to the structure installed on between two main girders to facilitate the vehicle smoothly pass the bridge deck and to meet the deformation of the upper structure of the bridge. It is comprised of rubber and steel parts.

Table 9.28 IfcBridgeExpansionInstallation contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridge</td>
<td>IfcBridgeExpansionInstallation is a component of IfcBridge.</td>
</tr>
</tbody>
</table>

Table 9.29 Property sets for IfcBridgeExpansionInstallation

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_ExpansionInstallation</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcBridgeExpansionInstallation
    SUBTYPE OF (IfcBridgeElement);
    PreDefinedType: IfcBridgeExpansionInstallationTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType: It currently includes USERDEFINED and NOTDEFINED.

9.3.22 IfcBridgeProtectingWall

IfcBridgeProtectingWall refers to the structure located on the bridge deck to protect the pedestrians and to retain ballast.

Table 9.30 IfcBridgeProtectingWall contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgePart\BRIDGEFLOORSYSTEM</td>
<td>IfcBridgeProtectingWall is a component of IfcBridgePart\BRIDGEFLOORSYSTEM.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcBridgeProtectingWall
    SUBTYPE OF (IfcBridgeElement);
PreDefinedType: IfcBridgeProtectingWallTypeEnum;
END_ENTITY;

**Attribute definitions:**
PreDefinedType: It currently includes USERDEFINED and NOTDEFINED.

### 9.3.23 IfcFrameSegment

IfcFrameSegment refers to a segment of a frame bridge.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridge\FRAMEBRIDGE</td>
<td>IfcFrameSegment is a component of IfcBridge\FRAMEBRIDGE.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**
ENTITY IfcFrameSegment
  SUBTYPE OF (IfcBridgeElement);
  PreDefinedType: IfcFrameSegmentWallTypeEnum;
END_ENTITY;

**Attribute definitions:**
PreDefinedType: It currently includes USERDEFINED and NOTDEFINED.

### 9.3.24 IfcBridgeWingWall

IfcBridgeWingWall refers to the structure on the inlet and outlet of culvert and a frame bridge to ensure the two sides of the embankment slope stability and to guide the river.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridge\FRAMEBRIDGE</td>
<td>IfcBridgeWingWall is a component of IfcBridge\FRAMEBRIDGE.</td>
</tr>
<tr>
<td>IfcBridge\CULVERT</td>
<td>IfcBridgeWingWall is a component of IfcBridge\CULVERT.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**
ENTITY IfcBridgeWingWall
  SUBTYPE OF (IfcBridgeElement);
  PreDefinedType: IfcBridgeWingWallTypeEnum;
END_ENTITY;

**Attribute definitions:**
PreDefinedType: It currently includes USERDEFINED and NOTDEFINED.

### 9.3.25 IfcBridgeCulvertSegment

IfcBridgeCulvertSegment refers to a segment of a culvert.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridge\CULVERT</td>
<td>IfcBridgeCulvertSegment is a component of IfcBridge\CULVERT.</td>
</tr>
</tbody>
</table>
EXPRESS Specification:
ENTITY IfcBridgeCulvertSegment
  SUBTYPE OF (IfcBridgeElement);
  PreDefinedType: IfcBridgeCulvertSegmentTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType: It currently includes USERDEFINED and NOTDEFINED.

9.3.26 IfcBridgeHatStone
IfcBridgeHatStone refers to the structure on the end of wall of the culvert used to support the subgrade filling material.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgeCULVERT</td>
<td>IfcBridgeHatStone is a component of IfcBridge\CULVERT.</td>
</tr>
</tbody>
</table>

EXPRESS Specification:
ENTITY IfcBridgeHatStone
  SUBTYPE OF (IfcBridgeElement);
  PreDefinedType: IfcBridgeHatStoneTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType: It currently includes USERDEFINED and NOTDEFINED.

9.3.27 IfcBridgeCoping
IfcBridgeCoping refers to the structure set on the top of the frame or the double column pier to support, distribute and transfer the load of the upper structure, also known as cap beam.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgePart\PIRE</td>
<td>IfcBridgeCoping is a component of IfcBridgePart\PIRE.</td>
</tr>
</tbody>
</table>

EXPRESS Specification:
ENTITY IfcBridgeCoping
  SUBTYPE OF (IfcBridgeElement);
  PreDefinedType: IfcBridgeCopingTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType: It currently includes USERDEFINED and NOTDEFINED.

9.3.28 IfcBridgeEmbeddedPartsFoundation
IfcBridgeEmbeddedPartsFoundation refers to the joint structure placed on bridge deck or piers to connect other structures.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgeEmbeddedPartsFoundation\CRBIM</td>
<td>IfcBridgeEmbeddedPartsFoundation is a component of IfcBridgeEmbeddedPartsFoundation\CRBIM.</td>
</tr>
</tbody>
</table>

Table 9.36 IfcBridgeEmbeddedPartsFoundation contained in spatial structure
<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgePart\BRIDGEFLOORSYSTEM</td>
<td>IfcBridgeEmbeddedPartsFoundation is a component of IfcBridgePart\BRIDGEFLOORSYSTEM.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcBridgeEmbeddedPartsFoundation

SUBTYPE OF (IfcBridgeElement);

PreDefinedType: IfcBridgeEmbeddedPartsFoundationTypeEnum;

END_ENTITY;

**Attribute definitions:**

PreDefinedType: It only includes USERDEFINED and NOTDEFINED.

9.3.29 IfcBridgeRefugePlatform

IfcBridgeRefugePlatform refers to the platform on the bridge for maintenance personnel to avoid the train.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgePart\BRIDGEFLOORSYSTEM</td>
<td>IfcBridgeRefugePlatform is a component of IfcBridgePart\BRIDGEFLOORSYSTEM</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcBridgeRefugePlatform

SUBTYPE OF (IfcBridgeElement);

PreDefinedType: IfcBridgeRefugePlatformTypeEnum;

END_ENTITY;

**Attribute definitions:**

PreDefinedType: It only includes USERDEFINED and NOTDEFINED.

9.3.30 IfcBridgeElementAssembly

IfcBridgeElementAssembly is derived from the IfcCivilElementAssembly, which is the supertype of all element assemblies in bridge engineering.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridge</td>
<td>IfcBridgeElementAssembly is a component of IfcBridge.</td>
</tr>
<tr>
<td>IfcBridgePart</td>
<td>IfcBridgeElementAssembly is a component of IfcBridgePart.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcBridgeElementAssembly

ABSTRACT SUPERTYPE OF (ONEOF (IfcBridgeTruss,IfcBridgeJoint,
IfcBeamFallingPreventionDevice, IfcCrossBrace))

SUBTYPE OF (IfcCivilElementAssembly);

END_ENTITY;

9.3.31 IfcBridgeTruss
IfcBridgeTruss refers to a truss structure comprised of members and is a part of a steel truss bridge.

### Table 9.39 IfcBridgeTruss entity composition

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Contained Entities</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgeMember</td>
<td>IfcBridgeMember can be contained in IfcBridgeTruss.</td>
<td></td>
</tr>
<tr>
<td>IfcBridgeStiffeningRib</td>
<td>IfcBridgeStiffeningRib can be contained in IfcBridgeTruss.</td>
<td></td>
</tr>
<tr>
<td>IfcBridgeSlab</td>
<td>IfcBridgeSlab can be contained in IfcBridgeTruss.</td>
<td></td>
</tr>
<tr>
<td>IfcBridgeJoint</td>
<td>IfcBridgeJoint can be contained in IfcBridgeTruss.</td>
<td></td>
</tr>
</tbody>
</table>

### Table 9.40 IfcBridgeTruss contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgePart\GIRD</td>
<td>IfcBridgeTruss is a component of IfcBridgePart\GIRD.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

```express
ENTITY IfcBridgeTruss
  SUBTYPE OF (IfcBridgeElementAssembly);
  PreDefinedType: IfcBridgeTrussTypeEnum;
END_ENTITY;
```

**Attribute definitions:**

PreDefinedType: It includes N-TRUSS and TRI-TRUSS.

### 9.3.32 IfcBridgeJoint

IfcBridgeJoint refers to the structure to connect the members of truss.

### Table 9.41 IfcBridgeJoint entity composition

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Contained Entities</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgeStiffeningRib</td>
<td>IfcBridgeStiffeningRib can be contained in IfcBridgeJoint.</td>
<td></td>
</tr>
<tr>
<td>IfcBridgeSlab</td>
<td>IfcBridgeSlab can be contained in IfcBridgeJoint.</td>
<td></td>
</tr>
</tbody>
</table>

### Table 9.42 IfcBridgeJoint contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgePart\GIRD</td>
<td>IfcBridgeJoint is a component of IfcBridgePart\GIRD.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

```express
ENTITY IfcBridgeJoint
  SUBTYPE OF (IfcBridgeElementAssembly);
  PreDefinedType: IfcBridgeJointTypeEnum;
END_ENTITY;
```

**Attribute definitions:**

PreDefinedType: It includes INTEGRALJOINT and DISTRIBUTEDJOINT.
9.3.33 IfcBeamFallingPreventionDevice

IfcBeamFallingPreventionDevice refers to the structure to prevent the falling of main girder during earthquake.

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Contained Entities</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgeMember</td>
<td>IfcBridgeMember can be contained in IfcBeamFallingPreventionDevice.</td>
<td></td>
</tr>
<tr>
<td>IfcBridgeStiffeningRib</td>
<td>IfcBridgeStiffeningRib can be contained in IfcBeamFallingPreventionDevice.</td>
<td></td>
</tr>
<tr>
<td>IfcBridgeSlab</td>
<td>IfcBridgeSlab can be contained in IfcBeamFallingPreventionDevice.</td>
<td></td>
</tr>
</tbody>
</table>

Table 9.44 IfcBeamFallingPreventionDevice contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridge</td>
<td>IfcBeamFallingPreventionDevice is a component of IfcBridge.</td>
</tr>
</tbody>
</table>

EXPRESS Specification:

ENTITY IfcBeamFallingPreventionDevice
SUBTYPE OF (IfcBridgeElementAssembly);
PreDefinedType: IfcBeamFallingPreventionDeviceTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType: It currently includes USERDEFINED and NOTDEFINED.

9.3.34 IfcCrossBrace

IfcCrossBrace refers to the transverse connection structure of arch rib.

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Contained Entities</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgeMember</td>
<td>IfcBridgeMember can be contained in IfcCrossBrace.</td>
<td></td>
</tr>
<tr>
<td>IfcBridgeStiffeningRib</td>
<td>IfcBridgeStiffeningRib can be contained in IfcCrossBrace.</td>
<td></td>
</tr>
<tr>
<td>IfcBridgeSlab</td>
<td>IfcBridgeSlab can be contained in IfcCrossBrace.</td>
<td></td>
</tr>
</tbody>
</table>

Table 9.46 IfcCrossBrace contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcBridgePart\ARCH</td>
<td>IfcCrossBrace is a component of IfcBridgePart\ARCH.</td>
</tr>
</tbody>
</table>

EXPRESS Specification:

ENTITY IfcCrossBrace
SUBTYPE OF (IfcBridgeElementAssembly);
PreDefinedType: IfcCrossBraceTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType: It only includes USERDEFINED and NOTDEFINED.

9.4 Property Set Definition

9.4.1 Pset_BridgeCommon

Name: Pset_BridgeCommon
Applicable Entities: IfcBridge
Description: Common property set of bridge.
Property Definitions: See Table 9.47.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Name of a bridge.</td>
</tr>
<tr>
<td>BridgeArrangement</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Arrangement of a bridge.</td>
</tr>
<tr>
<td>CenterKilometerage</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Center kilometer age of a bridge.</td>
</tr>
<tr>
<td>Number</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Number of a bridge.</td>
</tr>
<tr>
<td>Span</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The length of a bridge.</td>
</tr>
</tbody>
</table>

**ConstructionMethod**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DrainForm</td>
<td>TypePropertyEnumeratedValue/PEnum_DrainForm: DirectDriange, ConcentratedDrainage</td>
<td>Drain form, including DirectDriange and ConcentratedDrainage.</td>
</tr>
</tbody>
</table>

9.4.2 Pset_TechnicalStandard

Name: Pset_TechnicalStandard
Applicable Entities: IfcBridge

**Scale**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>TypePropertyEnumeratedValue/PEnum_Scale: extra-long bridge,major bridge,medium bridge,minor bridge</td>
<td>Scale of a bridge. It is classified by the length of a bridge, including extra-long bridge, major bridge, medium bridge and minor bridge.</td>
</tr>
</tbody>
</table>
Description: Property set of technical standard of a bridge.

Property Definitions: See Table 9.48.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Speed</td>
<td>TypePropertySingleValue/IfcLinearVelocityMeasure/m/s</td>
<td>Design speed.</td>
</tr>
<tr>
<td>Maximum Distance Between Centers of Tracks</td>
<td>TypePropertySingleValue/IfcPositiveLengthMeasure/m</td>
<td>Maximum distance between centers of tracks.</td>
</tr>
<tr>
<td>Minimum Distance Between Centers of Tracks</td>
<td>TypePropertySingleValue/IfcPositiveLengthMeasure/m</td>
<td>Minimum distance between centers of tracks.</td>
</tr>
<tr>
<td>Road Level</td>
<td>TypePropertyEnumeratedValue/PEnum_RoadLevel: Highway, First-Class Highway, Secondary-Class Highway, Third-Class Highway, Forth-Class Highway</td>
<td>Road level. It includes Highway, First-Class Highway, Secondary-Class Highway, Third-Class Highway and Forth-Class Highway.</td>
</tr>
<tr>
<td>Highest Driving Speed Of Car</td>
<td>TypePropertySingleValue/IfcLinearVelocityMeasure/m/s</td>
<td>The highest driving speed of a car.</td>
</tr>
<tr>
<td>Design Flood Frequency</td>
<td>TypePropertyEnumeratedValue/PEnum_DesignFloodFrequency: 1/100, 1/50, 1/30, 1/20, 1/10</td>
<td>Design flood frequency. It includes 1/100, 1/50, 1/30, 1/20 and 1/10.</td>
</tr>
</tbody>
</table>

9.4.3 Pset_TechnicalIndex

Name: Pset_TechnicalIndex

Applicable Entities: IfcBridgePart/GIRD

Description: Property set of technical index of a bridge.

Property Definitions: See Table 9.49.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Ratio Of Deflection To Span</td>
<td>TypePropertySingleValue/IfcRatioMeasure</td>
<td>The ratio of deflection to span.</td>
</tr>
<tr>
<td>Rotation Angle At Beam End</td>
<td>TypePropertySingleValue/IfcPositivePlaneAngleMeasure/rad</td>
<td>Rotation angle at beam end.</td>
</tr>
<tr>
<td>Residual Creep</td>
<td>TypePropertySingleValue/IfcNonNegativeLengthMeasure/m</td>
<td>The residual deformation of creep.</td>
</tr>
<tr>
<td>Deflection</td>
<td>TypePropertySingleValue/IfcNonNegativeLengthMeasure/m</td>
<td>Deflection.</td>
</tr>
<tr>
<td>The Ratio Of Height To Span</td>
<td>TypePropertySingleValue/IfcRatioMeasure</td>
<td>The ratio of height to span.</td>
</tr>
</tbody>
</table>
9.4.4 Pset_Bellow

Name: Pset_Bellow

Applicable Entities: IfcTendonBellow

Description: Common property set of tendon bellows.

Property definitions: See Table 9.50.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>TypePropertyDescriptor/PEnum_Material : Metal, Plastic</td>
<td>Material of bellows, including metal and plastic.</td>
</tr>
<tr>
<td>Specifications</td>
<td>TypePropertyDescriptor/IfcLabel</td>
<td>Specifications of bellows.</td>
</tr>
</tbody>
</table>

9.4.5 Pset_BridgeCable

Name: Pset_BridgeCable

Applicable Entities: IfcBridgeCable

Description: Common property set of bridge cables.

Property Definitions: See Table 9.51.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LengthError</td>
<td>TypePropertyDescriptor/IfcLengthMeasure/m</td>
<td>The length between the actual length and designed length.</td>
</tr>
<tr>
<td>SuperTensionForce</td>
<td>TypePropertyDescriptor/IfcForceMeasure/N</td>
<td>The force beyond the design force.</td>
</tr>
<tr>
<td>CableTensionForce</td>
<td>TypePropertyDescriptor/IfcForceMeasure/N</td>
<td>Tension force of the cable.</td>
</tr>
<tr>
<td>WithdrawalValueOfChill</td>
<td>TypePropertyDescriptor/IfcLengthMeasure/m</td>
<td>Withdrawal value of chill casting anchor plate.</td>
</tr>
<tr>
<td>CastingAnchorPlate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DeadLoadBreakingForce</td>
<td>TypePropertyDescriptor/IfcForceMeasure/N</td>
<td>The breaking force of cable on dead load.</td>
</tr>
<tr>
<td>NominalBreakingForce</td>
<td>TypePropertyDescriptor/IfcForceMeasure/N</td>
<td>The nominal breaking force of cable.</td>
</tr>
<tr>
<td>DeadLoadBreakingElongation</td>
<td>TypePropertyDescriptor/IfcRatioMeasure</td>
<td>The elongation value when the cable breaking.</td>
</tr>
<tr>
<td>TensileElasticModulus</td>
<td>TypePropertyDescriptor/IfcPressureMeasure/Pa</td>
<td>Tensile elastic modulus.</td>
</tr>
<tr>
<td>SafetyCoefficient</td>
<td>TypePropertyDescriptor/IfcReal</td>
<td>Safety coefficient.</td>
</tr>
</tbody>
</table>

9.4.6 Pset_ArchBridge

Name: Pset_ArchBridge

Applicable Entities: IfcBridge\ARCHBRIDGE

Description: Common property set of arch bridges.

Property Definitions: See Table 9.52.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRBIM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Type</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------</td>
<td>----------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>StructureForm</td>
<td>TypePropertyEnumeratedValue/PEnum_StructureForm; Portal TypeRigidFrameBridge, SlantLeggedRigidFrameBridge, TRigidFrameBridge, ContinueRigidFrameBridge</td>
<td>Structure Form of arch bridges, including Portal Type, Slant Legged, T-Rigid, and Continuous Rigid frame bridges.</td>
</tr>
<tr>
<td>HorizontalThrust</td>
<td>TypePropertyEnumeratedValue/PEnum_HorizontalThrust:YES,NON</td>
<td>Indicates whether there is a horizontal force.</td>
</tr>
<tr>
<td>HingeNumber</td>
<td>TypePropertyEnumeratedValue/PEnum_HingeNumber:Non,One,Two,Three</td>
<td>Indicates the hinge number of an arch bridge.</td>
</tr>
<tr>
<td>ArchCurveType</td>
<td>TypePropertyEnumeratedValue/PEnum_ArchCurve; Arc,Parabola,Catenary</td>
<td>Indicates the axis type of an arch. It can be Arc, Parabola and Catenary.</td>
</tr>
</tbody>
</table>

### 9.4.7 Pset_RigidBridge

**Name:** Pset_RigidBridge  
**Applicable Entities:** IfcBridge\RIGIDFRAMEBRIDGE  
**Description:** Common property set of rigid bridges.  
**Property Definitions:** See Table 9.53.

**Table 9.53 Property definitions of Pset_RigidBridge**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>StructureForm</td>
<td>TypePropertyEnumeratedValue/PEnum_StructureForm; Portal TypeRigidFrameBridge, SlantLeggedRigidFrameBridge, TRigidFrameBridge, ContinueRigidFrameBridge</td>
<td>Indicates the structure form of a rigid bridge. It can be Portal Type rigid frame bridge, slant legged rigid frame bridge, T-rigid frame bridge and continuous rigid frame bridge.</td>
</tr>
</tbody>
</table>

### 9.4.8 Pset_Gird

**Name:** Pset_Gird  
**Applicable Entities:** IfcBridgePart\GIRD  
**Description:** Common property set of girds.  
**Property Definitions:** See Table 9.54.

**Table 9.54 Property definitions of Pset_Gird**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>StructureForm</td>
<td>TypePropertyEnumeratedValue/PEnum_StructureForm: BoxGird, T-Gird, SlabGird, TroughGird, CompositeGird.</td>
<td>Indicates the structure form of a gird. It can be BoxGird, T-Gird, SlabGird, TroughGird and CompositeGird.</td>
</tr>
<tr>
<td>StraightOrCurve</td>
<td>TypePropertyEnumeratedValue/PEnum_StraightOrCurve: Straight, Curve</td>
<td>Indicates the gird is straight or curve.</td>
</tr>
<tr>
<td>ConstantOrVariable</td>
<td>TypePropertyEnumeratedValue/PEnum_ConstantOrVariable</td>
<td>Indicates whether the size of the gird is constant or variable.</td>
</tr>
</tbody>
</table>
### 9.4.9 Pset_BridgePier

Name: Pset_BridgePier

Applicable Entities: IfcBridgePart\PIER

Description: Common property set of bridge piers.

Property Definitions: See Table 9.55.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>StructureForm</td>
<td>TypePropertyEnumeratedValue/PEnum_ _StructureForm:SolidPier,HollowPier</td>
<td>Indicates the structure form of bridge pier. It can be solid pier or hollow pier.</td>
</tr>
</tbody>
</table>

### 9.4.10 Pset_PileCommon

Name: Pset_PileCommon

Applicable Entities: IfcPile

Description: Common property set of pile foundation.

Property Definitions: See Table 9.56.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PileArrangement</td>
<td>TypePropertyEnumeratedValue/PEnum_ _PileArrangement: Quincunx Determinant, Userdefined</td>
<td>Indicates the arrangement form of piles. It can be quincunx or determinant.</td>
</tr>
<tr>
<td>PileForceTransmitType</td>
<td>TypePropertyEnumeratedValue/PEnum_ _PileForceTransmitType: ColumnPile, FrictionPile</td>
<td>Indicates the mode of bearing force of a pile. It can be column pile and friction pile.</td>
</tr>
</tbody>
</table>

### 9.4.11 Pset_Abutment

Name: Pset_Abutment

Applicable Entities: IfcBridgePart\ABUTMENT

Description: Common property set of abutments.

Property Definitions: See Table 9.57.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>StructureForm</td>
<td>TypePropertyEnumeratedValue/PEnum_ _StructureForm: One-glyph Type, T-Type</td>
<td>Indicates the structure form of an abutment. It can be One-glyph-Type or T-Type.</td>
</tr>
</tbody>
</table>

### 9.4.12 Pset_Culvert

Name: Pset_Culvert
Applicable Entities: IfcBridgePart/ABUTMENT

Description: Common property set of culverts.

Property Definitions: See Table 9.58.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>StructureForm</td>
<td>TypePropertyEnumeratedValue/ PEnum_StructureForm: SlabCulvert, Frame</td>
<td>Indicates the structure form of a culvert. It can be slab culvert, frame culvert, arch culvert and pipe culvert.</td>
</tr>
<tr>
<td>PressureBearingType</td>
<td>TypePropertyEnumeratedValue/PEnum_PressureBearingType: HavePress,</td>
<td>Indicates the pressure bearing type of a culvert. It can be have press, none press and half press.</td>
</tr>
<tr>
<td></td>
<td>NonePress, HalfPress</td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td>TypePropertyEnumeratedValue/PEnum_Function: FloodDrainageCulvert,</td>
<td>Indicates the function of a culvert. It can be flood and drainage culvert</td>
</tr>
<tr>
<td></td>
<td>InterchangeCulvert, IrrigationCulvert, InvertedSiphonProtectionCulvert,</td>
<td>interchange culvert, irrigation culvert, inverted siphon and protection culvert, irrigation and interchange culvert, flood drainage and interchange culvert, flood drainage and irrigation culvert.</td>
</tr>
</tbody>
</table>

9.4.13 Pset_BridgeBearing

Name: Pset_BridgeBearing

Applicable Entities: IfcBridgeBearing

Description: Common property set of bridge bearings.

Property Definitions: See Table 9.59.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DrawingNumber</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Indicates the drawing number of the bridge bearing.</td>
</tr>
<tr>
<td>Type</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Indicates the type of the bearing.</td>
</tr>
<tr>
<td>CarryingCapacity</td>
<td>TypePropertySingleValue/IfcForceMeasure/N</td>
<td>Indicates the carrying capacity of the bearing.</td>
</tr>
<tr>
<td>MoveOrientation</td>
<td>TypePropertyEnumeratedValue/PEnum_MoveOrientation: DX, ZX, HX, GD, Multi-Orientation.</td>
<td>The orientation of the bearing can be moved. It can be DX, ZX, HX, GD and Multi-Orientation.</td>
</tr>
<tr>
<td>SeismalAcceleration</td>
<td>TypePropertyEnumeratedValue/PEnum_SeismalAcceleration: a≤0.1g, 0.1g &lt;a≤0.2g, 0.2g &lt;a≤0.3g, 0.3g &lt;a≤0.4g, a&gt;0.4g</td>
<td>The range of seismal acceleration of bearing can be used, it can be a ≤0.1g, 0.1g&lt;a≤0.2g, 0.2g&lt;a≤0.3g, 0.3g&lt;a≤0.4g and a&gt;0.4g.</td>
</tr>
<tr>
<td>Displacement</td>
<td>TypePropertySingleValue/IfcLength Measure/m</td>
<td>Indicates the displacement of the bearing.</td>
</tr>
</tbody>
</table>

9.4.14 Pset_BridgeExpansionInstallation
Name: Pset_ExpansionInstallation
Applicable Entities: IfcBridgeExpansionInstallation
Description: Common property set of bridge expansion installation.
Property Definitions: See Table 9.60.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DrawingNumber</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The drawing number of the bridge expansion installation.</td>
</tr>
<tr>
<td>Type</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The type of the bridge expansion installation.</td>
</tr>
<tr>
<td>Displacement</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The displacement of the expansion installation.</td>
</tr>
<tr>
<td>Length</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The length of the expansion installation.</td>
</tr>
</tbody>
</table>

10. Tunnel Schema
10.1 Schema Definition

The information model defined in this schema is applicable to tunnel and its components designed and constructed with New Austrian Tunneling Method. The data structure of tunnel information model consists of IfcTunnelStructureElement, IfcTunnelElement and IfcElementComponent. The definition of element components refers to Section 4.3.

The spatial structure elements of tunnel mainly include IfcTunnel and IfcTunnelPart.


The relationship between spatial structure elements and physical elements of tunnel is described in Figure 10.1.
10.1.1 Spatial Structure Elements of Tunnel

As supertype of all the tunnel spatial structure elements, the IfcTunnelStructureElement inherits from IfcCivilStructureElement. And then IfcTunnelStructureElement derives IfcTunnel and IfcTunnelPart. The inheritance relationship is shown in Figure 10.2.
IfcTunnelStructureElement inherits from IfcCivilStructureElement and is the supertype of all the spatial structure elements of tunnel.

IfcTunnel refers to a tunnel which is spatially composed of a number of IfcTunnelParts. IfcTunnel is further subdivided into CIRCULARTUNNEL, CURVEDWALLANDARCHCROWNTUNNEL, STRAIGHTWALLANDARCHCROWNTUNNEL, RECTANGULARTUNNEL, THESHEDEDTUNNEL and THEOPEN-CUTTUNNEL by PredefinedType property. IfcTunnel can be subdivided into RAILWAYTUNNEL, HIGHWAYTUNNEL, HYDRAULICTUNNEL, MUNICIPALTUNNEL, MINETUNNEL and SERVICEGALLERY by FunctionType property.

IfcTunnelPart refers to the various parts forming a tunnel. IfcTunnelPart can be further divided into PORTAL, OPEN-CUTTUNNEL, UNDER-CUTTUNNEL, TUNNELCHAMBER and SHEDTUNNEL by PredefinedType property.

10.1.2 Physical Elements of Tunnel

The EXPRESS-G diagram for physical elements of tunnel is shown in Figure 10.3.
IfcTunnelElement inherits from IfcCivilElement and is the supertype of all the tunnel elements.

IfcTunnelAdvanceSupport refers to a pre-reinforced support to the face of surrounding rock before tunnel excavation. It inherits from IfcTunnelElement and is contained in UNDER-CUT TUNNEL or TUNNELCHAMBER. IfcTunnelAdvanceSupport is further subdivided into ADVANCEPIPE-ROOFSUPPORT, ADVANCEFOREPOLING and GROUTING by predefined types.

IfcTunnelPrimarySupport refers to the supporting structure made immediately after the excavation. It inherits from IfcTunnelElement and is contained in UNDER-CUTTUNNEL or TUNNELCHAMBER.

IfcSystemAnchorBolt refers to the anchor group arranged according to certain vertical and horizontal spacing along the tunnel perimeter to stabilize the surrounding rock. It inherits from IfcTunnelElement and is contained in under-cut tunnel or tunnel chamber.

IfcSystemSteelFrame refers to the frame supporting structure made of section steels, steel rails or steel bars. It inherits from IfcTunnelElement and is contained in UNDER-CUTTUNNEL or TUNNELCHAMBER.
IfcInitialSupportShotcrete refers to a kind of concrete structure. The concrete mixture is vertically sprayed on the surface at a higher speed utilizing the compressed air or other power to be compacted by the continuous impact of cement and aggregate during the spraying process. It inherits from IfcTunnelElement and is contained in UNDER-CUTTUNNEL or TUNNELCHAMBER.

IfcTunnelLiningStructure refers to the permanent supporting structure of tunnel. It inherits from IfcTunnelElement and is contained in under-cut tunnel, open-cut tunnel or tunnel chamber. IfcTunnelLiningStructure is further subdivided into ARCHWALLLINING, INVERTLINING, SEGMENT and BASESLAB by predefined types.

IfcTunnelPortalStructure refers to door type building to maintain the stability of the front slope and side slope, to guide drainage slope flow and to decorate the entrance. It inherits from IfcTunnelElement and is contained in the spatial structure element of tunnel portal. IfcTunnelPortalStructure is further subdivided into HATSTYLEPORTALSTRUCTURE, BELLSTYLEPORTALSTRUCTURE, STRAIGHT-CUTPORTALSTRUCTURE, POURCHAMFEREDPORTALSTRUCTURE, BUFFEREDPORTALSTRUCTURE and ENDWALLPORTALSTRUCTURE by predefined types.

IfcTunnelInvertFilling refers to the concrete filled in the tunnel invert. It inherits from IfcTunnelElement and is contained in PORTAL, OPEN-CUTTUNNEL or UNDER-CUTTUNNEL.

IfcWaterproofLayer refers to the waterproof structure attached to the lining, construction joints and deformation joints. It inherits from IfcTunnelElement and is contained in PORTAL, OPEN-CUTTUNNEL or UNDER-CUTTUNNEL.

IfcLevelingBlanket refers to the cushion at the bottom of the structure or the leveling layer before the waterproof layer. It inherits from IfcTunnelElement and is contained in PORTAL or OPEN-CUTTUNNEL.

IfcProtectiveLayer refers to the protective layer for the tunnel portal or open-cut tunnel before backfilling. It inherits from IfcTunnelElement and is contained in PORTAL or OPEN-CUTTUNNEL.

IfcTemporarySupport refers to the temporary support to maintain the stability of the surrounding rock during the process of tunnel excavation. The support needs to be removed in the construction process. It inherits from IfcTunnelElement and is contained in UNDER-CUTTUNNEL.

IfcProtectiveArch refers to the protective structure to ensure the safety of tunnel excavation which is usually chosen when there is no condition for open cutting. It inherits from IfcTunnelElement and is contained in UNDER-CUTTUNNEL.

10.2 Type Definition

10.2.1 IfcTunnelTypeEnum

This enumeration defines the different predefined types of tunnels that can further specify an
IfcTunnel.

**Enumerated Item Definitions:**

CIRCULARTUNNEL;
CURVEDWALLANDARCHCROWNTUNNEL;
STRAIGHTWALLANDARCHCROWNTUNNEL;
RECTANGULARTUNNEL;
THESHEDTUNNEL;
THEOPEN-CUTTUNNEL;
USERDEFINED;
NOTDEFINED.

**EXPRESS Specification:**

TYPE IfcTunnelTypeEnum = ENUMERATION OF
(CIRCULARTUNNEL,
CURVEDWALLANDARCHCROWNTUNNEL,
STRAIGHTWALLANDARCHCROWNTUNNEL,
RECTANGULARTUNNEL,
THESHEDTUNNEL,
THEOPEN-CUTTUNNEL,
USERDEFINED,
NOTDEFINED);
END_TYPE;

### 10.2.2 IfcTunnelFunctionTypeEnum

This enumeration defines the different function types of tunnels.

**Enumerated Item Definitions:**

RAILWAYTUNNEL;
HIGHWAYTUNNEL;
HYDRAULICTUNNEL;
MUNICIPALTUNNEL;
MINETUNNEL;
SERVICEGALLERY;
USERDEFINED;
NOTDEFINED.

**EXPRESS Specification:**

TYPE IfcTunnelFunctionTypeEnum = ENUMERATION OF
(RAILWAYTUNNEL,
HIGHWAYTUNNEL,
HYDRAULICTUNNEL,
MUNICIPALTUNNEL,
MINETUNNEL,
SERVICEGALLERY,
USERDEFINED,
NOTDEFINED);
END_TYPE;

10.2.3 IfcTunnelPartTypeEnum
This enumeration defines the different composition types of tunnels.

Enumerated Item Definitions:
PORTAL;
OPEN-CUTTUNNEL;
UNDER-CUTTUNNEL;
TUNNELCHAMBER;
SHEDTUNNEL;
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:
TYPE IfcTunnelPartTypeEnum = ENUMERATION OF
( PORTAL,
  OPEN-CUTTUNNEL,
  UNDER-CUTTUNNEL,
  TUNNELCHAMBER,
  SHEDTUNNEL,
  USERDEFINED,
  NOTDEFINED);
END_TYPE;

10.2.4 IfcAdvanceSupportTypeEnum
This enumeration defines the different advance support types of tunnels.

Enumerated Item Definitions:
ADVANCEPIPE-ROOFSUPPORT;
ADVANCEFOREPOLING;
GROUTING;
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:
TYPE IfcAdvanceSupportTypeEnum = ENUMERATION OF
( ADVANCEPIPE-ROOFSUPPORT,
ADVANCEFOREPOLING,
GROUTING,
USERDEFINED,
NOTDEFINED);
END_TYPE;

10.2.5 IfcPrimarySupportTypeEnum
This enumeration defines the different primary support types of tunnels.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:
TYPE IfcPrimarySupportTypeEnum = ENUMERATION OF
(USERDEFINED,
NOTDEFINED);
END_TYPE;

10.2.6 IfcSystemAnchorBoltTypeEnum
This enumeration defines the different anchor bolt types of tunnels.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:
TYPE IfcSystemAnchorBoltTypeEnum = ENUMERATION OF
(USERDEFINED,
NOTDEFINED);
END_TYPE;

10.2.7 IfcSystemSteelFrameTypeEnum
This enumeration defines the different system steel frame types of tunnels.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:
TYPE IfcSystemSteelFrameTypeEnum = ENUMERATION OF
(USERDEFINED,
NOTDEFINED);
END_TYPE;

10.2.8 IfcInitialSupportShotcreteTypeEnum
This enumeration defines the different initial support shotcrete types of tunnels.

**Enumerated Item Definitions:**

- USERDEFINED;
- NOTDEFINED.

**EXPRESS Specification:**

```plaintext
TYPE IfcInitialSupportShotcreteTypeEnum = ENUMERATION OF
  (USERDEFINED,
   NOTDEFINED);
END_TYPE;
```

**10.2.9 IfcTunnelLiningTypeEnum**

This enumeration defines the different lining types of tunnels.

**Enumerated Item Definitions:**

- ARCHWALLLINING;
- INVERTLINING;
- SEGMENT;
- BASESLAB;
- USERDEFINED;
- NOTDEFINED.

**EXPRESS Specification:**

```plaintext
TYPE IfcTunnelLiningTypeEnum = ENUMERATION OF
  (ARCHWALLLINING,
   INVERTLINING,
   SEGMENT,
   BASESLAB,
   USERDEFINED,
   NOTDEFINED);
END_TYPE;
```

**10.2.10 IfcPortalStructureTypeEnum**

This enumeration defines the different portal structure types of tunnels.

**Enumerated Item Definitions:**

- HATSTYLEPORTALSTRUCTURE;
- BELLSTYLEPORTALSTRUCTURE;
- STRAIGHT-CUTPORTALSTRUCTURE;
- POURCHAMFEREDPORTALSTRUCTURE;
- BUFFEREDPORTALSTRUCTURE;
- ENDWALLPORTALSTRUCTURE;
USERDEFINED;
NOTDEFINED.

**EXPRESS Specification:**
TYPE IfcPortalStructureTypeEnum = ENUMERATION OF
(HATSTYLEPORTALSTRUCTURE,
BELLSTYLEPORTALSTRUCTURE,
STRAIGHT-CUTCUTPORTALSTRUCTURE,
POURCHAMFEREDPORTALSTRUCTURE,
BUFFEREDPORTALSTRUCTURE,
ENDWALLPORTALSTRUCTURE,
USERDEFINED,
NOTDEFINED);
END_TYPE;

**10.2.11 IfcInvertFillingTypeEnum**
This enumeration defines the different invert filling types of tunnels.

**Enumerated Item Definitions:**
USERDEFINED;
NOTDEFINED.

**EXPRESS Specification:**
TYPE IfcInvertFillingTypeEnum = ENUMERATION OF
(USERDEFINED,
NOTDEFINED);
END_TYPE;

**10.2.12 IfcWaterproofLayerTypeEnum**
This enumeration defines the different waterproof layer types of tunnels.

**Enumerated Item Definitions:**
USERDEFINED;
NOTDEFINED.

**EXPRESS Specification:**
TYPE IfcWaterproofLayerTypeEnum = ENUMERATION OF
(USERDEFINED,
NOTDEFINED);
END_TYPE;

**10.2.13 IfcLevelingBlanketTypeEnum**
This enumeration defines the different leveling blanket types of tunnels.

**Enumerated Item Definitions:**
USERDEFINED;
NOTDEFINED.

**EXPRESS Specification:**

```
TYPE IfcLevelingBlanketTypeEnum = ENUMERATION OF
  (USERDEFINED,
   NOTDEFINED);
END_TYPE;
```

**10.2.14 IfcProtectiveLayerTypeEnum**

This enumeration defines the different protective layer types of tunnels.

**Enumerated Item Definitions:**

USERDEFINED;

NOTDEFINED.

**EXPRESS Specification:**

```
TYPE IfcProtectiveLayerTypeEnum = ENUMERATION OF
  (USERDEFINED,
   NOTDEFINED);
END_TYPE;
```

**10.2.15 IfcProtectiveArchTypeEnum**

This enumeration defines the different protective arch types of tunnels.

**Enumerated Item Definitions:**

USERDEFINED;

NOTDEFINED.

**EXPRESS Specification:**

```
TYPE IfcProtectiveArchTypeEnum = ENUMERATION OF
  (USERDEFINED,
   NOTDEFINED);
END_TYPE;
```

**10.2.16 IfcTemporarySupportTypeEnum**

This enumeration defines the different Temporary Support types of tunnels.

**Enumerated Item Definitions:**

USERDEFINED;

NOTDEFINED.

**EXPRESS Specification:**

```
TYPE IfcTemporarySupportTypeEnum = ENUMERATION OF
  (USERDEFINED,
   NOTDEFINED);
```
10.3 Entity Definition

10.3.1 IfcTunnelStructureElement

IfcTunnelStructureElement is the supertype of all the spatial structure elements of tunnel.

**EXPRESS Specification:**

```plaintext
ENTITY IfcTunnelStructureElement
  SUPERTYPE OF (ONEOF (IfcTunnel, IfcTunnelPart))
  SUBTYPE OF (IfcCivilStructureElement);
END_ENTITY;
```

10.3.2 IfcTunnel

IfcTunnel refers to a tunnel which is a part of IfcRailway and is composed of a number of IfcTunnelPart in space. IfcTunnel is further subdivided into CIRCULAR TUNNEL, CURVED WALL AND ARCH CROWNTUNNEL, STRAIGHT WALL AND ARCH CROWNTUNNEL, RECTANGULAR TUNNEL, THESHED TUNNEL, THE OPEN-CUT TUNNEL by predefined types and into RAILWAY TUNNEL, HIGHWAY TUNNEL, HYDRAULIC TUNNEL, MUNICIPAL TUNNEL, MINETUNNEL, SERVICE GALLERY by function types.

<table>
<thead>
<tr>
<th>Spatial Composite</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcRailway</td>
<td>IfcTunnel is a part of IfcRailway.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spatial Parts</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTunnelPart</td>
<td>IfcTunnel is composed of one or more IfcTunnelPart.</td>
</tr>
</tbody>
</table>

### Table 10.3 Property sets for IfcTunnel

<table>
<thead>
<tr>
<th>Predefined Type</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_TunnelCommon</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

```plaintext
ENTITY IfcTunnel
  SUBTYPE OF (IfcTunnelStructureElement);
  PredefinedType: IfcTunnelTypeEnum;
  FunctionType: IfcTunnelFunctionTypeEnum;
END_ENTITY;
```

**Attribute definitions:**

PredefinedType: IfcTunnel is further subdivided into CIRCULAR TUNNEL, CURVED WALL AND ARCH CROWNTUNNEL, STRAIGHT WALL AND ARCH CROWNTUNNEL, RECTANGULAR TUNNEL, THESHED TUNNEL and THE OPEN-CUT TUNNEL by structural style.
FunctionType: IfcTunnel is further subdivided into RAILWAYTUNNEL, HIGHWAYTUNNEL, HYDRAULICTUNNEL, MUNICIPALTUNNEL, MINETUNNEL and SERVICEGALLERY by function.

10.3.3 IfcTunnelPart

IfcTunnelPart is the decomposition of an IfcTunnel in terms of spatial structure, containing various tunnel elements. IfcTunnel is further subdivided into PORTAL, OPEN-CUTTUNNEL, UNDER-CUTTUNNEL, TUNNELCHAMBER and SHEDTUNNEL by predefined types.

<table>
<thead>
<tr>
<th>Spatial Composite</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTunnel</td>
<td>IfcTunnelPart is a part of IfcTunnel.</td>
</tr>
</tbody>
</table>

Table 10.4 IfcTunnelPart spatial composition

<table>
<thead>
<tr>
<th>Spatial Composite</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PORTAL</td>
<td>IfcTunnelPortalStructure, IfcTunnelInvertFilling, IfcWaterproofLayer</td>
</tr>
<tr>
<td>TUNNELCHAMBER</td>
<td>IfcTunnelPrimarySupport, IfcSystemAnchorBolt, IfcSystemSteelFrame</td>
</tr>
</tbody>
</table>

10.3.4 IfcTunnelPart containment

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Contained Entities</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TUNNELCHAMBER</td>
<td>IfcTunnelPrimarySupport, IfcSystemAnchorBolt, IfcSystemSteelFrame</td>
<td>Tunnel chamber can contain IfcTunnelPrimarySupport, IfcSystemAnchorBolt, IfcSystemSteelFrame.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>PORTAL</td>
<td>Pset_PortalCommon</td>
</tr>
<tr>
<td>OPEN-CUTTUNNEL</td>
<td>Pset_Open-cutTunnelCommon</td>
</tr>
<tr>
<td>UNDER-CUTTUNNEL</td>
<td>Pset_Under-cutTunnelCommon</td>
</tr>
<tr>
<td>TUNNELCHAMBER</td>
<td>Pset_TunnelChamberCommon</td>
</tr>
<tr>
<td>SHEDTUNNEL</td>
<td>Pset_ShedTunnelCommon</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcTunnelPart

  SUBTYPE OF (IfcTunnelStructureElement);

  PreDefinedType: IfcTunnelPartTypeEnum;

END_ENTITY;

**Attribute definitions:**

PreDefinedType: IfcTunnelPart is further subdivided into PORTAL, OPEN-CUTTUNNEL, UNDER-CUTTUNNEL, TUNNELCHAMBER and SHEDTUNNEL by structural style.

**10.3.4 IfcTunnelElement**

IfcTunnelElement is the supertype of all tunnel physical elements.

**EXPRESS Specification:**

ENTITY IfcTunnelElement

  SUPERTYPE OF (ONEOF

IfcLevelingBlanket,  
IfcProtectiveLayer,  
IfcTemporarySupport,  
IfcProtectiveArch))  
SUBTYPE OF (IfcCivilElement);  
END_ENTITY;

10.3.5 IfcTunnelAdvanceSupport

IfcTunnelAdvanceSupport refers to a pre-reinforced support to the face of surrounding rock before tunnel excavation. It inherits from IfcTunnelElement and is contained in UNDER-CUTTUNNEL or TUNNELCHAMBER. IfcTunnelAdvanceSupport is further subdivided into ADVANCEPIPE-ROOFSUPPORT, ADVANCEFOREPOLING and GROUTING by predefined types.

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pset_TunnelAdvanceSupportCommon</td>
<td></td>
</tr>
</tbody>
</table>

Table 10.7 Property sets for IfcTunnelAdvanceSupport

Table 10.8 IfcTunnelAdvanceSupport contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTunnelPart/UNDER-CUTTUNNEL</td>
<td>IfcTunnelAdvanceSupport should be contained in UNDER-CUTTUNNEL.</td>
</tr>
<tr>
<td>IfcTunnelPart/TUNNELCHAMBER</td>
<td>IfcTunnelAdvanceSupport is also contained in TUNNELCHAMBER.</td>
</tr>
</tbody>
</table>

EXPRESS Specification:

ENTITY IfcTunnelAdvanceSupport  
SUBTYPE OF (IfcTunnelElement);  
PreDefinedType: IfcTunnelAdvanceSupportTypeEnum;  
END_ENTITY;

Attribute definitions:

PreDefinedType: IfcTunnelAdvanceSupport is further subdivided into ADVANCEPIPE-ROOFSUPPORT, ADVANCEFOREPOLING and GROUTING by structural style.

10.3.6 IfcTunnelPrimarySupport

IfcTunnelPrimarySupport refers to the supporting structure made immediately after the excavation. It inherits from IfcTunnelElement and is contained in UNDER-CUTTUNNEL or TUNNELCHAMBER which are the predefined types of IfcTunnelPart.

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pset_TunnelPrimarySupportCommon</td>
<td></td>
</tr>
</tbody>
</table>

Table 10.9 Property sets for IfcTunnelPrimarySupport

Table 10.10 IfcTunnelPrimarySupport contained in spatial structure
IfcTunnelPart/UNDER-CUTTUNNEL
IfcTunnelPrimarySupport should be contained in UNDER-CUTTUNNEL.

IfcTunnelPart/TUNNELCHAMBER
IfcTunnelPrimarySupport is also contained in TUNNELCHAMBER.

**EXPRESS Specification:**

ENTITY IfcTunnelPrimarySupport
SUBTYPE OF (IfcTunnelElement);
PreDefinedType: IfcTunnelPrimarySupportTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType.

### 10.3.7 IfcSystemAncherBolt

IfcSystemAncherBolt refers to the anchor group arranged according to certain vertical and horizontal spacing along the tunnel perimeter to stabilize the surrounding rock. It inherits from IfcTunnelElement and is contained in UNDER-CUTTUNNEL or TUNNELCHAMBER.

**Table 10.11 Property sets for IfcSystemAncherBolt**

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_SystemAncherBoltCommon</td>
</tr>
</tbody>
</table>

**Table 10.12 IfcSystemAncherBolt contained in spatial structure**

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTunnelPart/UNDER-CUTTUNNEL</td>
<td>IfcSystemAncherBolt should be contained in UNDER-CUTTUNNEL.</td>
</tr>
<tr>
<td>IfcTunnelPart/TUNNELCHAMBER</td>
<td>IfcSystemAncherBolt is also contained in TUNNELCHAMBER.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcSystemAncherBolt
SUBTYPE OF (IfcTunnelElement);
PreDefinedType: IfcSystemAncherBoltTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType.

### 10.3.8 IfcSystemSteelFrame

IfcSystemSteelFrame refers to the frame supporting structure made of section steels, steel rails or steel bars. It inherits from IfcTunnelElement and is contained in UNDER-CUTTUNNEL or TUNNELCHAMBER.

**Table 10.13 Property sets for IfcSystemSteelFrame**
### EXPRESS Specification:

ENTITY IfcSystemSteelFrame
  SUBTYPE OF (IfcTunnelElement);
  PreDefinedType: IfcSystemSteelFrameTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType.

#### 10.3.9 IfcInitialSupportShotcrete

IfcInitialSupportShotcrete refers to a kind of concrete structure. The concrete mixture is vertically sprayed on the surface at a higher speed utilizing the compressed air or other power to be compacted by the continuous impact of cement and aggregate during the spraying process. It inherits from IfcTunnelElement and is contained in UNDER-CUTTUNNEL or TUNNELCHAMBER.

**Table 10.15 Property sets for IfcInitialSupportShotcrete**

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_InitialSupportShotcreteCommon</td>
</tr>
</tbody>
</table>

**Table 10.16 IfcInitialSupportShotcrete contained in spatial structure**

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTunnelPart/UNDER-CUTTUNNEL</td>
<td>IfcInitialSupportShotcrete should be contained in UNDER-CUTTUNNEL.</td>
</tr>
<tr>
<td>IfcTunnelPart/TUNNELCHAMBER</td>
<td>IfcInitialSupportShotcrete is also contained in TUNNELCHAMBER.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcInitialSupportShotcrete
  SUBTYPE OF (IfcTunnelElement);
  PreDefinedType: IfcInitialSupportShotcreteTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType.

#### 10.3.10 IfcTunnelLiningStructure
IfcTunnelLiningStructure refers to the permanent supporting structure of tunnel. It inherits from IfcTunnelElement and is contained in UNDER-CUTTUNNEL, OPEN-CUTTUNNEL or TUNNELCHAMBER. IfcTunnelLiningStructure is further subdivided into ARCHWALLLINING, INVERTLINING, SEGMENT and BASESLAB by PredefinedType property.

Table 10.17 Property sets for IfcTunnelLiningStructure

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_TunnelLiningStructureCommon</td>
</tr>
</tbody>
</table>

Table 10.18 IfcTunnelLiningStructure contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTunnelPart/UNDER-CUTTUNNEL</td>
<td>IfcTunnelLiningStructure should be contained in UNDER-CUTTUNNEL.</td>
</tr>
<tr>
<td>IfcTunnelPart/OPEN-CUTTUNNEL</td>
<td>IfcTunnelLiningStructure is also contained in OPEN-CUTTUNNEL.</td>
</tr>
<tr>
<td>IfcTunnelPart/TUNNELCHAMBER</td>
<td>IfcTunnelLiningStructure is also contained in TUNNELCHAMBER.</td>
</tr>
</tbody>
</table>

EXPRESS Specification:

ENTITY IfcTunnelLiningStructure

  SUBTYPE OF (IfcTunnelElement);

  PreDefinedType: IfcTunnelLiningStructureTypeEnum;

END_ENTITY;

Attribute definitions:

PreDefinedType: IfcTunnelLiningStructure is further subdivided into ARCHWALLLINING, INVERTLINING, SEGMENT and BASESLAB by structural style.

10.3.11 IfcTunnelPortalStructure

IfcTunnelPortalStructure refers to door type building to maintain the stability of the front slope and side slope, to guide drainage slope flow and to decorate the entrance. It inherits from IfcTunnelElement and is contained in the spatial structure element of tunnel portal. IfcTunnelPortalStructure is further subdivided into HATSTYLEPORTALSTRUCTURE, BELLSTYLEPORTALSTRUCTURE, STRAIGHT-CUTPORTALSTRUCTURE, POURCHAMFEREDPORTALSTRUCTURE, BUFFEREDPORTALSTRUCTURE, and ENDWALLPORTALSTRUCTURE by predefined types.

Table 10.19 IfcTunnelPortalStructure contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTunnelPart/PORTAL</td>
<td>IfcTunnelPortalStructure should be contained in PORTAL.</td>
</tr>
</tbody>
</table>

EXPRESS Specification:

ENTITY IfcTunnelPortalStructure
SUBTYPE OF (IfcTunnelElement);
PreDefinedType: IfcTunnelPortalStructureTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType: IfcTunnelPortalStructure is further subdivided into HATSTYLEPORTALSTRUCTURE, BELLSTYLEPORTALSTRUCTURE, STRAIGHT-CUTPORTALSTRUCTURE, POURCHAMFEREDPORTALSTRUCTURE, BUFFEREDPORTALSTRUCTURE and ENDWALLPORTALSTRUCTURE by structural style.

10.3.12 IfcTunnelInvertFilling

IfcTunnelInvertFilling refers to the concrete filled in the tunnel invert. It inherits from IfcTunnelElement and is contained in PORTAL, OPEN-CUTTUNNEL or UNDER-CUTTUNNEL.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTunnelPart/PORTAL</td>
<td>IfcTunnelInvertFilling should be contained in PORTAL.</td>
</tr>
<tr>
<td>IfcTunnelPart/OPEN-CUTTUNNEL</td>
<td>IfcTunnelInvertFilling is also contained in OPEN-CUTTUNNEL.</td>
</tr>
<tr>
<td>IfcTunnelPart/UNDER-CUTTUNNEL</td>
<td>IfcTunnelInvertFilling is also contained in UNDER-CUTTUNNEL.</td>
</tr>
</tbody>
</table>

EXPRESS Specification:
ENTITY IfcTunnelInvertFilling
SUBTYPE OF (IfcTunnelElement);
PreDefinedType: IfcTunnelInvertFillingTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType.

10.3.13 IfcWaterproofLayer

IfcWaterproofLayer refers to the waterproof structure attached to the lining, construction joints and deformation joints. It inherits from IfcTunnelElement and is contained in PORTAL, OPEN-CUTTUNNEL or UNDER-CUTTUNNEL.

Table 10.21 Property sets for IfcWaterproofLayer

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pset_WaterproofLayer</td>
<td></td>
</tr>
</tbody>
</table>

Table 10.22 IfcWaterproofLayer contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTunnelPart/PORTAL</td>
<td>IfcWaterproofLayer should be contained in PORTAL.</td>
</tr>
</tbody>
</table>
**EXPRESS Specification:**

ENTITY IfcWaterproofLayer
  SUBTYPE OF (IfcTunnelElement);
  PreDefinedType: IfcWaterproofLayerTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType.

10.3.14 IfcLevelingBlanket

IfcLevelingBlanket refers to the cushion at the bottom of the structure or the leveling layer before the waterproof layer. It inherits from IfcTunnelElement and is contained in PORTAL or OPEN-CUTTUNNEL.

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_LevelingBlanketCommon</td>
</tr>
</tbody>
</table>

Table 10.23 Property sets for IfcLevelingBlanket

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTunnelPart/PORTAL</td>
<td>IfcLevelingBlanket should be contained in PORTAL.</td>
</tr>
<tr>
<td>IfcTunnelPart/OPEN-CUTTUNNEL</td>
<td>IfcLevelingBlanket is also contained in OPEN-CUTTUNNEL.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcLevelingBlanket
  SUBTYPE OF (IfcTunnelElement);
  PreDefinedType: IfcLevelingBlanketTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType.

10.3.15 IfcProtectiveLayer

IfcProtectiveLayer refers to the protective layer for the tunnel portal or open-cut tunnel before backfilling. It inherits from IfcTunnelElement and is contained in PORTAL or OPEN-CUTTUNNEL.

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_IfcProtectiveLayerCommon</td>
</tr>
</tbody>
</table>

Table 10.25 Property sets for IfcProtectiveLayer
Table 10.26 IfcLevelingBlanket contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTunnelPart/PORTAL</td>
<td>IfcProtectiveLayer should be contained in PORTAL.</td>
</tr>
<tr>
<td>IfcTunnelPart/OPEN-CUTTUNNEL</td>
<td>IfcProtectiveLayer is also contained in OPEN-CUTTUNNEL.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcProtectiveLayer
    SUBTYPE OF (IfcTunnelElement);
    PreDefinedType: IfcProtectiveLayerTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType.

10.3.16 IfcTemporarySupport

IfcTemporarySupport refers to the temporary support to maintain the stability of the surrounding rock during the process of tunnel excavation. The support needs to be removed in the construction process. It inherits from IfcTunnelElement and is contained in UNDER-CUTTUNNEL.

Table 10.27 IfcTemporarySupport contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTunnelPart/UNDER-CUTTUNNEL</td>
<td>IfcTemporarySupport should be contained in UNDER-CUTTUNNEL.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcTemporarySupport
    SUBTYPE OF (IfcTunnelElement);
    PreDefinedType: IfcTemporarySupportTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType.

10.3.17 IfcProtectiveArch

IfcProtectiveArch refers to the protective structure to ensure the safety of tunnel excavation which is usually chosen when there is no condition for open cutting. It inherits from IfcTunnelElement and is contained in UNDER-CUTTUNNEL.

Table 10.28 IfcProtectiveArch contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTunnelPart/UNDER-CUTTUNNEL</td>
<td>IfcProtectiveArch should be contained in UNDER-CUTTUNNEL.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcProtectiveArch

CRBIM
10.4 Property Set Definition

10.4.1 Pset_TunnelCommon

Name: Pset_TunnelCommon
Applicable Entities: IfcTunnel
Description: The common property set of tunnel.
Property Definitions: See Table 10.29.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TunnelName</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The name of the tunnel.</td>
</tr>
<tr>
<td>TunnelLength</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The length of the tunnel.</td>
</tr>
<tr>
<td>MaximumDepthOfTunnel</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The maximum depth of the tunnel.</td>
</tr>
<tr>
<td>SingleOrDoubleLine</td>
<td>TypePropertyEnumeratedValue/PEnum_ElementSingleOrDoubleLine: SINGLTRACKTUNNEL, DOUBLETRACKTUNNEL, BIFURCATONTUNNEL</td>
<td>The tunnel is single line or double line or others.</td>
</tr>
<tr>
<td>MaximumFloordLevel</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The maximum flood level of the area.</td>
</tr>
<tr>
<td>DesignSpeed</td>
<td>TypePropertySingleValue/IfcInteger/(Km/h)</td>
<td>The design speed of the tunnel.</td>
</tr>
<tr>
<td>AseismicLevel</td>
<td>TypePropertyEnumeratedValue/PEnum_ElementAseismicLevel(FortificationIntensity): 6, 7, 8, 9</td>
<td>The fortification intensity of the tunnel.</td>
</tr>
</tbody>
</table>

10.4.2 Pset_PortalCommon

Name: Pset_PortalCommon
Applicable Entities: IfcTunnelPart/PORTAL
Description: The common property set of portal.
Property Definitions: See Table 10.30.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PortalType</td>
<td>TypePropertyEnumeratedValue/PEnum_ElementPortalType: HATSTYLEPORTAL, BELLSTYLEPORTAL, STRAIGHT</td>
<td>The type of the tunnel portal. typePropertyEnumeratedValue: HATSTYLEPORTAL, BELLSTYLEPORTAL, STRAIGHT</td>
</tr>
</tbody>
</table>
HT-CUTPORTAL,POURCHAMFEREDPORTAL,BUFFEREDPORTAL,ENDWALLPORTAL

| Widening | TypePropertySingleValue/IfcLengthMeasure/m | The width value of the tunnel. |

10.4.3 Pset_Open-cutTunnelCommon

Name: Pset_Open-cutTunnelCommon
Applicable Entities: IfcTunnelPart/OPEN-CUTTUNNEL
Description: The common property set of open-cut tunnel.
Property Definitions: See Table 10.31.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open-cutTunnelType</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The type of open-cut tunnel.</td>
</tr>
<tr>
<td>Widening</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The width value of the tunnel.</td>
</tr>
</tbody>
</table>

10.4.4 Pset_Under-cutTunnelCommon

Name: Pset_Under-cutTunnelCommon
Applicable Entities: IfcTunnelPart/UNDER-CUTTUNNEL
Description: The common property set of under-cut tunnel.
Property Definitions: See Table 10.32.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under-cutTunnelType</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The type of under-cut tunnel.</td>
</tr>
<tr>
<td>Widening</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The width value of the tunnel.</td>
</tr>
</tbody>
</table>

10.4.5 Pset_TunnelChamberCommon

Name: Pset_TunnelChamberCommon
Applicable Entities: IfcTunnelPart/TUNNELCHAMBER
Description: The common property set of chamber.
Property Definitions: See Table 10.33.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
</table>

Table 10.33 Property definitions of Pset_TunnelChamberCommon

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
</table>

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### Tunnel Chamber Type

Tunnel Chamber Type: TypePropertyEnumeratedValue/Enum_ElementTunnelChamberType: REFUGE, POWERTUNNELECHamber, COMMUNICATION TUNNEL CHAMBER, COMPREHENSIVE TUNNEL CHAMBER.

<table>
<thead>
<tr>
<th>Mileage</th>
<th>TypePropertySingleValue/IfcLabel</th>
<th>Mileage</th>
</tr>
</thead>
</table>

#### 10.4.6 Pset_ShedTunnelCommon

**Name:** Pset_ShedTunnelCommon  
**Applicable Entities:** IfcTunnelPart/SHEDTUNNEL  
**Description:** The common property set of shed tunnel.  
**Property Definitions:** See Table 10.34.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ShedTunnelType</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The type of shed tunnel.</td>
</tr>
<tr>
<td>Widening</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The width value of the tunnel.</td>
</tr>
</tbody>
</table>

#### 10.4.7 Pset_TunnelAdvanceSupportCommon

**Name:** Pset_TunnelAdvanceSupportCommon  
**Applicable Entities:** IfcTunnelAdvanceSupport  
**Description:** The common property set of advance support.  
**Property Definitions:** See Table 10.35.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TubeType</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The type of the tube.</td>
</tr>
<tr>
<td>TubeDiameter</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The diameter of the tube.</td>
</tr>
<tr>
<td>TubeWallThickness</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The thickness of the tube wall.</td>
</tr>
<tr>
<td>TubeLength</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The length of the tube.</td>
</tr>
<tr>
<td>TubeCircumferentialSpacing</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The circumferential spacing of the tube.</td>
</tr>
<tr>
<td>TubeLongitudinalSpacing</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The longitudinal spacing of</td>
</tr>
</tbody>
</table>
10.4.8 Pset_TunnelPrimarySupportCommon

Name: Pset_TunnelPrimarySupportCommon

Applicable Entities: IfcTunnelPrimarySupport

Description: The common property set of primary support.

Property Definitions: See Table 10.36.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TunnelPrimarySupportType</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The type of the TunnelPrimarySupport.</td>
</tr>
</tbody>
</table>

10.4.9 Pset_SystemAncherBoltCommon

Name: Pset_SystemAncherBoltCommon

Applicable Entities: IfcSystemAncherBolt

Description: The common property set of system ancher bolt.

Property Definitions: See Table 10.37.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CircumferentialSpacing</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The circumferential spacing of the bolt.</td>
</tr>
<tr>
<td>LongitudinalSpacing</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The longitudinal spacing of the bolt.</td>
</tr>
<tr>
<td>location</td>
<td>TypePropertyEnumeratedValue/PEnum_ElementLocation:ARCH, SIDEWALL, ARCHWALL</td>
<td>The location of the bolt. TypePropertyEnumeratedValue/PEnum_ElementLocation:ARCH, SIDEWALL, ARCHWALL</td>
</tr>
</tbody>
</table>
GroutingMaterial: TypePropertySingleValue/IfcLabel
The grouting pressure.

SlurryRatio: TypePropertySingleValue/IfcRatioMeasure
The ratio of the material and water.

10.4.10 Pset_SystemSteelArchCommon

Name: Pset_SystemSteelArchCommon
Applicable Entities: IfcSystemSteelArch
Description: The common property set of system steel arch.
Property Definitions: See Table 10.38.

Table 10.38 Property definitions of Pset_SystemSteelArchCommon

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LongitudinalSpacing</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The longitudinal spacing of steel arch.</td>
</tr>
</tbody>
</table>

10.4.11 Pset_InitialSupportShotcreteCommon

Name: Pset_InitialSupportShotcreteCommon
Applicable Entities: IfcInitialSupportShotcrete
Description: The common property set of initial support shotcrete.
Property Definitions: See Table 10.39.

Table 10.39 Property definitions of Pset_InitialSupportShotcreteCommon

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The thickness of the primary support.</td>
</tr>
<tr>
<td>InjectionProcess</td>
<td>TypePropertyEnumeratedValue/PEnum_ElementInjectionProcess:DRYSPRAYING,WETSPLAYING</td>
<td>The method of injection. TypePropertyEnumeratedValue:DRYSPRAYING,WETSPLAYING</td>
</tr>
<tr>
<td>ThicknessOfCover</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The thickness of the concret out of the reinforcing bar or others.</td>
</tr>
</tbody>
</table>

10.4.12 Pset_TunnelLiningCommon

Name: Pset_TunnelLiningCommon
Applicable Entities: IfcTunnelLining
Description: The common property set of tunnel lining.
Property Definitions: See Table 10.40.
Table 10.40 Property definitions of Pset_TunnelLiningCommon

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The thickness of the tunnel lining.</td>
</tr>
<tr>
<td>AntiPermeabilityLevel</td>
<td>TypePropertyEnumeratedValue/IfcLabel</td>
<td>Ability to resist water penetration under a certain pressure.</td>
</tr>
</tbody>
</table>

10.4.13 Pset_WaterproofLayerCommon

Name: Pset_WaterproofLayerCommon
Applicable Entities: IfcWaterproofLayer
Description: The common property set of waterproof layer.
Property Definitions: See Table 10.41.

Table 10.41 Property definitions of Pset_WaterproofLayerCommon

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Useness</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The useness of the layer.</td>
</tr>
<tr>
<td>Material</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The material of the layer.</td>
</tr>
<tr>
<td>Process</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The method of application.</td>
</tr>
<tr>
<td>Thickness</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The thickness of the layer.</td>
</tr>
</tbody>
</table>

10.4.14 Pset_LevelingBlanketCommon

Name: Pset_LevelingBlanketCommon
Applicable Entities: IfcLevelingBlanket
Description: The common property set of leveling blanket.
Property Definitions: See Table 10.42.

Table 10.42 Property definitions of Pset_LevelingBlanketCommon

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Useness</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The useness of the layer.</td>
</tr>
<tr>
<td>Material</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The material of the layer.</td>
</tr>
<tr>
<td>Process</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The method of application.</td>
</tr>
<tr>
<td>Thickness</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The thickness of the layer.</td>
</tr>
</tbody>
</table>

10.4.15 Pset_ProtectiveLayerCommon

Name: Pset_ProtectiveLayerCommon
Applicable Entities: IfcProtectiveLayer
Description: The common property set of protective layer.
Property Definitions: See Table 10.43.

Table 10.43 Property definitions of Pset_ProtectiveLayerCommon

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Data Type/Description</td>
<td>Description</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>Useness</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The useness of the layer.</td>
</tr>
<tr>
<td>Material</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The material of the layer.</td>
</tr>
<tr>
<td>Process</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The method of application.</td>
</tr>
<tr>
<td>Thickness</td>
<td>TypePropertySingleValue/IfcLengthMeasure/m</td>
<td>The thickness of the layer.</td>
</tr>
</tbody>
</table>

11. Drainage Schema

11.1 Schema Definition

The object in this schema is a network designed to receive, store, maintain, distribute, or control the flow of rainwater or groundwater near the railway subgrade, bridge and tunnel.

The drainage schema is developed by referencing the IfcDistributionSystem, IfcPipeSegmentand IfcDistributionChamberElement in IfcSharedBldgServiceElements schema of IFC4 and adding some necessary property sets.

11.2 Distribution System Definition

IfcDistributionSystem is used to represent a drainage ditch, a pipe or a groove. The predefined type “STORMWATER” of IfcDistributionSystemEnum is used when the flow media is surface water, such as subgrade drainage ditch, side gutter, overhead ditch, chute, intercepting ditch, etc.

The predefined type “DRAINAGE” of IfcDistributionSystemEnum is used when the flow media is ground water, such as tunnel center ditch, circumferential french drain, longitudinal french drain, etc.

A new property set named “Pset_DS_DrainageDitchCommon” for IfcDistributionSystem is added to describe the types of the drainage ditch (see Table 11.1).

**Table 11.1 Property definitions of Pset_DS_DrainageDitchCommon**

<table>
<thead>
<tr>
<th>Name</th>
<th>Data Type/Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>TypePropertyEnumeratedValue/IfcLabel</td>
<td>Type</td>
</tr>
<tr>
<td>DrainageDitch</td>
<td>DrainageDitch</td>
<td>DrainageDitch Near embankment</td>
</tr>
<tr>
<td>SideDitch</td>
<td>DrainageDitch</td>
<td>DrainageDitch Near cutting</td>
</tr>
<tr>
<td>Gutter</td>
<td>DrainageDitch</td>
<td>DrainageDitch on the top of cutting roof</td>
</tr>
<tr>
<td>CatchwaterDitch</td>
<td>Ditch to hold water on the side slope</td>
<td></td>
</tr>
<tr>
<td>SubgradeSurfaceDrainage</td>
<td>Ditch on the surface of subgrade along the track</td>
<td></td>
</tr>
<tr>
<td>SubgradeSurfaceDrainageCrossRailway</td>
<td>Ditch on the surface of subgrade crossing the track</td>
<td></td>
</tr>
<tr>
<td>RoadDrainage</td>
<td>DrainageDitch</td>
<td>DrainageDitch Near road</td>
</tr>
</tbody>
</table>
InterchangebridgeDrainage DrainageDitch Near interchange bridge
PermeableFrenchDrain PermeableFrench drain
SlopeDrain Slope drain
TunnelcenterDritch Ditch in the center of tunnel
CircumferentialFrenchDrain Circumferential French Drain in the tunnel
LongitudinalFrenchDrain Longitudinal French Drain in the tunnel
TransverseDrainpipe Transverse Drainpipe in the tunnel
VerticalDrainpipe Vertical Drainpipe in the tunnel

11.3 Drainage Segment Definition

IfcPipeSegment is used to represent drainage ditch segment, pipe segment or groove segment. The predefined type “GUTTER” of IfcPipeSegmentEnum is used when the flow media is surface water.

A new property set named “Pset_PS_DitchSegmentCommon” for IfcPipeSegment is added to describe the types and properties of drainage ditch segment.

<table>
<thead>
<tr>
<th>Name</th>
<th>Data Type/Data Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>TypePropertyEnumeratedValue/IfcLabel</td>
<td>Type</td>
</tr>
<tr>
<td>DrainageDitch</td>
<td></td>
<td>DrainageDitch Near embankment</td>
</tr>
<tr>
<td>SideDitch</td>
<td></td>
<td>DrainageDitch Near cutting</td>
</tr>
<tr>
<td>Gutter</td>
<td></td>
<td>DrainageDitch on the top of cutting roof</td>
</tr>
<tr>
<td>CatchwaterDitch</td>
<td></td>
<td>Ditch to hold water on the side slope</td>
</tr>
<tr>
<td>SubgradeSurfaceDrainage</td>
<td></td>
<td>Ditch on the surface of subgrade along the track</td>
</tr>
<tr>
<td>SubgradeSurfaceDrainageCrossRailway</td>
<td></td>
<td>Ditch on the surface of subgrade crossing the track</td>
</tr>
<tr>
<td>RoadDrainage</td>
<td></td>
<td>DrainageDitch Near road</td>
</tr>
<tr>
<td>InterchangebridgeDrainage</td>
<td></td>
<td>DrainageDitch Near Interchange bridge</td>
</tr>
<tr>
<td>PermeableFrenchDrain</td>
<td></td>
<td>Permeable French Drain</td>
</tr>
<tr>
<td>SlopeDrain</td>
<td></td>
<td>Slope Drain</td>
</tr>
<tr>
<td>TunnelcenterDitch</td>
<td></td>
<td>Ditch in the center of tunnel</td>
</tr>
<tr>
<td>CircumferentialFrenchDrain</td>
<td></td>
<td>CircumferentialFrench Drain in the tunnel</td>
</tr>
<tr>
<td>LongitudinalFrenchDrain</td>
<td></td>
<td>LongitudinalFrench Drain in the tunnel</td>
</tr>
<tr>
<td>TransverseDrainpipe</td>
<td></td>
<td>Transverse Drainpipe in the tunnel</td>
</tr>
<tr>
<td>ReferenceName</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>ReferenceName of Standard graph volume</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>ReferenceSectionName</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>ReferenceName of section of the Standard graph volume</td>
</tr>
<tr>
<td>Status</td>
<td>TypePropertyEnumeratedValue/IfcLabel</td>
<td>Status of the element, predominately used in renovation or retrofitting projects. The status can be assigned to as &quot;New&quot; - element designed as new addition, &quot;Existing&quot; - element exists and remains, &quot;Demolish&quot; - element existed but is to be demolished, &quot;Temporary&quot; - element will exists only temporary</td>
</tr>
</tbody>
</table>

**11.4 Chamber Facility**

IfcDistributionChamberElement is used to represent the inspection well on a drainage ditch, and the predefined type “MANHOLE” should be selected from the IfcDistributionChamberElementTypeEnum.

IfcDistributionChamberElement is used to represent water collection sump on a drainage ditch, and the predefined type “SUMP” should be selected from the IfcDistributionChamberElementTypeEnum.

**12. Track Schema**

**12.1 Schema Definition**

This schema defines the basic data architecture of information model in track engineering domain. Track engineering includes tracks and its components on both main lines and station lines with ballasted track and ballastless track structures.

The basic data architecture of the track information model consists of IfcSpatialStructureElement, IfcElementAssembly, IfcElement and IfcElementComponent. The relationship between all the classes in the track schema is shown in Figure 12.1.
Spatial structure elements in track engineering domain mainly include IfcTrack and IfcTrackPart.

Physical elements in track engineering domain mainly include IfcTrackRail, IfcTrackFastening, IfcTrackSleeper, IfcTrackSlab, IfcTrackConcreteSlab, IfcTrackIsolationLayer, IfcTrackElasticCushion, IfcTrackAdjustmentLayer, IfcTrackBase, IfcTrackTurnout, IfcTrackBallastLayer and IfcTrackExpansionJoint.

Element assemblies in track engineering domain mainly include IfcTrackPanel and IfcBallastBed.

Element components in track engineering domain mainly include IfcTrackRailJoint, IfcTrackStrengtheningEquipment and IfcTrackAccessoryEquipment.

Element components in railway engineering domain relevant to track engineering mainly include IfcEarthTerminal.

**12.1 Spatial Structure Elements of Track**

Spatial structure elements in track engineering domain refer to the main parts in track spatial structures and their main composition structures, including IfcTrack and IfcTrackPart. The inheritance relationship of spatial structure elements in track engineering domain is shown in Figure 12.2.
IfcTrack refers to a track with certain functions and explicit start and end points, and may also refer to the track engineering containing one or more tracks. IfcTrack can be used to define one or several main line tracks and station line tracks with explicit functions in a station. An IfcTrack may contain one or more IfcTracks and may also contain one or more IfcTrackParts. IfcTrack may be contained in IfcRailway and IfcRailwayStation.

IfcTrackPart refers to a segment of track which is part of the IfcTrack and has unique structural type and functional type. IfcTrackPart shall be contained in IfcTrack.

12.1.2 Physical Elements of Track

Physical elements in track engineering domain refer to important and common physical elements which are part of track structures, mainly including IfcTrackRail, IfcTrackFastening, IfcTrackSleeper, IfcTrackSlab, IfcTrackConcreteSlab, IfcTrackIsolationLayer, IfcTrackElasticCushion, IfcTrackAdjustmentLayer, IfcTrackBase, IfcTrackTurnout, IfcTrackBallastLayer and IfcTrackExpansionJoint. The inheritance relationship of physical elements in track engineering domain is shown in Figure 12.3.
IfcTrackRail refers to a segment of rails. Rail is a main part of track structure, which directly supports and guides wheels and supplies wheels with continuous and smooth rolling surface with minimum resistance. And it leads locomotives and rolling stocks forward, bears heavy load of wheels, transfers it to the sub-structures and could be used as track circuit as well. IfcTrackRail, IfcTrackFastening and IfcTrackSleeper may comprise IfcTrackPanel. IfcTrackRail should be contained in IfcTrackPart, and may be contained in IfcTrack.

IfcTrackFastening refers to a set of track fastening. Fastening is a connecting element which buckle rails on sleepers or other sub-structures. IfcTrackFastening, IfcTrackRail and IfcTrackSleeper may be composed into IfcTrackPanel. IfcTrackFastening should be contained in IfcTrackPart, and may be contained in IfcTrack.

IfcTrackSleeper refers to a piece of track sleeper. Track sleeper is an element to support rails, to maintain gauges and to transfer load to the ballast bed or the track concrete slab. IfcTrackSleeper, IfcTrackFastening and IfcTrackRail may be composed into IfcTrackPanel. IfcTrackSleeper should be contained in IfcTrackPart, and may be contained in IfcTrack.

IfcTrackSlab refers to a piece of track slab. Track slab is a prefabricated reinforced concrete slab or a prestressed reinforced concrete slab, which is a main element of slab track. It transfers the load from rails and fastenings to sub-structures uniformly and from longitudinal and lateral load of track structures to displacement-stopping structures. IfcTrackSlab shall only appear in ballastless
track structures. IfcTrackSlab should be contained in IfcTrackPart, and may be contained in IfcTrack.

IfcTrackConcreteSlab refers to a piece of track concrete slab. Track concrete slab is an integral reinforced concrete layer cast in-situ, in which bi-block sleepers, concrete turnout sleepers or other sleepers are embedded. IfcTrackConcreteSlab shall only appear in ballastless track structures. IfcTrackConcreteSlab should be contained in IfcTrackPart, and may be contained in IfcTrack.

IfcTrackIsolationLayer refers to a piece of track isolation layer. Isolation layer is a structure layer placed on the top surface of track bases. It may implement functions of damage repair of track superstructure under special circumstances and coordinate temperature deformation. IfcTrackIsolationLayer shall only appear in ballastless track structures. IfcTrackIsolationLayer should be contained in IfcTrackPart, and may be contained in IfcTrack.

IfcTrackElasticCushion refers to a piece of track elastic cushion. Elastic cushion is a kind of layer set on trough sides of a concrete base, which is used for mitigating the impact of longitudinal and lateral load on track structures. IfcTrackElasticCushion shall only appear in ballastless track structures. IfcTrackElasticCushion should be contained in IfcTrackPart, and may be contained in IfcTrack.

IfcTrackAdjustmentLayer refers to a piece of adjustment layer. Adjustment layer is a concrete layer or a mortar layer cast or paved in-situ, which is used for supporting track slabs or track concrete slabs. IfcTrackAdjustmentLayer shall only appear in ballastless track structures. IfcTrackAdjustmentLayer should be contained in IfcTrackPart, and may be contained in IfcTrack.

IfcTrackBase refers to a piece of concrete base. Concrete base is a kind of reinforced foundation cast in-situ, which is used for supporting track slabs or track concrete slabs. IfcTrackBase shall only appear in ballastless track structures. IfcTrackBase should be contained in IfcTrackPart, and may be contained in IfcTrack.

IfcTrackTurnout refers to a set of turnout. Turnout is a facility to transform one track into two or more tracks. IfcTrackTurnout should be contained in all the types of IfcTrackPart except the type of WITHNOTURNOUT and may be contained in IfcTrack.

IfcTrackBallastLayer refers to one ballast layer. Ballast layer is a structure layer which comprises different kinds of granular materials with different particle size grading, such as crushed stones, pebbles, sands, slags and so on. It can directly support or fix sleepers, transfer loads and play a role in drainage system, etc. One or more IfcTrackBallastLayer may be composed into an IfcBallastBed. IfcTrackBallastLayer shall only appear in ballasted track structures. IfcTrackBallastLayer should be contained in IfcTrackPart, and may be contained in IfcTrack.

IfcTrackExpansionJoint refers to a set of rail expansion joint. Rail expansion joint is a facility to adjust the expansion of rails. IfcTrackExpansionJoint should be contained in IfcTrackPart, and may be contained in IfcTrack.
12.1.3 Element Assemblies of Track

Element assemblies in track engineering domain refer to the assemblies consisting in physical elements or the combination of physical elements and assemblies. They always have certain functions and may play specific roles in track structures, including IfcBallastBed and IfcTrackPanel. Inheritance relationships of element assemblies in track engineering domain are shown in Figure 12.4.

![Diagram](image)

**Figure 12.4 EXPRESS-G diagram for element assemblies of track**

IfcBallastBed is a part of the track structure, which supports and fixes sleepers and transfers and distributes its load to the top surface of the sub-structures. IfcBallastBed shall only appear in ballasted track structures. One IfcBallastBed may contain one or more IfcTrackBallastLayer. IfcBallastBed should be contained in IfcTrackPart, and may be contained in IfcTrack.

IfcTrackPanel is an element assembly which consists of (two pieces of) rails, sleepers and fastenings which buckle rails on sleepers. IfcTrackPanel may be comprised of IfcTrackRail, IfcTrackFastening and IfcTrackSleeper. IfcTrackPanel should be contained in IfcTrackPart, and may be contained in IfcTrack.

12.1.4 Element Components of Track

Element components in track engineering domain refer to minor items to play auxiliary roles of strengthening and connecting, which are added to or included in physical elements in track engineering domain. They mainly include IfcTrackRailJoint, IfcTrackStrengtheningEquipment and IfcTrackAccessoryEquipment. Inheritance relationships of element components in track engineering domain are shown in Figure 12.5.
IfcTrackRailJoint refers to a set of rail joint. Rail joint is a kind of connecting component, which is used at joints between adjacent rails. IfcTrackRailJoint should be contained in IfcTrackPart, and may be contained in IfcTrack.

IfcTrackStrengtheningEquipment refers to one strengthening equipment for track structures. Strengthening equipment for track structures is a kind of facility installed on track structures, which improves the rail’s ability to resist longitudinal and lateral slippage. By properties of predefined types, strengthening equipment for track structures could be further subdivided into ANTICREEPER, ANTICREEPSTRUT, GAUGETIEROD, RAILBRACE, and so on. IfcTrackStrengtheningEquipment should be contained in IfcTrackPart, and may be contained in IfcTrack.

IfcTrackAccessoryEquipment refers to one accessory equipment for track structures. It is a kind of facility installed on or nearby track structures, which plays a specific role of sealing, protection and absorption, etc. By properties of predefined types, accessory equipment for track structures could be further subdivided into SEALINGSTRIPBETWEEN SLEEPERS, STEELSPRING VIBRATION ISOLATOR, RUBBERDAMPINGPAD, SOUN DABSORBING PANEL, GUARDRAIL, and so on. IfcTrackAccessoryEquipment should be contained in IfcTrackPart, and may be contained in IfcTrack.

12.1.5 Other Element Components

Other element components refer to minor items playing auxiliary roles of strengthening and connecting, which are appended to or included in physical elements in track engineering domain or applied in other engineering. It mainly includes IfcEarthingTerminal. Inheritance relationships of

Figure 12.5 EXPRESS-G diagram for element components of track
other element components are shown in Figure 12.5.

IfcEarthingTerminal refers to a terminal connected to a grounding object. IfcEarthingTerminal should be contained in IfcTrackPart, and may be contained in IfcTrack.

12.2 Type Definition

12.2.1 IfcTrackTypeEnum

IfcTrackTypeEnum is an enumeration of track types, which defines the different functional types of track.

**Enumerated Item Definitions:**

MAINTRACK;
CONNECTINGLINE;
RUNNINGTRACKFORMULTIPLEUNIT;
UNTWININGLINE;
RECEIVINGDEPATURETRACK;
SWITCHINGLEAD;
CATCHSIDING;
FREIGHTTRACK;
CLASSIFICATIONTRACK;
LOCOMOTIVERUNNINGTRACK;
REFUGESIDING;
ROUNDBOUTLINE;
ROLLINGFORBIDDENTRACK;
ROLLINGTRACK;
LOCOMOTIVESERVICETRACK;
LOCOMOTIVEHOLDTRACK;
STORAGETRACK;
REPAIRSIDING;
USERDEFINED;
NOTDEFINED.

**EXPRESS Specification:**

TYPE IfcTrackTypeEnum = ENUMERATION OF
(MAINTRACK
,CONNECTINGLINE
,RUNNINGTRACKFORMULTIPLEUNIT
,UNTWININGLINE
,RECEIVINGDEPATURETRACK
,SWITCHINGLEAD

(continued...)

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12.2.2 IfcTrackRouteDirectionTypeEnum

IfcTrackRouteDirectionTypeEnum is an enumeration of directional types of track route, which defines the different directional types of track route.

**Enumerated Item Definitions:**
- UPDIRECTIONROUTE;
- DOWNDIRECTIONROUTE;
- EITHERDIRECTIONALROUTE.

**EXPRESS Specification:**

```plaintext
TYPE IfcTrackRouteDirectionTypeEnum = ENUMERATION OF
  (UPDIRECTIONROUTE,
   DOWNDIRECTIONROUTE,
   EITHERDIRECTIONALROUTE);
END_TYPE;
```

12.2.3 IfcTrackRouteFunctionTypeEnum

IfcTrackRouteFunctionTypeEnum is an enumeration of functional types of track route, which defines the different functional types of track route.

**Enumerated Item Definitions:**
- PASSENGERLINE;
- FREIGHTLINE;
- PASSENGERFREIGHTLINE;
- ENTERDEPOTLINEFORLOCOMOTIVE;
- EXITDEPOTLINEFORLOCOMOTIVE.
EXPRESS Specification:

```plaintext
TYPE IfcTrackRouteFunctionTypeEnum = ENUMERATION OF
  (PASSENGERLINE
   , FREIGHTLINE
   , PASSENGERFREIGHTLINE
   , ENTERDEPOTLINEFORLOCOMOTIVE
   , EXITDEPOTLINEFORLOCOMOTIVE
  )
END_TYPE;
```

12.2.4 IfcTrackPartStructureTypeEnum

IfcTrackPartStructureTypeEnum is an enumeration of the structural types of track part, which defines the different structural types of track part foundation.

**Enumerated Item Definitions:**

- ONSUBGRADE;
- ONBRIDGE;
- INTUNNEL;
- TRANSITIONSECTION;
- ONSPECIALFOUNDATION;
- USERDEFINED;
- NOTDEFINED.

EXPRESS Specification:

```plaintext
TYPE IfcTrackPartStructureTypeEnum = ENUMERATION OF
  (ONSUBGRADE
   , ONBRIDGE
   , INTUNNEL
   , TRANSITIONSECTION
   , ONSPECIALFOUNDATION
   , USERDEFINED
   , NOTDEFINED
  )
END_TYPE;
```

12.2.5 IfcTrackPartFunctionTypeEnum

IfcTrackPartFunctionTypeEnum is an enumeration of functional types of track part, which defines the different functional types of track part.

**Enumerated Item Definitions:**

- WITHTURNOUT;
- WITHNOTURNOUT.
EXPRESS Specification:

```plaintext
TYPE IfcTrackPartFunctionTypeEnum = ENUMERATION OF 
  (WITHTURNOUT 
    , WITHOUTTURNOUT 
  );
END_TYPE;
```

12.2.6 IfcTrackRailTypeEnum

IfcTrackRailTypeEnum is an enumeration of rail types, which defines the different types of rails.

**Enumerated Item Definitions:**

- HEAVYDUTYTRACK;
- LIGHTDUTYTRACK;
- USERDEFINED;
- NOTDEFINED.

EXPRESS Specification:

```plaintext
TYPE IfcTrackRailTypeEnum = ENUMERATION OF 
  (HEAVYDUTYTRACK 
    , LIGHTDUTYTRACK 
    , USERDEFINED 
    , NOTDEFINED 
  );
END_TYPE;
```

12.2.7 IfcTrackFasteningElasticityTypeEnum

IfcTrackFasteningElasticityTypeEnum is an enumeration of fastening types, which defines the different types of fastening clips.

**Enumerated Item Definitions:**

- ELASTICRAILFASTENING;
- RIGIDRAILFASTENING.

EXPRESS Specification:

```plaintext
TYPE IfcTrackFasteningElasticityTypeEnum = ENUMERATION OF 
  (ELASTICRAILFASTENING 
    , RIGIDRAILFASTENING 
  );
END_TYPE;
```

12.2.8 IfcTrackFasteningStructureTypeEnum

IfcTrackFasteningStructureTypeEnum is an enumeration of structural types of fastening
components, which defines the different structural types of fastening components.

**Enumerated Item Definitions:**

SEPARATEDRAILFASTENING;
SEMISEPARATEDRAILFASTENING;
NONSEPARATEDRAILFASTENING.

**EXPRESS Specification:**

TYPE IfcTrackFasteningStructureTypeEnum= ENUMERATION OF
(SEPARATEDRAILFASTENING
, SEMISEPARATEDRAILFASTENING
, NONSEPARATEDRAILFASTENING
);
END_TYPE;

12.2.9 IfcTrackSleeperTypeEnum

IfcTrackSleeperTypeEnum is an enumeration of sleeper types, which defines the different structural types of sleepers.

**Enumerated Item Definitions:**

CONCRETESLEEPER;
WOODENSLEEPER;
BROADCONCRETESLEEPER;
CONCRETELASTICSLEEPER;
CAPACITIVESLEEPER;
ELECTRICINSULATEDSLEEPER;
BIBLOCKSLEEPER;
SUPPORTINGBLOCK;
USERDEFINED;
NOTDEFINED.

**EXPRESS Specification:**

TYPE IfcTrackSleeperTypeEnum= ENUMERATION OF
( CONCRETESLEEPER
, WOODENSLEEPER
, BROADCONCRETESLEEPER
, CONCRETELASTICSLEEPER
, CAPACITIVESLEEPER
, ELECTRICINSULATEDSLEEPER
, BIBLOCKSLEEPER
, SUPPORTINGBLOCK
, USERDEFINED

IfcTrackSlabTypeEnum is an enumeration of track slab types, which defines the different types of track slabs from the perspective of being pre-stressed or not.

**Enumerated Item Definitions:**
- NONPRESTRESSEDTRACKSLAB;
- UNIDIRECTIONALPRESTRESSEDTRACKSLAB;
- BIDIRECTIONALPRESTRESSEDTRACKSLAB;
- USERDEFINED;
- NOTDEFINED.

**EXPRESS Specification:**

```plaintext
TYPE IfcTrackSlabTypeEnum = ENUMERATION OF
  ( NONPRESTRESSEDTRACKSLAB
  , UNIDIRECTIONALPRESTRESSEDTRACKSLAB
  , BIDIRECTIONALPRESTRESSEDTRACKSLAB
  , USERDEFINED
  , NOTDEFINED
  );
END_TYPE;
```

12.2.11 IfcTrackConcreteSlabTypeEnum

IfcTrackConcreteSlabTypeEnum is an enumeration of track concrete slab types.

**Enumerated Item Definitions:**
- USERDEFINED;
- NOTDEFINED.

**EXPRESS Specification:**

```plaintext
TYPE IfcTrackConcreteSlabTypeEnum = ENUMERATION OF
  ( USERDEFINED
  , NOTDEFINED
  );
END_TYPE;
```

12.2.12 IfcTrackIsolationLayerTypeEnum

IfcTrackIsolationLayerTypeEnum is an enumeration of track isolation layer types.

**Enumerated Item Definitions:**
- USERDEFINED;
- NOTDEFINED.
EXPRESS Specification:
TYPE IfcTrackIsolationLayerTypeEnum= ENUMERATION OF
  ( USERDEFINED
    , NOTDEFINED
  );
END_TYPE;

12.2.13 IfcTrackElasticCushionTypeEnum
IfcTrackElasticCushionTypeEnum is an enumeration of track elastic cushion types.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:
TYPE IfcTrackElasticCushionTypeEnum= ENUMERATION OF
  ( USERDEFINED
    , NOTDEFINED
  );
END_TYPE;

12.2.14 IfcTrackAdjustmentLayerTypeEnum
IfcTrackAdjustmentLayerTypeEnum is an enumeration of track adjustment layer types.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:
TYPE IfcTrackAdjustmentLayerTypeEnum= ENUMERATION OF
  ( USERDEFINED
    , NOTDEFINED
  );
END_TYPE;

12.2.15 IfcTrackBaseTypeEnum
IfcTrackBaseTypeEnum is an enumeration of track base types.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:
TYPE IfcTrackBaseTypeEnum= ENUMERATION OF
12.2.16 IfcTrackTurnoutTypeEnum

IfcTrackTurnoutTypeEnum is an enumeration of turnout types, which defines the different structural types of turnout.

Enumerated Item Definitions:
- LEFTHANDDTURNOUT;
- RIGHTHANDDTURNOUT;
- SYMMETRICALTURNOUT;
- SLIPTOURNOUT;
- SCISSORSCROSSING;
- COMBINATIONOFSLIPTOURNOUTANDSCISSORSCROSSING;
- USERDEFINED;
- NOTDEFINED.

EXPRESS Specification:

```plaintext
TYPE IfcTrackTurnoutTypeEnum = ENUMERATION OF
  ( LEFTHANDDTURNOUT
  , RIGHTHANDDTURNOUT
  , SYMMETRICALTURNOUT
  , SLIPTOURNOUT
  , SCISSORSCROSSING
  , COMBINATIONOFSLIPTOURNOUTANDSCISSORSCROSSING
  , USERDEFINED
  , NOTDEFINED
  );
END_TYPE;
```

12.2.17 IfcTrackBallastLayerTypeEnum

IfcTrackBallastLayerTypeEnum is an enumeration of functional types of the ballast layer, which defines the different functional types of the ballast layer.

Enumerated Item Definitions:
- TOPBALLAST;
- SUBBALLAST;
- SPACEFILLEDBALLAST;
- USERDEFINED;
- NOTDEFINED.
**EXPRESS Specification:**

```
TYPE IfcTrackBallastLayerTypeEnum= ENUMERATION OF
   (TOPBALLAST, SUBBALLAST, SPACEFILLEDBALLAST, USERDEFINED, NOTDEFINED);
END_TYPE;
```

12.2.18 IfcTrackExpansionJointTypeEnum

IfcTrackExpansionJointTypeEnum is an enumeration of expansion joint types, which defines the different structural types of the expansion joint.

**Enumerated Item Definitions:**

- SINGLE DIRECTION
- BIDIRECTION

**EXPRESS Specification:**

```
TYPE IfcTrackExpansionJointTypeEnum= ENUMERATION OF
   (SINGLE DIRECTION, BIDIRECTION);
END_TYPE;
```

12.2.19 IfcBallastBedTypeEnum

IfcBallastBedTypeEnum is an enumeration of ballast bed types.

**Enumerated Item Definitions:**

- USERDEFINED
- NOTDEFINED

**EXPRESS Specification:**

```
TYPE IfcBallastBedTypeEnum= ENUMERATION OF
   (USERDEFINED, NOTDEFINED);
END_TYPE;
```

12.2.20 IfcTrackPanelTypeEnum

IfcTrackPanelTypeEnum is an enumeration of track panel types.

**Enumerated Item Definitions:**

- USERDEFINED
NOTDEFINED.

**EXPRESSION Specification:**

```plaintext
TYPE IfcTrackPanelTypeEnum = ENUMERATION OF
   ( USERDEFINED
     , NOTDEFINED
   );
END_TYPE;
```

**12.2.21 IfcTrackRailJointTypeEnum**

IfcTrackRailJointTypeEnum is an enumeration of rail joint types, which defines the different functional types of the rail joint.

**Enumerated Item Definitions:**

- RAILJOINTFASTENING;
- COMPROMISINGJOINT;
- INSULATEDJOINT;
- WELDEDJOINT;
- CONDUCTIVEJOINT;
- UNCHANGEABLEJOINT;
- USERDEFINED;
- NOTDEFINED.

**EXPRESSION Specification:**

```plaintext
TYPE IfcTrackRailJointTypeEnum = ENUMERATION OF
   ( RAILJOINTFASTENING
     , COMPROMISINGJOINT
     , INSULATEDJOINT
     , WELDEDJOINT
     , CONDUCTIVEJOINT
     , UNCHANGEABLEJOINT
     , USERDEFINED
     , NOTDEFINED
   );
END_TYPE;
```

**12.2.22 IfcTrackStrengtheningEquipmentTypeEnum**

IfcTrackStrengtheningEquipmentTypeEnum is an enumeration of track strengthening equipment types, which defines the different structural types of the track strengthening equipment.

**Enumerated Item Definitions:**

- ANTICREEPER;
- ANTICREEPSTRUT;
EXPRESS Specification:

TYPE IfcTrackStrengtheningEquipmentTypeEnum = ENUMERATION OF
  (ANTICREEPER,
   ANTICREEPSTRUT,
   GAUGETIEROD,
   RAILBRACE,
   USERDEFINED,
   NOTDEFINED);
END_TYPE;

12.2.23 IfcTrackAccessoryEquipmentTypeEnum

IfcTrackAccessoryEquipmentTypeEnum is an enumeration of track accessory equipment types, which defines the different functional types of the track accessory equipment.

Enumerated Item Definitions:

  SEALINGSTRIPBETWEENSLINEPERS;
  STEELSPRINGVIBRATIONISOLATOR;
  RUBBERDAMPINGPAD;
  SOUNDABSORBINGPANEL;
  GUARDRAIL;
  USERDEFINED;
  NOTDEFINED;

EXPRESS Specification:

TYPE IfcTrackAccessoryEquipmentTypeEnum = ENUMERATION OF
  (SEALINGSTRIPBETWEENSLINEPERS,
   STEELSPRINGVIBRATIONISOLATOR,
   RUBBERDAMPINGPAD,
   SOUNDABSORBINGPANEL,
   GUARDRAIL,
   USERDEFINED,
   NOTDEFINED);
END_TYPE;

12.2.24 IfcEarthingTerminalTypeEnum
IfcEarthingTerminalTypeEnum is an enumeration of earthing terminal types.

**Enumerated Item Definitions:**

USERDEFINED;

NOTDEFINED.

**EXPRESS Specification:**

```plaintext
TYPE IfcEarthingTerminalTypeEnum = ENUMERATION OF
  ( USERDEFINED
    , NOTDEFINED
  );
END_TYPE;
```

### 12.3 Entity Definition

#### 12.3.1 IfcTrack

IfcTrack refers to a track with certain functions and explicit start and end points, and may also refer to the track engineering containing one or more tracks. IfcTrack can be used to define one or several main line tracks and station line tracks with explicit functions in a station. An IfcTrack may contain one or more IfcTracks and may also contain one or more IfcTrackParts. IfcTrack may be contained in IfcRailway and IfcRailwayStation.

<table>
<thead>
<tr>
<th>Table 12.1 IfcTrack spatial composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial Composite</td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>IfcRailway</td>
</tr>
<tr>
<td>IfcRailwayStation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 12.2 IfcTrack spatial decomposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spatial Parts</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>IfcTrackPart</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 12.3 IfcTrack spatial containment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contained Entities</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>IfcTrackElement</td>
</tr>
<tr>
<td>IfcBallastBed</td>
</tr>
<tr>
<td>IfcTrackPanel</td>
</tr>
<tr>
<td>IfcTrackElementComponent</td>
</tr>
<tr>
<td>IfcEarthingTerminal</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 12.4 Property sets for IfcTrack</th>
</tr>
</thead>
<tbody>
<tr>
<td>PredefinedType</td>
</tr>
<tr>
<td>----------------</td>
</tr>
</tbody>
</table>
ENTITY IfcTrack
SUBTYPE OF (IfcRailwayStructureElement);
  PreDefinedType: IfcTrackTypeEnum;
  RouteDirectionType: IfcTrackRouteDirectionTypeEnum;
  RouteFunctionType: IfcTrackRouteFunctionTypeEnum;
END_ENTITY;

Attribute definitions:

PreDefinedType: It defines the functional types of a track, such as MAINTRACK, CONNECTINGLINE, RUNNINGTRACKFORMULTIPLEUNIT, UNTWININGLINE, RECEIVINGDEPATURETRACK, SWITCHINGLEAD, CATCHSIDING, FREIGHTTRACK, CLASSIFICATIONTRACK, LOCOMOTIVERUNNINGTRACK, REFUGESIDING, ROUNDABOUTLINE, ROLLINGFORBIDDENTRACK, ROLLINGTRACK, LOCOMOTIVESERVICETRACK, LOCOMOTIVEHOLDTRACK, STORAGETERACK, REPAIRSIDING, etc.

RouteDirectionType: It defines the permissible directions of a train on a track route, such as UPDIRECTIONROUTE, DOWNDIRECTIONROUTE, and EITHERDIRECTIONALROUTE.

RouteFunctionType: It defines the permissible train types on a track route, such as PASSENGERLINE, FREIGHTLINE, PASSENGERFREIGHTLINE, ENTERDEPOTLINEFORLOCOMOTIVE, EXITDEPOTLINEFORLOCOMOTIVE, etc.

12.3.2 IfcTrackPart

IfcTrackPart refers to a segment of track engineering which is part of the IfcTrack and has a unique structural type and functional type.

<table>
<thead>
<tr>
<th>Spatial Composite</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTrack</td>
<td>IfcTrackPart is a part of IfcTrack.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contained Entities</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTrackElement</td>
<td>All of the physical elements in track engineering domain may be contained in IfcTrackPart.</td>
</tr>
<tr>
<td>IfcBallastBed</td>
<td>IfcBallastBed may be contained in IfcTrackPart.</td>
</tr>
<tr>
<td>IfcTrackPanel</td>
<td>IfcTrackPanel may be contained in IfcTrackPart.</td>
</tr>
<tr>
<td>IfcTrackElementComponent</td>
<td>All of the element components in track engineering domain may be contained in IfcTrackPart.</td>
</tr>
<tr>
<td>IfcEarthingTerminal</td>
<td>IfcEarthingTerminal may be contained in IfcTrackPart.</td>
</tr>
</tbody>
</table>
Table 12.7 Property sets for IfcTrackPart

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_TrackPartCommon</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcTrackPart

SUBTYPE OF (IfcRailwayStructureElement);

PreDefinedType: IfcTrackPartStructureTypeEnum;

FunctionType: IfcTrackPartFunctionTypeEnum;

END_ENTITY;

**Attribute definitions:**

PreDefinedType: It defines the different structural types of track part foundation, such as ONSUBGRADE, ONBRIDGE, INTUNNEL, TRANSITIONSECTION, ONSPECIALFOUNDATION, etc.

FunctionType: It defines whether a track part contains a turnout structure or not, such as WITHTURNOUT and WITHNOTURNOUT.

12.3.3 IfcTrackElement

IfcTrackElement refers to specific elements in track engineering domain. And it is the superclass of all the physical elements in track engineering domain.

**EXPRESS Specification:**

ENTITY IfcTrackElement

SUPERTYPE OF (ONEOF

(IfcTrackRail,IfcTrackFastening,IfcTrackSleeper,IfcTrackSlab,IfcTrackConcreteSlab,IfcTrackIsolationLayer,IfcTrackElasticCushion,IfcTrackAdjustmentLayer,IfcTrackBase,IfcTrackTurnout,IfcTrackBallastLayer,IfcTrackExpansionJoint))

SUBTYPE OF (IfcRailwayElement);

END_ENTITY;

12.3.4 IfcTrackRail

IfcTrackRail is a main part of track structure, which directly supports and guides wheels and supplies wheels with continuous and smooth rolling surface with minimum resistance. And it leads locomotives and rolling stocks forward, bears heavy load of wheels, transfers the load to the substructures and could be used as track circuit as well. IfcTrackRail, IfcTrackFastening and IfcTrackSleeper may be composed into IfcTrackPanel.

Table 12.8 Property sets for IfcTrackRail

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_RailCommon</td>
</tr>
</tbody>
</table>

Table 12.9 IfcTrackRail contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
</table>
IfcTrackPart | IfcTrackRail should be contained in IfcTrackPart.
--- | ---
IfcTrack | IfcTrackRail may be contained in IfcTrack.

**EXPRESS Specification:**

ENTITY IfcTrackRail  
  SUBTYPE OF (IfcTrackElement);  
  PreDefinedType: IfcTrackRailTypeEnum;  
END_ENTITY;

**Attribute definitions:**

PreDefinedType: It defines the different types of rails, such as HEAVYDUTYTRACK and LIGHTDUTYTRACK, etc.

**12.3.5 IfcTrackFastening**

IfcTrackFastening is a connecting element to buckle rails on sleepers or other sub-structures. IfcTrackFastening, IfcTrackRail and IfcTrackSleeper may be composed into IfcTrackPanel.

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pset_TrackFasteningCommon</td>
<td></td>
</tr>
</tbody>
</table>

**Table 12.10 Property sets for IfcTrackFastening**

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTrackPart</td>
<td>IfcTrackFastening should be contained in IfcTrackPart.</td>
</tr>
<tr>
<td>IfcTrack</td>
<td>IfcTrackFastening may be contained in IfcTrack.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcTrackFastening  
  SUBTYPE OF (IfcTrackElement);  
  PreDefinedType: IfcTrackFasteningElasticityTypeEnum;  
  StructureType: IfcTrackFasteningStructureTypeEnum;  
END_ENTITY;

**Attribute definitions:**

PreDefinedType: It defines the different types of fastening clips, such as ELASTICRAILFASTENING and RIGIDRAILFASTENING.

StructureType: It defines structural types of fastening components, such as SEPARATEDRAILFASTENING, SEMISEPARATEDRAILFASTENING and NONSEPARATEDRAILFASTENING.

**12.3.6 IfcTrackSleeper**

IfcTrackSleeper is an element to support rails, maintain gauges and transfer the load to the ballast bed or track concrete slab. IfcTrackSleeper, IfcTrackFastening and IfcTrackRail may be composed into IfcTrackPanel.

**Table 12.12 Property sets for IfcTrackSleeper**
### Table 12.13 IfcTrackSleeper contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTrackPart</td>
<td>IfcTrackSleeper should be contained in IfcTrackPart.</td>
</tr>
<tr>
<td>IfcTrack</td>
<td>IfcTrackSleeper may be contained in IfcTrack.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

```express
ENTITY IfcTrackSleeper
  SUBTYPE OF (IfcTrackElement);
    PreDefinedType: IfcTrackSleeperTypeEnum;
  END_ENTITY;
```

**Attribute definitions:**

PreDefinedType: It defines the different structural types of track sleepers. Such as CONCRETESLEEPER, WOODENSLEEPER, BROADCONCRETESLEEPER, CONCRETELASTICSLEEPER, CAPACITIVESLEEPER, ELECTRICINSULATEDSLEEPER, BIBLOCKSLEEPER, SUPPORTINGBLOCK, etc.

### 12.3.7 IfcTrackSlab

IfcTrackSlab refers to a prefabricated reinforced concrete slab or a pre-stressed reinforced concrete slab, which is a main element of slab track. It transfers the load from rails and fastenings to sub-structures uniformly, and transfers the longitudinal and lateral load of track structures to displacement-stopping structures. IfcTrackSlab shall only appear in ballastless track structures.

### Table 12.14 Property sets for IfcTrackSlab

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_TrackSlabCommon</td>
</tr>
<tr>
<td></td>
<td>Pset_ConcreteElementGeneral</td>
</tr>
<tr>
<td></td>
<td>Pset_PrecastConcreteElementFabrication</td>
</tr>
<tr>
<td></td>
<td>Pset_PrecastConcreteElementGeneral</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

```express
ENTITY IfcTrackSlab
  SUBTYPE OF (IfcTrackElement);
    PreDefinedType: IfcTrackSlabTypeEnum;
  END_ENTITY;
```

### Table 12.15 IfcTrackSlab contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTrackPart</td>
<td>IfcTrackSlab should be contained in IfcTrackPart.</td>
</tr>
<tr>
<td>IfcTrack</td>
<td>IfcTrackSlab may be contained in IfcTrack.</td>
</tr>
</tbody>
</table>
SUBTYPE OF (IfcTrackElement);
  PreDefinedType: IfcTrackSlabTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType: It defines whether the track slab is pre-stressed or not and the different pre-stressed types of track slab. Such as NONPRESTRESSEDTRACKSLAB, UNIDIRECTIONALPRESTRESSEDTRACKSLAB and BIDIRECTIONALPRESTRESSEDTRACKSLAB.

12.3.8 IfcTrackConcreteSlab

IfcTrackConcreteSlab refers to an integral reinforced concrete layer cast in-situ, in which bi-block sleepers, concrete turnout sleepers or other sleepers are embedded. IfcTrackConcreteSlab shall only appear in ballastless track structures.

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_ConcreteElementGeneral</td>
</tr>
</tbody>
</table>

Table 12.16 Property sets for IfcTrackConcreteSlab

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTrackConcreteSlab</td>
<td>IfcTrackConcreteSlab should be contained in IfcTrackPart.</td>
</tr>
<tr>
<td>IfcTrack</td>
<td>IfcTrackConcreteSlab may be contained in IfcTrack.</td>
</tr>
</tbody>
</table>

EXPRESS Specification:

ENTITY IfcTrackConcreteSlab
  SUBTYPE OF (IfcTrackElement);
  PreDefinedType: IfcTrackConcreteSlabTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType.

12.3.9 IfcTrackIsolationLayer

IfcTrackIsolationLayer is a structure layer placed on the top surface of track bases. It may implement the damage repair of track superstructure under special circumstances and coordinate temperature deformation. IfcTrackIsolationLayer shall only appear in ballastless track structures.

Table 12.18 Property sets for IfcTrackIsolationLayer

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_TrackIsolationLayerCommon</td>
</tr>
</tbody>
</table>

Table 12.19 IfcTrackIsolationLayer contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTrackIsolationLayer</td>
<td>IfcTrackIsolationLayer should be contained in IfcTrackPart.</td>
</tr>
</tbody>
</table>
IfcTrackIsolationLayer may be contained in IfcTrack.

**EXPRESS Specification:**

ENTITY IfcTrackIsolationLayer
    SUBTYPE OF (IfcTrackElement);
    PreDefinedType: IfcTrackIsolationLayerTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType.

### 12.3.10 IfcTrackElasticCushion

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

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTrackElasticCushion</td>
<td>IfcTrackElasticCushion should be contained in IfcTrackPart.</td>
</tr>
<tr>
<td>IfcTrack</td>
<td>IfcTrackElasticCushion may be contained in IfcTrack.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcTrackElasticCushion
    SUBTYPE OF (IfcTrackElement);
    PreDefinedType: IfcTrackElasticCushionTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType.

### 12.3.11 IfcTrackAdjustmentLayer

IfcTrackAdjustmentLayer is a concrete layer or a mortar layer cast or paved in-situ to support track slabs or track concrete slabs. IfcTrackAdjustmentLayer shall only appear in ballastless track structures.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTrackAdjustmentLayer</td>
<td>IfcTrackAdjustmentLayer should be contained in IfcTrackPart.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcTrackAdjustmentLayer
    SUBTYPE OF (IfcTrackElement);
    PreDefinedType: IfcTrackAdjustmentLayerTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType.
IfcTrackAdjustmentLayer may be contained in IfcTrack.

**EXPRESS Specification:**

ENTITY IfcTrackAdjustmentLayer
  SUBTYPE OF (IfcTrackElement);
  PreDefinedType: IfcTrackAdjustmentlayerTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType.

12.3.12 IfcTrackBase

IfcTrackBase is a kind of reinforced foundation cast in-situ to support track slabs or track concrete slabs. IfcTrackBase shall only appear in ballastless track structures.

**Table 12.24 Property sets for IfcTrackBase**

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_TrackBaseCommon</td>
</tr>
<tr>
<td></td>
<td>Pset_ConcreteElementGeneral</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcTrackBase
  SUBTYPE OF (IfcTrackElement);
  PreDefinedType: IfcTrackBaseTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType.

12.3.13 IfcTrackTurnout

IfcTrackTurnout is a facility which transforms one track into two or more tracks.

**Table 12.25 IfcTrackBase contained in spatial structure**

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTrackPart</td>
<td>IfcTrackBase should be contained in IfcTrackPart.</td>
</tr>
<tr>
<td>IfcTrack</td>
<td>IfcTrackBase may be contained in IfcTrack.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcTrackTurnout
  SUBTYPE OF (IfcTrackElement);
  PreDefinedType: IfcTrackTurnoutTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType.

**Table 12.26 Property sets for IfcTrackTurnout**

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_TurnoutCommon</td>
</tr>
</tbody>
</table>

**Table 12.27 IfcTrackTurnout contained in spatial structure**

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTrackPart</td>
<td>IfcTrackTurnout should be contained in all the types of IfcTrackPart except the type of WITHNOTURNOUT.</td>
</tr>
<tr>
<td>IfcTrack</td>
<td>IfcTrackTurnout may be contained in IfcTrack.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**
ENTITY IfcTrackTurnout
  SUBTYPE OF (IfcTrackElement);
    PreDefinedType: IfcTrackTurnoutTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType: It defines the different structural types of track turnouts. Such as
LEFTHANDTURNOUT, RIGHTHEANDTURNOUT, SYMMETRICALTURNOUT,
SLIPTOURNOUT, SCISSORSROSSING and
COMBINATIONOFSLIPTOURNOUTANDSCISSORSROSSING, etc.

12.3.14 IfcTrackBallastLayer

IfcTrackBallastLayer is a structure layer which comprises different kinds of granular materials
with different particle size grading, such as crushed stones, pebbles, sands, slags and so on. It can
directly support or fix sleepers, transfer loads and play a role in drainage system, etc. One or more
IfcTrackBallastLayer may be composed into an IfcBallastBed. IfcTrackBallastLayer shall only
appear in ballasted track structures.

Table 12.28 Property sets for IfcTrackBallastLayer

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pset_TrackBallastLayerCommon</td>
<td></td>
</tr>
</tbody>
</table>

Table 12.29 IfcTrackBallastLayer contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTrackPart</td>
<td>IfcTrackBallastLayer should be contained in IfcTrackPart.</td>
</tr>
<tr>
<td>IfcTrack</td>
<td>IfcTrackBallastLayer may be contained in IfcTrack.</td>
</tr>
</tbody>
</table>

EXPress Specification:

ENTITY IfcTrackBallastLayer
  SUBTYPE OF (IfcTrackElement);
    PreDefinedType: IfcTrackBallastLayerTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType: It defines the different functional types of ballast layers. Such as
TOPBALLAST, SUBBALLAST, SPACEFILLEDBALLAST, etc.

12.3.15 IfcTrackExpansionJoint

IfcTrackExpansionJoint is a facility to adjust the expansion of rails.

Table 12.30 Property sets for IfcTrackExpansionJoint

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pset_TrackExpansionJointCommon</td>
<td></td>
</tr>
</tbody>
</table>

Table 12.31 IfcTrackExpansionJoint contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
</table>

177
IfcTrackPart | IfcTrackExpansionJoint should be contained in IfcTrackPart.
IfcTrack    | IfcTrackExpansionJoint may be contained in IfcTrack.

**EXPRESS Specification:**

ENTITY IfcTrackExpansionJoint
  SUBTYPE OF (IfcTrackElement);
  PreDefinedType: IfcTrackExpansionJointTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType: It defines the different structural types of expansion joints. Such as SINGLEDIRECTION and BIDIRECTION.

**12.3.16 IfcRailwayAssembly**

IfcRailwayAssembly refers to specific element assemblies in track engineering domain. And it is the superclass of all the element assemblies in track engineering domain.

**EXPRESS Specification:**

ENTITY IfcRailwayAssembly
  SUPERTYPE OF (ONEOF
    (IfcBallastBed, IfcTrackPanel))
  SUBTYPE OF (IfcCivilElementAssembly);
END_ENTITY;

**12.3.17 IfcBallastBed**

IfcBallastBed is a part of track structure to support and fix sleepers, which transfers and distributes its load to the top surface of sub-structures. IfcBallastBed shall only appear in ballasted track structures. One IfcBallastBed may contain one or more IfcTrackBallastLayer.

**Table 12.32 IfcBallastBed contained in spatial structure**

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTrackPart</td>
<td>IfcBallastBed should be contained in IfcTrackPart.</td>
</tr>
<tr>
<td>IfcTrack</td>
<td>IfcBallastBed may be contained in IfcTrack.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcBallastBed
  SUBTYPE OF (IfcRailwayAssembly);
  PreDefinedType: IfcBallastBedTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType.

**12.3.18 IfcTrackPanel**
IfcTrackPanel is an element assembly consisting of (two pieces of) rails, sleepers and fastenings which buckle rails on sleepers. IfcTrackPanel may be comprised of IfcTrackRail, IfcTrackFastening and IfcTrackSleeper.

### Table 12.34 Property sets for IfcTrackPanel

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_TrackPanelCommon</td>
</tr>
</tbody>
</table>

### Table 12.35 IfcTrackPanel contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTrackPart</td>
<td>IfcTrackPanel should be contained in IfcTrackPart.</td>
</tr>
<tr>
<td>IfcTrack</td>
<td>IfcTrackPanel may be contained in IfcTrack.</td>
</tr>
</tbody>
</table>

### Table 12.36 IfcTrackPanel entity composition

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Contained Entities</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IfcTrackRail</td>
<td>IfcTrackPanel may contain IfcTrackRail.</td>
</tr>
<tr>
<td></td>
<td>IfcTrackFastening</td>
<td>IfcTrackPanel may contain IfcTrackFastening.</td>
</tr>
<tr>
<td></td>
<td>IfcTrackSleeper</td>
<td>IfcTrackPanel may contain IfcTrackSleeper.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcTrackPanel

SUBTYPE OF (IfcRailwayAssembly);

PreDefinedType: IfcTrackPanelTypeEnum;

END_ENTITY;

**Attribute definitions:**

PreDefinedType.

#### 12.3.19 IfcTrackElementComponent

IfcTrackElementComponent refers to specific element components in track engineering domain. And it is the superclass of all the element components in track engineering domain.

**EXPRESS Specification:**

ENTITY IfcTrackElementComponent

SUPERTYPE OF (ONEOF

(IfcTrackRailJoint, IfcTrackStrengtheningEquipment, IfcTrackAccessoryEquipment))

SUBTYPE OF (IfcRailwayElementComponent);

END_ENTITY;

#### 12.3.20 IfcTrackRailJoint

IfcTrackRailJoint is a kind of connecting component, which is used at joints between adjacent rails.

**Table 12.37 Property sets for IfcTrackRailJoint**

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAILJOINTFASTENING</td>
<td>Pset_RailJointFasteningCommon</td>
</tr>
<tr>
<td>Spatial Structure</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>IfcTrackPart</td>
<td>IfcTrackRailJoint should be contained in IfcTrackPart.</td>
</tr>
<tr>
<td>IfcTrack</td>
<td>IfcTrackRailJoint may be contained in IfcTrack.</td>
</tr>
</tbody>
</table>

### COMPROMISINGJOINT
- Pset_RailCompromisingJointCommon

### INSULATEDJOINT
- Pset_RailInsulatedJointCommon

### WELDEDJOINT
- Pset_RailWeldedJointCommon

### CONDUCTIVEJOINT
- Pset_RailConductiveJointCommon

### UNCHANGEABLEJOINT
- Pset_RailUnchangeableJointCommon

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTrackPart</td>
<td>IfcTrackRailJoint should be contained in IfcTrackPart.</td>
</tr>
<tr>
<td>IfcTrack</td>
<td>IfcTrackRailJoint may be contained in IfcTrack.</td>
</tr>
</tbody>
</table>

### EXPRESS Specification:

ENTITY IfcTrackRailJoint  
  SUBTYPE OF (IfcTrackElementComponent);  
  PreDefinedType: IfcTrackRailJointTypeEnum;  
END_ENTITY;

### Attribute definitions:

PreDefinedType: It defines the different functional types of rail joints. Such as RAILJOINTFASTENING, COMPROMISINGJOINT, INSULATEDJOINT, WELDEDJOINT, CONDUCTIVEJOINT, UNCHANGEABLEJOINT, etc.

### 12.3.21 IfcTrackStrengtheningEquipment

IfcTrackStrengtheningEquipment is a kind of facility installed on track structures to improve the rail's ability to resist longitudinal and lateral slippage.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTrackPart</td>
<td>IfcTrackStrengtheningEquipment should be contained in IfcTrackPart.</td>
</tr>
<tr>
<td>IfcTrack</td>
<td>IfcTrackStrengtheningEquipment may be contained in IfcTrack.</td>
</tr>
</tbody>
</table>

### EXPRESS Specification:

ENTITY IfcTrackStrengtheningEquipment  
  SUBTYPE OF (IfcTrackElementComponent);  
  PreDefinedType: IfcTrackStrengtheningEquipmentTypeEnum;  
END_ENTITY;

### Attribute definitions:

PreDefinedType: It defines the different structural types of track strengthening equipment. Such as ANTICREEPER, ANTICREEPSTRUT, GAUGETIEROD, RAILBRACE, etc.

### 12.3.22 IfcTrackAccessoryEquipment
IfcTrackAccessoryEquipment is a kind of facility installed on or nearby track structures, which plays a specific role of sealing, protection, absorption, etc.

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_TrackAccessoryEquipmentCommon</td>
</tr>
</tbody>
</table>

### Table 12.41 Property sets for IfcTrackAccessoryEquipment

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTrackPart</td>
<td>IfcTrackAccessoryEquipment should be contained in IfcTrackPart.</td>
</tr>
<tr>
<td>IfcTrack</td>
<td>IfcTrackAccessoryEquipment may be contained in IfcTrack.</td>
</tr>
</tbody>
</table>

**EXPRESSION Specification:**

ENTITY IfcTrackAccessoryEquipment

  SUBTYPE OF (IfcTrackElementComponent);

  PreDefinedType: IfcTrackAccessoryEquipmentTypeEnum;

END_ENTITY;

**Attribute definitions:**

PreDefinedType: It defines the different functional types of track accessory equipment. Such as SEALINGSTRIPBETWEENSLPETERS, STEELSPRINGVIBRATIONISOLATOR, RUBBERDAMPINGPAD, SOUNDABSORBINGPANEL, GUARDRAIL, etc.

12.3.23 IfcEarthingTerminal

IfcEarthingTerminal refers to a terminal connected to a grounding object.

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_EarthingTerminalCommon</td>
</tr>
</tbody>
</table>

### Table 12.43 Property sets for IfcEarthingTerminal

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcTrackPart</td>
<td>IfcEarthingTerminal should be contained in IfcTrackPart.</td>
</tr>
<tr>
<td>IfcTrack</td>
<td>IfcEarthingTerminal may be contained in IfcTrack.</td>
</tr>
</tbody>
</table>

**EXPRESSION Specification:**

ENTITY IfcEarthingTerminal

  SUBTYPE OF (IfcRailwayElementComponent);

  PreDefinedType: IfcEarthingTerminalTypeEnum;

END_ENTITY;

**Attribute definitions:**

PreDefinedType:

12.4 Property Set Definition

12.4.1 Pset_TrackCommon

Name: Pset_TrackCommon
Applicable Entities: IfcTrack

Description: Properties common to the definition of all occurrences of IfcTrack.

Property Definitions: See Table 12.45.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The ID of a track.</td>
</tr>
<tr>
<td>EffectiveLength</td>
<td>TypePropertySingleValue/IfcNonNegativeLengthMeasure/m</td>
<td>The effective length of a track.</td>
</tr>
<tr>
<td>IsOutOfGauge</td>
<td>TypePropertySingleValue/IfcBoolean</td>
<td>Out of Gauge or not. It shows whether an out-of-gauge freight train is permissible on a track or not.</td>
</tr>
<tr>
<td>IsElectrified</td>
<td>TypePropertySingleValue/IfcBoolean</td>
<td>Electrified or not. It shows whether a track is an electrified route or not.</td>
</tr>
<tr>
<td>IsCWR</td>
<td>TypePropertySingleValue/IfcBoolean</td>
<td>CWR or not. It shows whether a track is a CWR or not.</td>
</tr>
<tr>
<td>CWRType</td>
<td>TypePropertyEnumeratedValue/PEnum_ElementCWRType:WITHTEMPERATURESTRESSCWR,AUTO DISPERSINGTEMPERATURESTRESSCWR,REGULARDISPERSINGTEMPERATURESTRESSCWR</td>
<td>It shows the type of CWR of a track (It is valid only when IsCWR is TRUE). The enumeration is WITHTEMPERATURESTRESSCWR, AUTODISPERSINGTEMPERATURESTRESSCWR and REGULARDISPERSINGTEMPERATURESTRESSCWR.</td>
</tr>
<tr>
<td>LengthOfCWR</td>
<td>TypePropertyEnumeratedValue/PEnum_ElementLengthOfCWR:ORDINARYCWR,CWRWITHINSECTION,CWRWITHWELDEDTURNOUT</td>
<td>The type of long rails of CWR. It shows the long rails type of CWR of a track (It is valid only when IsCWR is TRUE). The enumeration is ORDINARYCWR, CWRWITHINSECTION and CWRWITHWELDEDTURNOUT.</td>
</tr>
</tbody>
</table>

12.4.2 Pset_TrackPartCommon

Name: Pset_TrackPartCommon

Applicable Entities: IfcTrackPart

Description: Properties common to the definition of all occurrences of IfcTrackPart.

Property Definitions: See Table 12.46.
<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>StructureType</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The structural type of a track structure. It shows the structural type of track structure in a track part.</td>
</tr>
<tr>
<td>Height</td>
<td>TypePropertySingleValue/IfcNonNegativeLengthMeasure/m</td>
<td>The height of a track structure. For ballasted track, it shows the elevation difference between the top surface of inner rail and the shoulder of its sub-foundations. For ballastless track, it shows the elevation difference between the top surface of inner rail and the top surface of its sub-foundations.</td>
</tr>
<tr>
<td>Stress-free Rail Temperature</td>
<td>TypePropertySingleValue/IfcThermodynamicTemperatureMeasure/°C</td>
<td>The temperature of the rail when it is Stress-free.</td>
</tr>
</tbody>
</table>

12.4.3 Pset_RailCommon

Name: Pset_RailCommon

Applicable Entities: IfcTrackRail

Description: Properties common to the definition of all occurrences of IfcTrackRail.

Property Definitions: See Table 12.47.

Table 12.47 Property definitions of IfcTrackRail

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>TypePropertyEnumeratedValue/PEnum_ElementType:75N,75kg/m,60N,60kg/m,50kg/m,43kg/m,75-60kg/m,60-50kg/m,50-43kg/m</td>
<td>The type of a rail. The enumeration is 75N, 75kg/m, 60N, 60kg/m, 50kg/m, 43kg/m, 75-60kg/m, 60-50kg/m and 50-43kg/m.</td>
</tr>
<tr>
<td>SpecifiedLength</td>
<td>TypePropertyEnumeratedValue/PEnum_ElementSpecifiedLength:100m,75m,25m,12.5m,12.46m,12.42m,12.38m,24.96m,24.92m,24.84m</td>
<td>The specified length of a rail calibrated in the factory. The enumeration is 100m, 75m, 25m, 12.5m, 12.46m, 12.42m, 12.38m, 24.96m, 24.92m and 24.84m.</td>
</tr>
<tr>
<td>ChemicalComposition</td>
<td>TypePropertyEnumeratedValue/PEnum_ElementChemicalComposition</td>
<td>The chemical composition of a rail. The enumeration is</td>
</tr>
<tr>
<td>Property</td>
<td>Description</td>
<td>Example Values</td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
<td>---------------</td>
</tr>
<tr>
<td>DeliveryState</td>
<td>The delivery state of a rail. The enumeration is HOTROLLING and HEATTREATMENT.</td>
<td>HOTROLLING, HEATTREATMENT</td>
</tr>
<tr>
<td>MinimumTensileStrength</td>
<td>The minimum tensile strength of a rail.</td>
<td></td>
</tr>
<tr>
<td>SteelGrade</td>
<td>The grade of the steel made into a rail. The enumeration is U74, U71Mn, U75V, U77MnCr, U76NbRe, U78CrV.</td>
<td>U74, U75V, U77MnCr, U76NbRe, U78CrV</td>
</tr>
<tr>
<td>IsReusable</td>
<td>Whether a rail is a reusable rail or not.</td>
<td></td>
</tr>
<tr>
<td>ProcessingStatusOfTheEnd</td>
<td>The processing status of the ends of a rail. It shows whether there are bolt holes at the ends of a rail and heat treated conditions of the ends of a rail.</td>
<td></td>
</tr>
<tr>
<td>TechnicalStandard</td>
<td>The technical standard, requirement or code of a rail. It shows the name of the technical standard, technical requirement and code executed when a rail is produced, processed, manufactured, etc.</td>
<td></td>
</tr>
<tr>
<td>MassPerLength</td>
<td>The mass of a rail per unit length.</td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td>The design length of a rail.</td>
<td></td>
</tr>
</tbody>
</table>

**12.4.4 Pset_TrackFasteningCommon**

Name: Pset_TrackFasteningCommon

Applicable Entities: IfcTrackFastening

Description: Properties common to the definition of all occurrences of IfcTrackFastening.

Property Definitions: See Table 12.48.

*Table 12.48 Property definitions of IfcTrackFastening*
<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The type of a fastening.</td>
</tr>
<tr>
<td>IsSmallResistanceFastening</td>
<td>TypePropertySingleValue/IfcBoolean</td>
<td>Whether a fastening is a small resistance fastening or not.</td>
</tr>
<tr>
<td>StandardDrawingNumber</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The index number of the standard drawing applied to a fastening.</td>
</tr>
<tr>
<td>TechnicalStandard</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The technical standard, requirement or code of a fastening. It shows the name of the technical standard, technical requirement and code executed when a fastening is produced, processed, manufactured, etc.</td>
</tr>
</tbody>
</table>

12.4.5 Pset_TrackSleeperCommon

Name: Pset_TrackSleeperCommon

Applicable Entities: IfcTrackSleeper

Description: Properties common to the definition of all occurrences of IfcTrackSleeper.

Property Definitions: See Table 12.49.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The type of a sleeper.</td>
</tr>
<tr>
<td>StandardDrawingNumber</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The index number of the standard drawing applied to a sleeper.</td>
</tr>
<tr>
<td>TechnicalStandard</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The technical standard, requirement or code of a sleeper. It shows the name of the technical standard, technical requirement and code executed when a sleeper is produced, processed, manufactured, etc.</td>
</tr>
</tbody>
</table>

12.4.6 Pset_TrackSlabCommon
Name: Pset_TrackSlabCommon
Applicable Entities: IfcTrackSlab
Description: Properties common to the definition of all occurrences of IfcTrackSlab.
Property Definitions: See Table 12.50.

Table 12.50 Property definitions of Pset_TrackSlabCommon

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The type of a track slab.</td>
</tr>
<tr>
<td>StandardDrawingNumber</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The index number of the standard drawing applied to a track slab.</td>
</tr>
<tr>
<td>TechnicalStandard</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The technical standard, requirement or code of a track slab. It shows the name of the technical standard, technical requirement and code executed when a track slab is produced, processed, manufactured, etc.</td>
</tr>
</tbody>
</table>

12.4.7 Pset_TrackIsolationLayerCommon

Name: Pset_TrackIsolationLayerCommon
Applicable Entities: IfcTrackIsolationLayer
Description: Properties common to the definition of all occurrences of IfcTrackIsolationLayer.
Property Definitions: See Table 12.51.

Table 12.51 Property definitions of Pset_TrackIsolationLayerCommon

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>StructureComposition</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Structural component.</td>
</tr>
<tr>
<td>TechnicalStandard</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The technical standard, requirement or code of an isolation layer. It shows the name of the technical standard, technical requirement and code executed when an isolation layer is produced, processed, manufactured, etc.</td>
</tr>
</tbody>
</table>

12.4.8 Pset_TrackElasticCushionCommon
Name: Pset_TrackElasticCushionCommon
Applicable Entities: IfcTrackElasticCushion
Description: Properties common to the definition of all occurrences of IfcTrackElasticCushion.
Property Definitions: See Table 12.52.

Table 12.52 Property definitions of TrackElasticCushionCommon

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>StructureComposition</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Structural component.</td>
</tr>
<tr>
<td>TechnicalStandard</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The technical standard, requirement or code of an elastic cushion. It shows the name of the technical standard, technical requirement and code executed when an elastic cushion is produced, processed, manufactured, etc.</td>
</tr>
</tbody>
</table>

12.4.9 Pset_TrackAdjustmentlayerCommon
Name: Pset_TrackAdjustmentlayerCommon
Applicable Entities: IfcTrackAdjustmentlayer
Description: Properties common to the definition of all occurrences of IfcTrackAdjustmentlayer.
Property Definitions: See Table 12.53.

Table 12.53 Property definitions of TrackAdjustmentlayerCommon

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The type of an adjustment layer.</td>
</tr>
<tr>
<td>TechnicalStandard</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The technical standard, requirement or code of an adjustment layer. It shows the name of the technical standard, technical requirement and code executed when an adjustment layer is produced, processed, manufactured, etc.</td>
</tr>
</tbody>
</table>

12.4.10 Pset_TrackBaseCommon
Name: Pset_TrackBaseCommon
Applicable Entities: IfcTrackBase
Description: Properties common to the definition of all occurrences of IfcTrackBase.
Property Definitions: See Table 12.54.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IsSurfaceGalling</td>
<td>TypePropertySingleValue/IfcBoolean</td>
<td>Galling the top surface of a track base or not. It shows whether the surface of a track base shall be galled or not.</td>
</tr>
<tr>
<td>SurfaceGallingArea</td>
<td>TypePropertySingleValue/IfcArea Measure/m²</td>
<td>The galling area of the top surface of a track base (It is valid only when IsSurfaceGalling is TRUE).</td>
</tr>
</tbody>
</table>

12.4.11 Pset_TrackBallastLayerCommon

Name: Pset_TrackBallastLayerCommon
Applicable Entities: IfcTrackBallastLayer
Description: Properties common to the definition of all occurrences of IfcTrackBallastLayer.

Property Definitions: See Table 12.55.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BallastClassification</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The classification name of the ballast in a ballast layer.</td>
</tr>
</tbody>
</table>

12.4.12 Pset_TrackExpansionJointCommon

Name: Pset_TrackExpansionJointCommon
Applicable Entities: IfcTrackExpansionJoint
Description: Properties common to the definition of all occurrences of IfcTrackExpansionJoint.

Property Definitions: See Table 12.56.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The type of a rail expansion joint.</td>
</tr>
<tr>
<td>StandardDrawing Number</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The index number of the standard drawing applied to a rail expansion joint.</td>
</tr>
<tr>
<td>TechnicalStandard</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The technical standard, requirement or code of a rail expansion joint. It shows the name of the technical standard, technical requirement and code executed when a rail</td>
</tr>
</tbody>
</table>
Expansion joint is produced, processed, manufactured, etc.

12.4.13 Pset_TrackPanelCommon

Name: Pset_TrackPanelCommon
Applicable Entities: IfcTrackPanel
Description: Properties common to the definition of all occurrences of IfcTrackPanel.
Property Definitions: See Table 12.57.

Table 12.57 Property definitions of Pset_TrackPanelCommon

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LayingStandard</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The laying standard of a track panel. It shows the number of the sleepers contained in a panel per unit length (kilometer).</td>
</tr>
</tbody>
</table>

12.4.14 Pset_TurnoutCommon

Name: Pset_TurnoutCommon
Applicable Entities: IfcTrackTurnout
Description: Properties common to the definition of all occurrences of IfcTrackTurnout.
Property Definitions: See Table 12.58.

Table 12.58 Property definitions of Pset_TurnoutCommon

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ReferenceName</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The index number of the standard drawing applied to a turnout.</td>
</tr>
<tr>
<td>DrawingName</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The name of the standard drawing applied to a turnout.</td>
</tr>
<tr>
<td>DrawingType</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The type of the standard drawing applied to a turnout.</td>
</tr>
<tr>
<td>TurnoutNumber</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The frog number of a turnout.</td>
</tr>
<tr>
<td>Weight</td>
<td>TypePropertySingleValue/IfcLabel IFcInteger / (kg/m)</td>
<td>The type of rails in a turnout suitable to the track.</td>
</tr>
<tr>
<td>Note</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Notes.</td>
</tr>
<tr>
<td>ApplicableScope</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The application scope of a turnout.</td>
</tr>
<tr>
<td>SleeperReferenceName</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The index number of the standard drawing applied to sleepers in a turnout.</td>
</tr>
<tr>
<td>Property</td>
<td>Type</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>SpeedStraight</td>
<td>TypePropertySingleValue/IfcLinearVelocityMeasure/(km/h)</td>
<td>The permissible passing speed of a turnout in the straight direction.</td>
</tr>
<tr>
<td>SpeedSide</td>
<td>TypePropertySingleValue/IfcLinearVelocityMeasure/(km/h)</td>
<td>The permissible passing speed of a turnout in the lateral direction.</td>
</tr>
<tr>
<td>Angle</td>
<td>TypePropertySingleValue/IfcCompoundPlaneAngleMeasure</td>
<td>The crossing angle ((\alpha)) of the frog of a turnout.</td>
</tr>
<tr>
<td>radius</td>
<td>TypePropertySingleValue/IfcPositiveLengthMeasure/mm</td>
<td>The radius of a divert curve ((R)) of a turnout.</td>
</tr>
<tr>
<td>Lq</td>
<td>TypePropertySingleValue/IfcPositiveLengthMeasure/mm</td>
<td>The whole length (LQ) of a turnout.</td>
</tr>
<tr>
<td>La</td>
<td>TypePropertySingleValue/IfcPositiveLengthMeasure/mm</td>
<td>The distance (a) from the beginning to the center of a turnout.</td>
</tr>
<tr>
<td>Lb</td>
<td>TypePropertySingleValue/IfcPositiveLengthMeasure/mm</td>
<td>The distance (b) from the center to the end of a turnout.</td>
</tr>
<tr>
<td>LL</td>
<td>TypePropertySingleValue/IfcPositiveLengthMeasure/mm</td>
<td>The distance (L') from the end to the last turnout sleeper of a turnout.</td>
</tr>
<tr>
<td>LLq</td>
<td>TypePropertySingleValue/IfcPositiveLengthMeasure/mm</td>
<td>The distance (q) from the beginning to the switch rail of a turnout.</td>
</tr>
<tr>
<td>L0</td>
<td>TypePropertySingleValue/IfcPositiveLengthMeasure/mm</td>
<td>The length (L0) of the switch rail of a turnout.</td>
</tr>
<tr>
<td>SwitchRailType</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The type of the switch rail of a turnout.</td>
</tr>
<tr>
<td>FastenerType</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The type of the fastening of a turnout.</td>
</tr>
<tr>
<td>Linkagetype</td>
<td>TypePropertyEnumeratedValue / PEnum_ElementLinkagetype:innerLock, outerLock</td>
<td>The type of the linkage of a turnout. The enumeration is INNERLOCK and OUTERLOCK.</td>
</tr>
<tr>
<td>QuenchType</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The quenching treatment (heat treatment) type of rails of a turnout.</td>
</tr>
<tr>
<td>FrogType</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The type of the frog of a turnout.</td>
</tr>
</tbody>
</table>
Space | TypePropertySingleValue/IfcPositiveLengthMeasure/mm | The distance between centerlines of tracks involved in a scissors crossing.

| 12.4.15 Pset_RailJointFasteningCommon |
| Name: Pset_RailJointFasteningCommon |
| Applicable Entities: IfcTrackRailJoint / RAILJOINTFASTENING |
| Description: Properties common to the definition of all occurrences of IfcTrackRailJoint / RAILJOINTFASTENING. |
| Property Definitions: See Table 12.59. |

**Table 12.59 Property definitions of Pset_RailJointFasteningCommon**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>StructureComposition</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Structural component. It shows structural components of an ordinary rail joint fastening, and it mainly includes information about the number and type of the joint bars and its matching bolts and washers.</td>
</tr>
</tbody>
</table>

| 12.4.16 Pset_RailCompromisingJointCommon |
| Name: Pset_RailCompromisingJointCommon |
| Applicable Entities: IfcTrackRailJoint / COMPROMISINGJOINT |
| Description: Properties common to the definition of all occurrences of IfcTrackRailJoint / COMPROMISINGJOINT. |
| Property Definitions: See Table 12.60. |

**Table 12.60 Property definitions of Pset_RailCompromisingJointCommon**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The type of a compromising rail joint fastening.</td>
</tr>
</tbody>
</table>

| 12.4.17 Pset_RailInsulatedJointCommon |
| Name: Pset_RailInsulatedJointCommon |
| Applicable Entities: IfcTrackRailJoint / INSULATEDJOINT |
| Description: Properties common to the definition of all occurrences of IfcTrackRailJoint / INSULATEDJOINT. |
| Property Definitions: See Table 12.61. |

**Table 12.61 Property definitions of Pset_RailInsulatedJointCommon**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The type of an insulated rail</td>
</tr>
</tbody>
</table>
12.4.18 Pset_RailWeldedJointCommon

Name: Pset_RailWeldedJointCommon
Applicable Entities: IfcTrackRailJoint / WELDEDJOINT
Description: Properties common to the definition of all occurrences of IfcTrackRailJoint / WELDEDJOINT.

Property Definitions: See Table 12.62.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WeldedJointType</td>
<td>TypePropertyEnumeratedValue/PEnum_ElementWeldedJointType:FACTORYWELDEDJOINT,UNIONWELDEDJOINT,RAILLINKWELDEDJOINT</td>
<td>The type of a welded rail joint. The enumeration is FACTORYWELDEDJOINT, UNIONWELDEDJOINT and RAILLINKWELDEDJOINT.</td>
</tr>
<tr>
<td>WeldedType</td>
<td>TypePropertyEnumeratedValue/PEnum_ElementWeldedType:FIELDWELDING,BASEWELDING,FACTORYWELDING</td>
<td>The welded type of a welded rail joint. The enumeration is FIELDWELDING, BASEWELDING and FACTORYWELDING.</td>
</tr>
<tr>
<td>WeldedMethod</td>
<td>TypePropertyEnumeratedValue/PEnum_ElementWeldedMethod:FLASHWELDING,EXOTHERMICWELDING</td>
<td>The welded method of a welded rail joint. The enumeration is FLASHWELDING and EXOTHERMICWELDING.</td>
</tr>
</tbody>
</table>

12.4.19 Pset_RailConductiveJointCommon

Name: Pset_RailConductiveJointCommon
Applicable Entities: IfcTrackRailJoint / CONDUCTIVEJOINT
Description: Properties common to the definition of all occurrences of IfcTrackRailJoint / CONDUCTIVEJOINT.

Property Definitions: See Table 12.63.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>StructureComposition</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Structural component. It mainly includes information about the number and type of the joint bars and its matching bolts</td>
</tr>
</tbody>
</table>
12.4.20 Pset_RailUnchangeableJointCommon

Name: Pset_RailUnchangeableJointCommon
Applicable Entities: IfcTrackRailJoint / UNCHANGEABLEJOINT
Description: Properties common to the definition of all occurrences of IfcTrackRailJoint / UNCHANGEABLEJOINT.
Property Definitions: See Table 12.64.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>StructureComposition</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Structural component. It mainly includes information about the number and type of the joint bars and its matching bolts and washers.</td>
</tr>
</tbody>
</table>

12.4.21 Pset_TrackStrengtheningEquipmentCommon

Name: Pset_TrackStrengtheningEquipmentCommon
Applicable Entities: IfcTrackStrengtheningEquipment
Description: Properties common to the definition of all occurrences of IfcTrackStrengtheningEquipment.
Property Definitions: See Table 12.65.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The type of a track strengthening equipment.</td>
</tr>
<tr>
<td>StandardDrawingNumber</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The index number of the standard drawing applied to a track strengthening equipment.</td>
</tr>
<tr>
<td>TechnicalStandard</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The technical standard, requirement or code of a track strengthening equipment. It shows the name of the technical standard, technical requirement and code executed when a track</td>
</tr>
</tbody>
</table>
12.4.22 Pset_TrackAccessoryEquipmentCommon

Name: Pset_TrackAccessoryEquipmentCommon
Applicable Entities: IfcTrackAccessoryEquipment
Description: Properties common to the definition of all occurrences of IfcTrackAccessoryEquipment.
Property Definitions: See Table 12.66.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The type of a track accessory equipment.</td>
</tr>
<tr>
<td>StandardDrawingNumber</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The index number of the standard drawing applied to a track accessory equipment.</td>
</tr>
<tr>
<td>TechnicalStandard</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The technical standard, requirement or code of a rail. It shows the name of the technical standard, technical requirement and code executed when a track accessory equipment is produced, processed, manufactured, etc.</td>
</tr>
</tbody>
</table>

12.4.23 Pset_EarthingTerminalCommon

Name: Pset_EarthingTerminalCommon
Applicable Entities: IfcEarthingTerminal
Description: Properties common to the definition of all occurrences of IfcEarthingTerminal.
Property Definitions: See Table 12.67.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>The type of an earthing terminal.</td>
</tr>
<tr>
<td>StructureComposition</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Structural component.</td>
</tr>
</tbody>
</table>
This schema defines the structure of railway terminal, railway station and their components. The objects in this schema is composed of spatial structure elements and physical elements.

The spatial structure elements of the station schema include IfcRailwayTerminal, IfcRailwayStation and IfcRailwayPlatform.

The physical elements of the station schema include IfcRailwaySignalDevice, IfcRailwaySpeedControlDevice, IfcRailwayDenoterDevice, IfcRailwaySafetyDevice, IfcRailwayMechanicalEquipment, IfcRailwayPlatformWall and IfcRailwayFlatAisle.

Figure 13.1 shows the relationship of all the classes in the station schema.

**Figure 13.1 Relationships of all the classes in the station schema**

### 13.1.1 Spatial Structure Elements of Station

The spatial structure elements of railway station represent the spatial objects and its components, including IfcRailwayTerminal, IfcRailwayStation and IfcRailwayStation. Figure 13.2 shows the relationship of all spatial structure elements in the station schema.

IfcRailwayTerminal is derived from IfcRailwayStructureElement. It represents the spatial structure composed of one or several railway stations (IfcRailwayStation) and railways (IfcRailway).
IfcRailwayStation is derived from IfcRailwayStructureElement. It represents a railway station that can implement passenger and freight transportion and other technical operation. It includes several railway elements such as IfcRailwaySignalDevice, IfcRailwayDenoterDevice, IfcRailwaySafetyDevice, IfcRailwayMechanicalEquipment and IfcBuildingElement. In addition, it can also be decomposed into IfcTrack, IfcSubgrade, IfcBridge, IfcRailwayPlatform, IfcBuilding, and IfcRoad by the aggregation relationship IfcRelAggregates.

IfcRailwayPlatform is derived from IfcRailwayStructureElement. It represents a platform including serveral railway and building elements such as IfcRailwayPlatformWall, IfcRamp and IfcStair.

![Diagram of railway station elements](image)

**Figure 13.2 EXPRESS-G diagram for spatial structure elements in station schema**

### 13.1.2 Physical Elements in Station Schema

The elements of railway station refer to the physical elements contained in railway station. They are derived from IfcRailwayElement, including IfcRailwaySignalDevice, IfcRailwaySpeedControlDevice, IfcRailwayFlatAisle, IfcRailwayDenoterDevice, IfcRailwaySafetyDevice, IfcRailwayMechanicalEquipment and IfcRailwayPlatformWall.

IfcRailwaySignalDevice represents the signal devices used in railway station. It has two subtypes named IfcRailwaySignal and IfcRailwayClearancePost.

IfcRailwaySpeedControlDevice represents the facilities to control the speed of train in station yard or throat of yard. It has two subtypes named IfcRailwaySpeedReducer and
IfcRailwaySpeedReducer.

IfcRailwayDenenotorDevice represents the facilities to show some information, usually placed in station yards or near railway lines.

IfcRailwaySafetyDevice represents the facilities to ensure the safe train operation. It has four subtypes named IfcRailwayCarBumper, IfcRailwayCarStopper, IfcRailwayIronShoe and IfcRailwayStopRetarder.

IfcRailwayMechanicalEquipment represents the mechanical equipment used in freight transportation. It currently includes three subtypes named IfcWagonScale, IfcTruckScale, and IfcDeflectionInstrument.

IfcRailwayPlatformWall represents the facilities to retain the earthwork in platform.

IfcRailwayFlatAisle represents the facilities placed for people or vehicle to cross railway tracks.

Figure 13.3 shows the inheritance relationship of all elements in station schema.

![Figure 13.3 EXPRESS-G diagram for elements in station schema](image)

13.2 Type Definition

13.2.1 IfcRailwayTerminalTypeEnum

This enumeration defines the different types of railway terminals from the perspective of the terminal’s form.

Enumerated Item Definitions:

ONESTATIONTERMINAL;
TRIANGLETERMINAL;
LINEARTERMINAL;
CROSSTERMINAL;
PARALLELTEMINAL;
RINGLIKETERMINAL;
MAKEENDTERMINAL;
COMBINEDTERMINAL;
USERDEFINED;
NOTDEFINED.

**EXPRESS Specification:**

```plaintext
TYPE IfcRailwayTerminalTypeEnum = ENUMERATION OF
  (ONESTATIONTERMINAL,
   TRIANGLETERMINAL,
   LINEARTERMINAL,
   CROSSTERMINAL,
   PARALLELTEMINAL,
   RINGLIKETERMINAL,
   MAKEENDTERMINAL,
   COMBINEDTERMINAL,
   USERDEFINED,
   NOTDEFINED);
END_TYPE;
```

### 13.2.2 IfcRailwayTerminalFeatureTypeEnum

This enumeration defines the different types of railway terminals from the perspective of the terminal’s function.

**Enumerated Item Definitions:**

- NETWORKTERMINAL
- REGIONALTERMINAL
- LOCALTERMINAL
- USERDEFINED
- NOTDEFINED

**EXPRESS Specification:**

```plaintext
TYPE IfcRailwayTerminalFeatureTypeEnum = ENUMERATION OF
  (NETWORKTERMINAL,
   REGIONALTERMINAL,
   LOCALTERMINAL)
```
13.2.3 IfcRailwayStationTypeEnum

IfcRailwayStationTypeEnum defines the different types of railway stations from the perspective of the station’s technical operation.

Enumerated Item Definitions:
INTERMEDIATESTATION;
DISTRICTSTATION;
MARSHALLINGSTATION;
PASSINGSTATION;
OVERTAKINGSTATION;
HALTSTATION: Halt station.
BLOCKPOST;
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:

TYPE IfcRailwayStationTypeEnum = ENUMERATION OF
(INTERMEDIATESTATION
, DISTRICTSTATION
, MARSHALLINGSTATION
, PASSINGSTATION
, OVERTAKINGSTATION
, HALTSTATION
, BLOCKPOST
, USERDEFINED
, NOTDEFINED
);
END_TYPE;

13.2.4 IfcRailwayStationFeatureTypeEnum

IfcRailwayStationFeatureTypeEnum defines the different types of railway stations from the perspective of the station’s function.

Enumerated Item Definitions:
PASSERGERSTATION;
FREIGHTSTATION;
PASSENGERANDFREIGHTSTATION;
USERDEFINED;
**EXPRESS Specification:**

```plaintext
TYPE IfcRailwayStationFeatureTypeEnum = ENUMERATION OF
(PASSENGERSTATION
,FREIGHTSTATION
,PASSSENGERANDFREIGHTSTATION
,USERDEFINED
,NOTDEFINED
);
END_TYPE;
```

**13.2.5 IfcRailwayStationFormTypeEnum**

IfcRailwayStationFormTypeEnum defines the different types of railway stations from the perspective of the station’s form.

- **Enumerated Item Definitions:**
  - TRANSVERSEARRANGEMENT;
  - LONGITUDINALARRANGEMENT;
  - MIXEDARRANGEMENT;
  - USERDEFINED;
  - NOTDEFINED.

**EXPRESS Specification:**

```plaintext
TYPE IfcRailwayStationFormTypeEnum = ENUMERATION OF
(TRANSVERSEARRANGEMENT
,LONGITUDINALARRANGEMENT
,MIXEDARRANGEMENT
,USERDEFINED
,NOTDEFINED
);
END_TYPE;
```

**13.2.6 IfcRailwayStationGradeTypeEnum**

IfcRailwayStationGradeTypeEnum defines the different types of railway stations from the perspective of the station’s grade.

- **Enumerated Item Definitions:**
  - GRADESUPER;
  - GRADEFIRST;
  - GRADESECOND;
  - GRADETHIRD;
  - GRADEFORTH;
GRADEFIFTH;
USERDEFINED;
NOTDEFINED.

**EXPRESS Specification:**

```plaintext
EXPRESS Specification:
TYPE IfcRailwayStationGradeTypeEnum = ENUMERATION OF 
  (GRADESUPER,
   GRADEFIRST,
   GRADESECOND,
   GRADETHIRD,
   GRADEFOURTH,
   GRADEFIFTH,
   USERDEFINED,
   NOTDEFINED);

END_TYPE;
```

**13.2.7 IfcRailwayPlatformTypeEnum**

IfcRailwayPlatformTypeEnum defines the different types of station platforms from the perspective of the platform’s function.

**Enumerated Item Definitions:**

- PASSENGERPLATFORM;
- FREIGHTPLATFORM;
- USERDEFINED;
- NOTDEFINED.

**EXPRESS Specification:**

```plaintext
EXPRESS Specification:
TYPE IfcRailwayPlatformTypeEnum = ENUMERATION OF 
  (PASSENGERPLATFORM,
   FREIGHTPLATFORM,
   USERDEFINED,
   NOTDEFINED);

END_TYPE;
```

**13.2.8 IfcRailwayPlatformPositionTypeEnum**

IfcRailwayPlatformPositionTypeEnum defines the different types of station platforms from the perspective of the platform’s position.

**Enumerated Item Definitions:**

- INTERMEDIATEPLATFORM;
- BASICPLATFORM;
- ENDTYPEPLATFORM;
USERDEFINED;
NOTDEFINED.

**EXPRESS Specification:**

```plaintext
TYPE IfcRailwayPlatformPositionTypeEnum = ENUMERATION OF
  (INTERMEDIATEPLATFORM,
   BASICPLATFORM,
   ENDTYPEPLATFORM,
   USERDEFINED,
   NOTDEFINED);
END_TYPE;
```

**13.2.9 IfcRailwaySignalTypeEnum**

IfcRailwaySignalTypeEnum defines the different types of signals from the perspective of the signal’s function.

**Enumerated Item Definitions:**

```plaintext
STARTINGSIGNAL;
HOMESIGNAL;
ROUTESIGNAL;
SHUNTINGSIGNAL;
HUMPSIGNAL;
BLOCKSIGNAL;
DISTANTSIGNAL;
APPROACHSIGNAL;
REPEATINGSIGNAL;
USERDEFINED;
NOTDEFINED.
```

**EXPRESS Specification:**

```plaintext
TYPE IfcRailwaySignalTypeEnum = ENUMERATION OF
  (STARTINGSIGNAL,
   HOMESIGNAL,
   ROUTESIGNAL,
   SHUNTINGSIGNAL,
   HUMPSIGNAL,
   BLOCKSIGNAL,
   DISTANTSIGNAL,
   APPROACHSIGNAL,
   REPEATINGSIGNAL,
   USERDEFINED)
```

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13.2.10 IfcRailwayClearancePostTypeEnum

IfcRailwayClearancePostTypeEnum defines the different types of clearance posts from the perspective of the clearance post’s function.

**Enumerated Item Definitions:**
USERDEFINED;
NOTDEFINED.

**EXPRESS Specification:**

```express
TYPE IfcRailwayClearancePostTypeEnum = ENUMERATION OF
    (USERDEFINED,
     NOTDEFINED);
END_TYPE;
```

13.2.11 IfcRailwaySpeedReducerTypeEnum

IfcRailwaySpeedReducerTypeEnum defines the different types of speed reducers from the perspective of the speed reducer’s operation type.

**Enumerated Item Definitions:**
WINDPRESSURECLAMP;
WINDPRESSUREGRAVITY;
USERDEFINED;
NOTDEFINED.

**EXPRESS Specification:**

```express
TYPE IfcRailwaySpeedReducerTypeEnum = ENUMERATION OF
    (WINDPRESSURECLAMP,
     WINDPRESSUREGRAVITY,
     USERDEFINED,
     NOTDEFINED);
END_TYPE;
```

13.2.12 IfcRailwayRetarderTypeEnum

IfcRailwayRetarderTypeEnum defines the different types of railway retarders from the perspective of the railway retarder’s operation type.

**Enumerated Item Definitions:**
COMMONRETARDER;
CONTROLLABLEDRETARDER;
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:
TYPE IfcRailwayRetarderTypeEnum = ENUMERATION OF
  (COMMONRETARDER
   ,CONTROLLABLEDRETARDER
   ,USERDEFINED
   ,NOTDEFINED
   );
END_TYPE;

13.2.13 IfcRailwayDenoterTypeEnum
IfcRailwayDenoterTypeEnum defines the different types of denoters from the perspective of
the denoter’s function.

Enumerated Item Definitions:
  BOUNDARYSIGN;
PARKINGSIGN;
SAFETYSIGN;
LANDMARKSIGN;
CROSSINGALERTSIGN;
ROUTESIGN;
SIGNALSIGN;
DISPLACEMENTOBSERVATIONPEG;
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:
TYPE IfcRailwayDenoterTypeEnum = ENUMERATION OF
  (BOUNDARYSIGN
   ,PARKINGSIGN
   ,SAFETYSIGN
   ,LANDMARKSIGN
   ,CROSSINGALERTSIGN
   ,ROUTESIGN
   ,SIGNALSIGN
   ,DISPLACEMENTOBSERVATIONPEG
   ,USERDEFINED
   ,NOTDEFINED
   );
END_TYPE;
13.2.14 IfcRailwayCarBumperTypeEnum

IfcRailwayCarBumperTypeEnum defines the different types of car bumpers from the perspective of the car bumper’s pattern.

**Enumerated Item Definitions:**

- MOUNDTYPE;
- MORTARRUBBLETYPE;
- CURVEDTYPEA;
- CURVEDTYPEB;
- USERDEFINED;
- NOTDEFINED.

**EXPRESSION Specification:**

```plaintext
TYPE IfcRailwayCarBumperTypeEnum = ENUMERATION OF
   (MOUNDTYPE
   ,MORTARRUBBLETYPE
   ,CURVEDTYPEA
   ,CURVEDTYPEB
   ,USERDEFINED
   ,NOTDEFINED
   );
END_TYPE;
```

13.2.15 IfcRailwayCarStopperTypeEnum

IfcRailwayCarStopperTypeEnum defines the different types of car stoppers from the perspective of the car stopper’s pattern.

**Enumerated Item Definitions:**

- FIXEDSTOPPER;
- SLIDESTOPPER;
- USERDEFINED;
- NOTDEFINED.

**EXPRESSION Specification:**

```plaintext
TYPE IfcRailwayCarStopperTypeEnum = ENUMERATION OF
   (FIXEDSTOPPER
   ,SLIDESTOPPER
   ,USERDEFINED
   ,NOTDEFINED
   );
END_TYPE;
```

13.2.16 IfcRailwayCarStopperPostionTypeEnum
IfcRailwayCarStopperPostionTypeEnum defines the different types of car stoppers from the perspective of the car stopper’s position.

**Enumerated Item Definitions:**

INSIDETYPE;
OUTSIDETYPE;
USERDEFINED;
NOTDEFINED.

**EXPRESSION Specification:**

```
TYPE IfcRailwayCarStopperPostionTypeEnum = ENUMERATION OF 
    (INSIDETYPE ,OUTSIDETYPE ,NOTDEFINED ,USERDEFINED ) ;
END_TYPE ;
```

13.2.17 IfcRailwayPlatformWallTypeEnum

IfcRailwayPlatformWallTypeEnum defines the different types of platform walls from the perspective of the platform wall’s pattern.

**Enumerated Item Definitions:**

STRAIGHTWALL;
INCLINEDWALL;
USERDEFINED;
NOTDEFINED.

**EXPRESSION Specification:**

```
TYPE IfcRailwayPlatformWallTypeEnum = ENUMERATION OF 
    (STRAIGHTWALL ,INCLINEDWALL ,USERDEFINED ,NOTDEFINED ) ;
END_TYPE ;
```

13.2.18 IfcRailwayFlatAisleTypeEnum

IfcRailwayFlatAisleTypeEnum defines the different types of flat aisles from the perspective of the flat aisle’s function.

**Enumerated Item Definitions:**

USERDEFINED;
NOTDEFINED.
EXPRESS Specification:
TYPE IfcRailwayFlatAisleTypeEnum = ENUMERATION OF
  (USERDEFINED
   , NOTDEFINED
  )
END_TYPE;

13.2.19 IfcRailwayWagonScaleTypeEnum
IfcRailwayWagonScaleTypeEnum defines the different types of wagon scales from the perspective of the wagon scale’s function.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:
TYPE IfcRailwayWagonScaleTypeEnum = ENUMERATION OF
  (USERDEFINED
   , NOTDEFINED
  )
END_TYPE;

13.2.20 IfcRailwayDeflectionInstrumentTypeEnum
IfcRailwayDeflectionInstrumentTypeEnum defines the different types of deflection instruments from the perspective of the deflection instrument’s function.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:
TYPE IfcRailwayDeflectionInstrumentTypeEnum = ENUMERATION OF
  (USERDEFINED
   , NOTDEFINED
  )
END_TYPE;

13.2.21 IfcRailwayIronShoeRemovingTypeEnum
IfcRailwayIronShoeRemovingTypeEnum defines the type of Iron Shoe Removing from the perspective of the Iron Shoe Removing’s function.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.
EXPRESS Specification:
TYPE IfcRailwayIronShoeRemovingTypeEnum = ENUMERATION OF
    (USERDEFINED
     , NOTDEFINED
     );
END_TYPE;

13.2.22 IfcRailwayStopDeviceTypeEnum
IfcRailwayStopDeviceTypeEnum defines the type of railway stop device from the perspective of the railway stop device’s function.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:
TYPE IfcRailwayStopDeviceTypeEnum = ENUMERATION OF
    (USERDEFINED
     , NOTDEFINED
     );
END_TYPE;

13.2.23 IfcRailwayStopRetarderTypeEnum
IfcRailwayStopRetarderTypeEnum defines the type of railway stop retarder from the perspective of function.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.

EXPRESS Specification:
TYPE IfcRailwayStopRetarderTypeEnum = ENUMERATION OF
    (USERDEFINED
     , NOTDEFINED
     );
END_TYPE;

13.2.24 IfcRailwayIronShoeTypeEnum
IfcRailwayIronShoeTypeEnum defines the type of railway iron shoes from the perspective of the function.

Enumerated Item Definitions:
USERDEFINED;
NOTDEFINED.
EXPRESS Specification:
TYPE IfcRailwayIronShoeTypeEnum = ENUMERATION OF 
  (USERDEFINED
   ,NOTDEFINED
  );
END_TYPE;

13.3 Entity Definition

13.3.1 IfcRailwayTerminal

IfcRailwayTerminal defines the spatial structure that is composed of several stations, facilities and railway lines serving railway transportation.

<table>
<thead>
<tr>
<th>Spatial Parts</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcRailwayStation</td>
<td>Spatial decomposition into railway stations.</td>
</tr>
<tr>
<td>IfcRailway</td>
<td>Spatial decomposition into railway lines.</td>
</tr>
</tbody>
</table>

EXPRESS Specification:
ENTITY IfcRailwayTerminal
  SUBTYPE OF (IfcRailwayStructureElement);
  PreDefinedType: IfcRailwayTerminalTypeEnum;
  TerminalFeature: IfcRailwayTerminalFeatureTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType: Predefined types of IfcRailwayTerminal.
TerminalFeature: Functional types of IfcRailwayTerminal.

13.3.2 IfcRailwayStation

IfcRailwayStation defines a railway station.

Table 13.2 IfcRailwayStation spatial composition

<table>
<thead>
<tr>
<th>Spatial Composite</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcRailway</td>
<td>Direct assignment to railway, if Railway Station is the outermost spatial container, and no terminal information is provided for station.</td>
</tr>
<tr>
<td>IfcRailwayTerminal</td>
<td>Assignment to Railway Terminal, if Railway Station is the spatial container for railway with terminal information.</td>
</tr>
</tbody>
</table>

Table 13.3 IfcRailwayStation spatial decomposition

<table>
<thead>
<tr>
<th>Spatial Parts</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcCivilStructureElement</td>
<td>Spatial decomposition into other civil structure elements, e.g. IfcTrack, IfcBridge, IfcSubgrade, IfcRailwayPlatform.</td>
</tr>
<tr>
<td>IfcBuilding</td>
<td>Spatial decomposition into several buildings.</td>
</tr>
</tbody>
</table>
Table 13.4 IfcRailwayStation spatial containment

<table>
<thead>
<tr>
<th>Contained Entities</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcCivilElement</td>
<td>Physical civil elements contained in the station, e.g. IfcRailwaySignalDevice, IfcRailwaySpeedControlDevice, IfcRailwayDenoterDevice, IfcRailwaySafetyDevice, IfcRailwayMechanicalEquipment, IfcRailwayFlatAisle.</td>
</tr>
<tr>
<td>IfcBuildingElement</td>
<td>Building elements can also be contained in the station.</td>
</tr>
</tbody>
</table>

Table 13.5 Property sets for IfcRailwayStation

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_StationCommon</td>
</tr>
</tbody>
</table>

EXPRESS Specification:

ENTITY IfcRailwayStation

SUBTYPE OF (IfcRailwayStructureElement);

<table>
<thead>
<tr>
<th>PreDefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_StationCommon</td>
</tr>
</tbody>
</table>

StationFeatureType: Predefined types of IfcRailwayStation

StationGradeType: functional types of IfcRailwayStation

StationFormType: Grade types of IfcRailwayStation

StationFormType: Form types of IfcRailwayStation

END_ENTITY;

Attribute definitions:

13.3.3 IfcRailwayPlatform

IfcRailwayPlatform represents a platform which can implement passenger and freight transportation.

Table 13.6 IfcRailwayPlatform spatial composition

<table>
<thead>
<tr>
<th>Spatial Composite</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcRailwayStation</td>
<td>Assignment to railway station</td>
</tr>
</tbody>
</table>

Table 13.7 IfcRailwayPlatform spatial containment

<table>
<thead>
<tr>
<th>Contained Entities</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcElement</td>
<td>Building elements and civil elements can be contained in a railway platform, such as IfcRailwayPlatformWall, IfcSubgradeElement, IfcRamp, IfcStair, etc.</td>
</tr>
</tbody>
</table>

EXPRESS SPECIFICATION:

ENTITY IfcRailwayPlatform

SUBTYPE OF (IfcRailwayStructureElement);
PredefinedType: IfcRailwayPlatformTypeEnum;
PositionType: IfcRailwayPlatformPositionTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType: Predefined types of IfcRailwayPlatform.
PositionType: Location types of IfcRailwayPlatform.

### 13.3.4 IfcRailwaySignalDevice

IfcRailwaySignalDevice defines the facilities which can control the train operation.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcRailwayStation</td>
<td>IfcRailwaySignalDevice can be contained in a railway station.</td>
</tr>
<tr>
<td>IfcRailway</td>
<td>Directly contained in railway, if the signal device has no station information.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcRailwaySignalDevice
SUPERTYPE OF (ONEOF (IfcRailwaySignal, IfcRailwayClearancePost))
SUBTYPE OF (IfcRailwayElement);
END_ENTITY;

### 13.3.5 IfcRailwaySignal

IfcRailwaySignal defines the control facility with colorful lamp to control the train operation by unified management.

**Table 13.9 Property sets for IfcRailwaySignal**

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_SignalCommon</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcRailwaySignal
SUBTYPE OF (IfcRailwaySignalDevice);
    PredefinedType: IfcRailwaySignalTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType: Predefined types of IfcRailwaySignal.

### 13.3.6 IfcRailwayClearancePost

IfcRailwayClearancePost defines the facility to alert limited position for train parking.

**EXPRESS Specification:**

ENTITY IfcRailwayClearancePost
SUBTYPE OF (IfcRailwaySignalDevice);
    PredefinedType: IfcRailwayClearancePostTypeEnum;
END_ENTITY;

**Attribute definitions:**
PreDefinedType: Predefined types of IfcRailwayClearancePost.

13.3.7 IfcRailwaySpeedControlDevice

IfcRailwaySpeedControlDevice defines the facility to adjust the speed of the train.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcRailwayStation</td>
<td>IfcRailwaySpeedControlDevice is contained in the railway station.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcRailwaySpeedControlDevice
  SUPERTYPE OF (ONEOF (IfcRailwaySpeedReducer, IfcRailwayRetarder));
  SUBTYPE OF (IfcRailwayElement);
END_ENTITY;

13.3.8 IfcRailwaySpeedReducer

IfcRailwaySpeedReducer defines the facility placed in the classification yard or the head of hump to control the speed of the train.

**EXPRESS Specification:**

ENTITY IfcRailwaySpeedReducer
  SUBTYPE OF (IfcRailwaySpeedControlDevice);
  PredefinedType: IfcRailwaySpeedReducerTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType: Predefined types of IfcRailwaySpeedReducer.

13.3.9 IfcRailwayRetarder

IfcRailwayRetarder defines the facility placed in the classification yard or the retarder zone to control the speed of the train.

**EXPRESS Specification:**

ENTITY IfcRailwayRetarder
  SUBTYPE OF (IfcRailwaySpeedControlDevice);
  PredefinedType: IfcRailwayRetarderTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType: Predefined types of IfcRailwayRetarder.

13.3.10 IfcRailwayDenoterDevice

IfcRailwayDenoterDevice defines the facility placed in station yards or near railway lines to show some useful information.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcRailwayStation</td>
<td>IfcRailwayDenoterDevice is contained in railway station.</td>
</tr>
<tr>
<td>IfcRailway</td>
<td>Directly contained in railway, if the signal device has no station</td>
</tr>
</tbody>
</table>
EXPRESS Specification:
ENTITY IfcRailwayDenoterDevice
    SUBTYPE OF (IfcRailwayElement);
    PredefinedType: IfcRailwayDenoterTypeEnum;
    Note: IfcText;
END_ENTITY;

Attribute definitions:
PreDefinedType: Predefined types of IfcRailwayDenoterDevice.
Note: Text showed on the denoter device.

13.3.11 IfcRailwaySafetyDevice
IfcRailwaySafetyDevice defines the facility which ensures the safety of train operation in the station.

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcRailwayStation</td>
<td>IfcRailwaySafetyDevice is contained in the railway station.</td>
</tr>
</tbody>
</table>

EXPRESS Specification:
ENTITY IfcRailwaySafetyDevice
    SUPERTYPE OF (ONEOF (IfcRailwayCarBumper, IfcRailwayCarStopper, IfcRailwayIronShoeRemoving, IfcRailwayStopDevice, IfcRailwayStopRetarder, IfcRailwayIronShoe))
    SUBTYPE OF (IfcRailwayElement);
END_ENTITY;

13.3.12 IfcRailwayCarBumper
IfcRailwayCarBumper defines the facility placed at the end of the railway line to prevent the train from running off the rails.

EXPRESS Specification:
ENTITY IfcRailwayCarBumper
    SUBTYPE OF (IfcRailwaySafetyDevice);
    PredefinedType: IfcRailwayCarBumperTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType: Predefined types of IfcRailwayCarBumper.

13.3.13 IfcRailwayCarStopper
IfcRailwayCarStopper defines the facility placed in front of the railway car bumper to prevent the train from running off the rails.

EXPRESS Specification:
ENTITY IfcRailwayCarStopper
    SUBTYPE OF (IfcRailwaySafetyDevice);
    PredefinedType: IfcRailwayCarStopperTypeEnum;
13.3.14 IfcRailwayIronShoe
IfcRailwayIronShoe defines a kind of safety facility to ensure the train to stop at the proper position.

**EXPRESS Specification:**

ENTITY IfcRailwayIronShoe
  SUBTYPE OF (IfcRailwaySafetyDevice);
  PredefinedType: IfcRailwayIronShoeTypeEnum;
END_ENTITY;

**Attribute definitions:**
PreDefinedType: Predefined types of IfcRailwayIronShoe.

13.3.15 IfcRailwayStopRetarde
IfcRailwayStopRetarder defines a kind of safety facility to ensure the train to stop at the proper position.

**EXPRESS Specification:**

ENTITY IfcRailwayStopRetarder
  SUBTYPE OF (IfcRailwaySafetyDevice);
  PredefinedType: IfcRailwayStopRetarderTypeEnum;
END_ENTITY;

**Attribute definitions:**
PreDefinedType: Predefined types of IfcRailwayStopRetarder.

13.3.16 IfcRailwayStopDevice
IfcRailwayStopRetarder defines a kind of safety facility to ensure the train to stop at the proper position.

**EXPRESS Specification:**

ENTITY IfcRailwayStopDevice
  SUBTYPE OF (IfcRailwaySafetyDevice);
  PredefinedType: IfcRailwayStopDeviceTypeEnum;
END_ENTITY;

**Attribute definitions:**
PreDefinedType: Predefined types of IfcRailwayStopDevice.

13.3.17 IfcRailwayIronShoeRemoving
IfcRailwayIronShoeRemoving defines a kind of safety facility to ensure the iron shoe to fall off from rails at the proper position.
EXPRESS Specification:
ENTITY IfcRailwayIronShoeRemoving
  SUBTYPE OF (IfcRailwaySafetyDevice);
  PredefinedType: IfcRailwayIronShoeRemovingTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType: Predefined types of IfcRailwayIronShoeRemoving.

13.3.18 IfcRailwayPlatformWall
IfcRailwayPlatformWall defines the facility which holds the earthwork in the platform.

Table 13.13 IfcRailwayPlatformWall contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcRailwayPlatform</td>
<td>IfcRailwayPlatformWall is contained in station platform</td>
</tr>
</tbody>
</table>

EXPRESS Specification:
ENTITY IfcRailwayPlatformWall
  SUBTYPE OF (IfcRailwayElement);
  PredefinedType: IfcRailwayPlatformWallTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType: Predefined types of IfcRailwayPlatformWall.

13.3.19 IfcRailwayFlatAisle
IfcRailwayFlatAisle defines the facility placed for people or vehicle to cross the railway track.

Table 13.14 IfcRailwayFlatAisle contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcRailwayStation</td>
<td>IfcRailwayFlatAisle is contained in the railway station.</td>
</tr>
</tbody>
</table>

Table 13.15 Property sets for IfcRailwayFlatAisle

<table>
<thead>
<tr>
<th>PredefinedType</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pset_FlatAisleCommon</td>
</tr>
</tbody>
</table>

EXPRESS Specification:
ENTITY IfcRailwayFlatAisle
  SUBTYPE OF (IfcRailwayElement);
  PredefinedType: IfcRailwayFlatAisleTypeEnum;
END_ENTITY;

Attribute definitions:
PreDefinedType: Predefined types of IfcRailwayFlatAisle.

13.3.20 IfcRailwayMechanicalEquipment
IfcRailwayMechanicalEquipment defines the mechanical facilities which are used in freight transportation operation. It currently has three subtypes, while more kinds of facilities will be added.
as needed in the future.

Table 13.16 IfcRailwayMechanicalEquipment contained in spatial structure

<table>
<thead>
<tr>
<th>Spatial Structure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IfcRailwayStation</td>
<td>IfcRailwayMechanicalEquipment is contained in the railway station.</td>
</tr>
</tbody>
</table>

**EXPRESS Specification:**

ENTITY IfcRailwayMechanicalEquipment
  SUPERTYPE OF (ONEOF
    (IfcRailwayWagonScale, IfcRailwayTruckScale, IfcRailwayDeflectionInstrument))
  SUBTYPE OF (IfcRailwayElement);
END_ENTITY;

13.3.21 IfcRailwayWagonScale

IfcRailwayWagonScale defines the facility placed under the rails to measure the vehicle’s load.

**EXPRESS Specification:**

ENTITY IfcRailwayWagonScale
  SUBTYPE OF (IfcRailwayMechanicalEquipment);
  PredefinedType: IfcRailwayWagonScaleTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType: Predefined types of IfcRailwayWagonScale.

13.3.22 IfcRailwayTruckScale

IfcRailwayWagonScale defines the facility placed under the road to measure the truck’s load in the railway station.

**EXPRESS Specification:**

ENTITY IfcRailwayTruckScale
  SUBTYPE OF (IfcRailwayMechanicalEquipment);
  PredefinedType: IfcRailwayTruckScaleTypeEnum;
END_ENTITY;

**Attribute definitions:**

PreDefinedType: Predefined types of IfcRailwayTruckScale.

13.3.23 IfcRailwayDeflectionInstrument

IfcRailwayDeflectionInstrument defines the facility placed under the rails to analyze whether the train is partially loaded or overloaded in the railway station.

**EXPRESS Specification:**

ENTITY IfcRailwayDeflectionInstrument
  SUBTYPE OF (IfcRailwayMechanicalEquipment);
  PredefinedType: IfcRailwayDeflectionInstrumentTypeEnum;
END_ENTITY;
**Attribute definitions:**
PreDefinedType: Predefined types of IfcRailwayDeflectionInstrument.

**13.4 Property Set Definition**

**13.4.1 Pset_StationCommon**

Name: Pset_StationCommon  
Applicable Entities: IfcRailwayStation  
Description: General property set for IfcRailwayStation.  
Property Definitions: See Table 13.17.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>StationHousePos</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Position of the station house. The position of the station house is on the left or right side along the forward direction of railway lines.</td>
</tr>
<tr>
<td>EffectiveLength</td>
<td>TypePropertySingleValue/IfcNonNegativeLengthMeasure/m</td>
<td>Effective length of the track.</td>
</tr>
<tr>
<td>CentralPoint</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Center mileage of the station.</td>
</tr>
<tr>
<td>DividingPoint</td>
<td>TypePropertySingleValue/IfcLabel</td>
<td>Divided mileage of the station.</td>
</tr>
</tbody>
</table>

**13.4.2 Pset_FlatAisleCommon**

Name: Pset_FlatAisleCommon  
Applicable Entities: IfcRailwayFlatAisle  
Description: General property set for IfcRailwayFlatAisle.  
Property Definitions: See Table 13.18.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spacing</td>
<td>TypePropertySingleValue/IfcPositiveLengthMeasure/m</td>
<td>Track spacing. The sum of railway track spacing crossed by the flat aisle.</td>
</tr>
<tr>
<td>CrossLineNumber</td>
<td>TypePropertySingleValue/IfcInteger</td>
<td>Track number. The number of railway tracks crossed by the flat aisle.</td>
</tr>
<tr>
<td>HasGuard</td>
<td>TypePropertySingleValue/IfcBoolean</td>
<td>Whether there is guard near the flat aisle.</td>
</tr>
</tbody>
</table>

**13.4.3 Pset_SignalCommon**

Name: Pset_SignalCommon  
Applicable Entities: IfcRailwaySignal  
Description: General property set for IfcRailwaySignal.  
Property Definitions: See Table 13.29.
Table 13.19 Property definitions of IfcRailwaySignal

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IsHighPole</td>
<td>TypePropertySingleValue/IfcBoolean</td>
<td>Whether the signal has a high pole.</td>
</tr>
<tr>
<td>NumberOfInstitutions</td>
<td>TypePropertySingleValue/IfcInteger</td>
<td>The number of the signal’s Institutions.</td>
</tr>
<tr>
<td>HasExpress</td>
<td>TypePropertySingleValue/IfcBoolean</td>
<td>Whether the signal has express indicator.</td>
</tr>
</tbody>
</table>

14. Others

14.1 Cable Slot

IfcDistributionSystem is used to represent the railway cable slot. The predefined type “CONVEYING” or “USERDEFINED” should be selected from the IfcDistributionSystemEnum.

IfcCableCarrierSegment is used to represent railway cable slot segment. The predefined type “CABLETRUNKINGSEGMENT” should be selected from the IfcCableCarrierSegmentTypeEnum.

IfcDistributionChamberElement is used to represent the inspection well on the cable slot. The predefined type “MANHOLE” should be selected from the IfcDistributionChamberElementTypeEnum.