TECHNICAL SPECIFICATION

ISO/TS 22726-1

Intelligent transport systems — Dynamic data and map database specification for connected and automated driving system applications —

Part 1:
Architecture and logical data model for harmonization of static map data

Systèmes de transport intelligents — Spécification de données dynamiques et de bases de données cartographiques pour les applications de système de conduite connectées et automatisées —

Partie 1: Architecture et modèle logique de données pour l'harmonisation des données cartographiques statiques

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Foreword

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This document was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

A list of all parts in the ISO 22726 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

In response to emerging automated driving system (ADS) development, a new requirement for an intelligent transport system (ITS) map database standard has been raised to define a set of models for highly confident map data.

The data used in ADS are categorized into static data (i.e. map for highly automated driving (MHAD) and traditional map data) and dynamic data (e.g. traffic and travel information). These data are mutually related and linked to support ADS. The data model for ADS should have a structure specialized for automated driving and be presented in a manner useable for ADS.

In the case of static map data used by ITS, ISO 14296 specifies a logical data model applied to vehicle navigation systems and cooperative ITS (C-ITS). The data model of ISO 14296 is insufficient for ADS because of limitations to represent detailed or accurate carriageway and road-related features. In addition, new relationships between new map features and dynamic data are defined.

Even though GDF 5.1 (ISO 20524-2) defines map data used in ADS such as road belts or lane belts as detailed road map data, it focuses on a data model for exchanging and provisioning map data between map makers and data centres. The GDF model, which is based on three catalogues (Feature, Attribute, and Relationship), is inefficient not only for storing ITS map data in a database, but also for being able to access that data rapidly in vehicles. Therefore, this document defines a database standard to quickly and directly access detailed road map entities and their related information.

Implementation of this document can potentially lead to cost reductions in maintenance and expansion of map access libraries, as well as reductions in compilation and maintenance costs of map and map-related data for data providers for connected and automated driving, and vehicle control applications.

Intelligent transport systems — Dynamic data and map database specification for connected and automated driving system applications —

Part 1:
Architecture and logical data model for harmonization of static map data

1　Scope

This document specifies the architecture and the logical data model of static map data for connected and automated driving system applications.

2　Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 19501, *Information technology — Open Distributed Processing — Unified Modeling Language (UML) Version 1.4.2*

3　Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
belt
configuration concept for specifying an area bounded by side lines and terminal lines, characterized by directions and represented as one or more linear axes when skeletonized

Note 1 to entry: The number of skeletonized axes differs depending on the feature class. In the case of a belt applied to a one-way lane, the number is one. When applied to an intersection, the belt has axes corresponding to the number of unique allowable traffic directions.

[SOURCE: ISO 20524-2:2020, 3.2]

3.2
direction
signature of belt, determined by an allowed connection between a pair of terminal lines

[SOURCE: ISO 20524-2:2020, 3.3]

3.3
belt feature
two-dimensional Feature bounded by three or more Edges or four or more NET coordinate Tuple

[SOURCE: ISO 20524-2:2020, 3.1.]

3.4
feature
database representation of a real-world object

[SOURCE: ISO 20524-1:2020, 3.4.9]

3.5
link
directed topological connection between two nodes, composed of an ordered sequence of one or more segments and represented by an ordered sequence of zero or more shape points

[SOURCE: ISO/TS 20452:2007, 3.19]

3.6
node
data model entity for a topological junction of two or more links or end bounding a link

Note 1 to entry: A link stores the coordinate value of the corresponding GDF junction.

[SOURCE: ISO/TS 20452:2007, 3.23]

3.7
partition line
transversal line representing the boundary of a segment set to a road belt element and a lane belt element, and both terminations are set on the side line of road belt element or lane belt element

3.8
probe data
vehicle sensor information formatted as probe data elements and/or probe messages that are processed, formatted and transmitted to a land-based centre for processing to create a good understanding of the driving environment

[SOURCE: ISO 24100:2010, 3.14]

3.9
road feature
feature, specified by a belt, that represents an area for vehicle travel

EXAMPLE   Carriageways, intersections and lanes are examples of road features.

Note 1 to entry: This is a general term for the roadway, carriageways, intersections and lanes, and does not contain the sidewalks and paths for pedestrians.

3.10
side line
type of boundary line constituting a belt feature other than a terminal line

[SOURCE: ISO 20524-2:2020, 3.4, modified — The admitted term "side line" has been added.]

3.11
terminal line
type of boundary line constituting a belt feature and designated for determining a direction of a belt feature in combination with another terminal line

[SOURCE: ISO 20524-2:2020, 3.5]

2

4   Abbreviated terms and symbols

ADS   automated driving system

C-ITS   cooperative ITS

CMS   changeable message sign

GNSS   Global Navigation Satellite System

IAP   IntersectionAnchorPosition

IB   IntersectionBelt

IBSd   IntersectionBeltSideLine

IBTr   IntersectionBeltTerminalLine

ICP   IntersectionConnectionPoint

ITS   intelligent transport system

LAP   lane anchor position

LBE   LaneBeltElement

LBJ   LaneBeltJoint

LBSd   LaneBeltSideLine

LBSg   LaneBeltSegment

LBSSg   LaneBeltSideLineSegment

LBTr   LaneBeltTerminalLine

LCP   LaneConnectionPoint

MHAD   map for highly automated driving

POI   point of interest

RAP   RoadAnchorPosition

RBE   RoadBeltElement

RBS   RoadBeltSection

RBSg   RoadBeltSegment

RBSd   RoadBeltSideLine

RBSSg   RoadBeltSideLineSegment

RBTr   RoadBeltTerminalLine

RSE   RoadStructuresAndEquipment

RTK-GPS   real time kinematics - global positioning system

VMS   variable message sign

5 Document structure and conformance

5.1 Document structure

This document contains the following main clauses, subclauses and annexes:

— Conformance (5.2)

— Architecture (Clause 6)

— Logical data model of map data (Clause 7)

— Overall data model of map data (7.1)

— Transportation package (7.2)

— MHAD package (7.3)

— Relationship to dynamic information (7.4)

— Annex A (normative) Abstract test suite

— Annex B (normative) Basic data types and stereotypes

— Annex C (informative) Resolution and accuracy of the MHAD

— Annex D (informative) Comparison of the road network models of MHAD and existing map models

5.2 Conformance

Data model structures shall be provided as specified in Clause 7.

Any data structure claiming conformance with this document shall pass the requirements presented in the abstract test suite in Annex A.

UML expressions for diagrams in this document shall conform to ISO/IEC 19501.

Throughout this document, the data types and stereotypes as defined in Table B.1 apply.

6 Architecture

Automated driving systems (ADSs) and their applications can refer to both static map data and dynamic information data. In addition, ITS stations in automated driving vehicles, connected vehicles and road equipment can collect sensing data, such as contradictions between the static map and features of the real world, traffic data, and travel information, and distribute them as probe data.

Figure 1 depicts the conceptual system architecture of map data in an ITS station for an ADS.

In ITS vehicle stations that correspond to ADSs, the application uses map data (MHAD) and additional dynamic data. The original data, along with updates of the MHAD data and dynamic data, are intended to be provided through external transmitted messages received from outside of the station. Automated driving applications also use data collected from both in-vehicle and roadside mounted sensors and can also use conventional map data which complements the applications to which the navigation system and/or C-ITS refer.
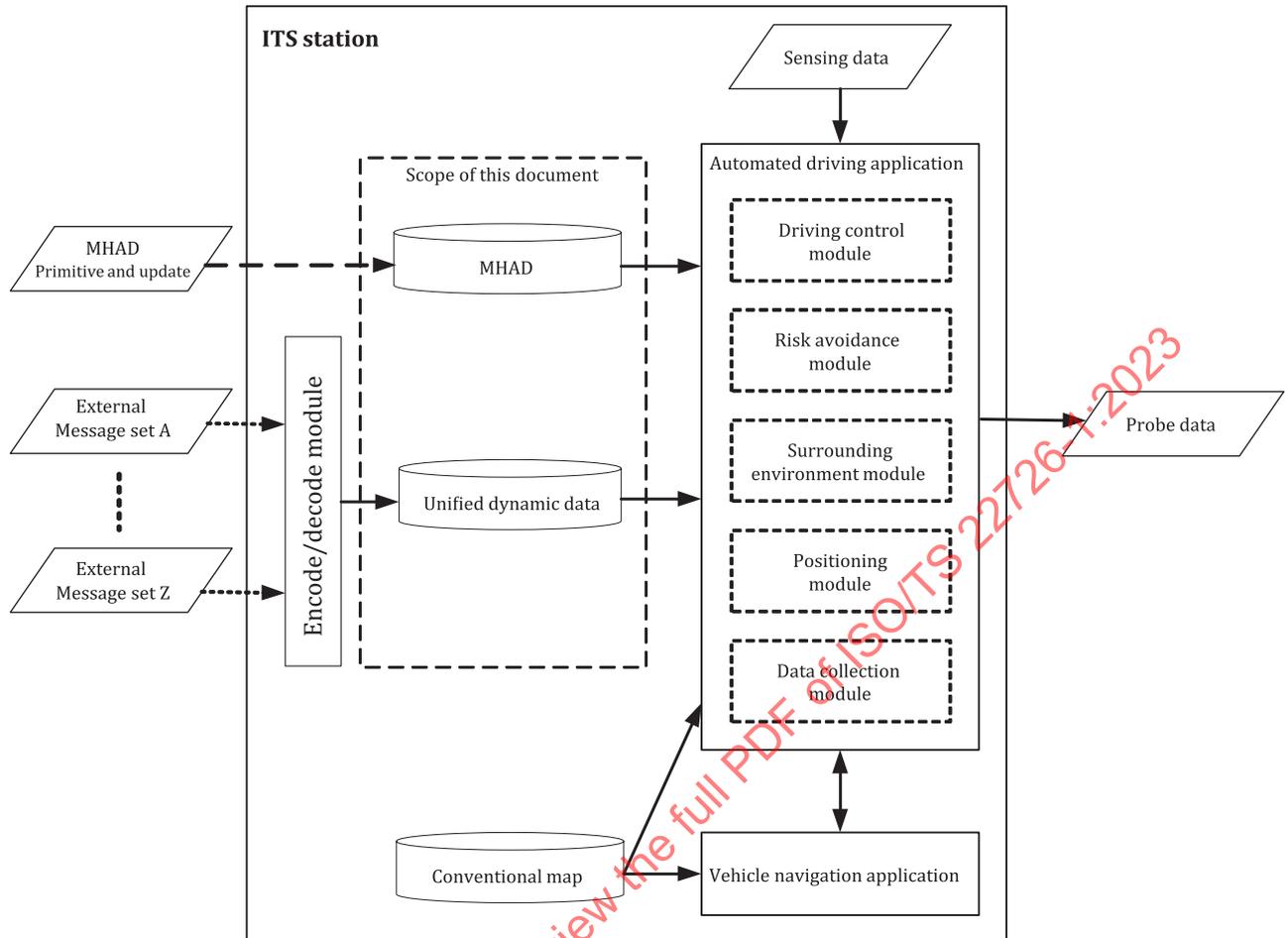
Figure 1 — Conceptual system architecture

7 Logical data model of map data

7.1 Overall data model of map data

The overall map data model for ITS is adopted from the model defined in ISO 14296 which consists of the following packages:

— AddressLocation: location information based on various types of information both on the Earth and in the map data;

— Cartographic: terrain map information for expressing a visual map;

— Service&POI: information of the services and POI that exist in a fixed location;

— Transportation: information concerning fixed features for transportation; and

— DynamicInformation: external information in association with transportation data for providing real-time conditions and/or status.

To support ADS, both the Transportation and DynamicInformation packages are expanded.

The DynamicInformation package is specified in ISO/TS 22726-2:—.[1)](1)

The overall map data model is shown in Figure 2.

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1)   Under preparation. Stage at the time of publication ISO/AWI TS 22726-2:2023.

Key
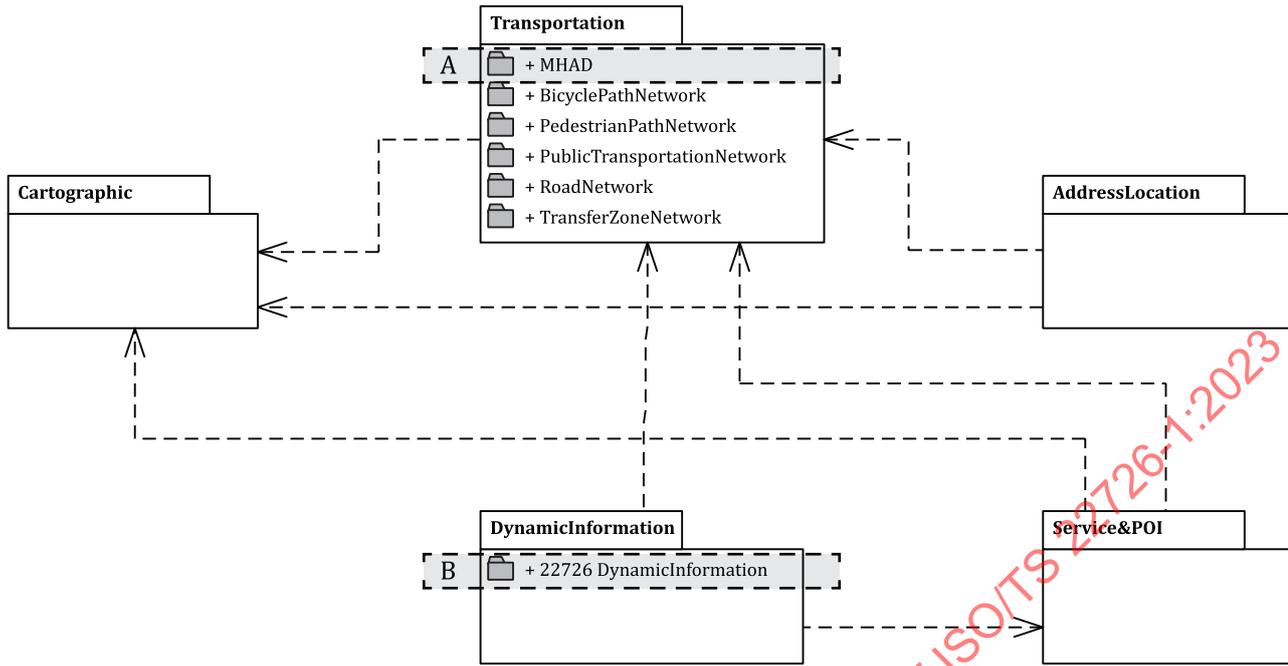
A   ISO/TS 22726-1 (this document)

B   ISO/TS 22726-2

Figure 2 — Overall map data model

7.2   Transportation package

Following the addition of the MHAD package to the Transportation package, the updated package consists of the following:

— MHAD: data for road belt network, lane belt network, and road structures and equipment for connected and automated driving systems;

— TransferZoneNetwork: information concerning place and connected network for transferring with the transport network;

— RoadNetwork: static road data using linear network modelling;

— PublicTransportationNetwork: static network data for the public transportation system;

— BicyclePathNetwork: static path network data for bicycle movement; and

— PedestrianPathNetwork: static path network data for pedestrian movement.

The overview of the Transportation package is shown in Figure 3.

The TransferZoneNetwork package and the RoadNetwork package are defined in ISO 14296. The RoadNetwork package contains features represented by links and nodes, in multiple levels corresponding to the concept of different map scales. The features in the MHAD package can be related to road features such as RoadElement, Intersection, IntersectionLink, IntersectionConnectionPoint and Lane in the RoadNetwork package and are described in Clause D.2.

This document only defines the specifications of features in the MHAD package.

Key
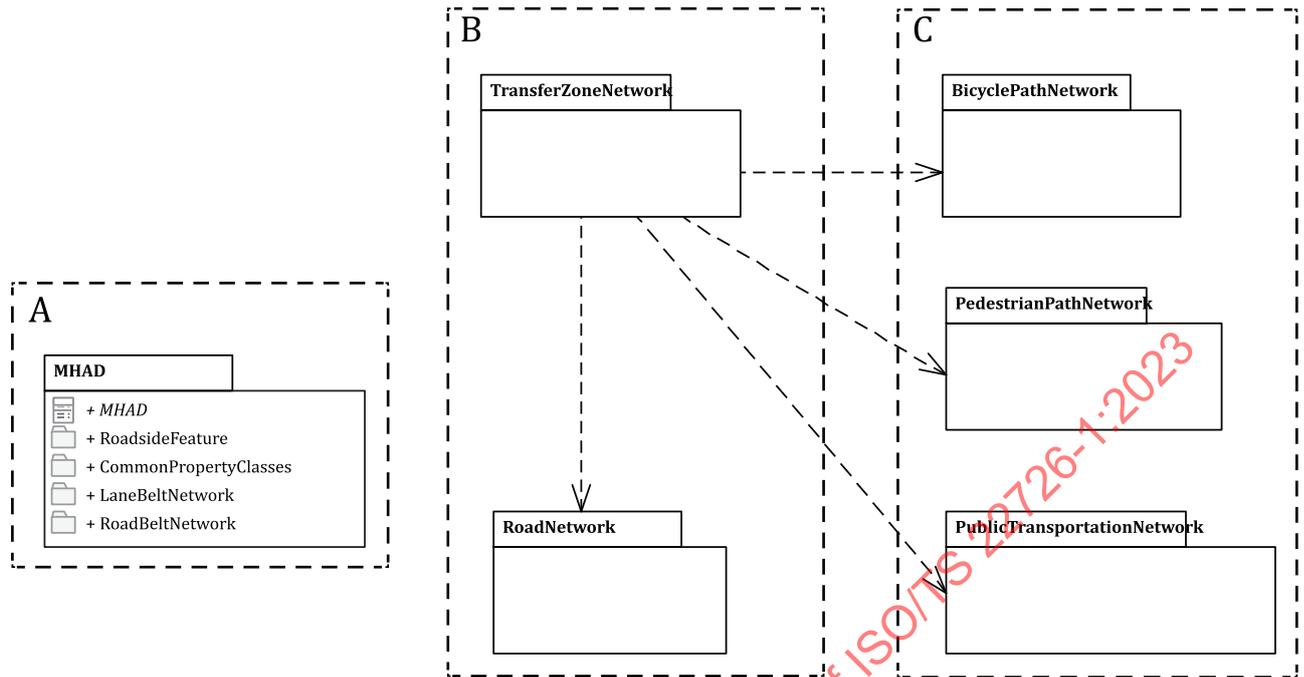
A   ISO/TS 22726-1 (this document)

B   ISO 14296

C   other standards

Figure 3 — Transportation package

7.3   MHAD package

7.3.1   General

7.3.1.1   Configuration of MHAD package

A connected and/or automated driving system requires the road belt network data, the lane belt network data and the road structures and equipment data related to road features. The MHAD represents the data model for a static map of the road and consists of the following packages:

— RoadBeltNetwork package — defines belt features and relevant features which compose road-level networks;

— LaneBeltNetwork package — defines belt features and relevant features which compose lane-level networks;

— RoadStructureAndEquipment package — defines road structures and road equipment which are related to road-level and/or lane-level networks;

— CommonPropertyClasses package — defines the data classes commonly used in multiple sub-packages belonging to the MHAD package.

Figure 4 shows the package configuration of the MHAD package.

The MHAD package contains an MHAD class which is defined as the root class for the entire package.
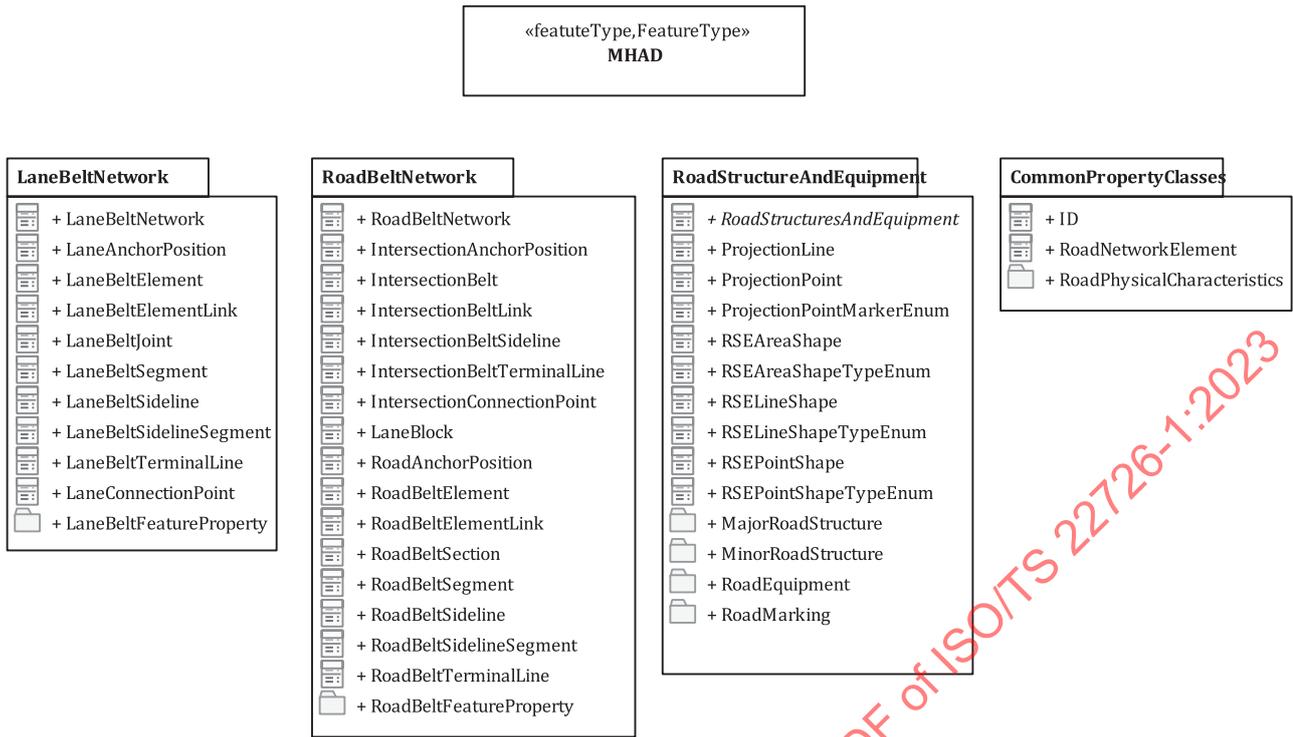
Figure 4 — MHAD package diagram

Figure 5 shows the classes and relationships for expressing the hierarchical model of the MHAD package.
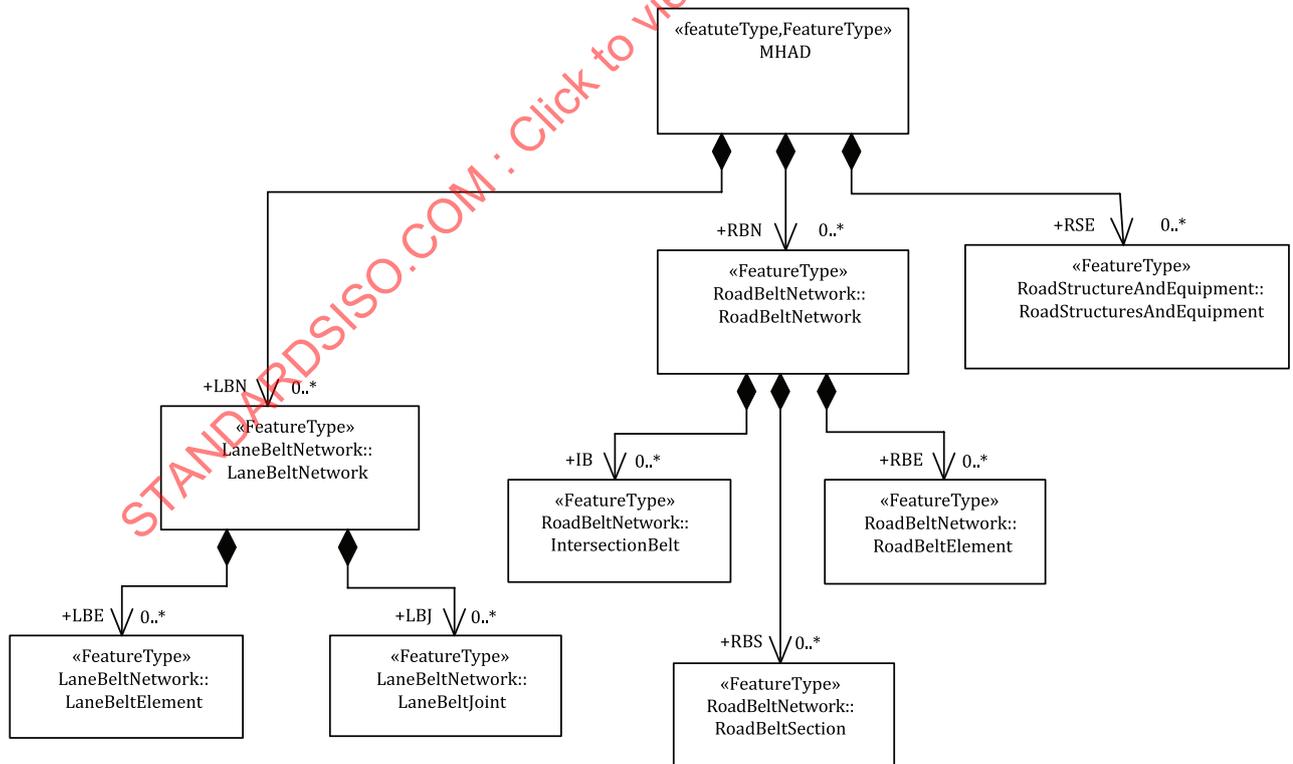
Figure 5 — Class diagram of MHAD package

7.3.1.2 Belt concept for roadway, intersection and lane

Roadways and intersections are expressed by lines and points in conventional road network data models. However, emerging ITS applications (e.g. lane keeping for C-ITS and automated driving systems) require highly defined information that enables the vehicle to identify where it is driving in a lane, and in which lane it is allowed to drive in order to overtake other vehicles.

To provide such information, road features, such as the roadway, intersections and lanes need to be expressed by specific area features which have characteristics implying directions and/or trajectories of moving vehicles. An instance of this specific area feature is transformed into a directed line that corresponds to a possible directed trajectory of regular vehicle movement when it is degenerated by means of a mathematical morphology transformation.

A conventional data model enables a vehicle to identify in which road and/or lane it is driving. However, an area feature in the conventional data model merely expresses a space for free motion and does not imply any specific directions. Thus, the area feature in the conventional data model does not meet the requirements of emerging ITS applications.

The "belt concept" and belt features specified in ISO 20524-2 meet the recommendation that roads, intersections and lanes should be represented by a specific area feature with the directions defined as their characteristics. As illustrated in Figure 6, a belt feature is a specific area feature which is bounded by a combination of side lines and terminal lines.

In the case of a road [Figure 6 a)], a belt has at least one directional characteristic, the "direction". Additionally, the belt can have other characteristics which include the widths of the belt that are calculated as the distance between a pair of side lines for that belt. The value width should be associated with a measure on the degenerated line representing the belt feature.

The terminal lines define the characteristics of the belt direction. In the case of an intersection [Figure 6 b)], a belt has at least two directional characteristics. Widths of a belt are calculated as the distance between a pair of side lines which determine both sides of the belt except in an intersection.

In the belt data model, terminal lines are conceptually represented and assumed to function as "directional control valves" at both ends of a flow. Side lines are also conceptually represented and can refer to real road-related objects (e.g. lane markings, flow-markings, kerbs, guardrails, etc.).

a) Road   b) Intersection
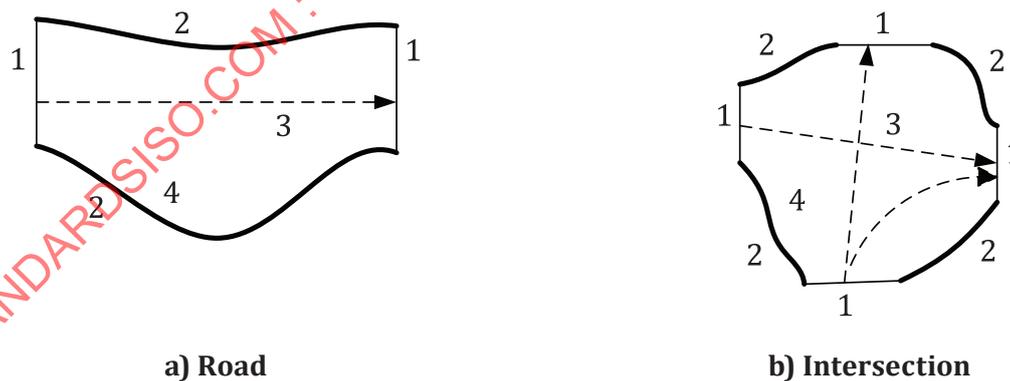
Key

1	terminal line	3	direction
2	side line	4	belt

Figure 6 — Example of belt structure

In the MHAD package, road features are instantiated as features in a RoadBeltNetwork package and a LaneBeltNetwork package.

7.3.1.3 Relationship between road feature and road structures and equipment feature

In the real world, there are various features located at or along roads such as road markings, traffic signals, kerbs, manholes, fences, walls, guardrails and poles. These features are referred to as road structures or road equipment and are instantiated as features in the RoadStructureAndEquipment package in MHAD.

As road structures and road equipment are located at or along a road, they can have relationships with road features such as those defined by the RoadBeltNetwork package and the LaneBeltNetwork package. When road structures and road equipment are interrelated, it is necessary to define the specific location on the road feature that relates to the corresponding part of the road structures and road equipment.

EXAMPLE   The outline of a kerb represents the boundary of the kerb itself and at the same time represents a part of a side line of the road feature where that kerb is located.

In the MHAD data model, road features have anchor positions that are used to associate road structures or pieces of road equipment to the road and indicate the position where the road structures and/or road equipment is anchored to the road feature.

A projection point is a point positioned on the geometry of the road structures and road equipment and associated to the anchor position. A projection line is an outline of the road structures or road equipment, partly specified by a pair of projection points. Both the projection point and project line of road structures or road equipment are designed to include traffic restrictions due to the physical properties of the road structures and road equipment, and they can be used as reference positions for positioning functions. Anchor positions are defined as RoadAnchorPosition, IntersectionAnchorPosition and LaneAnchorPosition in either a RoadBeltNetwork or LaneBeltNetwork package.

Figure 7 shows examples of the relationship of anchor positions and projection points between a RoadBeltElement and a bridge and a guardrail.
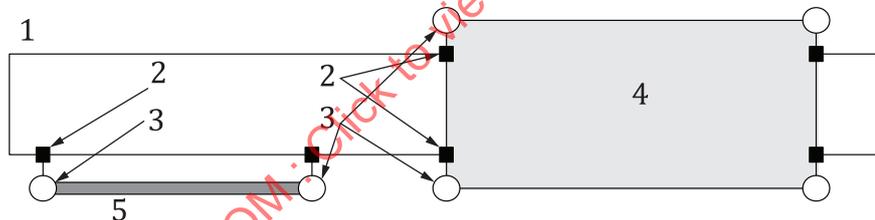
Key

1   RoadBeltElement
2   anchor position
3   projection position
4   bridge
5   guardrail

Figure 7 — Example of relationship between a road belt element and a bridge and a guardrail

7.3.1.4 MHAD class

The MHAD class is the root class of the MHAD package and has three composition relationships.

Table 1 defines the details of the MHAD class.

Table 1 — MHAD class

Class<<featureType>>: MHAD				
Definition	Dataset representing the static road network map which consists of the datasets of the road belt network, the lane belt network, and the road structures and equipment.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: RoadBeltNetwork	Specifies road belt network data.			
	RoadBeltNetwork	[0..*]		Composition relationship
role: LaneBeltNetwork	Specifies lane belt network data.			
	LaneBeltNetwork	[0..*]		Composition relationship
role: RoadStructureAnd-Equipment	Specifies road structures and equipment data.			
	RoadStructureAndEquipment	[0..*]		Composition relationship

7.3.2 RoadBeltNetwork package

7.3.2.1 General

7.3.2.1.1 Configuration of RoadBeltNetwork package

The RoadBeltNetwork package defines the road features of carriageways and intersections represented by the belt concept.

The RoadBeltNetwork package consists of:

— RoadBeltNetwork,

— RoadBeltElement,

— RoadBeltElementLink,

— RoadBeltSideLine,

— RoadBeltSideLineSegment,

— RoadBeltTerminalLine,

— RoadBeltSegment,

— RoadAnchorPosition,

— IntersectionBelt,

— IntersectionBeltLink,

— IntersectionSideLine,

— IntersectionTerminalLine,

— IntersectionConnectionPoint,

— IntersectionAnchorPosition,

— RoadBeltSection, and

— LaneBlock.

Figure 8 shows the classes and relationships of road features in the RoadBeltNetwork package (see https://standards.iso.org/iso/ts/22726/-1/ed-1/en for an enlarged version of this figure).

Additionally, the RoadBeltNetwork package contains a RoadBeltFeatureProperty package which defines the properties used in the road feature belonging to the RoadBeltNetwork.

Figure 8 — RoadBeltNetwork package

7.3.2.1.2 Modelling policy of RoadBeltNetwork

A RoadBeltNetwork is a class and is specified as the root class of the RoadBeltNetwork package, supporting a hierarchical model. A RoadBeltNetwork class has composition relationships to:

— IntersectionBelt,

— RoadBeltElement, and

— RoadBeltSection.

The network of RoadBeltNetwork consists of the IntersectionBelts, RoadBeltElements and relationships between IntersectionBelt and RoadBeltElement. It is also a networking concept in ISO 20524-2. Additionally, RoadBeltElement has composition relationships to:

— RoadBeltSideLine,

— RoadBeltTerminalLine,

— RoadBeltSegment,

— RoadBeltElementLink,

— LaneBlock, and

— RoadAnchorPosition.

An IntersectionBelt has composition relationships to:

— IntersectionBeltSideLine,

— IntersectionBeltTerminalLine,

— IntersectionBeltLink,

— LaneBlock, and

— IntersectionAnchorPosition.

The composition relationships listed above accommodate the requirements of ADS applications which are enabled to easily and quickly access properties of the road feature side lines and links as the vehicle moves.

Figure 9 shows the configurations of RoadBeltElement and IntersectionBelt.

A RoadBeltElement consists of two RoadBeltSideLines, two RoadBeltTerminalLines and a RoadBeltElementLink. The physical domain of a RoadBeltElement is defined by property data of RoadBeltSideLines and RoadBeltTerminalLines.

A RoadBeltElementLink is a feature that corresponds to the geometry data of a RoadBeltElement when it is degenerated by means of mathematical morphology transformations.

The first RoadBeltSideLine represents the right-side line with reference to the forward direction of RoadBeltElement while the second RoadBeltSideLine represents the left side line. The direction of the RoadBeltElement is determined by a pair of RoadBeltTerminalLines. The first RoadBeltTerminalLine represents the origin of the forward direction of RoadBeltElement and the second RoadBeltTerminalLine represents the destination.

The starting point of a RoadBeltElementLink is referred to as "the first point" and is located on the first RoadBeltTerminalLine and the ending point of each RoadBeltElementLine is referred to as "the second point" and is located on the second RoadBeltTerminalLine.

RoadBeltElements and IntersectionBelts are connected by their respective TerminalLines. A RoadBeltElement should be connected to a pair of IntersectionBelts, but a RoadBeltElement connected to the same IntersectionBelt, i.e., a circular RoadBeltElement, shall not be permitted.

An IntersectionBelt is distinguished as either a basic belt type or thin belt type according to the area of an intersection. A configuration example of a thin belt type IntersectionBelt is shown in Figure 9 d).

An IntersectionBelt that is connected to the first RoadBeltTerminalLine of a RoadBeltElement is referred to as the first IntersectionBelt for that RoadBeltElement. When another IntersectionBelt connected the RoadBeltElement is referred to as the second IntersectionBelt for that RoadBeltElement. The forward direction of a RoadBeltElement is specified as the direction from the first RoadBeltTerminalLine moving toward the second RoadBeltTerminalLine.

The traffic direction in the real world can be defined with reference to the direction of the RoadBeltElement. The traffic flow direction identified by key element "1", illustrated in Figure 9 a), is opposite to the belt direction. The traffic flow direction identified by key element "2" is the same direction as the belt direction.

a) RoadBeltElement

b) IntrsectionBelt (basic type) with IntersectionConnectionPoints defined inside IntersectionBelt

c) IntersectionBelt (basic type) without IntersectionConnectionPoints defined inside IntersectionBelt

d) IntersectionBelt (thin type)
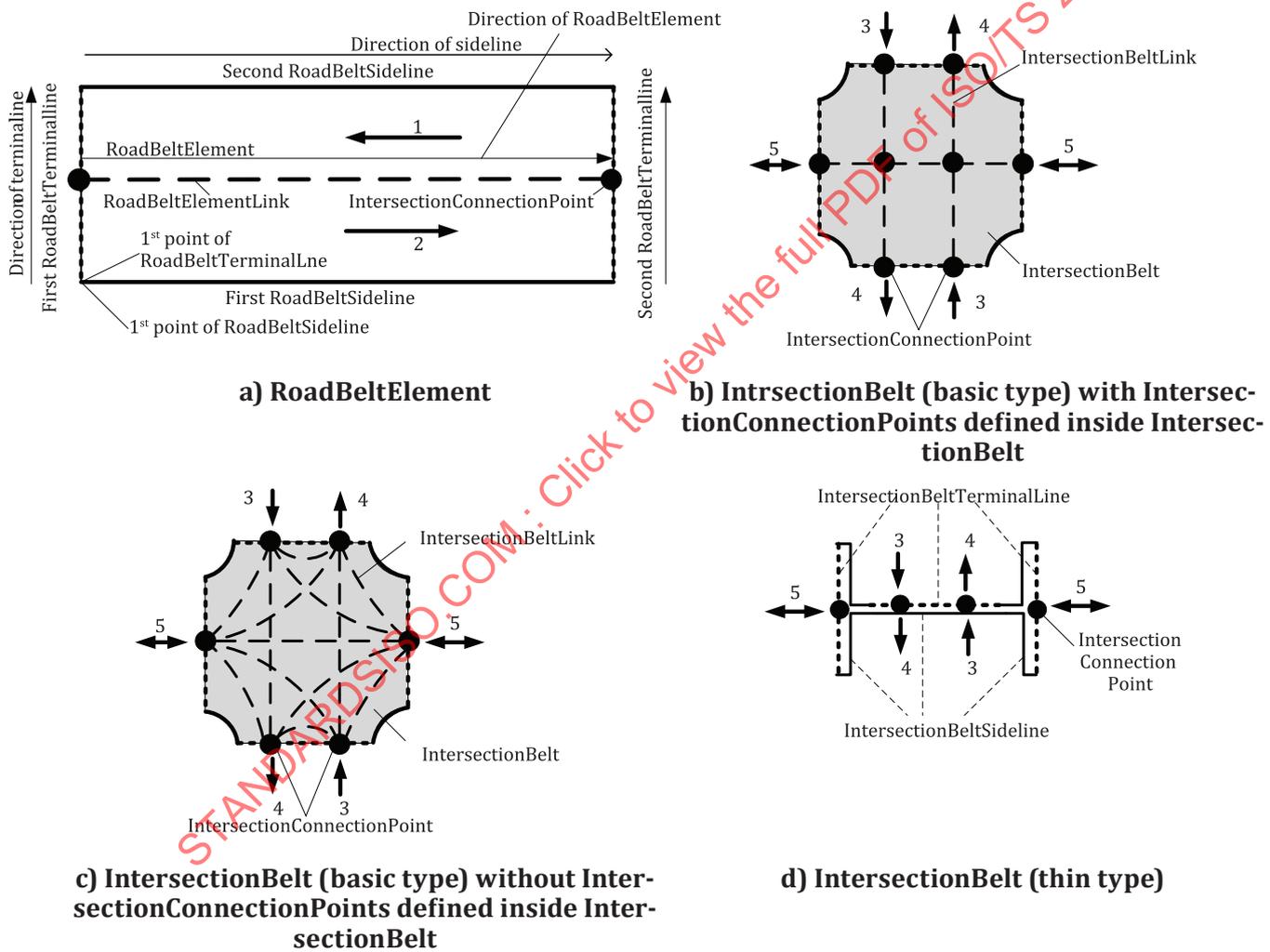
Key

1 - 5   traffic flow direction

Figure 9 — RoadBeltElement and IntersectionBelt with relevant features defined in RoadBeltNetwork package

IntersectionBeltSideLines and IntersectionBeltTerminalLines are connected in a counterclockwise chain and can be specified by the sequence number.

An IntersectionBeltLink is a feature that represents a linear representation generated by the degeneration of the Intersection Belt and is equivalent to a link in a linear network model. The degeneration is carried out by means of a mathematical morphology transformation.

An IntersectionConnectionPoint can be defined inside an IntersectionBelt. Figure 9 b) and Figure 9 c) illustrate examples of two distinct definitions of an IntersectionBeltLink depending on whether or not the IntersectionConnectionPoints are defined inside the IntersectionBelt.

The traffic direction inside an IntersectionBelt can be defined by the traffic flow direction (entering/exiting) with reference to the RoadBeltElementLink located on the IntersectionConnectionPoint on the terminal lines of the IntersectionBelt. The traffic flow direction identified by key element "3", illustrated in Figure 9 b) and Figure 9 c), is entering into the IntersectionBelt. The traffic flow direction identified by key element "4" is exiting from the IntersectionBelt. The traffic flow direction identified by key "5" is bidirectional, meaning both entering and exiting flows to the IntersectionBelt.

In implementations of ADS applications, the traffic flow direction of the carriageway should be specified with reference to the direction of the RoadBeltElement. Figure 10 describes an example of the configuration of the traffic flow direction and the direction of RoadBeltElement.

In a one-way road, illustrated in Figure 10 a), when the traffic flow direction is in the same direction as the RoadBeltElement, it should be referred to as "forward direction".

Conversely traffic flow direction opposite to the direction of the RoadBeltElement should be referred to as "reverse direction".

NOTE 1   Specifically, the traffic flow direction identified by key element "1" illustrated in Figure 10 a) is defined as the forward direction, key element "A_1" with reference to the direction of key element "A". The traffic direction key element "1" is specified as the reverse direction, key element "B_1" with reference to the direction of key element "B".

In a two-way road illustrated in Figure 10 b), the traffic flow direction should be referred to as bidirectional. Each traffic flow direction is identifiable with reference to the direction of the RoadBeltElement.

NOTE 2   Specifically, the traffic flow direction in a two-way carriageway, identified by both key element "1"and key element "2", Figure 10 b), is specified as bidirectional (key element "C_{12}"). The traffic flow direction identified by key element "1" or key element "2" is identifiable as the forward or reverse direction with reference to the direction of key "C".

a) One-way road   b) Two-way road
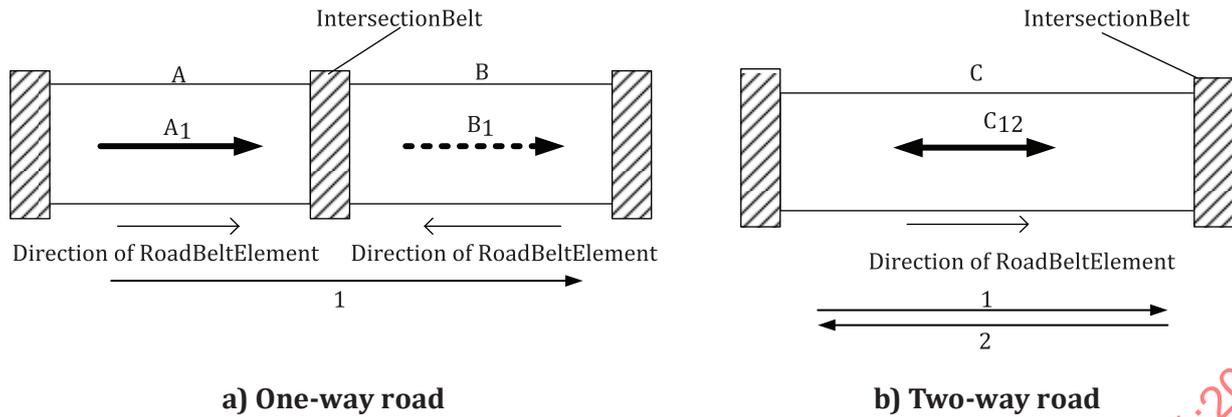
Key

1 and 2   traffic flow direction in the real world

A, B and C   RoadBeltElement

A_1, B_1, and C_{12} description of the traffic flow direction specified with reference to the direction of Road-
              BeltElement

Figure 10 — Relation between the traffic flow direction and the direction of RoadBeltElement

When existing on the same vertical level, an IntersectionBelt should not overlap any IntersectionBelts and any RoadBeltElements. A RoadBeltElement can overlap with adjacent RoadBeltElements for branching or merging.

7.3.2.2   RoadBeltNetwork

RoadBeltNetwork class is a class that may be instantiated and represents a branch class having only three composition relationships and used for expressing the hierarchical model.

Table 2 defines the details of the RoadBeltNetwork class.

Table 2 — RoadBeltNetwork class

Class<<featureType>>: RoadBeltNetwork				
Definition	Dataset representing the road network which consists of the datasets of the road belt element, intersection belt and road belt section.			
Role/Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
role: RoadBeltElement	Specifies data in a road belt element belonging to the road belt network.			
	RoadBeltElement	[0..*]		Composition relationship
role: IntersectionBelt	Specifies data in an intersection belt belonging to the road belt network.			
	IntersectionBelt	[0..*]		Composition relationship
role: RoadBeltSection	Specifies data in a road belt section belonging to the road belt network.			
	RoadBeltSection	[0..*]		Composition relationship

7.3.2.3   IntersectionAnchorPosition

IntersectionAnchorPosition is defined on IntersectionBeltSideLines and IntersectionBeltTerminalLines depending on the position of a projection point of RoadStructureAndEquipment.

Table 3 defines the details of IntersectionAnchorPosition class.

Table 3 — IntersectionAnchorPosition class

Class<<featureType>>: IntersectionAnchorPosition				
Definition	Feature that represents the anchor position used to relate road structures and road equipment with the intersection belt.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: RSE	Specifies a road structure or a piece of road equipment data linked with the intersection anchor position.			
	RoadStructureAndEquipment	[1..*]		Association relationship
distanceToIAP	Distance from the first point of the intersection belt terminal line or the intersection belt side line to the intersection anchor position.			
	Length	[1]		
coordinateOfIAP	Coordinates of the intersection anchor position.			
	DirectPosition	[1]		
anchoringInformation	Anchoring information of the road structure or a piece of road equipment.			
	AnchoringInformation	[1..*]		

7.3.2.4 IntersectionBelt

IntersectionBelt does not contain geometry data because IntersectionBeltSideLines and IntersectionBeltTerminalLines contain geometry data.

Table 4 defines the details of the IntersectionBelt class.

Table 4 — IntersectionBelt class

Class<<featureType>>: IntersectionBelt				
Definition	Road belt feature which represents the intersecting part of a road where one road is split into two or more roads or where roads merge into one road, or a roundabout.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: RBE	Specifies a road belt element connected to the intersection belt.			
	RoadBeltElement	[1..*]		Association relationship
role RBS	Specifies a road belt section including the intersection belt.			
	RoadBeltSection	[0..*]		Association relationship
role: LB	Specifies a lane block located in the intersection belt.			
	LaneBlock	[0..*]		Composition relationship {ordered} [a]
role: IBL	Specifies an intersection belt link existing in the intersection belt.			
	IntersectionBeltLink	[0..*]		Composition relationship
role: IBSd	Specifies an intersection belt side line in the intersection belt.			
	IntersectionBeltSideLine	[0..*]		Composition relationship
[a] The order of LaneBlock is counted by the sequence of IntersectionBeltTerminalLine for grouping by connected ingress (or egress) RoadBeltElement.				
[b] The intersection name can be different for each approach road at the intersection. In such cases, the intersection names are given in each IntersectionBeltTerminalLine.				

Table 4 *(continued)*

role: IBTr	Specifies an intersection belt terminal line in the intersection belt.			
	IntersectionBeltTreminal-Line	[0..*]		Composition relationship
role: IAP	Specifies an intersection anchor position located in the intersection belt.			
	IntersectionAnchorPosi-tion	[0..*]		Composition relationship
intersectionType	Type of an intersection.			
	IntersectionTypeEnum	[1]		
intersectionNational-Class	Class of an intersection based on a national classification.			
	RoadNationalClassList	[0..1]		
intersectionName	Name of the intersection.			
	CharacterString	[0..1]		b
representativePoint	Central point of the intersection belt.			
	DirectPosition	[0..1]		

a   The order of LaneBlock is counted by the sequence of IntersectionBeltTerminalLine for grouping by connected ingress (or egress) RoadBeltElement.

b   The intersection name can be different for each approach road at the intersection. In such cases, the intersection names are given in each IntersectionBeltTerminalLine.

7.3.2.5   IntersectionBeltLink

Both ends of an IntersectionBeltLink should be located at the IntersectionConnectionPoint defined on the IntersectionBeltTerminalLine.

If the IntersectionConnectionPoints are defined within the IntersectionBelt, the IntersectionBeltLink can be located at these inner IntersectionConnectionPoints.

In the case that an IntersectionBeltLink can be equivalent to an IntersectionLink defined in RoadNetwork package, an IntersectionBeltLink can be associated with an IntersectionLink.

An IntersectionConnectionPoint located at the starting point of the IntersectionBeltLink is designated as the first IntersectionConnectionPoint, and an IntersectionConnectionPoint located at the end point of the IntersectionBeltLink is designated as the second IntersectionConnectionPoint.

Table 5 defines the details of the IntersectionBeltLink class.

Table 5 — IntersectionBeltLink class

Class<<featureType>>: IntersectionBeltLink				
Definition	Feature that represents a linear representation generated by the degeneracy of the intersection belt equivalent to a link in a linear network model in an intersection.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: ICP	Specifies the first and the second intersection connection points connected to the intersection belt link.			
	IntersectionConnection-Point	[2]		Association relationship {ordered}
trafficDirection	Direction of traffic flow of the intersection belt link.			
	TrafficDirectionEnum	[1]		
linkLength	Length of the intersection belt link shape.			
	Length	[0..1]		

Table 5 *(continued)*

linkTravelTime	Estimated travel time for passing through the intersection belt link.			
	TimeMeasure	[0..*]		
linkShapeData	Geometry data of the intersection belt link.			
	LineData	[1]		

7.3.2.6 IntersectionBeltSideLine

IntersectionBeltSideLines and IntersectionBeltTerminalLines are chained in a counterclockwise direction. Therefore, the start point of an IntersectionBeltSideLine is located at the starting side of the chain.

Table 6 defines the details of the IntersectionBeltSideLine class.

Table 6 — IntersectionBeltSideLine class

Class<<featureType>>: IntersectionBeltSideLine				
Definition	Feature which represents the side line of an intersection belt.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: IAP	Specifies an intersection anchor position on the intersection belt side line.			
	IntersectionAnchorPosition	[0..*]		Composition relationship
shapeData	Geometry data of the intersection belt side line.			
	LineData	[1]		
sequenceNumber	Sequence number of an intersection belt side line that is comprised in the intersection belt outline. This number is defined in a counterclockwise direction.			
	Integer	[1]		

7.3.2.7 IntersectionBeltTerminalLine

IntersectionBeltSideLines and IntersectionBeltTerminalLines are chained in a counterclockwise direction. Therefore, the start point of an IntersectionBeltTerminalLine is located at the starting side of the chain.

Table 7 defines the details of the RoadBeltTerminalLine class.

Table 7 — IntersectionBeltTerminalLine class

Class<<featureType>>: IntersectionBeltTerminalLine				
Definition	Feature which represents the terminal line of an intersection belt.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: ICP	Specifies an intersection connection point that exists on the intersection belt terminal line.			
	IntersectionConnectionPoint	[1..*]		Composition relationship
role: RBTr	Specifies a road belt terminal line connected to the intersection belt terminal line.			
	RoadBeltTerminalLine	[1..*]		Association relationship
role: IAP	Specifies an intersection anchor position on the intersection belt terminal line.			
	IntersectionAnchorPosition	[0..*]		Composition relationship

Table 7 *(continued)*

shapeData	Geometry data of the intersection belt terminal line.			
	LineData	[1]		
sequenceNumber	Sequence number of an intersection belt terminal line that is part of the intersection belt outline. This number is defined in a counterclockwise direction.			
	Integer	[1]		
intersectionName	Usual name of an intersection based on the road entering the intersection.			
	CharacterString	[0..1]		

7.3.2.8   IntersectionConnectionPoint

An IntersectionConnectionPoint is defined on an IntersectionBeltTerminalLine of an IntersectionBelt for representing the connection between a RoadBeltElementLink and an IntersectionBeltLink. An IntersectionConnectionPoint can be defined within an IntersectionBelt for representing the connection between IntersectionBeltLinks. The location of an IntersectionConnectionPoint can be specified by degenerating the IntersectionBeltTerminalLine into a point geometry.

Table 8 defines the details of the IntersectionConnectionPoint class.

Table 8 — IntersectionConnectionPoint class

Class<<featureType>>: IntersectionConnectionPoint				
Definition	Feature that represents a connection point joining a road belt element link to an intersection belt link or adjoining road belt element links, or that connects an intersection belt link to adjoining road belt element links or other intersection belt links.			
Role/Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
role: IBL	Specifies an intersection belt link connected to the intersection connection point.			
	IntersectionBeltLink	[0..*]		Association relationship
role: RBEL	Specifies a road belt element link connected to the intersection connection point.			
	RoadBeltElementLink	[0..*]		Association relationship
role: connectedOther-ICP	Specifies another intersection connection point in the same intersection, connected to the intersection connection point.			
	IntersectionConnectionPoint	[0..*]		Association relationship
iCPPositionCategory	Position category where the intersection connection point exists.			
	ICPPositionCategoryEnum	[1]		
coordinatesOfICP	Coordinates of the intersection connection point.			
	DirectPosition	[1]		
distanceToICP	Distance from the first point of the intersection belt terminal line where this intersection connection point is located.			
	Length	[0..1]		If ICPPositionCategory is an 'internalPoint', it is omitted.

IntersectionConnectionPoint ensures the linear network connectivity between a RoadBeltElementLink and an IntersectionBeltLink, between RoadBeltElementLinks, and between IntersectionBeltLinks by specifying the association. An IntersectionConnectionPoint should have at least one association with either RoadBeltElementLink or IntersectionBeltLink.

When creating networks without IntersectionBeltLink inside IntersectionBelt, the linear network connectivity inside the IntersectionBelt can be provided by means of the association ("*Role name:* connectedOtherICP").

The association "*Role name:* connectedOtherICP" implies a direct network connection from the current IntersectionConnectionPoint to other IntersectionConnectionPoints specified by the association role.

7.3.2.9   LaneBlock

An Individual LaneBlock is associated to either a RoadBeltElement or an IntersectionBelt.

A LaneBlock in relation to RoadBeltElement provides information on a group of LaneBeltElement defined in an entire RoadBeltElement. RoadBeltElement or a segment thereof. A RoadBeltElement can be semantically partitioned at the following locations:

— where a RoadBeltElement connects to an IntersectionBelt (i.e. terminal line of RoadBeltElement);

— where the number of lanes begins to increase (or decrease);

— where the number of lanes finishes to increase (or decrease);

— where an important characteristic change of a RoadBeltElement regarding lanes begins and ends;

   EXAMPLE   A junction (branching/merging), the beginning (or end) of the narrowing (or widening) of the road width, the border of freely accessible area in front of (or behind) the tollgate, etc.

— where an important characteristic change of RoadBeltElement regarding lanes is completed.

LaneBeltElement should be defined inside each segment when RoadBeltElement is divided into multiple segments by above conditions. This means inevitably that RoadBeltElement can be segmented by the following characteristics based on the composition of a LaneBeltElement:

— invariable in the number of lanes;

— homogeneous; and/or

— altered by either branching, merging, narrowing or widening.

Three examples of a LaneBlock (LS11, LS12 and LS13) in relation to RoadBeltElement (RBE01) are shown in Figure 11 a). LS11 is defined between the terminal line of RBE01 and the location where the number of lanes begins to increase (or the point where the decreasing number of lanes is completed). LS12 is defined in the segment where the characteristic of the RoadBeltElement changes, e.g. the road width changes, and the lane is widening (or narrowing). LS13 is defined between the terminal line of RBE01 and the location where the road width change is complete (or begins). A LaneBlock in the RoadBeltElement can be defined for each traffic flow direction.

A LaneBlock in relation to an IntersectionBelt provides information on a group of LaneBeltElements defined inside the IntersectionBelt. All LaneBeltElements inside an IntersectionBelt can be defined as one LaneBlock, or a group of LaneBeltElements for each ingress (or egress) RoadBeltElement connected to the IntersectionBeltTerminalLine can be defined as one LaneBlock.

An example of LaneBlock (LB21) in relation to an IntersectionBelt (IB11) is shown in Figure 11 b). LB21 is defined as a group of four LaneBeltElements (i.e. LBE51, LBE52, LBE53 and LBE54) related to IntersectionBeltTerminalLine and connected at ingress RoadBeltElement (RBE41).

Lane Block LB11 | Lane Block LB12 | Lane Block LB13
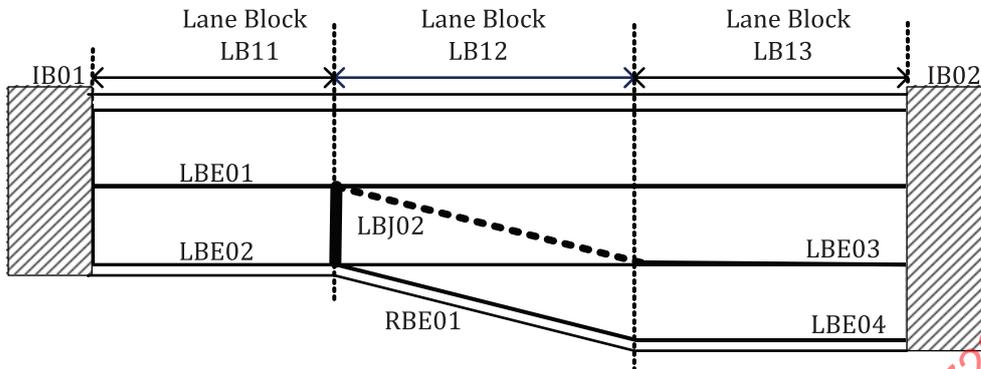
a) LaneBlock for RoadBeltElement
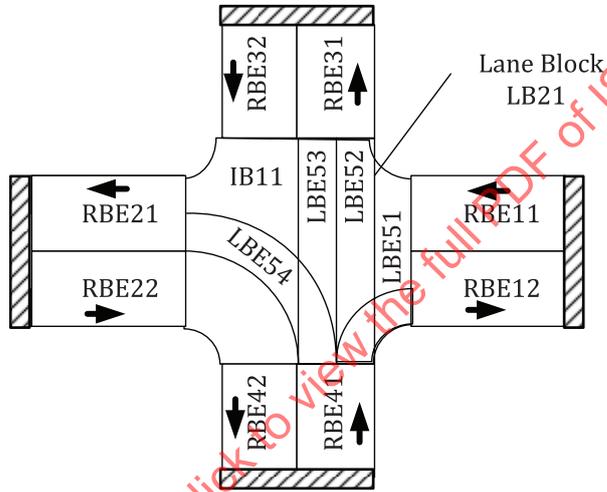
b) LaneBlock for IntersectionBelt

Figure 11 — Example of LaneBlock for RoadBeltElement and IntersectionBelt

Table 9 defines the details of the LaneBlock class.

Table 9 — LaneBlock class

Class<<featureType>>: LaneBlock				
Definition	Feature which represents a group of lane belt elements in a defined area, either a whole road belt element, a segment of road belt element, or whole intersection belt.			
Role/Attribute name	**Definition**			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: LBE	Specifies a lane belt element belonging to the lane block.			
	LaneBeltElement	[1..*]		Association relationship
laneBlockType	Type of lane block where either a road or intersection exists.			
	LaneBlockTypeEnum	[1]		
numberOfLane	The number of lanes in the lane block.			
	Integer	[1]		

Table 9 *(continued)*

laneBlockInRBE	Properties of a lane block that exists in a road belt element.			
	LaneBlockInRBE	[0..1]		it occurs when LaneBlock-Type is "in RBE"
idOfIntersectionBelt-TerminalLine	Identifier of an intersection belt terminal line, specified as either ingress or egress, and used for grouping lane belt elements in an intersection belt.			
	ID	[0..1]		it occurs when Lane-Block Type is "ingress" or "egress"

7.3.2.10 RoadAnchorPosition

The RoadAnchorPosition for a RoadBeltElement is located on a RoadBeltSideLine, a RoadBeltTerminalLine, and/or a RoadBeltElementLink depending on the location of either the Projection point or a Projection line of a RoadStructureAndEquipment class.

Table 10 defines the details of RoadAnchorPosition class.

Table 10 — RoadAnchorPosition class

Class<<featureType>>: RoadAnchorPosition				
Definition	Feature which represents the anchor position to associate road structure or a piece of road equipment with the road belt element.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: RSE	Specifies a road structure or a piece of road equipment associated to the road anchor position.			
	RoadStructureAndE-quipment	[1..*]		Association relationship
distanceToRAP	Distance from the first point of the road belt side line, road belt terminal line or road belt element link to the anchor position.			
	Length	[1]		
coordinateOfRAP	Coordinates of the road anchor position.			
	PointData	[1]		
anchoringInformation	Anchoring information of the road structure and/or a piece of road equipment.			
	AnchoringInformation	[1..*]		

7.3.2.11 RoadBeltElement

A RoadBeltElement has no geometry data for the defining area, because a RoadBeltSideLine and a RoadBeltTerminalLine have geometry data.

Table 11 defines the details of the RoadBeltElement class.

Table 11 — RoadBeltElement class

Class<<featureType>>: RoadBeltElement	
Definition	Road belt feature which represents a part of a road, excluding intersections, which is used for the movement of vehicles.

a   The order of LaneBlock is counted from first terminal line of RBE.

b   The order of RoadBeltSegment is counted from first terminal line of RBE.

c   The order of RoadAnchorPosition is counted by order of BeltLineCategory of line and the distance from first point of its line.

Table 11 *(continued)*

Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: IB	Specifies the first or the second intersection belt connected to the road belt element.			
	IntersectionBelt	[2]		Association relationship {ordered}
role: RBS	Specifies a road belt section that includes the road belt element.			
	RoadBeltSection	[0..*]		Association relationship
role: LB	Specifies a lane block located in a road belt element.			
	LaneBlock	[1..*]		Composition relationship {ordered} [a]
role: overlappingRBE	Specifies an adjacent road belt element overlapping the road belt element.			
	RoadBeltElement	[0..*]		Association relationship
role: RBEL	Specifies a road belt element link of the road belt element.			
	RoadBeltElementLink	[0..1]		Composition relationship
role: RBSd	Specifies a road belt side line belonging to the road belt element.			
	RoadBeltSideLine	[2]		Composition relationship {ordered}
role: RBTr	Specifies a road belt terminal lines of the road belt element.			
	RoadBeltTerminalLine	[2]		Composition relationship {ordered}
role: RBSg	Specifies a road belt segment located in the road belt element.			
	RoadBeltSegment	[0..*]		Composition relationship {ordered} [b]
role: RAP	Specifies a road anchor position located on the road belt element.			
	RoadAnchorPosition	[0..*]		Composition relationship {ordered} [c]
roadNationalClass	Class of a road based on a national classification.			
	RoadNationalClassList	[0..1]		
formOfWay	Code representing the form of way.			
	FormOfWayList	[0..1]		
length	Length between the first and second terminal line along a central line.			
	Length	[1]		
trafficDirection	Direction of traffic flow of the road belt element.			
	TrafficDirectionEnum	[1]		
areaType	Category of a specific area where a road exists.			
	AreaTypeList	[0..*]		
[a] The order of LaneBlock is counted from first terminal line of RBE.				
[b] The order of RoadBeltSegment is counted from first terminal line of RBE.				
[c] The order of RoadAnchorPosition is counted by order of BeltLineCategory of line and the distance from first point of its line.				

7.3.2.12 RoadBeltElementLink

RoadBeltElementLink should be located between IntersectionConnectionPoints located on the IntersectionTerminalLine of the adjoining IntersectionBelt.

The direction of a RoadBeltElementLink should be in the same direction as the RoadBeltElement.

Line geometry of a RoadBeltElementLink can be specified by degenerating a RoadBeltElement into a line geometry.

An IntersectionConnectionPoint is located at the starting point of a RoadBeltElementLink and is designated as the first IntersectionConnectionPoint. The IntersectionConnectionPoint located at the end point of a RoadBeltElementLink is designated as the second IntersectionConnectionPoint.

Table 12 defines the details of the RoadBeltElementLink class.

Table 12 — RoadBeltElementLink class

Class<<featureType>>: RoadBeltElementLink				
Definition	Feature which represents a linear representation generated by the degeneracy of road belt element, which is equivalent to the link of a linear network model.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: ICP	Specifies the first or the second intersection connection points connected to the road belt element link.			
	IntersectionConnection-Point	[2]		Association relationship {ordered}
role: RAP	Specifies a road anchor position on the road belt element link.			
	RoadAnchorPosition	[0..*]		Composition relationship
trafficDirection	Direction of traffic flow of the road belt element link.			
	TrafficDirectionEnum	[1]		
linkLength	Length of the line shape of the road belt element link.			
	Length	[0..1]		
linkTravelTime	Estimated travel time for passing through the link.			
	TimeMeasure	[0..1]		
linkShapeData	Geometry data of the road belt element link.			
	LineData	[1]		

7.3.2.13 RoadBeltSection

A RoadBeltSection is a dataset which represents one route such as an avenue/street or a detour and where RoadBeltElements and IntersectionBelts are located in series.

Both ends of a RoadBeltSection should be IntersectionBelts. All RoadBeltElements that compose a RoadBeltSection shall support appropriate traffic direction of the RoadBeltSection to enable continuity of flow of traffic from start to end of the RoadBeltSection. If traffic direction does not support the flow throughout the RoadBeltElement, the RoadBeltElement shall not be adopted in the configuration of the RoadBeltSection. If the traffic direction of the RoadBeltSection is bidirectional, all constituent RoadBeltElements should be bidirectional.

Table 13 defines the details of the RoadBeltSection class.

Table 13 — RoadBeltSection class

Class<<featureType>>: RoadBeltSection
[a]   The order of RoadBeltElement is counted from the starting RBE because RoadBeltSection consists of a sequence of IBs and RBEs.
[b]   The order of IntersectionBelt is counted from the starting IB because RoadBeltSection consists of a sequence of IBs and RBEs.
[c]   If the traffic direction of all RoadBeltElements is bidirectional, the traffic direction of RoadBeltSection is defined as bidirectional.

Table 13 *(continued)*

Definition	Feature that represents a route or a diversion to which road belt elements and inter-section belts belong.			
Role/Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
role: IB	Specifies an intersection belt comprising the road belt section.			
	IntersectionBelt	[2..*]		Association relationship {ordered} [a]
role: RBE	Specifies a road belt element comprising the road belt section.			
	RoadBeltElement	[1..*]		Association relationship {ordered} [b]
rBSCategory	Category of the road belt section.			
	RBSCategoryList	[1]		
trafficDirection	Passable direction of the road belt section. Direction is forward when travel from the first intersection to the last intersection can be passed, reverse when travel from the last intersection to the first intersection can be passed, and bidirectional when both can be passed.			
	TrafficDirectionEnum	[1]		[c]
categoryDescription	Description of category of the road belt section.			
	CharacterString	[0..*]		
length	Length from the start intersection to the last intersection.			
	Length	[1]		
[a] The order of RoadBeltElement is counted from the starting RBE because RoadBeltSection consists of a sequence of IBs and RBEs.				
[b] The order of IntersectionBelt is counted from the starting IB because RoadBeltSection consists of a sequence of IBs and RBEs.				
[c] If the traffic direction of all RoadBeltElements is bidirectional, the traffic direction of RoadBeltSection is defined as bidirectional.				

7.3.2.14 RoadBeltSegment

A RoadBeltSegment is either a segment area of RoadBeltElement surrounded by two partition lines (transversals) and two side lines or a partition line located in a RoadBeltElement. The side line is a part of RoadBeltSideLine so line shape data is omitted to avoid duplication with RoadBeltSideLine. The partition line is a straight line jointing two points on RoadBeltSideLine on both sides so line shape data is end points only. Therefore, the shape of RoadBeltSegment is represented by either two or four points. The first partition line is located at the starting side of the orientation of the RoadBeltElement and the start point of the partition line is located at the first RoadBeltSideLine.

Table 14 defines the details of RoadBeltSegment class.

Table 14 — RoadBeltSegment class

Class<<featureType>>: RoadBeltSegment				
Definition	Feature that represents a part (possibly of zero-length) of a road belt element that is distinct from other parts with respect to a particular characteristic.			
Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
hasSegmentLength	Indicates if the road belt segment has a length (true) or is zero-length (false).			
	Boolean	[1]		{true: section, false: transversal}
[a] If segment type is a line, End partition line does not exist.				
[b] If the segment characteristic applies with full width of RoadBeltElement. The item 'validatedSide' is null.				

Table 14 *(continued)*

startPointOfFirstPartitionLine	Coordinates of the start point of the first partition line that is located on the first road belt side line.			
	PointData	[1]		
endPointOfFirstPartitionLine	Coordinates of the end point of the first partition line that is located on the second road belt side line.			
	PointData	[1]		
linearLocationForStartPointOfFirstPartitionLine	Distance along first road belt side line from the first point of that road belt side line to the start point of the first partition line.			
	Length	[1]		
linearLocationForEndPointOfFirstPartitionLine	Distance along second road belt side line from the first point of that road belt side line to the end point of the first partition line.			
	Length	[1]		
startPointOfSecondPartitionLine	Coordinates of the start point of the second partition line that is located on the first road belt side line.			
	PointData	[0..1]		a
endPointOfSecondPartitionLine	Coordinates of the end point of the second partition line that is located on the second road belt side line.			
	PointData	[0..1]		a
linearLocationForStartPointOfSecondPartitionLine	Distance along first road belt side line from the first point of that road belt side line to the start point of the second partition line.			
	Length	[0..1]		
linearLocationForEndPointOfSecondPartitionLine	Distance along second road belt side line from the first point of that road belt side line to the end point of the second partition line.			
	Length	[0..1]		
validatedSide	Distinction of the side line when applying the segment properties to a portion of road belt element on either the first or second road belt side line side.			
	SideLineDistinctionEnum	[0..1]		b
roadDesignProperty	Properties of the road design.			
	RoadDesignProperty	[0..*]		
roadManagementProperty	Properties of the road management used in an ADS.			
	RoadManagementProperty	[0..*]		
roadTrafficControlProperty	Properties of the lane traffic control used in an ADS.			
	RoadDesignProperty	[0..*]		

a   If segment type is a line, End partition line does not exist.

b   If the segment characteristic applies with full width of RoadBeltElement. The item 'validatedSide' is null.

7.3.2.15 RoadBeltSideLine

Table 15 defines the details of RoadBeltSideLine class.

Table 15 — RoadBeltSideLine class

Class<<featureType>>: RoadBeltSideLine	
Definition	Feature that represents properties of a side line of a road belt element. The first point of the road belt side line is located at the first road belt terminal line.

a   The order of RoadBeltSideLineSegment is counted by the distance from the first point of RoadBeltSideLine to start point of RBSSg.

Table 15 *(continued)*

Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: RAP	Specifies a road anchor position located on the road belt side line.			
	RoadAnchorPosition	[0..*]		Composition relationship
role: RBSSg	Specifies a road belt side line segment belonging to the road belt side line.			
	RoadBeltSideLineSegment	[0..*]		Composition relationship {ordered} [a]
sideLineDistinction	Distinction that identifies the first or the second side line.			
	SideLineDistinctionEnum	[1]		
numberOfLaneBlock	The number of lane block on the road belt side line.			
	Integer	[0..1]		
numberOfRBSg	The number of the road belt segment located on the road belt side line.			
	Integer	[0..1]		
outgoingTransferPossibility	Transfer possibility of outgoing direction across a side line of a road belt element.			
	TransferPossibilityEnum	[0..1]		
incomingTransferPossibility	Transfer possibility of incoming direction across a side line of a road belt element.			
	TransferPossibilityEnum	[0..1]		
includingRoadShoulder	Indicates if a road shoulder is included (true) or not (false) in a road belt element.			
	Boolean	[1]		{true: include / false: not include}
sideLineShapeData	Geometry data of the road belt side line.			
	LineData	[1]		
[a] The order of RoadBeltSideLineSegment is counted by the distance from the first point of RoadBeltSideLine to start point of RBSSg.				

7.3.2.16 RoadBeltSideLineSegment

Table 16 defines the details of the RoadBeltSideLineSegment class.

Table 16 — RoadBeltSideLineSegment class

Class<<featureType>>: RoadBeltSideLineSegment				
Definition	Feature which represents the properties of a specific portion of road belt side line.			
Attribute name	**Definition**			
	Value type	Multiplicity	Stereotypes	Note/Constraint
distanceToFirstBorder	Distance from the first point of the road belt side line to the start point of the road belt side line segment.			
	Length	[1]		
distanceToSecondBorder	Distance from the first point of the road belt side line to the end point of the road belt side line segment.			
	Length	[0..1]		
outgoingTransferPossibility	Transfer possibility of outgoing direction of the side line segment.			
	TransferPossibilityEnum	[0..1]		
incomingTransferPossibility	Transfer possibility of incoming direction of the side line segment.			
	TransferPossibilityEnum	[0..1]		

7.3.2.17 RoadBeltTerminalLine

Table 17 defines the details of the RoadBeltTerminalLine class.

Table 17 — RoadBeltTerminalLine class

Class<<featureType>>: RoadBeltTerminalLine				
Definition	Feature which represents the terminal line of road belt element. A start point of the road belt terminal line is located at the first road belt side line.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: IBTr	Specifies an intersection belt terminal line connected to a road belt terminal line.			
	IntersectionBeltTerminalLine	[1..*]		Composition relationship
role: RAP	Specifies a road anchor position on the road belt terminal line.			
	RoadAnchorPosition	[0..*]		Composition relationship
terminalLineDistinction	Distinction that identifies the first or the second terminal line.			
	TerminalLineDistinction Enum	[1]		
terminalLineCategory	Category of the terminal line.			
	TerminalLineCategoryEnum	[1]		
shapeData	Geometry data of the road belt terminal line.			
	LineData	[1]		

7.3.2.18 RoadBeltFeatureProperty package

7.3.2.18.1 General

RoadBeltFeatureProperty package contains the properties for road belt feature classes belonging to a RoadBeltNetwork. Figure 12 shows a class diagram of RoadBeltFeatureProperty.

The RoadBeltFeatureProperty package contains a RoadBeltSegmentProperty package defining the properties of the RoadBeltSegment feature.

«DataType»
AnchoringInformation

+ projectonLineSeqNo: Integer[0..1]
+ projectonPointSeqNo: Integer [0..1]
+ anchoringType: AnchoringTypeEnum
+ featureExistenceCateory: FeatureExistenceCategoryEnum
+ distanceBetweenAPAndRP: Length

«DataType»
LaneBlockInRBE

+ laneBlockTrafficDirection: TrafficDirectionEnum
+ laneBlockLocationType: LaneBlockLocationTypeEnum
+ startPointFirstPartition: PointData [0..1]
+ endPointFirstPartition: PointData [0..1]
+ startPointFirstPartitionDistance: Length[0..1]
+ endPointFirstPartitionDistance: Length [0..1]
+ startPointSecondPartition: PointData [0..1]
+ endPointSecondPartition: PointData [0..1]
+ startPointSecondPartitionDistance: Length[0..1]
+ endPointSecondPartitionDistance: Length [0..1]
+ isContainingOverlappedLanes: Boolean

«CodeList»
FormOfWayList

+ motorway = 1
+ multipleCarriageway = 2
+ singleCarriageway = 3
+ trafficSquare = 4
+ enclosedTrafficArea = 5
+ slipRoad = 6
+ serviceRoad = 7
+ entranceExitRoadForParking = 8
+ entranceExitRoadForServiceAndPOIs = 9
+ escapeRoad = 10
+ pedestrianZone = 11

«CodeList»
RoadNatonalClassList

+ theFirstClassRoad = 1
+ theSecondClassRoad = 2
+ theThirdClassRoad = 3
+ theFourthClassRoad = 4
+ theFithClassRoad = 5
+ theSixthClassRoad = 6
+ theSeventhClassRoad = 7
+ theEighthClassRoad = 8
+ theNinthClassRoad = 9

«CodeList»
RBSCategoryList

+ referenceRoute = 1
+ highwayRoute = 2
+ streetAvenue = 3
+ specialVehicleRoute = 4
+ planedEvacuatonRoute = 5
+ plannedDetour = 6
+ plannedRoad = 7
+ scenicRoute = 8

«enumeration»
AnchoringTypeEnum

point = 1
traversalLine = 2
longitudinalLine = 3

«enumeration»
AreaTypeList

inNationalPark = 1
insideCites = 2
nearRailroadCrossing = 3
nearSchool = 4
outsideCities = 5
trafficCalmingArea = 6

«enumeration»
BeltLineCategoryEnum

firstSideline = 1
secondSideline = 2
firstTerminalLine = 3
secondTerminalLine = 4
linkLine = 5
intersectonSideline = 6
intersectionTerminalLine = 7

«enumeration»
FeatureExistenceCategoryEnum

onFirstSideline = 1
outsideFirstSideline = 2
insideFirstSideLine = 3
onSecondSideline = 4
outsideSecondSideline = 5
insideSecondSideline = 6
nearLinkline = 7
nearFirstTerminalline = 8
nearSecondTerminalline = 9
onBorderOfIntersecton = 10
insideIntersecton = 11
outsideIntersecton = 12

«enumeration»
IntersectionTypeEnum

basicBeltType = 1
thinBeltType = 2
roundaboutType = 3

«enumeration»
ICPPositionCategoryEnum

onTerminallineOfIB = 1
internalPointInIB = 2

«enumeration»
LaneBlockLocationTypeEnum

onlyOne = 1
firstBlock = 2
intermediateBlock = 3
lastBlock = 4

«enumeration»
LaneBlockTypeEnum

inRoadBeltElement = 1
inIntersectionBelt = 2
ingressIBTr = 3
egressIBTr = 4

«enumeration»
SidelineDistinctionEnum

firstSideline = 1
secondSideline = 2

«enumeration»
TerminalLineCategoryEnum

normalTerminal = 1
culDeSacTerminalD = 2

«enumeration»
TerminalLineDistinctionEnum

firstTerminalLine = 1
secondTerminalLine = 2

«enumeration»
TrafficDirectionEnum

forward = 1
reverse = 2
bidirectonal = 3

«enumeration»
TransferPossibilityEnum

shouldTransfer = 1
canTransfer = 2
considerTransferByShortObstacles = 3
canNotTransferByTheTrafficRegulaton = 4
canNotTransferByTallObstacles = 5
canNotTransferByInaccessibleSloppedZone = 6

Figure 12 — Class diagram of RoadBeltFeatureProperty

7.3.2.18.2 AnchoringInformation

Table 18 defines the details of the AnchoringInformation class.

Table 18 — AnchoringInformation class

Class<<dataType>>: AnchoringInformation				
Definition	Information about a projection point and/or projection line of a road structure or a piece of road equipment that is attached to an anchor position.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
projectionLineSeqNo	Sequence number of a projection line of the road structure or a piece of road equipment.			
	Integer	[0..1]		
projectionPointSeqNo	Sequence number of a projection point of the road structure or a piece of road equipment.			
	Integer	[0..1]		
anchoringType	Type of the anchoring characteristics of the road feature.			
	AnchoringTypeEnum	[1]		
featureExistenceCategory	Category defining where a projection point of the road structure, or a piece of road equipment exists.			
	FeatureExistenceCategoryEnum	[1]		
distanceBetweenAPAndRP	Distance between the road anchor position and a projection point of the road structure or a piece of road equipment.			
	Length	[1]		

7.3.2.18.3 AnchoringTypeEnum

Table 19 defines the details of the AnchoringTypeEnum class.

Table 19 — AnchoringTypeEnum class

Class<<enumeration>>: AnchoringTypeEnum		
Definition	Available list of enumerations for types of the arrangement characteristic on the road feature.	
Code	Value	Definition
1	point	Road structure or a piece of road equipment that is anchored to an anchor position by the projection point in a projection line or representative point.
2	traversalLine	Road structure or a piece of road equipment that is anchored to an anchor position by a projection point in a projection line along the traversal direction which is perpendicular to the primary axis of a road feature.
3	longitudinalLine	Road structure or a piece of road equipment that is anchored to an anchor position by a projection point in a projection line along the longitudinal direction which defines the axis aligned with the primary axis of a road feature.

7.3.2.18.4 AreaTypeList

Table 20 defines the details of the AreaTypeList class.

Table 20 — AreaTypeList class

Class<<enumeration>>: AreaTypeList		
Definition	Available list of enumerations for types of special area where the road exists.	
Code	Value	Definition
1	inNationalPark	Within the boundary of a recognized national park.
2	insideCities	Within the notional or actual boundary of a city.
3	nearRailroadCrossing	Near a railway level crossing.
4	nearSchool	Near a school.
5	outsideCities	Outside the notional or actual boundary of a city.
6	trafficCalmingArea	In a zone which is subject to traffic calming measures.

7.3.2.18.5 BeltLineCategoryEnum

Table 21 defines the details of BeltLineCategoryEnum class.

Table 21 — BeltLineCategoryEnum class

Class<<enumeration>>: BeltLineCategoryEnum		
Definition	Available list of enumerations of a line element that constitutes a belt feature.	
Code	Value	Definition
1	firstSideLine	The first side line of a road or lane belt.
2	secondSideLine	The second side line of a road or lane belt.
3	firstTerminalLine	The first terminal line of a road or lane belt.
4	secondTerminalLine	The second terminal line of a road or lane belt.
5	linkLine	Line that can be associated to a belt feature for representation in a road link (uni-dimensional) graph.
6	intersectionSideLine	Side line of an intersection belt.
7	intersectionTerminalLine	Terminal line of an intersection belt.

7.3.2.18.6 FeatureExistenceCategoryEnum

Table 22 defines the details of the FeatureExistenceCategoryEnum class.

Table 22 — FeatureExistenceCategoryEnum class

Class<<enumeration>>: FeatureExistenceCategoryEnum		
Definition	Available list of enumerations for a position where a projection point of a road structure, or a piece of road equipment exists.	
Code	Value	Definition
1	onFirstSideLine	The road structure or the road equipment is located on the first side line.
2	outsideFirstSideLine	The road structure or the road equipment is located outside the first side line.
3	insideFirstSideLine	The road structure or the road equipment is located inside the first side line.
4	onSecondSideLine	The road structure or the road equipment is located on the second Side line.
5	outsideSecondSideLine	The road structure or the road equipment is located outside the second side line.
6	insideSecondSideLine	The road structure or the road equipment is located inside the second side line.

Table 22 *(continued)*

7	nearLinkline	The road structure or the road equipment is located near the link line.
8	nearFirstTerminalLine	The road structure or the road equipment is located near the first terminal line.
9	nearSecondTerminal line	The road structure or the road equipment is located near the second terminal line.
10	onBorderOfIntersection	The road structure or the road equipment is located on the border of the intersection
11	outsideIntersection	The road structure or the road equipment is located outside the intersection.
12	insideIntersection	The road structure or the road equipment is located inside the intersection

7.3.2.18.7 FormOfWayList

Table 23 defines the details of the FormOfWayList class.

Table 23 — FormOfWayList class

Class<<CodeList>>: FormOfWayList		
Definition		Available list of enumerations for the form of way. [Source: ISO 20524-1:2020].
Code	**Value**	**Definition**
1	motorway	Road specially designed and built for motor traffic which does not cross, at the same level, with any road or motorway, railway or tramway track, or footpath.
2	multipleCarriageway	Road that is composed of several carriageways separated by physical traffic separators.
3	singleCarriageway	Road that is composed of only one carriageway. Note: A single carriageway road segment could have multiple lanes and could allow travel in opposite directions.
4	trafficSquare	Public square or equivalent area that is passable by vehicles.
5	enclosedTrafficArea	An enclosed area that is passable by vehicles.
6	slipRoad	Lane(s) providing access to and exit from a through road.
7	serviceRoad	Subsidiary road parallel to a more important road with adjacent buildings or properties facing thereon and connected with that road only at a limited number of points.
8	entranceExitRoadFor-Parking	Road to enter and/or to exit from the parking facility.
9	entranceExitRoadForServiceAndPOIs	Road to enter and/or to exit from the service and POI facility.
10	escapeRoad	Ramp designed to stop out-of-control vehicles, usually lorries, by using gravel arrester beds, reverse gradients, or a combination of both.
11	pedestrianZone	Street or group of streets designed primarily to meet the needs of pedestrians and where the speed and dominance of motor vehicles are reduced.

7.3.2.18.8 ICPPositionCategoryEnum

Table 24 defines the details of the ICPPositionCategoryEnum class.

Table 24 — ICPPositionCategoryEnum class

Class<<enumeration>>: ICPPositionCategoryEnum		
Definition	Available list of enumerations for a position category where an intersection connection position exists.	
Code	**Value**	**Definition**
1	onTerminalLineOfIB	An intersection connection point exists on the intersection belt terminal line.
2	internalPointInIB	An intersection connection point exists inside of the intersection belt.

7.3.2.18.9 IntersectionTypeEnum

Table 25 defines the details of the IntersectionTypeEnum class.

Table 25 — IntersectionTypeEnum class

Class<<enumeration>>: IntersectionTypeEnum		
Definition	Available list of enumerations for type of the intersection.	
Code	**Value**	**Definition**
1	basicBeltType	An intersection is represented by an area.
2	thinBeltType	An intersection is represented by a line and has no inner area representing this intersection.
3	roundaboutType	A special basic belt type, that represents one basic belt type and only contains circular internal links.

7.3.2.18.10   LaneBlockInRBE

A LaneBlock in RoadBeltElement is a segment area surrounded by two partition lines and two side line and is represented by four points; an intersection of the first side line and the first partition line, an intersection of the second side line and the first partition line, an intersection of the first side line and the second partition line, and an intersection of the second side line and the second partition line.

The first partition line is located at the starting side of the orientation of the RoadBeltElement and the starting point of the partition line is located at the first RoadBeltSideLine and is referred to as "the first point".

Table 26 defines the details of the LaneBlockInRBE class.

Table 26 — LaneBlockInRBE class

Class<<dataType>>: LaneBlockInRBE				
Definition	A lane block in the road belt element represents the characteristics regarding lanes and is an area surrounded by two partition lines and two side lines of the road belt element.			
Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
laneBlockTrafficDirection	Traffic direction of the lane block.			
	TrafficDirectionEnum	[1]		
laneBlockLocationType	Distinction of the position of the lane block set in the road belt element.			
	LaneBlockLocation-TypeEnum	[1]		
startPointFirstPartition	The first point of the first partition line that is located at the first side line.			
	PointData	[0..1]		

Table 26 *(continued)*

endPointFirstPartition	The second point of the first partition line that is located at the second side line.		
	PointData	[0..1]	
startPointFirstPartitionDistance	Distance from the first point of the first road belt side line to the first point of the first partition line.		
	Length	[0..1]	{it occurs if location type = 3 or 4}
endPointFirstPartitionDistance	Distance from the first point of the second road belt side line to the second point of the first partition line.		
	Length	[0..1]	{it occurs if location type = 3 or 4}
startPointSecondPartition	The first point of the second partition line that is located at the first side line.		
	PointData	[0..1]	
endPointSecondPartition	The second point of the second partition line that is located at the second side line.		
	PointData	[0..1]	
startPointSecondPartitionDistance	Distance from the first point of the first road belt side line to the first point of the second partition line.		
	Length	[0..1]	{it occurs if location type = 2 or 3}
endPointSecondPartitionDistance	Distance from the first point of the second road belt side line to the second point of the second partition line.		
	Length	[0..1]	{it occurs if location type = 2 or 3}
isContainingOverlappedLanes	Determines if the lane block contains overlapped lanes (true) or not (false).		
	Boolean	[1]	{true: contain / false: not contain}

7.3.2.18.11   LaneBlockLocationTypeEnum

Table 27 defines the details of the LaneBlockLocationTypeEnum class.

Table 27 — LaneBlockLocationTypeEnum class

Class<<enumeration>>: LaneBlockLocationTypeEnum		
Definition	Available list of enumerations for the location order in the carriageway.	
Code	**Value**	**Definition**
1	onlyOne	There is one lane block in the road belt element.
2	firstBlock	The lane block is located in the first block of the road belt element.
3	intermediateBlock	The lane block is located in the intermediate block of the road belt element.
4	lastBlock	The lane block is located in the last block of the road belt element.

7.3.2.18.12   LaneBlockTypeEnum

Table 28 defines the details of the LaneBlockTypeEnum class.

Table 28 — LaneBlockTypeEnum class

Class<<enumeration>>: LaneBlockTypeEnum		
Definition	Available list of enumerations where a lane block exists.	
Code	**Value**	**Definition**
1	inRoadBeltElement	The lane block exists in a road belt element.
2	inIntersectionBelt	The lane block exists in the entire intersection belt.
3	ingressIBTr	The lane block exists in the intersection belt and groups lanes corresponding to an ingress intersection belt terminal line.

Table 28 *(continued)*

| 4 | egressIBTr | The lane block exists in the intersection belt and groups lanes corresponding to an egress intersection belt terminal line. |

7.3.2.18.13   RBSCategoryList

Table 29 defines the details of the RBSCategoryList class.

Table 29 — RBSCategoryList class

Class<<CodeList>>: RBSCategoryList		
Definition	Available list of enumerations for the road belt section.	
Code	Value	Definition
1	referenceRoute	The road section is specified as a reference route.
2	highwayRoute	The road section is specified as a highway route.
3	streetOrAvenue	The road section is specified as a street or avenue.
4	specialVehicleRoute	The road section is specified as a special vehicle route.
5	plannedEvacuationRoute	The road section is specified as a planned evacuation route.
6	plannedDetour	The road section is specified as a planned detour.
7	plannedRoad	The road section is specified as a planned road, not yet operational.
8	scenicRoute	The road section is specified as a scenic route.

7.3.2.18.14   RoadNationalClassList

Table 30 defines the details of the RoadNationalClassList class.

Table 30 — RoadNationalClassList class

Class<<CodeList>>: RoadNationalClassList		
Definition	Available list of enumerations representing the national classification of the road. NOTE The properties of this list are from examples defined in ISO 20524-1:2020.	
Code	Value	Definition
1	theFirstClassRoad	The highest-class road.
2	theSecondClassRoad	The second higher-class road.
3	theThirdClassRoad	The third higher-class road.
4	theFourthClassRoad	The fourth higher-class road.
5	theFifthClassRoad	The fifth higher-class road.
6	theSixthClassRoad	The sixth higher-class road.
7	theSeventhClassRoad	The seventh higher-class road.
8	theEighthClassRoad	The eighth higher-class road.
9	theNinthClassRoad	The lowest-class road.

7.3.2.18.15   SideLineDistinctionEnum

Table 31 defines the details of the SideLineDistinctionEnum class.

Table 31 — SideLineDistinctionEnum class

Class<<enumeration>>: SideLineDistinctionEnum		
Definition	Available list of enumerations for either the first or second side line.	
Code	Value	Definition

Table 31 *(continued)*

1	firstSideLine	The side line on the right side of the direction from the first terminal line to the second terminal line of a road belt element or lane belt element.
2	secondSideLine	The side line on the left side of the direction from the first terminal line to the second terminal line of a road belt element or lane belt element.

7.3.2.18.16 TerminalLineCategoryEnum

Table 32 defines the details of the TerminalLineCategoryEnum class.

Table 32 — TerminalLineCategoryEnum class

Class<<enumeration>>: TerminalLineCategoryEnum		
Definition	Available list of enumerations for a terminal line for a road belt element and lane belt element.	
Code	Value	Definition
1	normalTerminal	Terminal line other than a cul-de-sac terminal line.
2	culDeSacTerminal	Terminal line of a cul-de-sac or a terminal line of a road or lane connected to a cul-de-sac intersection.

7.3.2.18.17 TerminalLineDistinctionEnum

Table 33 defines the details of the TerminalLineDistinctionEnum class.

Table 33 — TerminalLineDistinctionEnum class

Class<<enumeration>>: TerminalLineDistinctionEnum		
Definition	Available list of enumerations for the location of either the first or second terminal line of a road belt element and a lane belt element.	
Code	Value	Definition
1	firstTerminalLine	Located at the starting side of the orientation of a road belt element or lane belt element.
2	secondTerminalLine	Located at the ending side of the orientation of a road belt element or lane belt element.

7.3.2.18.18 TrafficDirectionEnum

Table 34 defines the details of the TrafficDirectionEnum class.

Table 34 — TrafficDirectionEnum class

Class<<enumeration>>: TrafficDirectionEnum		
Definition	Available list of enumerations for traffic flow direction as referenced to the belt direction of the road feature.	
Code	Value	Definition
1	forward	The traffic flow direction is in the same orientation as the belt direction of the road feature.
2	reverse	The traffic flow direction is in the reverse orientation to the belt direction of the road feature.
3	bidirectional	The traffic flow direction is bidirectional supporting traffic flow in both the forward and reverse directions simultaneously.

7.3.2.18.19   TransferPossibilityEnum

Table 35 defines the details of the TransferPossibilityEnum class.

Table 35 — TransferPossibilityEnum class

Class<<enumeration>>: TransferPossibilityEnum		
Definition		Available list of enumerations for the transfer possibility to an adjacent space.
Code	Value	Definition
1	shouldTransfer	A vehicle should move to an adjacent space.
2	canTransfer	A vehicle can move to an adjacent space.
3	considerTransferByShortObstacles	A vehicle can consider transferring around short obstacles.
4	cannotTransferByTheTrafficRegulation	A vehicle cannot transfer around the traffic regulation.
5	cannotTransferByTallObstacles	A vehicle cannot move to an adjacent space due to tall obstacles.
6	cannotTransferByInaccessibleSlopedZone	A vehicle cannot move to an adjacent space due to an inaccessible sloped zone.

7.3.2.19   RoadBeltSegmentProperty package

7.3.2.19.1   General

The RoadBeltSegmentProperty sub-package contains the property classes for the RoadBeltSegment feature. Figure 13 shows the class diagram of a RoadBeltFeatureProperty.
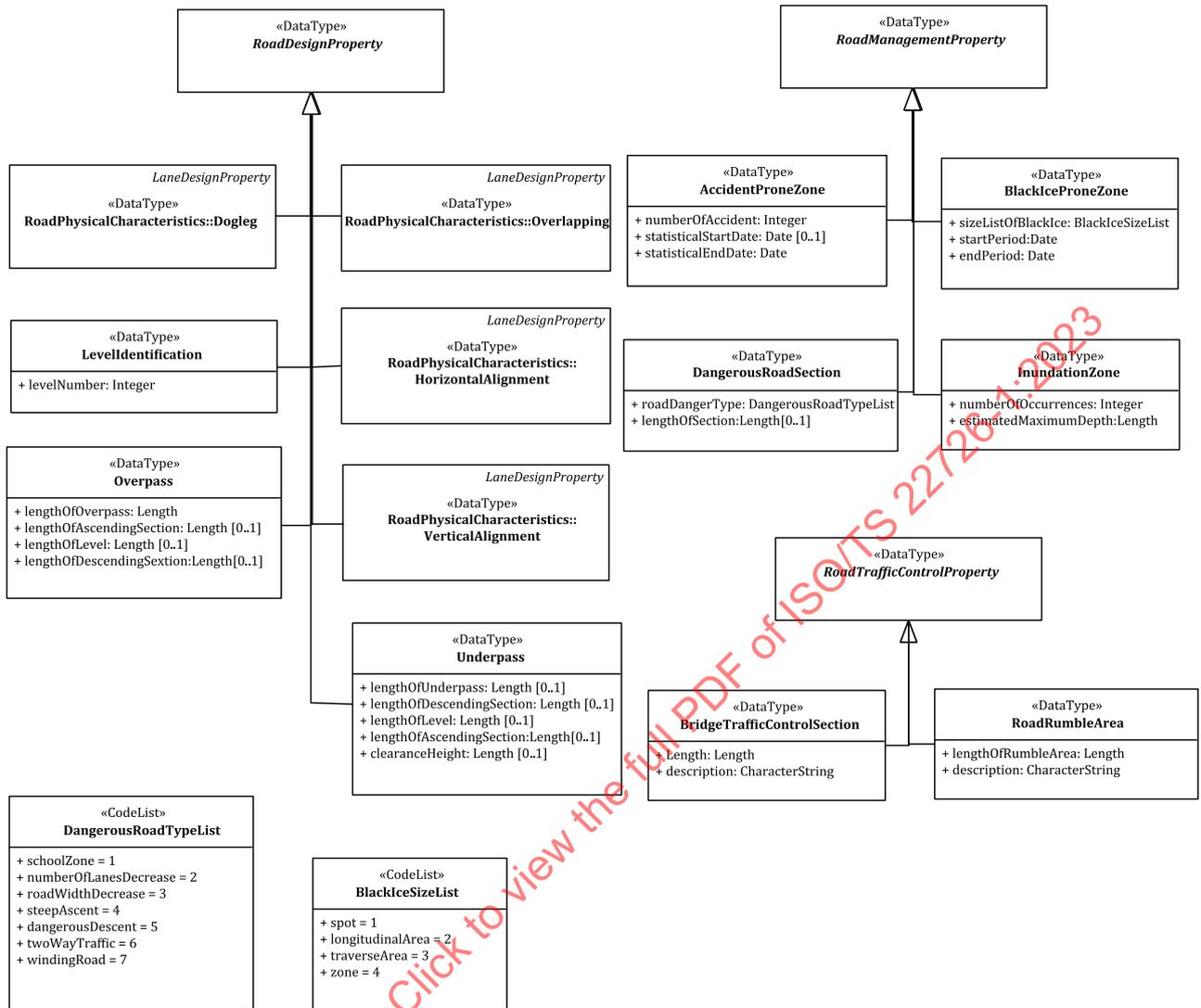
Figure 13 — Class diagram of RoadBeltSegmentProperty

7.3.2.19.2 AccidentProneZone

Table 36 defines the details of the AccidentProneZone class.

Table 36 — AccidentProneZone class

Class<<dataType>>: AccidentProneZone				
Definition	A zone where it has been identified that the likelihood of accidents is raised.			
Attribute name	**Definition**			
	Value type	Multiplicity	Stereotypes	Note/Constraint
numberOfAccident	The number of traffic accidents that occurred during the statistical reporting period.			
	Integer	[1]		
startPeriodOfStatistic	Start date of the statistical reporting period.			
	Date	[0..1]		
endPeriodOfStatistic	End date of the statistical reporting period.			
	Date	[0..1]		

7.3.2.19.3 BlackIceProneZone

Table 37 defines the details of the BlackIceProneZone class.

Table 37 — BlackIceProneZone class

Class<<dataType>>: BlackIceProneZone				
Definition	A zone where it has been identified that the likelihood of black ice danger is raised.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
sizeTypeOfBlackIce	Statistical average size of the area of black ice danger.			
	BlackIceSizeList	[1]		
startPeriod	Statistical start date of the period when black ice danger can occur.			
	Date	[1]		
endPeriod	Statistical end date of the period when black ice danger can occur.			
	Date	[1]		

7.3.2.19.4 BlackIceSizeList

Table 38 defines the details of the BlackIceSizeList class.

Table 38 — BlackIceSizeList class

Class<<CodeList>>: BlackIceSizeList		
Definition	Available list of enumerations representing the statistical size of a black ice zone.	
Code	Value	Definition
1	spot	A black ice zone covers a small area of the road.
2	longitudinalWidth	A black ice zone covers a longitudinal area of the road.
3	traversalWidth	A black ice zone covers a transverse area of the road.
4	zone	A black ice zone covers both longitudinal and transverse areas of the road.

7.3.2.19.5 BridgeTrafficControlSection

Table 39 defines the details of the BridgeTrafficControlSection class.

Table 39 — BridgeTrafficControlSection class

Class<<dataType>>: BridgeTrafficControlSection				
Definition	A section of the road under control for the bridge traffic.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
length	Length of the bridge traffic control section.			
	Length	[1]		
description	Description statement			
	CharacterString	[1]		

7.3.2.19.6 DangerousRoadTypeList

Table 40 defines the details of the DangerousRoadTypeList class.

Table 40 — DangerousRoadTypeList class

Class<<CodeList>>: DangerousRoadTypeList		
Definition	Available list of enumerations for road danger existing on the carriageway segment.	
Code	Value	Definition
1	schoolZone	The road has a school zone.
2	numberOfLanesDecrease	The number of lanes decreases.
3	roadWidthDecrease	The road width decreases.
4	steepAscent	The road has a steep ascent.
5	dangerousDescent	The road has a dangerous descent.
6	two-wayTraffic	The road has a two-way traffic segment.
7	windingRoad	The road has a winding part.

7.3.2.19.7 DangerousRoadSection

Table 41 defines the details of the DangerousRoadSection class.

Table 41 — DangerousRoadSection class

Class<<dataType>>: DangerousRoadSection				
Definition	Road section that can be considered as dangerous.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
roadDangerType	Categories of dangerous road section.			
	DangerousRoadTypeList	[1]		
lengthOfSection	Length of the dangerous road section.			
	Length	[0..1]		

7.3.2.19.8 InundationZone

Table 42 defines the details of the InundationZone class.

Table 42 — InundationZone class

Class<<dataType>>: InundationZone				
Definition	Zone where inundations are frequent.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
numberOfOccurrences	The number of inundation occurrences during the last five (5) years.			
	Integer	[1]		
estimatedMaximum-Depth	Estimated maximum depth of inundation within the zone based on a period of ten (10) years.			
	Length	[1]		

7.3.2.19.9 LevelIdentification

Table 43 defines the details of the LevelIdentification class.

Table 43 — LevelIdentification class

Class<<dataType>>: LevelIdentification				
Definition	Relative position of the carriageway segment in a multiple level structure, such as a spiral carriageway, or formed by a stacking of multiple carriageways.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
levelValue	Level number of the carriageway segment, as a sequential integer starting at 1, for the lowest position, and increasing upwards.			
	Integer	[1]		

7.3.2.19.10   Overpass

Table 44 defines the details of the Overpass class.

Table 44 — Overpass class

Class<<dataType>>: Overpass				
Definition	Physical characteristics of an overpass structure including its approaches which allows one road to pass above another road, railway or obstacle.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
lengthOfOverpass	Overall, horizontally-measured length of the overpass section.			
	Length	[1]		
lengthOfAscendingSection	Horizontally-measured length of the ascending section based on the direction from the first terminal line to the second terminal line of the road belt feature.			
	Length	[0..1]		
lengthOfLevel	Horizontally-measured length of the flat elevated section.			
	Length	[0..1]		
lengthOfDescendingSection	Horizontally-measured length of the descending section based on the direction from the first terminal line to the second terminal line of the road belt feature.			
	Length	[0..1]		

7.3.2.19.11   RoadDesignProperty

Table 45 defines the details of the RoadDesignProperty class.

Table 45 — RoadDesignProperty class

Class<<dataType>>: RoadDesignProperty				
Definition	Physical characteristics of a road used in an ADS.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: underpass	Represents an underpass section in the carriageway, where one road passes under another road, railway, or obstacle.			
	Underpass			Generalization relationship
role: overpass	Represents an overpass section in the carriageway, where one road passes over another road, railway, or obstacle.			
	Overpass			Generalization relationship

Table 45 *(continued)*

role: roadHolizonta-lAlignment	Represents characteristics of road horizontal alignment.			
	HolizontalAlignment			Generalization relation-ship
role:roadDogleg	Represents characteristics of the dogleg.			
	Dogleg			Generalization relation-ship
role: roadVerticalAlign-ment	Represents characteristics of road vertical alignment.			
	VerticalAlignment			Generalization relation-ship
role: roadLevelIdentifi-cation	Represents the hierarchical position of the carriageway segment, as a sequential integer starting at 1, for the lowest position, and increasing upwards.			
	LevelIdentification			Generalization relation-ship
role: roadOverlaping	Represents characteristics of a section where road is overlapped, with another sec-tion at the same level/grade.			
	Overlapping			Generalization relation-ship

7.3.2.19.12   RoadManagementProperty

Table 46 defines the details of the RoadManagementProperty class.

Table 46 — RoadManagementProperty class

Class<<dataType>>: RoadManagementProperty				
Definition	Properties for road management used in an ADS.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: accidentProneZone	Specifies characteristic of accident-prone zone.			
	AccidentProneZone			Generalization relation-ship
role: blackIceProneZone	Specifies characteristic of zone where black ice occurred in the past.			
	BlackIceProneZone			Generalization relation-ship
role: inundationZone	Specifies characteristic of zone where inundation occurred in the past.			
	InundationZone			Generalization relation-ship
role: dangerousroadSec-tion	Specifies characteristics of the zone representing a traffic warning.			
	DangerousRoadSection			Generalization relation-ship

7.3.2.19.13   RoadRumbleArea

Table 47 defines the details of the RoadRumbleArea class.

Table 47 — RoadRumbleArea class

Class<<dataType>>: RoadRumbleArea				
Definition	Area in a road where rumble strips are installed.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
lengthOfRumbleSection	Length of the road rumble area.			
	Length	[1]		
description	Description statement			
	CharacterString	[0..1]		

7.3.2.19.14   RoadTrafficControlProperty

Table 48 defines the details of the RoadTrafficControlProperty class.

Table 48 — RoadTrafficControlProperty class

Class<<dataType>>: RoadTrafficControlProperty				
Definition	Properties for road traffic control used in an ADS.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: rumbleArea	Specifies characteristics of the rumble section.			
	RoadRumbleArea			Generalization relationship
role: bridgeTrafficControl-Section	Specifies characteristics of bridge traffic control section.			
	BridgeTrafficControlSection			Generalization relationship

7.3.2.19.15   Underpass

Table 49 defines the details of the UnderpassSection class.

Table 49 — UnderpassSection class

Class<<dataType>>: UnderpassSection				
Definition	Physical characteristics of an underpass structure including its approaches which allow one road to pass under another road, railway or obstacle.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
lengthOfUnderpass	Overall, horizontally-measured length of the underpass section.			
	Length	[0..1]		
lengthOfDescendingSection	Horizontally-measured length of the descending section based on the direction from the first terminal line to the second terminal line of the road belt feature.			
	Length	[0..1]		
lengthOfLevel	Horizontally-measured length of the flat section.			
	Length	[0..1]		
lengthOfAscendingSection	Horizontally-measured length of the ascending section based on the direction from the first terminal line to the second terminal line of the road belt feature.			
	Length	[0..1]		

Table 49 *(continued)*

clearanceHeight	Minimum clearance distance measured from the road surface to the underside of the road structure, or road equipment that is installed above the road.			
	Length	[0..1]		

7.3.3 LaneBeltNetwork package

7.3.3.1 General

7.3.3.1.1 Configuration of LaneBeltNetwork package

The LaneBeltNetwork package defines road features which specify lane-level networks represented by the belt concept.

Figure 14 shows road feature classes of the LaneBeltNetwork package (see https://standards.iso.org/iso/ts/22726/-1/ed-1/en for an enlarged version of this figure).

The LaneBeltNetwork package consists of:

— LaneBeltNetwork,

— LaneBeltElement,

— LaneBeltJoint,

— LaneBeltElementLink,

— LaneBeltSideLine,

— LaneBeltSideLineSegment,

— LaneBeltTerminalLine,

— LaneBeltSegment,

— LaneConnectionPoint, and

— LaneAnchorPosition.

A lane-level network is composed of a LaneBeltElement and a LaneBeltJoint that are principal composition elements for the lane-level network. A LaneBeltElement, which is a belt feature, represents an actual lane. A LaneBeltJoint, which is a virtual feature, connects adjoining LaneBeltElements in a series and ensures connectivity of the LaneBeltElement network.

Figure 14 shows the class diagram of the lane features in the LaneBeltNetwork package.

Also, the LaneBeltNetwork package contains a LaneBeltFeatureProperty package which defines the properties used in lane features belonging to LaneBeltNetwork.

Figure 14 — LaneBeltNetwork package

7.3.3.1.2 Modelling policy of LaneBeltNetwork

The LaneBeltNetwork class is the root class for the LaneBeltNetwork package.

The LaneBeltNetwork class has composition relationships to:

— LaneBeltElement, and

— LaneBeltJoint.

The network of a LaneBeltNetwork is represented by LaneBeltElements, LaneBeltJoints and associations between a LaneBeltElement and LaneBeltJoint.

A LaneBeltElement has composition relationships to:

— LaneBeltSideLine,

— LaneBeltTerminalLine,

— LaneBeltSegment, and

— LaneBeltElementLink.

At intersections, a LaneBeltJoint is positioned at the boundary of an intersection, represented as an IntersectionBeltTerminalLine.

EXAMPLE   An ingress lane can be connected to four turning lanes: forward lane, right-turn lane, left-turn lane, and U-turn lane, and these four turning lanes are connected to each egress lanes. This example in illustrated in Figure 11 b).

However, it is sometimes necessary to consider the omission of the turning lanes. When the turning lanes are omitted, the lack of a LaneBeltElement means there is no connectivity between the LaneBeltJoints. However connectivity needs to be maintained in this case. The MHAD model maintains the connectivity by representing the LaneBeltJoints of both ends of the omitted LaneBeltElement as one LaneBeltJoint specified to a complex type, the model realizes ensuring connectivity and omitting LaneBeltElement. Use of the complex type indicates that there is an omission of a lane between the connected lanes. Therefore, the style type of a LaneBeltJoint is identified as either a simple or complex type with the required geometry data for each connection shape. Additionally, the LaneConnectionPoint is set in a LaneBeltJoint and has an association that indicates the connection with another LaneConnectionPoint.

A LaneBeltElement consists of two LaneBeltSideLines, two LaneBeltTerminalLines and a LaneBeltElementLink. The physical domain of a LaneBeltElement is defined by the shapes of the LaneBeltSideLines and LaneBeltTerminalLines. A LaneBeltElement when composed with LaneBeltTerminalLines in the same position, i.e. a circular LaneBeltElement, shall not be permitted. Also, fully overlapped LaneBeltElements shall not be permitted. A LaneBeltElementLink is a line feature that corresponds to the shape of a LaneBeltElement that is degenerated by means of a mathematical morphology transform.

The first LaneBeltSideLine represents the right-side line with reference to the forward direction of LaneBeltElement and the second LaneBeltSideLine is the left-side line. The direction of a LaneBeltElement is determined by a pair of LaneBeltTerminalLines. The first LaneBeltTerminalLine indicates the origin of the forward direction of the LaneBeltElement and the second LaneBeltTerminalLine indicates the destination.

The shape of each LaneBeltSideLine should be defined starting from the first side of the LaneBeltTerminalLine as the first point of the LaneBeltSideLine. The shape of a LaneBeltElementLink should be defined starting from the first side of the LaneBeltTerminalLine as the first point of the LaneBeltElementLink.

A LaneBeltElement should exist between LaneBeltJoints. A LaneBeltJoint located at the first LaneBeltTerminalLine is designated as the first LaneBeltJoint, and the subsequent one located at the second LaneBeltTerminalLine is the second LaneBeltJoint. In other words, the forward direction of

LaneBeltElement is specified as the direction from the first LaneBeltTerminalLine located at the first LaneBeltJoint toward the second LaneBeltTerminalLine located at the second LaneBeltJoint.

In a data implementation of the MHAD model, the traffic flow direction of the lane should be specified with reference to the direction of the LaneBeltElement.

In a single-direction lane, the traffic flow direction in the same direction of the LaneBeltElement should be referred to as "forward direction". The traffic flow direction opposite to the direction of the LaneBeltElement should be referred to as "reverse direction".

In a two-direction lane, such as a reversible lane and a tidal lane, the traffic flow direction should be referred to as "bidirectional". Each traffic flow direction is identifiable by reference to the direction of LaneBeltElement. The traffic flow direction in the same direction of LaneBeltElement is referred to as "forward direction". The traffic flow direction opposite to the direction of LaneBeltElement is referred to as "reverse direction".

7.3.3.2 LaneBeltNetwork

The LaneBeltNetwork class is a class that may be instantiated and serves as the branch class for expressing the hierarchical model.

Table 50 defines the details of the LaneBeltNetwork class.

Table 50 — LaneBeltNetwork class

Class<<featureType>>: LaneBeltNetwork				
Definition	Dataset representing the lane network which consists of the datasets of the lane belt element, and the lane belt joint datasets.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: LaneBeltElement	Specifies a lane belt element belonging to the lane belt network.			
	LaneBeltElement	[0..*]		Composition relationship
role: LaneBeltJoint	Specifies a lane belt joint belonging to the lane belt network.			
	LaneBeltJoint	[0..*]		Composition relationship

7.3.3.3 LaneAnchorPosition

A LaneAnchorPosition existing in a LaneBeltElement can be defined as either a LaneBeltSideLine and/or a LaneBeltElementLink depending on the location of a projection point of a road structure or a piece of road equipment.

Table 51 defines the details of LaneAnchorPosition class.

Table 51 — LaneAnchorPosition class

Class<<featureType>>: LaneAnchorPosition				
Definition	Feature which represents the anchor position for the lane used to associate road structure or road equipment with the lane belt element.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: RSE	Specifies a road structure or a piece of road equipment linked by the lane anchor position.			
	RoadStructureAndEquipment	[1..*]		Association relationship
categoryOfAnchoringLine	Category of a line feature where the lane anchor position is located.			
	BeltLineCategoryEnum	[1]		

Table 51 *(continued)*

distanceToLAP	Distance from the first point of a lane belt side line, lane belt terminal line, or lane belt element link to an anchor position along a line geometry.			
	Length	[1]		
coordinateOfLAP	Coordinates of the lane anchor position.			
	PointData	[1]		
AnchoringInformation	Anchoring information of the road structure or a piece of road equipment.			
	AnchoringInformation	[1..*]		

7.3.3.4 LaneBeltElement

A LaneBeltElement should exist in an area of a RoadBeltElement and/or IntersectionBelt. A LaneBeltElement can overlap a neighbouring LaneBeltElement, and both LaneBeltTerminalLines of the LaneBeltElement should be located on LaneBeltJoint.

A LaneBeltElement does not contain geometry data for representing an area boundary, because both LaneBeltSideLines and LaneBeltTerminalLines have geometry data.

Table 52 defines the details of the LaneBeltElement class.

Table 52 — LaneBeltElement class

Class<<featureType>>: LaneBeltElement				
Definition	Road feature which represents a strip of carriageway intended to accommodate a single line of moving vehicles, frequently defined by carriageway marks.			
Role/Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
role: LBJ	Specifies the first or the second lane belt joint connected to end of the lane belt element.			
	LaneBeltJoint	[2]		Association relationship {ordered}
role: LB	Specifies a lane block existing in the lane.			
	RoadBeltNetwork:: LaneBlock	[1..*]		Composition relationship
role: overlappingLBE	Specifies an adjacent lane belt element overlapping the lane belt element.			
	LaneBeltElement	[0..*]		Association relationship
role: opposingTraffi-cLane	Specifies an adjacent lane belt element which traffic direction is opposing.			
	LaneBeltElement	[0..*]		Composition relationship
role: LBEL	Specifies a lane belt element link belonging to the lane belt element.			
	LaneBeltElementLink	[0..1]		Composition relationship
role: LBSd	Specifies a lane belt side line belonging the lane belt element.			
	LaneBeltSideLine	[2]		Composition relationship {ordered}
role: LBTr	Specifies a lane belt terminal line belonging to the lane belt element.			
	LaneBeltTerminalLine	[2]		Composition relationship {ordered}
role: LBSg	Specifies a lane belt segment belonging to the lane belt element.			
	LaneBeltSegment	[0..*]		Composition relationship {ordered} [a]
[a] The order of LaneBeltSegment is counted from first terminal line of LBE.				
[b] The order of LaneAnchorPosition is counted by order of BeltLineCategory of line and the distance from the first point of its line.				

Table 52 *(continued)*

role: LAP	Specifies a lane anchor position located in the lane belt element.			
	LaneAnchorPositon	[0..*]		Composition relationship {ordered} [b]
existenceLocation	Distinction of whether the lane belt element is in an intersection belt or in a road belt element.			
	LaneExistenceLoca-tionEnum	[1]		
trafficDirection	Direction of traffic flow of the lane belt element.			
	TrafficDirectionEnum	[1]		
laneType	Lane type of the lane belt element.			
	LaneTypeList	[1]		
usageType	Usage type of the lane belt element.			
	LaneUsageTypeList	[1]		
neighbourLaneStatus	Existence status of neighbouring lane.			
	NeighbourLaneStatusE-num	[1]		
widthVariation	Lane width variation classification.			
	LaneWidthVariationE-num	[1]		
length	Length from the first terminal line to the second terminal line of the lane belt element, along a central line.			
	Length	[0..1]		
[a] The order of LaneBeltSegment is counted from first terminal line of LBE.				
[b] The order of LaneAnchorPosition is counted by order of BeltLineCategory of line and the distance from the first point of its line.				

7.3.3.5   LaneBeltElementLink

Both ends of a LaneBeltElementLink should be located on a LaneConnectionPoint respectively. The direction of the LaneBeltElementLink should be in the same direction as the LaneBeltElement.

The LaneConnectionPoint located at the starting point of LaneBeltElementLink is designated as the first LaneConnectionPoint, and the LaneConnectionPoint located at the end point of a LaneBeltElementLink is the second LaneConnectionPoint.

Line geometry of LaneBeltElementLink can be specified by degenerating the LaneBeltElement by means of a mathematical morphology transformation.

Table 53 defines the details of the LaneBeltElementLink class.

Table 53 — LaneBeltElementLink class

Class<<featureType>>: LaneBeltElementLink				
Definition	Feature which represents a linear representation generated by the degeneracy of the lane belt element.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: LCP	Specifies a first or second lane connection point to which the lane belt element link connects.			
	LaneConnectionPoint	[2]		Association relationship {ordered}

Table 53 *(continued)*

role: LAP	Specifies a lane anchor position located on the lane belt element link.			
	LaneAnchorPosition	[0..*]		Composition relationship
trafficDirection	Direction of traffic flow of the lane belt element link.			
	TrafficDirectionEnum	[1]		
length	Length along a shape of the lane belt element link.			
	Length	[0..1]		
travelTime	Estimated travel time for passing through the lane belt element link.			
	TimeMeasure	[0..1]		
shapeData	Geometry data from the first point to the second point of the lane belt element link.			
	LineData	[1]		

7.3.3.6 LaneBeltJoint

A LaneBeltJoint is associated with at least one LaneBeltElement. A LaneBeltJoint is located at the boundary according to the following conditions:

— a boundary where a lane encounters an intersection (mandatory);

NOTE 1 Usually these are IntersectionBeltTerminalLines.

— a boundary where lanes branch (mandatory);

— a boundary where lanes merge (mandatory);

— a boundary where lane attributes change (optional);

NOTE 2 Lane attributes above include lane usage, applicable traffic controls and others.

— a combination of the aforementioned boundaries in this list.

In the intersection, the style of a LaneBeltJoint is specified corresponding to the shape of the related IntersectionBeltTerminalLine and the omission of turn lanes and the style of the LaneBeltJoint is classified as either a simple type composed single line, or a complex type composed of multiple lines.

Table 54 defines the details of the LaneBeltJoint class.

Table 54 — LaneBeltJoint class

Class<<featureType>>:LaneBeltJoint				
Definition	Feature which represents a connection position joining lane belt elements logically for the configuration of a lane belt network.			
Role/Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
role: LBE	Specifies a lane belt element that is connected to the lane belt joint.			
	LaneBeltElement	[1..*]		Association relationship
role: LCP	Specifies a lane connection point existing in the lane belt joint.			
	LaneConnectionPoint	[1..*]		Composition relationship
laneJointCategory	Position category of the lane belt joint.			
	LaneJointCategoryE-num	[1]		
laneJointStyle	Style type of the lane belt joint.			
	LaneJointStyleEnum	[1]		

Table 54 *(continued)*

shapeData	Geometry data of lane belt joint depending on the lane joint style.			
	LineData	[1..*]		

At intersections, a LaneBeltJoint is located at the IntersectionBeltTerminalLine, and when the intersection type is a basic belt type, the LaneBeltJoint style is basically a simple type.

In a T-junction where a main road and a local road intersect, an IntersectionBelt type can be specified to a thin belt type and the LaneBeltJoint style can be specified as a complex type, which gives priority to the lanes of main road with turn lanes omitted.

Figure 15 shows examples of LaneJointStyle corresponding to IntersectionBelt types.
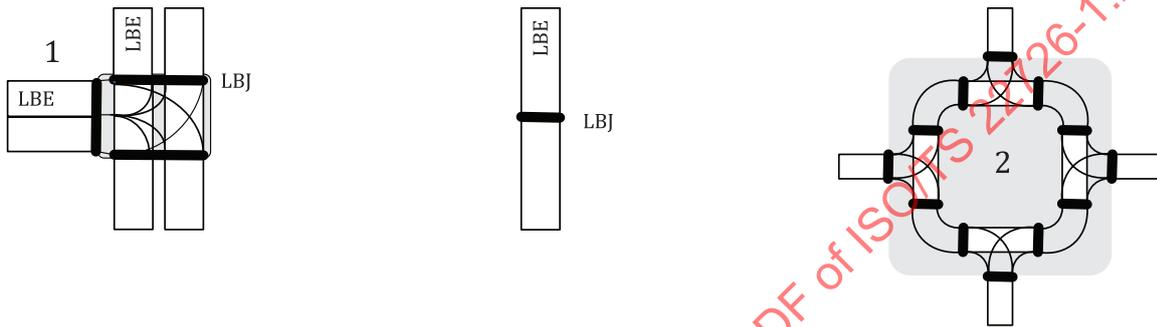
a) LaneBeltJoint simple type: at basic belt type intersection
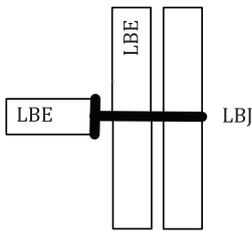
b) LaneBeltJoint simple type: at thin type intersection
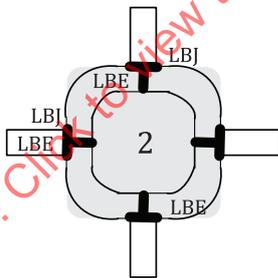
c) LaneBeltJoint simple type at: roundabout type intersection
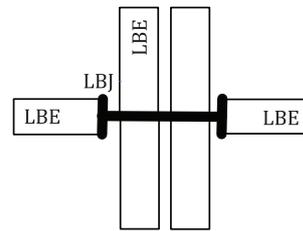
d) LaneBeltJoint complex: thin belt type intersection
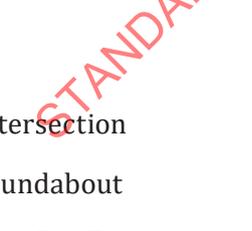
e) LaneBeltJoint complex type: at roundabout type intersection

f) LaneBeltJoint complex type: at thin belt type intersection

Key

1   intersection

2   roundabout

LBE   LaneBeltElement

LBJ   LaneBeltJoint

Figure 15 — Examples of LaneJointStyle

7.3.3.7 LaneBeltSegment

The LaneBeltSegment is either a segment area of a LaneBeltElement surrounded by two partition lines (transversals) and two side lines, or a partition line located in a LaneBeltElement. The side line is a part of the LaneBeltSideLine where line shape data is omitted to avoid duplication with LaneBeltSideLine. The partition line is a straight line jointing two points on the LaneBeltSideLine on both sides so line shape data is end points only. Therefore, the shape of LaneBeltSegment is represented by two or four points.

Table 55 defines the details of the LaneBeltSegment class. The first partition line is located at the start side of the orientation of LaneBeltElement and the starting point of the partition line is located at the first LaneBeltSideLine.

Table 55 — LaneBeltSegment class

Class<<featureType>>: LaneBeltSegment				
Definition	Feature that represents a part (possibly of zero-length) of a lane belt element that is distinct from other parts with respect to a particular characteristic.			
Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
hasSegmentLength	Indicates if the lane belt segment has a length (true) or is zero-length (false).			
	Boolean	[1]		{true: has length false: zero-length}
startPointOfFirstPartitionLine	Coordinates of the start point of the first partition line that is located on the first lane belt side line.			
	PointData	[1]		
endPointOfFirstPartitionLine	Coordinates of the end point of the first partition line that is located on the first lane belt side line.			
	PointData	[1]		
linearLocationForStartPointOfFirstPartitionLine	Distance along the first lane belt side line from the first point of that lane belt side line to the start point of the first partition line.			
	Length	[1]		
linearLocationForEndPointOfFirstPartitionLine	Distance along the second lane belt side line from the first point of that lane belt side line to the end point of the first partition line.			
	Length	[1]		
startPointOfSecondPartitionLine	Coordinates of the start point of the second partition line that is located on the first lane belt side line.			
	PointData	[0..1]		
endPointOfSecondPartitionLine	Coordinates of the end point of the second partition line that is located on the first lane belt side line.			
	PointData	[0..1]		
linearLocationForStartPointOfSecondPartitionLine	Distance along first lane belt side line from the first point of that lane belt side line to the start point of the second partition line.			
	Length	[0..1]		
linearLocationForSecondPartitionLine	Distance along second lane belt side line from the first point of that lane belt side line to the end point of the second partition line.			
	Length	[0..1]		
laneDesignProperty	Properties of the lane design used in an ADS.			
	LaneDesignProperty	[0..*]		
laneManagementProperty	Properties of the lane management used in an ADS.			
	LaneManagementProperty	[0..*]		

Table 55 *(continued)*

laneTrafficControlProp-erty	Properties of the lane traffic control used in an ADS.			
	LaneTrafficControl-Property	[0..*]		

7.3.3.8 LaneBeltSideLine

Table 56 defines the details of the LaneBeltSideLine class.

Table 56 — LaneBeltSideLine class

Class<<featureType>>: LaneBeltSideLine				
Definition	Feature that represents the properties of a side line of a lane belt element. The first point of the lane belt side line is located on the first lane belt terminal line.			
Role/Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
role: LBSSg	Specifies a lane belt side line segment belonging to the lane belt side line.			
	LaneBeltSideLineSeg-ment	[0..*]		Composition relation-ship {ordered}
role: LAP	Specifies a lane anchor position located on the lane belt side line.			
	LaneAnchorPosition	[0..*]		Composition relation-ship
SideLineDistinction	Distinction that identifies the first or the second side line.			
	SideLineDistinctionE-num	[1]		
numberOfLBSg	The number of the lane belt segment located on the lane belt side line.			
	Integer	[0..1]		
outgoingTransferPossi-bilityInForward	Transfer possibility of the outgoing direction of a side line in the forward direction of lane traffic.			
	TransferPossibilityEnum	[0..1]		
incomingTransferPossi-bilityInForward	Transfer possibility of incoming direction of side line in the forward direction of lane traffic.			
	TransferPossibilityEnum	[0..1]		
outgoingTransferPossi-bilityInReverse	Transfer possibility of outgoing direction of side line in the reverse direction of lane traffic.			
	TransferPossibilityEnum	[0..1]		
incomingTransferPossi-bilityInReverse	Transfer possibility of incoming direction of side line in the reverse direction of lane traffic.			
	TransferPossibilityEnum	[0..1]		
isReversibleLaneIn-Neighbour	Determines if the neighbouring lane is a reversible lane (true) or not (false).			
	Boolean	[1]		{true: reversible}
isOverlappedLaneIn-Neighbour	Determines if the neighbouring lane is overlapping (true) or not (false).			
	Boolean	[1]		{true: exists}
shapeData	Geometry data of the lane belt side line.			
	LineData	[1]		
NOTE The order of LaneBeltSideLineSegment is counted by the distance of the start point of LaneBeltSideLineSegment from the first point of LaneBeltSideLine.				

7.3.3.9 LaneBeltSideLineSegment

Table 57 defines the details of the LaneBeltSideLineSegment class.

Table 57 — LaneBeltSideLineSegment class

Class<<featureType>>: LaneBeltSideLineSegment				
Definition	Feature that represents a designated part of a lane belt side line, where the first point of the lane belt side line segment is located on the nearer side of the start lane belt terminal line.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
distanceToFirstBorder	Distance from the first point of a lane belt side line to the first point of the lane belt side line segment.			
	Length	[1]		
distanceToSecondBorder	Distance from the first point of a lane belt side line to the second point of the lane belt side line segment.			
	Length	[0..1]		
outgoingTransferPossibilityInForward	Transfer possibility of outgoing direction of a lane belt side line segment in the forward direction of lane traffic.			
	TransferPossibilityEnum	[0..1]		
incomingTransferPossibilityInForward	Transfer possibility of incoming direction of a lane belt side line segment in the forward direction of lane traffic.			
	TransferPossibilityEnum	[0..1]		
outgoingTransferPossibilityInReverse	Transfer possibility of outgoing direction of a lane belt side line segment in the reverse direction of lane traffic.			
	TransferPossibilityEnum	[0..1]		
incomingTransferPossibilityInReverse	Transfer possibility of incoming direction of a lane belt side line segment in the reverse direction of lane traffic.			
	TransferPossibilityEnum	[0..1]		

7.3.3.10 LaneBeltTerminalLine

Table 58 defines the details of the LaneBeltTerminalLine class.

Table 58 — LaneBeltTerminalLine class

Class<<featureType>>: LaneBeltTerminalLine				
Definition	Feature that represents the properties of a terminal line of a lane belt element. The first point of the lane belt element terminal line is located on the first lane belt element side line.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: LAP	Specifies a lane anchor position located on the lane belt terminal line.			
	LaneAnchorPosition	[0..*]		Composition relationship
terminalLineDistinction	Identifier of the start or the end terminal line.			
	TerminalLineDistinctionEnum	[1]		
shapeData	Geometry data of the lane belt terminal line.			
	LineData	[1]		

7.3.3.11 LaneConnectionPoint

A LaneConnectionPoint should be located on a LaneBeltJoint. Point geometry of a LaneConnectionPoint can be specified by degenerating a LaneBeltTerminalLine into a point geometry.

A LaneBeltElement is connected to the next LaneBeltElement by a LaneBeltJoint and its associations. However, a LaneBeltElementLink is a degenerated line of LaneBeltElement, therefore LaneBeltElementLink is not necessarily connected to the next LaneBeltElementLink at the identical LaneConnectionPoint.

EXAMPLE   In a branch from the main lane of a highway to a slip lane, when the main lanes are defined as an ordinary lane and the slip lane is defined as a tapered lane to avoid overlap, positions of the LaneConnectionPoint on the main lane and slip lane are different. Therefore, the main lane and slip lane are not physically connected. To ensure connectivity between those LaneBeltElementLinks, a LaneConnectionPoint defines the association with other LaneConnectionPoints in the same LaneBeltJoint in which it is considered to be connected.

Table 59 defines the details of the LaneConnectionPoint class.

Table 59 — LaneConnectionPoint class

Class<<featureType>>: LaneConnectionPoint				
Definition	Feature that represents the position where some lane belt element links are connected.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: LBEL	Specifies a lane belt element link connected to the lane connection point.			
	LaneBeltElementLink	[1..*]		Association relationship
role: connectedOther-LCP	Specifies another lane connection point on the same lane belt joint for representing the logical connection with the lane connection point.			
	LaneConnectionPoint	[0..*]		Composition relationship
seqNoOfConstituent-Line	Sequence number as identifier of a constituent geometry data of a lane belt joint where the lane connection point is located when the lane belt joint is a complex type.			
	Integer	[0..1]		
distanceToLCP	Distance from the start point of a constituent geometry data.			
	Length	[0..1]		
coordinateOfLCP	Coordinates of the line connection point.			
	DirectPosition	[1]		

7.3.3.12 LaneBeltFeatureProperty sub-package classes

7.3.3.12.1 General

The LaneBeltFeatureProperty sub-package contains the properties for the lane belt feature classes of LaneBeltNetwork package. A class diagram of the LaneBeltFeatureProperty package is shown in Figure 16.

The LaneBeltFeatureProperty sub-package contains the LaneBeltSegmentProperty dataset specified the properties of LaneBeltSegment feature.
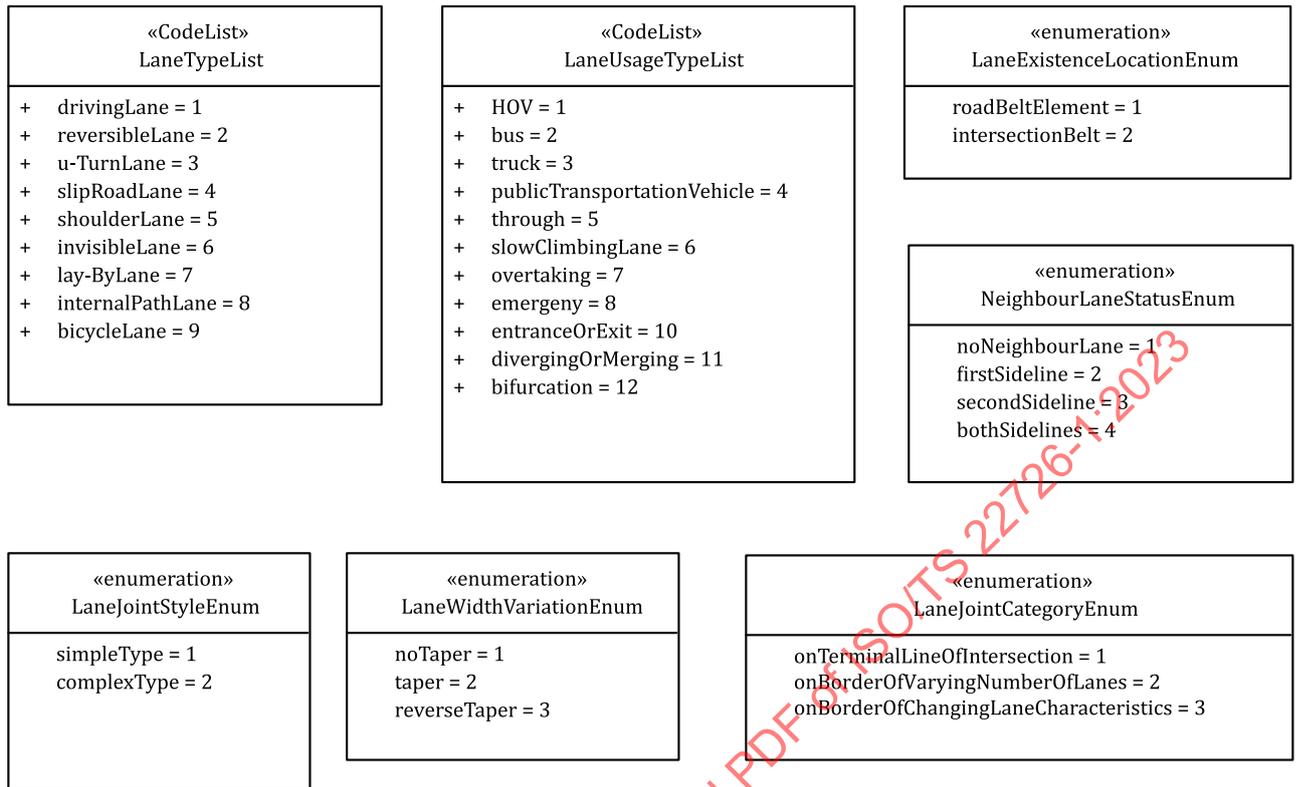
Figure 16 — Class diagram of the LaneBeltFeatureProperty package

7.3.3.12.2 LaneExistenceLocationEnum

Table 60 defines the details of the LaneExistenceLocationEnum class.

Table 60 — LaneExistenceLocationEnum class

Class<<enumeration>>: LaneExistenceLocationEnum		
Definition	Available list of enumerations for the existence location of a lane belt element.	
Code	Value	Definition
1	roadBeltElement	Lane is located on a carriageway.
2	intersectionBelt	Lane is located in an intersection.

7.3.3.12.3 LaneJointCategoryEnum

Table 61 defines the details of the LaneJointCategoryEnum class.

Table 61 — LaneJointCategoryEnum class

Class<<enumeration>>: LaneJointCategoryEnum		
Definition	Available list of enumerations for the position of a lane belt joint	
Code	Value	Definition
1	onTerminalLineOfInter-section	Lane belt joint is located on a terminal line of an intersection belt.
2	onBorderOfVaryingNum-berOfLanes	Lane belt joint is located at boundaries where the number of lanes varies, except for intersection terminal lines.
3	onBorderOfChangingLane-Characteristics	Lane belt joint is located at boundaries where the lane characteristics change.

7.3.3.12.4 LaneJointStyleEnum

Table 62 defines the details of the LaneJointStyleEnum class.

Table 62 — LaneJointStyleEnum class

Class<<enumeration>>: LaneJointStyleEnum		
Definition	Available list of enumerations for category of shape style of the lane belt joint.	
Code	Value	Definition
1	simpleType	A lane belt joint connection location expressed by a straight line.
2	complexType	A lane belt joint consisting of two or more connection locations that represent a logical connection even if they are physically separated.

7.3.3.12.5 LaneTypeList

Table 63 defines the details of the LaneTypeList class.

Table 63 — LaneTypeList class

Class<<CodeList>>: LaneTypeList		
Definition	Available list of enumerations for lane types.	
Code	Value	Definition
1	drivingLane	Driving lane for a vehicle.
2	reversibleLane	Lane where the traffic direction is switched under control.
3	uTurnLane	Lane for a U-turn located in an intersection or between different traffic direction lanes.
4	slipRoadLane	Lane for a slip road transferring to another road.
5	shoulderLane	Lane on the road shoulder where driving is allowed
6	invisibleLane	A lane set in an area where the position of the lane is not specified on the road by the road marking.
7	layByLane	Lane used for lay-by.
8	internalPathLane	A lane set in an intersection where the position of the lane is not marked.
9	bicycleLane	Lane for bicycles only.

7.3.3.12.6 LaneUsageTypeList

Table 64 defines the details of the LaneUsageTypeList class.

Table 64 — LaneUsageTypeList class

Class<<CodeList>>: LaneUsageTypeList		
Definition	Available list of enumerations for lane usage types.	
Code	Value	Definition
1	hov	High-occupancy vehicle (HOV) lane.
2	bus	Bus lane.
3	truck	Truck lane.
4	publicTransportVehicle	Public transport vehicle lane.
5	through	Through lane.
6	slowClimbing	Climbing lane for slower-moving vehicles.
NOTE LaneUsageTypeList is not intended to be used as a traffic regulation.		

Table 64 *(continued)*

7	overtaking	Overtaking vehicle lane.
8	emergency	Emergency vehicle lane.
9	entranceOrExit	Entrance/exit lane.
10	mergeOrBranch	Diverging lane/merging lane.
11	bifurcation	Lane branches in the designated direction.
NOTE LaneUsageTypeList is not intended to be used as a traffic regulation.		

7.3.3.12.7 LaneWidthVariationEnum

Table 65 defines the details of the LaneWidthVariationEnum class.

Table 65 — LaneWidthVariationEnum class

Class<<enumeration>>: LaneWidthVariationEnum		
Definition	Available list of enumerations for lane width variation types.	
Code	Value	Definition
1	noTaper	There is no lane taper.
2	taper	Lane narrows following the lane belt element orientation.
3	reverseTaper	Lane widens following the lane belt element orientation.

7.3.3.12.8 NeighbourLaneStatusEnum

Table 66 defines the details of the NeighbourLaneStatusEnum class.

Table 66 — NeighbourLaneStatusEnum class

Class<<enumeration>>: NeighbourLaneStatusEnum		
Definition	Available list of enumerations for existence status of neighbouring lanes on the left and right sides.	
Code	Value	Definition
1	noNeighbour	There is no neighbouring lane.
2	firstSide	There is a neighbouring lane on the first side.
3	secondSide	There is a neighbouring lane on the second side.
4	bothSides	There are neighbouring lanes on both sides.

7.3.3.13 LaneBeltSegmentProperty package

7.3.3.13.1 General

LaneBeltSegmentProperty package contains the property classes for the LaneBeltSegment feature. Figure 17 shows the class diagram of the LaneBeltSegmentProperty.
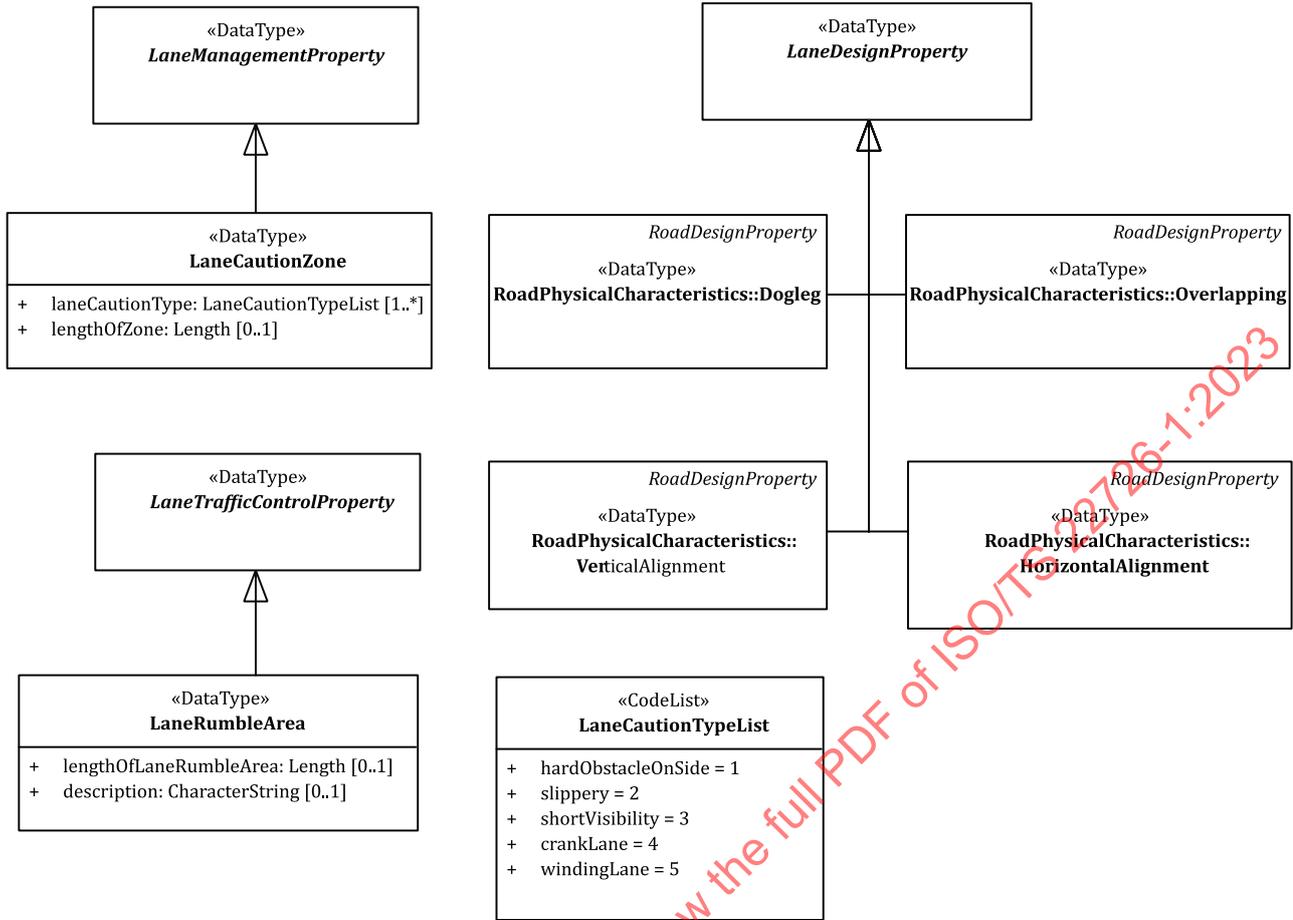
Figure 17 — Class diagram of LaneBeltSegmentProperty

7.3.3.13.2 LaneCautionTypeList

Table 67 defines the details of the LaneCautionTypeList class.

Table 67 — LaneCautionTypeList class

Class<<CodeList>>: LaneCautionTypeList		
Definition		Available list of enumerations for lane caution types on a lane segment.
Code	Value	Definition
1	hardObstacleOnSide	Lane has hard obstacles on either or both sides.
2	slippery	Surface of the lane is slippery.
3	shortVisibility	Lane has a section of short visibility.
4	crankLane	Lane has a sharp angle (e.g. 90°) dogleg without transition.
5	windingLane	Lane has a winding part.

7.3.3.13.3 LaneCautionZone

Table 68 defines the details of the LaneCautionZone class.

Table 68 — LaneCautionZone class

Class<<dataType>>: LaneCautionZone				
Definition	Zone in which road users are required to exercise caution.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
laneCautionType	Code type for lane caution.			
	LaneCautionTypeList	[1]		
lengthOfZone	Caution zone length.			
	Length	[0..1]		

7.3.3.13.4 LaneDesignProperty

Table 69 defines the details of the LaneDesignProperty class.

Table 69 — LaneDesignProperty class

Class<<dataType>>: LaneDesignProperty				
Definition	Physical design characteristics of a lane.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: laneHorizontalAlignment	Characteristics of horizontal alignment of the lane.			
	HorizontalAlignment			Generalization relationship
role: laneDogleg	Characteristics of the dogleg angle of the lane.			
	Dogleg			Generalization relationship
role: laneVerticalGradient	Characteristics of the vertical alignment of the lane.			
	VerticalAlignment			Generalization relationship
role: laneOverlapping	Characteristics of an overlapping area			
	Overlapping			Generalization relationship

7.3.3.13.5 LaneManagementProperty

Table 70 defines the details of the LaneManagementProperty class.

Table 70 — LaneManagementProperty class

Class<<dataType>>: LaneManagementProperty				
Definition	Properties for the lane management.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: laneCautionZone	Characteristics of a caution zone in the lane.			
	LaneCautionZone			Generalization relationship

7.3.3.13.6 LaneRumbleArea

Table 71 defines the details of the LaneRumbleArea class.

Table 71 — LaneRumbleArea class

Class<<dataType>>: LaneRumbleArea				
Definition	Area in a lane where rumble strips are installed.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
length	Length of lane rumble area.			
	Length	[0..1]		
description	Description statement.			
	CharacterString	[0..1]		

7.3.3.13.7 LaneTrafficControlProperty

Table 72 defines the details of the LaneTrafficControlProperty class.

Table 72 — LaneTrafficControlProperty class

Class<<dataType>>: LaneTrafficControlProperty				
Definition	Properties for lane traffic control used in an ADS.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: laneRumbleArea	Specifies a rumble zone in lane			
	LaneRumbleArea			Generalization relation-ship

7.3.4 RoadStructureAndEquipment package

7.3.4.1 General

7.3.4.1.1 Contents of RoadStructureAndEquipment package

The RoadStructureAndEquipment package contains the road structures and equipment data classifying the road structure, road equipment and road markings.

The RoadStructureAndEquipment package shown in Figure 18 contains the RoadStructureAndEquipment class that generalizes four specialization classes corresponding to the categories of MajorRoadStructure, MinorRoadStructure, RoadEquipment and RoadMarking sub-packages. Each of the four specialization classes generalizes individual features specified in Table 73.

The RoadStructureAndEquipment package also contains the common property classes which define the commonly used properties in the features belonging RoadStructureAndEquipment.
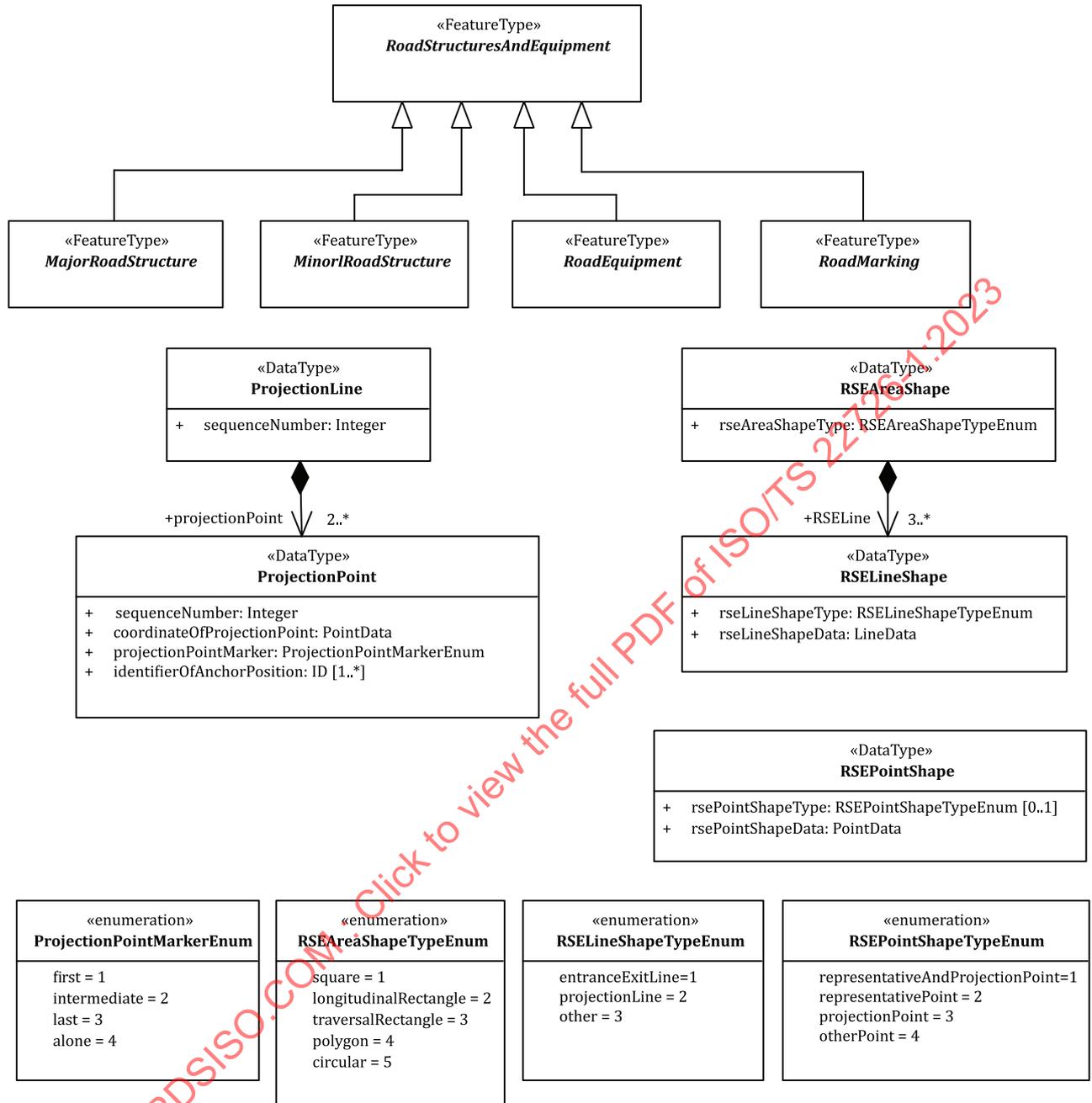
Figure 18 — Class diagram of RoadStructureAndEquipment package

Table 73 — Essential road structures and equipment belonging to RoadStructureAndEquipment package

Feature category	Feature	Related road features
Major road structure	Bridge	Road/Intersection/(Lane)
	Tunnel	Road/Intersection/(Lane)
	Viaduct	Road/Intersection/(Lane)
	InaccessibleSlopedZone	Road/(Lane)

Table 73 *(continued)*

Feature category	Feature	Related road features
Minor road structure	CentralReserve	Road/(Lane)
	Foundation	Road/Intersection/(Lane)
	Gantry	Road/Intersection
	Gutter	Road/Intersection
	Hedge	Road/Intersection/(Lane)
	Kerb	Road/Intersection
	Manhole	Road/Intersection
	PedestrianOverpass	Road/Intersection
	Pier	Road/Intersection/(Lane)
	RailwayCrossing	Road
	TrafficIsland	Road/Intersection/(Lane)
	TramTrack	Road/Intersection/(Lane)
	Wall	Road/Intersection/(Lane)
Road equipment	BusStopBoard	Road/(Lane)
	Delineator	Road/Intersection/Lane
	DistanceMarker	Road/Intersection
	Fence	Road/Intersection/(Lane)
	Gate	Road/Lane
	Guardrail	Road/Intersection/(Lane)
	IslandNose	Road/Intersection
	RisingBollard	Lane
	RoadLighting	Road/Intersection/Lane
	RoadSign	Road/Intersection/Lane
	RoadStud	Road/Intersection / Lane
	SpeedBump	Lane
	SupportPost	Road/Intersection/Lane
	InformationBoard	Road/Intersection/Lane
	TrafficPole	Road/Intersection/Lane
	TrafficSignalHead	Road/Intersection/Lane
	UtilityPole	Road/Intersection/Lane

Feature category	Feature	Related road features
Road marking	BusStopClearway	Road/Lane
	CarriagewayEdgeMarking	Road/Lane
	ClearwayArea	Road/Lane
	LaneEdgeMarking	Lane
	LayByMarking	Road/Lane
	PedestrianCrossing	Road/Intersection/Lane
	RegulatoryMarking	Road/Lane
	RoadCentreMarking	Road/Lane
	RoadShoulderMarking	Road/Lane
	StopLine	Road/Intersection/Lane
	SymbolRoadMarking	Road/Intersection/(Lane)
	TextRoadMarking	Road/Intersection/(Lane)
	TrafficChannelizingMarking	Road/Intersection/Lane
	TrafficIslandMarking	Road/Intersection/Lane

7.3.4.1.2 RoadStructureAndEquipment

The RoadStructureAndEquipment class is an abstract class and acts as the branch class for expressing the hierarchical model. Table 74 defines the details of the RoadStructureAndEquipment class.

Table 74 — RoadStructureAndEquipment class

Class<<featureType>>: RoadStructureAndEquipment				
Definition	Any feature that represents either a road structure situated along or across the roadway (bridges, tunnels, gantries, safety rails, etc.), or a road equipment including road markings used for road operation.			
Role/Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
role: majorRoadStructure	Specifies a major road structure.			
	MajorRoadStructure			Generalization relationship
role: minorRoadStructure	Specifies a minor road structure.			
	MinorRoadStructure			Generalization relationship
role: roadEquipment	Specifies a road equipment.			
	RoadEquipment			Generalization relationship
role: roadMarking	Specifies a road marking.			
	RoadMarking			Generalization relationship

7.3.4.1.3 RoadStructureAndEquipmentCommonProperty package

7.3.4.1.3.1 ProjectionLine

Table 75 defines the details of the ProjectionLine class.

Table 75 — ProjectionLine class

Class<<dataType>>: ProjectionLine				
Definition	Line consisting of two or more projection points, that represents either the entire outline, or part thereof, for the road structure or a piece of road equipment, and indicates that positional relationship to the road features.			
Role/Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
role: projectionPoint	Specifies a projection point in the projection line.			
	ProjectionPoint	[2..*]		Composition relationship {ordered by sequence number}
sequenceNumber	Sequence number of a projection lines of a road structure or a piece of road equipment.			
	Integer	[1]		

7.3.4.1.3.2   ProjectionPoint

Table 76 defines the details of the ProjectionPoint class.

Table 76 — ProjectionPoint class

Class<<dataType>>: ProjectionPoint				
Definition	Point set on the representative point or on the planar outline of the road structures or a piece of road equipment and represents a reference point to the anchor position of the road feature.			
Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
sequenceNumber	Sequence number of a projection point of the road structure or a piece of road equipment.			
	Integer	[1]		
coordinateOfProjection-Point	Coordinates of the projection point.			
	DirectPosition	[1]		
projectionPointMarker	Position order of the projection point.			
	ProjectionPointMarker-Enum	[1]		
identifierOfAnchorPosition	Identifier of the anchor position corresponding to the projection point.			
	ID	[1..*]		

7.3.4.1.3.3   ProjectionPointMarkerEnum

Table 77 defines the details of the ProjectionPointMarkerEnum class.

Table 77 — ProjectionPointMarkerEnum class

Class<<enumeration>>: ProjectionPointMarkerEnum		
Definition	Available list of enumerations for the order type of the projection point.	
Code	**Value**	**Definition**
1	first	The first projection point of a projection line.
2	intermediate	The intermediate projection point of a projection line.
3	last	The last projection point of a projection line.
4	alone	Projection point of a road structure or a piece of road equipment that does not set a projection line.

7.3.4.1.3.4　RSEAreaShape

Table 78 defines the details of RSEAreaShape class.

Table 78 — RSEAreaShape class

Class<<dataType>>: RSEAreaShape				
Definition	Configuration data for defining the area representing the footprint of a road structure or a piece of equipment, consisting of three or more-line shapes.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: rseLineShape	Specifies a line shape for representing an area shape of a road structure or a piece of road equipment.			
	RSELineShape	[2..*]		Composition relationship
rseAreaShapeType	Area shape classification of a road structure or a piece of road equipment.			
	RSEAreaShapeTypeE-num	[1]		

7.3.4.1.3.5　RSEAreaShapeTypeEnum

Table 79 defines the details of the RSEAreaShapeTypeEnum class.

Table 79 — RSEAreaShapeTypeEnum class

Class<<enumeration>>: RSEAreaShapeTypeEnum		
Definition	Available list of enumerations for area shapes of a road structure or a piece of road equipment.	
Code	Value	Definition
1	square	An area shape is a square.
2	longitudinalRectangle	An area shape is a longitudinal rectangle along the road.
3	traversalRectangle	An area shape is a traversal rectangle along the road.
4	polygon	An area shape is a polygon.
5	circular	An area shape is a circular form.

7.3.4.1.3.6　RSELineShape

Table 80 defines the details of the RSELineShape class.

Table 80 — RSELineShape class

Class<<dataType>>: RSELineShape				
Definition	Configuration data of a line shape for a road structure or a piece of road equipment.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
rseLineShapeType	Classification of a line for a road structure or a piece of road equipment.			
	RSELineShapeTypeE-num	[1]		
rseLineShapeData	Line geometry data of a road structure or a piece of road equipment.			
	LineData	[1]		

7.3.4.1.3.7　RSELineShapeTypeEnum

Table 81 defines the details of the RSELineShapeTypeEnum class.

Table 81 — RSELineShapeTypeEnum class

Class<<enumeration>>: RSELineShapeTypeEnum		
Definition	Available list of enumerations for line shapes of a road structure or a piece of road equipment.	
Code	Value	Definition
1	entranceExitLine	Line shape for indicating an entrance or exit.
2	projectionLine	Line shape for indicating projection.
3	other	Line shape for indicating others.

7.3.4.1.3.8 RSEPointShape

Table 82 defines the details of the RSEPointShape class.

Table 82 — RSEPointShape class

Class<<dataType>>: RSEPointShape				
Definition	Configuration data of a point shape for a road structure or a piece of road equipment.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
rsePointShapeType	Classification of a point for a road structure or a piece of road equipment.			
	RSEPointShapeTypeEnum	[0..1]		
rsePointShapeData	Point geometry data of a road structure or a piece of road equipment.			
	PointData	[1]		

7.3.4.1.3.9 RSEPointShapeTypeEnum

Table 83 defines the details of the RSEPointShapeTypeEnum class.

Table 83 — RSEPointShapeTypeEnum class

Class<<enumeration>>: RSEPointShapeTypeEnum		
Definition	Available list of enumerations for points representing a road structure or a piece of road equipment.	
Code	Value	Definition
1	representativePointAndProjectionPoint	The point is both a representative and projection point.
2	representativePoint	The point is a representative point.
3	projectionPoint	The point is a projection point.
4	otherPoint	The point is for another purpose.

7.3.4.2 MajorRoadStructure sub-package

7.3.4.2.1 Contents of MajorRoadStructure sub-package

The MajorRoadStructure sub-package contains the following features:

— MajorRoadStructure,

— Bridge,

— InaccessibleSlopedZone,

— Tunnel, and

— Viaduct.

An InaccessibleSlopedZone is not a road structure but is specially included in the MajorRoadStructure sub-package.

The MajorRoadStructure sub-package also contains the property package for the major road structure features.

The MajorRoadStructure sub-package contains the features which are usually constructed during the initial road construction phase as the road structures, and for which it is later difficult to change their positions and shapes.

Figure 19 shows the classes of the MajorRoadStructure sub-package.
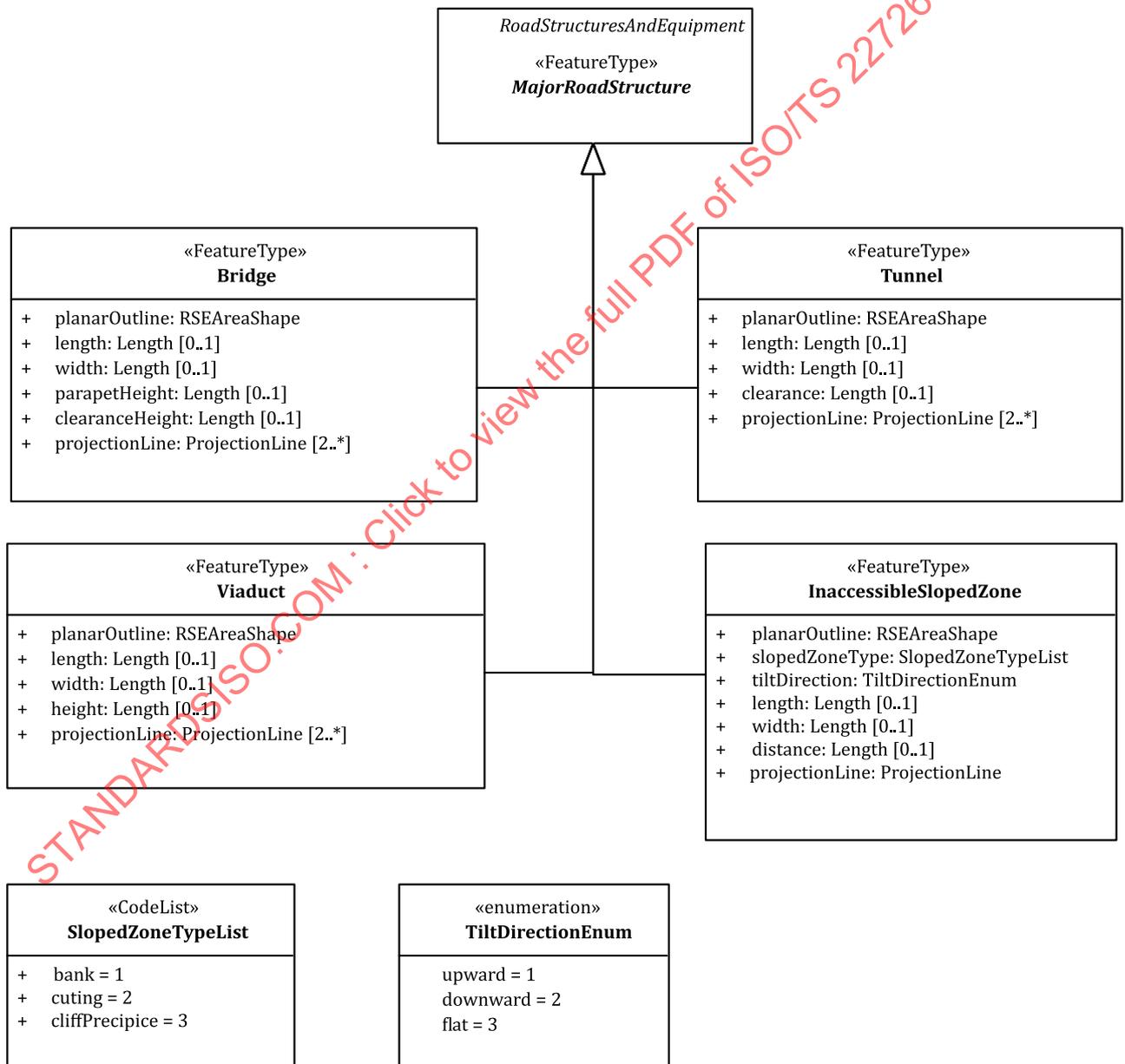
Figure 19 — MajorRoadStructure sub-package

7.3.4.2.2 MajorRoadStructure

The MajorRoadStructure class is an abstract class and is defined as the superclass in the MajorRoadStructure sub-package.

EXAMPLE   MajorRoadStructure are major civil engineering constructed road structures such as bridges, viaducts, and tunnels.

Table 84 defines the details of the MajorRoadStructure class.

Table 84 — MajorRoadStructure class

Class<<featureType>>: MajorRoadStructure				
Definition	Any large-sized feature located below, above or along the roadway forming a structural element of the road.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: Bridge	Specifies a bridge as a subclass.			
	Bridge			Generalization relationship
role: Tunnel	Specifies a tunnel as a subclass.			
	Tunnel			Generalization relationship
role: Viaduct	Specifies a viaduct as a subclass.			
	Viaduct			Generalization relationship
role: InaccessibleSlopedZone	Specifies an inaccessible sloped zone as a subclass.			
	InaccessibleSlopedZone			Generalization relationship

7.3.4.2.3 Bridge

A Bridge is located along the entire or part of a RoadBeltElement, and/or both a RoadBeltElement and an IntersectionBelt. A Bridge does not support the structure components under the road surface that can be supported by Pier, Wall and Foundation features.

A Bridge is expressed by a planar area surrounded by lines that are classified as entrance/exit lines and projection lines, and vehicles cannot move laterally out of the road due to the bridge.

If a Bridge is related to two or more RoadBeltElements, a Bridge can have intermediate ProjectionPoint in ProjectionLine at a location corresponding to terminal line of a RoadBeltElement, and that ProjectionPointMarker is defined as "intermediate".

If a RoadBeltElement is a single carriageway and two or more parallel Bridge features exist in the RoadBeltElement, each Bridge can optionally relate to the applicable LaneBeltElement.

In the case of double-decker bridges (stacked bridges), these can be defined separately as an upper bridge and a lower bridge.

Table 85 defines the details of the Bridge class.

Table 85 — Bridge class

Class<<featureType>>: Bridge				
Definition	Civil engineering structure that affords passage to pedestrians, animals, vehicles, waterways and services above obstacles or between two points at a height above the ground.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint

planarOutline	Planar geometry data of the bridge outline.			
	RSEAreaShape	[1]		
length	Longitudinal length of the bridge between abutments.			
	Length	[0..1]		
width	Maximum width of the bridge.			
	Length	[0..1]		
parapetHeight	Height from the road surface to a built-in parapet or fence.			
	Length	[0..1]		
clearance	Minimum clearance distance measured from the road surface to the underside of the bridge structure above.			
	Length	[0..1]		
projectionLine	Line that represents the side edge of the bridge that is projected onto the road feature.			
	ProjectionLine	[2..*]		

7.3.4.2.4 InaccessibleSlopedZone

An InaccessibleSlopedZone is a natural or human-maintained object that exists near the road such as cliff, cutting, bank, etc. which vehicle cannot access. An InaccessibleSlopedZone relates to a side line of the RoadBeltElement. An InaccessibleSlopedZone is specified by a planar area shape consisting of multiple lines classified into a projection line and other lines and projection points of InaccessibleSlopedZone are located on both end points of a projection line.

An InaccessibleSlopedZone rarely exists inside a road, but if an InaccessibleSlopedZone exists between LaneBeltElements, the InaccessibleSlopedZone will optionally relate to the LaneBeltElement. LaneAnchorPositions are linked by ProjectionPoints in a ProjectionLine of InaccessibleSlopedZone.

Table 86 defines the details of the InaccessibleSlopedZone class.

Table 86 — InaccessibleSlopedZone class

Class<<featureType>>: InaccessibleSlopedZone				
Definition	Natural or artificial sloped zones that exist near the road and are normally inaccessible to vehicles.			
Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
planarOutline	Planar geometry data of the inaccessible sloped zone outline.			
	RSEAreaShape	[1]		
slopedZoneType	The type of sloped zone.			
	SlopeZoneTypeList	[1]		
tiltDirection	Classification of the direction of the sloped zone.			
	TiltDirectionEnum	[1]		
length	Length of the inaccessible sloped zone.			
	Length	[0..1]		
width	Width of the inaccessible sloped zone.			
	Length	[0..1]		
distance	Minimum distance between the inaccessible sloped zone and the road edge.			
	Length	[0..1]		

Table 86 *(continued)*

projectionLine	Line that represents the side edge of the inaccessible sloped zone that is projected onto the road feature.			
	ProjectionLine	[1]		

7.3.4.2.5   Tunnel

A Tunnel is a long-enclosed road route that is located on the entire or part of a RoadBeltElement or across both a RoadBeltElement and an IntersectionBelt.

A Tunnel is expressed by a planar area surrounded by lines that are classified as entrance/exit lines and projection lines, because vehicles cannot move laterally out of the road when inside the tunnel.

If a Tunnel is related to two or more RoadBeltElements, and a tunnel can have an intermediate ProjectionPoint in a ProjectionLine at the location corresponding to the terminal line of RoadBeltElement, and its ProjectionPointMarker, it is defined as "intermediate".

If a RoadBeltElement is a single carriageway and two or more parallel tunnels exist in the RoadBeltElement, each tunnel can optionally relate to the applicable LaneBeltElement.

Table 87 defines the details of the Tunnel class.

Table 87 — Tunnel class

class<<featureType>>: Tunnel				
Definition	Structure dug into the ground, hills or mountains creating a long-enclosed road space. It is a long-enclosed transport route. A sub-surface structure in the ground, hills, or mountains creating a long-enclosed road space.			
Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
planarOutline	Planar geometry data of the tunnel outline.			
	RSEAreaShape	[1]		
length	Length of the tunnel.			
	Length	[0..1]		
width	Width of the tunnel.			
	Length	[0..1]		
clearanceHeight	Minimum clearance distance measured from the road surface to the tunnel ceiling.			
	Length	[0..1]		
projectionLine	Line that represents the side edge of the tunnel that is projected onto the road feature.			
	ProjectionLine	[2..*]		

7.3.4.2.6   Viaduct

A Viaduct is located along the entire or part of a RoadBeltElement and/or both a RoadBeltElement and an IntersectionBelt. A Viaduct does not support the structure components under the road surface that can be handled by Pier, Wall and Foundation features.

A Viaduct is expressed by a planar area surrounded by lines that are classified as entrance/exit lines and projection lines, because vehicles cannot move out of the road due to the viaduct.

If a Viaduct is related to two or more RoadBeltElements, the Viaduct can have an intermediate ProjectionPoint in a ProjectionLine at the location corresponding to the terminal line of RoadBeltElement, and its ProjectionPointMarker, it is defined as "intermediate".

If a RoadBeltElement is a single carriageway and two or more parallel Viaducts exist in the RoadBeltElement, each Viaduct can optionally relate to the applicable LaneBeltElement.

Table 88 defines the details of the Viaduct class.

Table 88 — Viaduct class

Class<<featureType>>: Viaduct				
Definition	Structure consisting of a series of piers or columns supporting an elevated carriageway built to span a physical obstacle.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
planarOutline	Planar geometry data of the viaduct outline.			
	RSEAreaShape	[1]		
length	Length of the viaduct.			
	Length	[0..1]		
width	Width of the viaduct.			
	Length	[0..1]		
height	Height from the road surface to a built-in parapet or fence.			
	Length	[0..1]		
projectionLine	Line that represents the side edge of the viaduct that is projected onto the road feature.			
	ProjectionLine	[2..*]		

7.3.4.2.7 MajorRoadStructureFeatureProperties package

7.3.4.2.7.1 SlopedZoneTypeList

Table 89 defines the details of the SlopedZoneTypeList class.

Table 89 — SlopedZoneTypeListclass

Class<<CodeList>>: SlopedZoneTypeList		
Definition	Available list of enumerations for an inaccessible sloped zone.	
Code	Value	Definition
1	bank	The sloped zone is defined by a bank and bank wall
2	cutting	The sloped zone is defined by a cut and cut wall
3	cliffPrecipice	The sloped zone is a cliff/precipice.

7.3.4.2.7.2 TiltDirectionEnum

Table 90 defines the details of the TiltDirectionEnum class.

Table 90 — TiltDirectionEnum class

Class<<enumeration>>: TiltDirectionEnum		
Definition	Available list of enumerations for the direction of tilt of the InaccessibleSlopedZone.	
Code	Value	Definition
1	upward	Upward tilt based on the projection line.
2	downward	Downward tilt based on the projection line.
3	flat	A flat field.

7.3.4.3   MinorRoadStructure sub-package

7.3.4.3.1   Contents of MinorRoadStructure sub-package

The MinorRoadStructure sub-package contains the following features:

— MinorRoadStructure,

— CentralReserve,

— Foundation,

— Gantry,

— Gutter,

— Hedge,

— Kerb,

— Manhole,

— PedestrianOverpass,

— Pier,

— RailwayCrossing,

— TrafficIsland,

— TramTrack, and

— Wall.

The MinorRoadStructure sub-package contains the property package for the minor road structure features. The MinorRoadStructure sub-package also contains the features usually implemented during the initial road construction, but which can later be added and/or have their positions and/or shapes changed.

Figure 20 shows the class diagram of the MinorRoadStructure sub-package (see https://standards.iso .org/iso/ts/22726/-1/ed-1/en for an enlarged version of this figure).
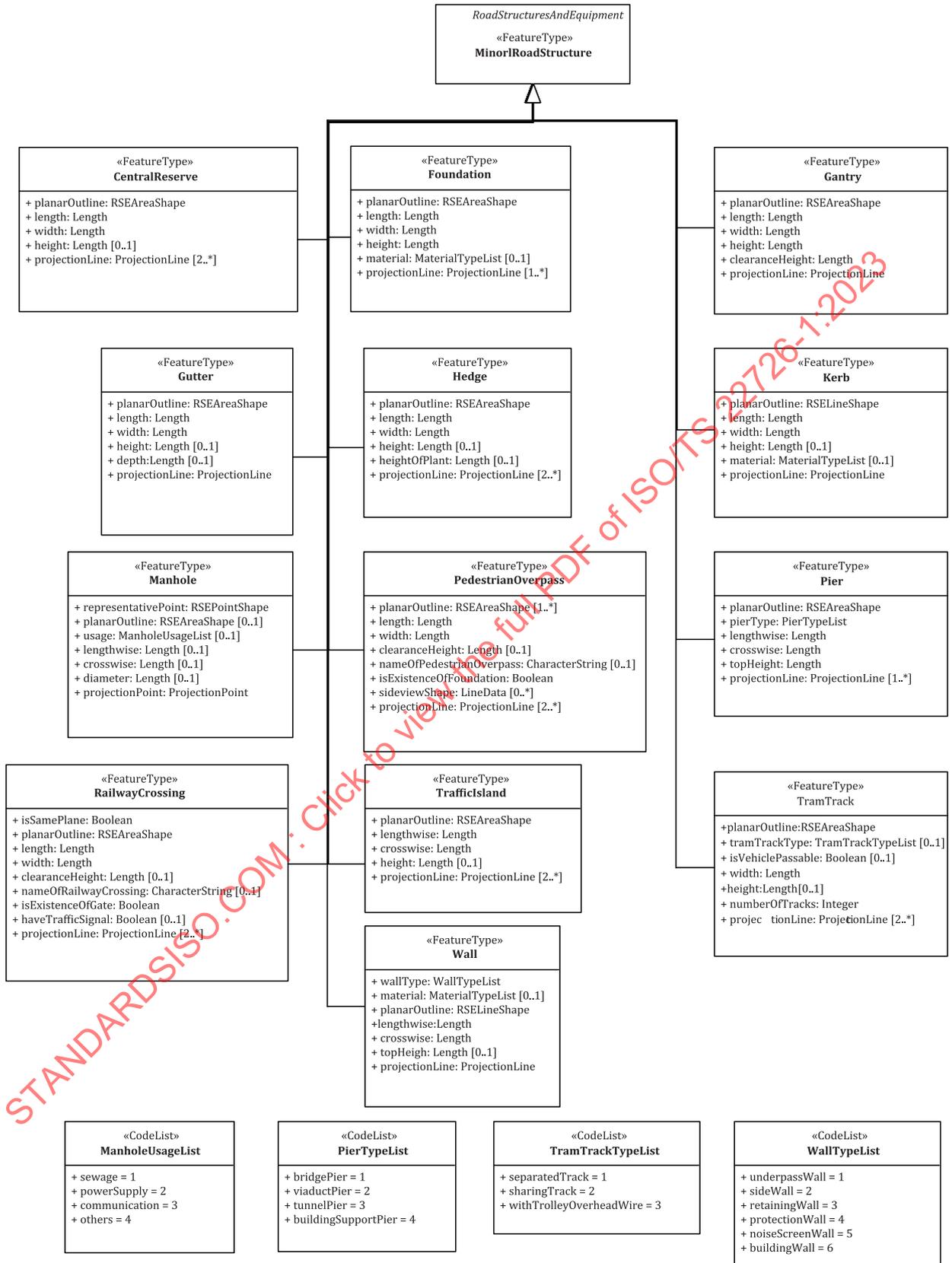
Figure 20 — MinorRoadStructure package

7.3.4.3.2 MinorRoadStructure

The MinorRoadStructure class is an abstract class and is defined as the root class for the MinorRoadStructure sub-package.

Table 91 defines the details of the MinorRoadStructure class.

Table 91 — MinorRoadStructure class

Class<<featureType>>: MinorRoadStructure				
Definition	Any medium- or small-sized feature located in, above or along the roadway forming a structural element of the road.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: CentralReserve	Specifies a central reservation, separating two or more carriageways.			
	CentralReserve			Generalization relationship
role: Foundation	Specifies a foundation.			
	Foundation			Generalization relationship
role: Gantry	Specifies a gantry.			
	Gantry			Generalization relationship
role: Gutter	Specifies a gutter.			
	Gutter			Generalization relationship
role: Hedge	Specifies a hedge.			
	Hedge			Generalization relationship
role: Kerb	Specifies a kerb.			
	Kerb			Generalization relationship
role: Manhole	Specifies a manhole.			
	Manhole			Generalization relationship
role: PedestrianOver-pass	Specifies a pedestrian overpass			
	PedestrianOverpass			Generalization relationship
role: Pier	Specifies a pier.			
	Pier			Generalization relationship
role: RailwayCrossing	Specifies a railway crossing.			
	RailwayCrossing			Generalization relationship
role: TrafficIsland	Specifies a traffic island as a subclass.			
	TrafficIsland			Generalization relationship
role: TramTrack	Specifies subclass TramTrack.			
	TramTrack			Generalization relationship
role: Wall	Specifies a wall.			
	Wall			Generalization relationship

7.3.4.3.3 CentralReserve

A CentralReserve is located either along the entire area or part of an area between the RoadBeltElements of a dual carriageway. A CentralReserve does not project to an IntersectionAnchorPosition.

A CentralReserve shape is a planar area shape consisting of multiple lines classified into projection lines and other lines. Projection lines of the CentralReserve are located on both sides along the road and are related to the RoadAnchorPositions on the RoadBeltSideLines.

If a CentralReserve is surrounded by a kerb or another low border, the CentralReserve can contain a height.

If a CentralReserve is related to two or more RoadBeltElements, a CentralReserve can have an intermediate ProjectionPoint in a ProjectionLine at a location corresponding to the terminal line of RoadBeltElement, and its ProjectionPointMarker is defined as 'intermediate'.

As a special case, if a CentralReserve exists in the central part of a RoadBeltElement, the CentralReserve can optionally relate to a LaneAnchorPosition in the LaneBeltElement and a RoadAnchorPosition in the RoadBeltElementLink.

Table 92 defines the details of the CentralReserve class.

Table 92 — CentralReserve class

Class<<featureType>>: CentralReserve				
Definition	Area separating the carriageways of a dual carriageway road.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
planarOutline	Planar geometry data of the central reserve outline.			
	RSEAreaShape	[1]		
length	Length of the central reserve.			
	Length	[0..1]		
width	Width of the central reserve.			
	Length	[0..1]		
height	Height of the central reserve from road surface.			
	Length	[0..1]		
projectionLine	Line that represents the side edge of the central reserve that is projected onto the road feature.			
	ProjectionLine	[2..*]		

7.3.4.3.4　Foundation

A Foundation along a RoadBeltElement or an IntersectionBelt that can affect road traffic, represents the base object installed under the road structures or a piece of road equipment.

The outline of a Foundation is a planar area shape consisting of multiple lines classified into projection lines and other lines. The projection lines of a Foundation are located on both sides of a foundation feature along a road.

If a Foundation exists between LaneBeltElements, it is optionally related to LaneBeltElement.

Table 93 defines the details of the Foundation class.

Table 93 — Foundation class

Class<<featureType>>: Foundation				
Definition	Base object installed under a road structure or a piece of road equipment.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
planarOutline	Planar geometry data of the foundation outline.			
	RSEAreaShape	[1]		
length	Length of the foundation.			
	Length	[1]		
NOTE A Foundation can be defined according to the impact of the traffic obstruction caused by its location and size.				

Table 93 *(continued)*

width	Width of the foundation			
	Length	[1]		
height	Height of the foundation.			
	Length	[1]		
material	Construction material of the foundation.			
	MaterialTypeList	[0..1]		
projectionLine	Line that represents the side edge of the foundation that is projected onto the road feature.			
	ProjectionLine	[1..*]		
NOTE A Foundation can be defined according to the impact of the traffic obstruction caused by its location and size.				

7.3.4.3.5 Gantry

A Gantry represents a structure comprised of two or more columns linked at their tops by a beam spanning across the carriageway that does not cause a traffic obstruction of the lanes.

EXAMPLE   A Gantry is used for installing the road signs, traffic signals, senser devices, road lighting equipment and others.

A Gantry is located transversely in the upper space of the RoadBeltElement or IntersectionBelt.

A Gantry is a narrow planar area consisting of multiple lines classified as projection lines across the roadway and partial lines of the outline. If a Gantry is related to two or more RoadBeltElements, the Gantry can have intermediate ProjectionPoint in ProjectionLine and its ProjectionPointMarker is defined as "intermediate".

Table 94 defines the details of the Gantry class.

Table 94 — Gantry class

Class<<featureType>>: Gantry				
Definition	Road structure comprised of two or more columns linked at their tops by a beam spanning across the carriageway.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
planarOutline	Planar geometry data of the gantry outline.			
	RSEAreaShape	[1]		
length	Length of the gantry.			
	Length	[1]		
width	Width of the gantry.			
	Length	[1]		
height	Height of the gantry.			
	Length	[1]		
clearanceHeight	Minimum clearance distance measured from the road surface to the underside of the gantry structure above.			
	Length	[1]		
projectionLine	Line that represents the side edge of the gantry that is projected onto the road feature.			
	ProjectionLine	[1..2]		

7.3.4.3.6 Gutter

A Gutter can exist in a RoadBeltElement, an IntersectionBelt or across both a RoadBeltElement and an IntersectionBelt.

When a Gutter exists in a RoadBeltElement it is positioned along the side line direction or traversal direction of the RoadBeltElement. When a Gutter exists in an IntersectionBelt it is positioned along the terminal line or the side line of the IntersectionBelt.

A Gutter is a narrow planar area consisting of multiple lines classified as projection lines across the roadway and partial lines of the outline. A projection line of a Gutter is located on the sides and is related to a side line of a RoadBeltElement and/or a side line or terminal line of an IntersectionBelt. A Gutter is not related to the LaneAnchorPosition unless it is placed along the inside of the lane.

If a Gutter is related to two or more sequential RoadBeltElements and/or IntersectionBelts, a Gutter can have an intermediate ProjectionPoint in ProjectionLine at a location corresponding to a terminal line of the RoadBeltElement, and its ProjectionPointMarker is defined as "intermediate".

NOTE   Common synonyms of "Gutter" are swales, ditches, grooves, drainage ditches, rainwater channels, rainwater slopes, and rainwater drains.

Table 95 defines the details of the Gutter class.

Table 95 — Gutter class

Class<<featureType>>: Gutter				
Definition	Facility for draining rainwater placed inside or along the road.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
planarOutline	Planar geometry data of the gutter outline.			
	RSEAreaShape	[1]		
length	Length of the gutter.			
	Length	[0..1]		
width	Width of the gutter.			
	Length	[0..1]		
height	Height from road surface to the top edge of the gutter.			
	Length	[0..1]		
depth	Depth from road surface to bottom of the gutter.			
	Length	[0..1]		
projectionLine	Line that represents the side edge of the gutter that is projected onto the road feature.			
	ProjectionLine	[1..2]		

7.3.4.3.7 Hedge

A Hedge is located along a RoadBeltElement and an IntersectionBelt. A Hedge contains the hedge bed.

If a Hedge exists on the roadway, it is located between lanes or between the road edge and a lane.

A Hedge is a planar area consisting of multiple lines classified as projection lines and other lines. The Projection lines of Hedge can be located on both sides along a road and are related to the side line of a RoadBeltElement and/or terminal line or side line of an IntersectionBelt.

If a Hedge exists inside a RoadBeltElement or an IntersectionBelt and along a LaneBeltElement, a Hedge can optionally project to the LaneBeltElement.

Table 96 defines the details of the Hedge class.

Table 96 — Hedge class

Class<<featureType>>: Hedge				
Definition	Area including its bed where vegetation is planted on the carriageway or intersection, or along the carriageway or intersection.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
planarOutline	Planar geometry data of the hedge outline.			
	RSEAreaShape	[1]		
length	Length of the hedge.			
	Length	[0..1]		
width	Width of the hedge.			
	Length	[0..1]		
height	Height of hedge bed from road surface.			
	Length	[0..1]		
heightOfPlant	Average height of the planted vegetation.			
	Length	[0..1]		
projectionLine	Line that represents the side edge of the hedge that is projected onto the road feature.			
	ProjectionLine	[1..*]		

7.3.4.3.8 Kerb

A Kerb is located along a RoadBeltElement and an IntersectionBelt as a separator or into a RoadBeltElement and an IntersectionBelt as a component of a traffic island.

A Kerb is represented by a RSELineShape as a projection line with the width. The projection line of a Kerb is located at the edges and is related to a side line of a RoadBeltElement and/or an IntersectionBelt.

If Kerb is related to two or more sequential RoadBeltElements and/or IntersectionBelts, Kerb can have intermediate ProjectionPoint in ProjectionLine at a location corresponding to terminal line of a RoadBeltElement, and its ProjectionPointMarker is defined as 'intermediate'.

If a Kerb exists between LaneBeltElements, it is handled as a TrafficIsland or a CentralReserve.

Table 97 defines the details of the Kerb class.

Table 97 — Kerb class

Class<<featureType>>: Kerb				
Definition	Units intended to separate the road surface from other zones and to provide physical delineation or containment.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
planarOutline	Planar geometry data of the kerb outline.			
	RSELineShape	[1]		
length	Length of the kerb.			
	Length	[1]		
width	Width of the kerb.			
	Length	[1]		
height	Height of the kerb from the road surface.			
	Length	[0..1]		

Table 97 *(continued)*

material	Construction material of the kerb.			
	MaterialTypeList	[0..1]		
projectionLine	Line that represents the side edge of the kerb that is projected onto the road feature.			
	ProjectionLine	[1]		

7.3.4.3.9 Manhole

A Manhole is expressed by point shape feature. A projection point of Manhole is set on a representative point. A Manhole is related to a RoadBeltElement or an IntersectionBelt. A Manhole can contain a planar outline shape.

Table 98 defines the details of the Manhole class.

Table 98 — Manhole class

Class<<featureType>>: Manhole				
Definition	Vertical hole with a removable cover constructed on roadways and intersections.			
Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
representativePoint	Representative point of the manhole.			
	RSEPointShape	[1]		
planarOutline	Planar geometry data of the manhole outline.			
	RSEAreaShape	[0..1]		
usage	Manhole usage.			
	ManholeUsageList	[0..1]		
lengthwise	Longitudinal length of the manhole.			
	Length	[0..1]		
crosswise	Transverse length of the manhole.			
	Length	[0..1]		
diameter	Diameter of the manhole.			
	Length	[0..1]		
projectionPoint	Point that represents the location of the manhole that is projected onto the road feature.			
	ProjectionPoint	[1]		

7.3.4.3.10 PedestrianOverpass

A PedestrianOverpass is located in the upper space of a RoadBeltElement.

A PedestrianOverpass is expressed as a planar area consisting of multiple lines classified as projection lines and other lines. Projection lines of a PedestrianOverpass are located across a road or an intersection.

NOTE   A synonym of a PedestrianOverpass is a footbridge.

Table 99 defines the details of the PedestrianOverpass class.

Table 99 — PedestrianOverpass class

Class<<featureType>>: PedestrianOverpass				
Definition	Bridge intended mainly to carry pedestrians and/or cycle track loads, and on which neither road traffic loads, except permitted vehicles (e.g. maintenance vehicles) nor any railway load are permitted.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
planarOutline	Planar geometry data, and optional outlines of access slope/stairs, of the pedestrian overpass outline.			
	RSEAreaShape	[1..*]		
length	Length of the pedestrian overpass across the road or intersection.			
	Length	[1]		
widthe	Width of the pedestrian overpass.			
	Length	[1]		
clearanceHeight	Minimum clearance distance measured from the road surface to the underside of the pedestrian overpass structure above.			
	Length	[0..1]		
nameOfPedestrianOver-pass	Name of the pedestrian overpass.			
	CharacterString	[0..1]		
isExistenceOfFoundation	Determines if the pedestrian overpass has a foundation (true) or not (false).			
	Boolean	[1]		{true: has}
featureSideviewShape-Data	Geometry data of the pedestrian overpass profile.			
	LineData	[0..*]		
projectionLine	Line that represents the side edge of the pedestrian overpass that is projected onto the road feature.			
	ProjectionLine	[2..*]		

7.3.4.3.11 Pier

Piers are located on the roadside to maintain the road space. Piers are located along RoadBeltElement and IntersectionBelt.

The footprint of a Pier is represented by a planar area consisting of multiple lines classified as projection lines and partial lines of the outline. Projection lines of a Pier are located on both sides of a pier along the road and are related to the side line of a RoadBeltElement and an IntersectionBelt.

If a Pier exists between two LaneBeltElement instances, it is related to both LaneBeltElements.

Table 100 defines the details of the Pier class.

Table 100 — Pier class

Class<<featureType>>: Pier				
Definition	A substructure of a road structure crossing over the road.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
planeOutline	Planar geometry data of the pier outline.			
	RSEAreaShape	[1]		

Table 100 (continued)

pierType	Category of the pier.			
	PierTypeList	[1]		
lengthwise	Longitudinal measure of the pier along the road centreline.			
	Length	[1]		
crosswise	Transverse measure of the pier across the road centreline.			
	Length	[1]		
topHeight	Height from road surface to top of the pier.			
	Length	[1]		
projectionLine	Line that represents the side edge of the pier that is projected onto the road feature.			
	ProjectionLine	[1..*]		

7.3.4.3.12 RailwayCrossing

A RailwayCrossing represents an area of the road which crosses the railway.

A road can cross a railway on the same level, using a railway bridge, using a tunnel, or using an underpass or overpass road.

A RailwayCrossing does not contain information of a railway and a railway bridge. Regarding other modes of transportation, for example tram and light rail, a crossing with other modes of transportation is not included in a RailwayCrossing, but rather in the TramTrack class. In the case of a railway bridge, it refers to the area under the railway bridge. In the case of the railway under the road, A RaiwayCrossing is not set.

A RailwayCrossing is expressed as an area consisting of multiple lines classified as entrance/exit lines and projection lines. Projection lines of a RailwayCrossing are located on both sides of the railway crossing and are related to the side line of a RoadBeltElement. If the road is a dual carriageway, a RailwayCrossing is related to two RoadBeltElements.

Table 101 defines the details of the RailwayCrossing class.

Table 101 — RailwayCrossing class

Class<<featureType>>: RailwayCrossing				
Definition	An area of the road which crosses the railway at the same level or under it.			
Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
isSamePlane	Determines if the railway crossing exists on the same plane (true) or not (false).			
	Boolean	[1]		{true: the same plane, false: not}
planarOutline	Planar geometry data of the railway crossing outline.			
	RSEAreaShape	[1]		
length	Length of the railway crossing.			
	Length	[1]		
width	Width of the railway crossing.			
	Length	[1]		
clearanceHeight	Minimum clearance distance measured from the road surface to an overhead wire or the underside of the railway bridge structure above.			
	Length	[0..1]		
nameOfRailwayCrossing	Name of the railway crossing			
	CharacterString	[0..1]		

isExistenceOfGate	Determines if the railway crossing has gate equipment (true) or not (false).			
	Boolean	[0..1]		{true: exist}
haveTrafficSignal	Determines if the railway crossing has a traffic signal system (true) or not (false).			
	Boolean	[0..1]		{true: have}
projectionLine	Line that represents the side edge of the railway crossing that is projected onto the road feature.			
	ProjectionLine	[2..*]		

7.3.4.3.13 TrafficIsland

A TrafficIsland represents a raised area with physical obstructions, usually Kerbs, located in the carriageway, the intersection, or at the edge of the carriageway. Their purpose is to channelize traffic, block the entry of vehicles as safety zone, and/or provide a waiting zone such as a tram platform. A TrafficIsland does not contain TrafficIslandMarking defined by the marking (e.g. painted line and road studs).

A TrafficIsland is located in a RoadBeltElement and an IntersectionBelt. A TrafficIsland is an area shape consisting of multiple lines classified into projection lines and other lines. Projection lines of a TrafficIsland are located on the sides of the traffic island along the lanes and are related to a side line of RoadBeltElement and/or IntersectionBelt. If a TrafficIsland is related to two or more sequential RoadBeltElement and/or IntersectionBelt, the TrafficIsland can have an intermediate ProjectionPoint in a ProjectionLine at a location corresponding to the terminal line of a RoadBeltElement, and its ProjectionPointMarker is defined as "intermediate".

If a TrafficIsland exists along a LaneBeltElement, the TrafficIsland can optionally relate to a LaneBeltElement.

A TrafficIsland applies to the tram station, the safety zone, and the orbicular field in the roundabout.

Table 102 defines the details of the TrafficIsland class.

Table 102 — TrafficIsland class

Class<<featureType>>: TrafficIsland				
Definition	An area with physical obstructions, usually kerbs, located in the carriageway (or the intersection) or at the edge of the carriageway.			
Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
planarOutline	Planar geometry data of the traffic island outline.			
	RSEAreaShape	[1]		
lengthwise	Longitudinal length of the traffic island.			
	Length	[1]		
crosswise	Transverse length of the traffic island.			
	Length	[1]		
height	Height of the traffic island from road surface.			
	Length	[0..1]		
projectionLine	Line that represents the side edge of the traffic island that is projected onto the road feature.			
	ProjectionLine	[2..*]		

7.3.4.3.14 TramTrack

A TramTrack represents a long-enclosed transport space for the tram, light rail vehicle or trolleybus. A TramTrack defies an area of a single track or set of tracks and can overlap with an area of a RoadBeltElement and an IntersectionBelt. In the case of a trolleybus, the TramTrack represents a virtual movement zone.

A TramTrack is located at a RoadBeltElement and/or an IntersectionBelt. A TramTrack is surrounded by lines classified as projection lines and other lines. The projection lines of a TramTrack are located on both sides of the TramTrack along a road and are related to the side lines of a RoadBeltElement and an IntersectionBelt. If TramTrack is related to two or more sequential RoadBeltElements and/or IntersectionBelts, TramTrack can have intermediate ProjectionPoint in ProjectionLine at a location corresponding to a terminal line of RoadBeltElement, and its ProjectionPointMarker is defined as 'intermediate'.

If a TramTrack in the roadway is passable, the LaneBeltElement which overlaps with the TramTrack can be set and the TramTrack can optionally relate to a LaneBeltElement.

Table 103 defines the details of the TramTrack class.

Table 103 — TramTrack class

Class<<featureType>>: TramTrack				
Definition	Long-enclosed transport space for a tram, light rail vehicle or other, installed in a road space.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
planarOutline	Planar geometry data of the tram track outline.			
	RSEAreaShape	[1]		
tramTrackType	Type of the tram track.			
	TramTrackTypeList	[0..1]		
isVehiclePassable	Determines if a vehicle can pass on the tracks (true) or not (false).			
	Boolean	[0..1]	{true: accessible}	
width	Width of the tram track.			
	Length	[1]		
height	Height from road surface to tram track bed.			
	Length	[0..1]		
numberOfTracks	The number of the tram tracks present.			
	Integer	[1]		
projectionLine	Line that represents the side edge of the tram track that is projected onto the road feature.			
	ProjectionLine	[2..*]		

7.3.4.3.15 Wall

A Wall represents part of the side-face of a structure or maintained land, or a vertically installed panel-shaped object.

A Wall is located along a RoadBeltElement and an IntersectionBelt. A Wall is represented by RSELineShape as a projection line with a width. A projection line of a Wall is related to the side line of a RoadBeltElement and an IntersectionBelt. If a Wall is related to two or more sequential RoadBeltElements and/or IntersectionBelts, a Wall can have intermediate ProjectionPoints in a ProjectionLine at a location corresponding to the terminal line of the RoadBeltElement.

If a Wall is located along a LaneBeltElement, a Wall can project optionally to the LaneBeltElement.

Table 104 defines the details of the Wall class.

Table 104 — Wall class

Class<<featureType>>: Wall				
Definition	Vertical construction made of stone, brick, concrete, etc. with a length and a height much greater than its thickness used to enclose, divide or support.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
wallType	Type of wall structures.			
	WallTypeList	[1]		
material	Construction material of the wall.			
	MaterialTypeList	[0..1]		
planarOutline	Planar geometry data of the wall outline.			
	RSELineShape	[1]		
lengthwise	Measure of the rectangular length or the major axis of the wall.			
	Length	[1]		
crosswise	Measure of the rectangular width or the minor axis of the wall.			
	Length	[1]		
topHeight	Height from the road surface to the top of the wall.			
	Length	[0..1]		
projectionLine	Line that represents the side edge of the wall that is projected onto the road feature.			
	ProjectionLine	[1]		

7.3.4.3.16 MinorRoadStructureFeatureProperties package

7.3.4.3.16.1 ManholeUsageList

Table 105 defines the details of the ManholeUsageList class.

Table 105 — ManholeUsageList class

Class<<CodeList>>: ManholeUsageList		
Definition	Available list of enumerations for manhole access.	
Code	Value	Definition
1	sewage	Manhole for sewage access.
2	powerSupply	Manhole for power supply access.
3	communication	Manhole for communication equipment access.
4	others	Manhole for other access.

7.3.4.3.16.2 PierTypeList

Table 106 defines the details of the PierTypeList class.

Table 106 — PierTypeList class

Class<<CodeList>>: PierTypeList		
Definition	Available list of enumerations for piers.	
Code	Value	Definition
1	bridgePier	Pier for a bridge.
2	viaductPier	Pier for a viaduct.
3	tunnelPier	Pillars that support a tunnel
4	buildingSupport	Pillars that support a building

7.3.4.3.16.3 TramTrackTypeList

Table 107 defines the details of the TramTrackTypeList class.

Table 107 — TramTrackTypeList class

Class<CodeList>>: TramTrackTypeList		
Definition	Available list of enumerations for tram tracks.	
Code	Value	Definition
1	separatedTrack	Tram track that cannot be shared by a motor vehicle.
2	sharingTrack	Tram track that can be shared by a motor vehicle.
3	tramTrackWithTrol-ley-overheadWire	Tram track that can be shared and has a trolley wire/overhead wire in the vertical space.

7.3.4.3.16.4 WallTypeList

Table 108 defines the details of the WallTypeList class.

Table 108 — WallTypeList class

Class<<CodeList>>: WallTypeList		
Definition	Available list of enumerations for type of walls.	
Code	Value	Definition
1	underpassWall	Wall in an underpass.
2	sideWall	Wall of a bank/slope along the road.
3	retainingWall	Retaining wall along a roadside.
4	protectionWall	Protection wall along a roadside.
5	noiseScreenWall	Wall to obstruct noise along a roadside.
6	buildingWall	Wall of a building or structure.

7.3.4.4 RoadEquipment sub-package

7.3.4.4.1 Contents of RoadEquipment sub-package

The RoadEquipment sub-package contains the following features:

— RoadEquipment,

— BusStopBoard,

— Delineator,

— DistanceMarker,

— Fence,

— Gate,

— Guardrail,

— IslandNose,

— RisingBollard,

— RoadLighting,

— RoadSign,

— RoadStud,

— SpeedBump,

— SupportPole,

— InformationBoard,

— TrafficPole,

— TrafficSignalHead, and

— UtilityPole.

The RoadEquipment sub-package also contains the property package for the road equipment features.

Figure 21 shows the class diagram of the RoadEquipment sub-package (see https://standards.iso.org/iso/ts/22726/-1/ed-1/en for an enlarged version of this figure).

«FeatureType»
RoadStructuresAndEquipment
RoadEquipment

«FeatureType»
BusStopBoard

+ featureExistenceType: FeatureExistenceTypeEnum
+ representativePoint: RSEPointShape [0..1]
+ lineShapeOfArray: RSELineShape [0..1]
+ boardLength: Length
+ boardShapeType: BoardShapeTypeList
+ boardWidth: Length
+ topHeight: Length
+ projectionPoint: ProjectionPoint [0..1]
+ projectionLine: ProjectionLine [0..1]

«FeatureType»
Delineator

+ delineatorExistenceType: FeatureExistenceTypeEnum
+ representativePoint: RSEPointShape [0..1]
+ lineShapeOfArray: RSELineShape [0..1]
+ length: Length
+ width: Length
+ height: Length
+ topHeight: Length
+ arrayInformation: FeatureArrayInfo [0..1]
+ projectionPoint: ProjectionPoint [0..1]
+ projectionLine: ProjectionLine [0..1]

«FeatureType»
DistanceMarker

+ representativePoint: RSEPointShape
+ shapeType: BoardShapeTypeList [0..1]
+ lengthwise: Length
+ crosswise: Length
+ topHeight: Length
+ hasFoundation: Boolean [0..1]
+ projectionPoint: ProjectionPoint

«FeatureType»
Fence

+ planarOutline: RSELineShape
+ lengthwise: Length
+ crosswise: Length
+ topHeight: Length
+ material: MaterialTypeList [0..1]
+ hasFoundation: Boolean [0..1]
+ projectionLine: ProjectionLine

«FeatureType»
Gate

+ planarOutline: RSELineShape
+ gateType: GateTypeList
+ lengthwise: Length [0..1]
+ crosswise: Length
+ height: Length
+ topHeight: Length [0..1]
+ projectionLine: ProjectionLine

«FeatureType»
Guardrail

+ planarOutlineShape: RSELineShape
+ guardrailType: GuardrailTypeList
+ material: MaterialTypeList [0..1]
+ length: Length
+ verticalWidth: Length
+ topHeight: Length
+ projectionLine: ProjectionLine

«FeatureType»
IslandNose

+ representativePoint: RSEPointShape
+ material: MaterialTypeList [0..1]
+ profileViewShape: LineData [0..*]
+ lengthwise: Length
+ crosswise: Length
+ height: Length
+ topHeight: Length
+ projectionPoint: ProjectionPoint

«FeatureType»
RisingBollard

+ risingBollardExistenceType: FeatureExistenceTypeEnum
+ representativePoint: RSEPointShape [0..1]
+ lineShapeOfArray: RSELineShape [0..1]
+ lengthwise: Length
+ crosswise: Length
+ height: Length
+ profileShape: LineData [0..*]
+ arrayInformation: FeatureArrayInfo [0..1]
+ projectionPoint: ProjectionPoint [0..1]
+ projectionLine: ProjectionLine [0..1]

«FeatureType»
RoadLighting

+ representativePoint: RSEPointShape
+ roadLightingInstallType: RoadLightingInstallTypeList
+ planeShape: RSEAreaShape [0..1]
+ lengthwise: Length
+ crosswise: Length
+ height: Length [0..1]
+ topHeight: Length
+ projectionPoint: ProjectionPoint

«FeatureType»
RoadStud

+ roadStudExistenceType: FeatureExistenceTypeEnum
+ representativePoint: RSEPointShape [0..1]
+ lineShapeOfArray: RSELineShape [0..1]
+ roadStudType: RoadStudTypeList
+ roadStudColour: ColourTypeList [0..1]
+ lengthwise: Length
+ crosswise: Length [0..1]
+ height: Length
+ arrayInformation: FeatureArrayInfo [0..1]
+ projectionPoint: ProjectionPoint [0..1]
+ projectionLine: ProjectionLine [0..1]

«FeatureType»
SpeedBump

+ deviceType: BumpTypeList
+ planarOutline: RSEAreaShape
+ lengthwise: Length
+ crosswise: Length
+ height: Length
+ projectionLine: ProjectionLine [2]

«FeatureType»
SupportPost

+ representativePoint: RSEPointShape
+ lengthwise: Length
+ crosswise: Length [0..1]
+ height: Length
+ hasFoundation: Boolean [0..1]
+ projectionPoint: ProjectionPoint

«FeatureType»
InformationBoard

+ informationBoardType: BoardTypeList
+ representativePoint: RSEPointShape
+ boardShapeType: BoardShapeTypeList
+ boardShapedata: RSEAreaShape [0..1]
+ lengthwise: Length
+ crosswise: Length
+ topHeight: Length
+ hasFoundation: Boolean [0..1]
+ projectionPoint: ProjectionPoint

«FeatureType»
TrafficPole

+ poleExistenceType: FeatureExistenceTypeEnum
+ representativePoint: RSEPointShape [0..1]
+ lineShapeOfArray: RSELineShape [0..1]
+ trafficPoleType: TrafficPoleTypeList
+ lengthwise: Length
+ crosswise: Length [0..1]
+ height: Length
+ poleArrayInformation: FeatureArrayInfo [0..1]
+ projectionPoint: ProjectionPoint [0..1]
+ projectionLine: ProjectionLine [0..1]

«FeatureType»
UtilityPole

+ representativePoint: RSEPointShape
+ lengthwise: Length
+ crosswise: Length [0..1]
+ height: Length
+ utilityPoleType: UtilityPoleTypeList
+ hasFoundation: Boolean [0..1]
+ projectionPoint: ProjectionPoint

«FeatureType»
RoadSign

+ representativePoint: RSEPointShape
+ roadSignShapeType: BoardShapeTypeList
+ lengthwise: Length
+ crosswise: Length [0..1]
+ topHeight: Length
+ roadSignCode: RoadSignCode [0..1]
+ projectionPoint: ProjectionPoint

«FeatureType»
TrafficSignalHead

+ representativePoint: RSEPointShape
+ planarOutlineShape: RSEAreaShape [0..*]
+ lengthwise: Length
+ crosswise: Length
+ depth: Length
+ topHeight: Length
+ lightLayout: LampLayoutList
+ numberOfLamps: Integer
+ associatedRoadBeltElementID: ID [0..1]
+ associatedTrafficDirectionOfRBE: TrafficDirectionEnum [0..1]
+ associatedLaneBeltElementID: ID [0..1]
+ associatedTrafficDirectionOfLBE: TrafficDirectionEnum [0..1]
+ projectionPoint: ProjectionPoint

+appliedPedCrossing

RoadMarking
«FeatureType»
RoadMarking::PedestrianCrossing

+appliedRoadSign

RoadMarking
«FeatureType»
RoadMarking::StopLine

+stoppingLocation

+appliedTrafficSignal

+stoppingLocation

«DataType»
RoadSignCode

referenceOfRoadSign: ANY
codeOfRoadSignSystem: ANY

«CodeList»
BoardShapeTypeList

+ rectangleWithHorizontalLongSide = 1
+ rectangleWithVerticalLongSide = 2
+ triangle = 3
+ invertedTriangle = 4
+ circle = 5
+ ellipse = 6
+ pentagon = 7
+ hexagon = 8
+ octagon = 9
+ diamond = 10

«CodeList»
BoardTypeList

+ cmsBoard = 1
+ vmsBoard = 2

«CodeList»
BumpTypeList

+ speedBump = 1
+ roundRoadHump = 2
+ flatTopRoadHump = 3

«DataType»
FeatureArrayInfo

+ numberOfFeature: Integer
+ intervalDistance: Length

«CodeList»
MaterialTypeList

+ brick = 1
+ concrete = 2
+ plaster = 3
+ plastic = 4
+ rubber = 5
+ sandbag = 6
+ steel = 7
+ steelPlate = 8
+ steelPipe = 9
+ steelWire = 10
+ stoneRock = 11
+ wood = 12

«CodeList»
GateTypeList

+ bars = 1
+ doors = 2
+ chains = 3
+ ropes = 4

«CodeList»
GuardrailTypeList

+ rail = 1
+ pipe = 2
+ wire = 3
+ netI ng = 4
+ concreteBlock = 5

«CodeList»
LampLayoutList

+ horizontal = 1
+ vertical = 2

«CodeList»
RoadLightingInstallTypeList

+ standAlone = 1
+ withinSupportPole = 2
+ withinGantry = 3
+ ceilingBuiltIn = 4
+ wallBuiltIn = 5
+ wallAtiachedTo = 6
+ onCable

«CodeList»
RoadStudTypeList

+ stoneStud = 1
+ reflectiveStud = 2
+ metalStud = 3
+ botis'Dots = 4

«CodeList»
TrafficPoleTypeList

+ cylindrical = 1
+ prism = 2
+ cone = 3
+ pyramid = 4
+ other = 5

«CodeList»
UtilityPoleTypeList

+ lowVoltagePole = 1
+ highVoltagePole = 2
+ telecomunicationPole = 3
+ aerialPole = 4

«enumeration»
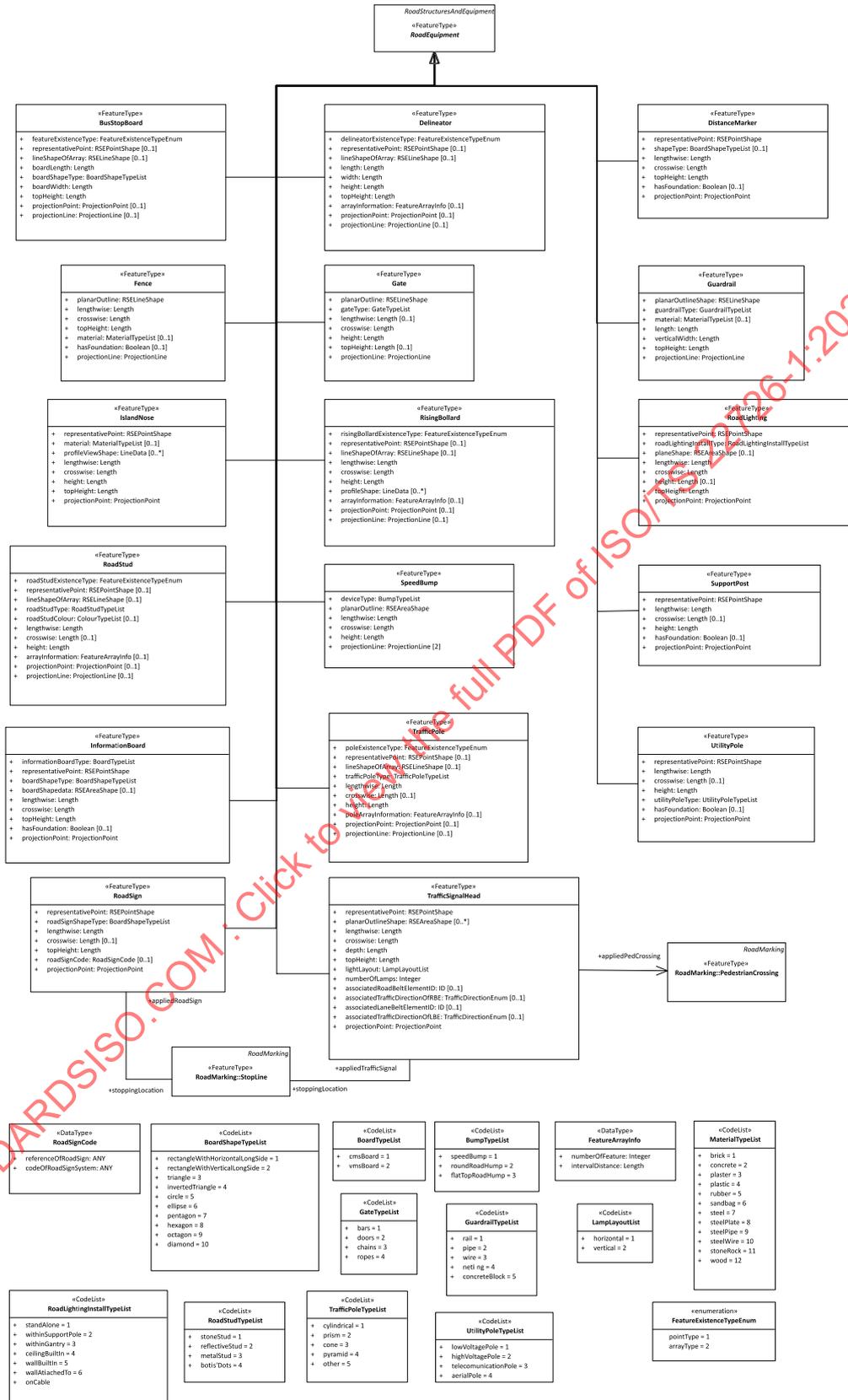**FeatureExistenceTypeEnum**

pointType = 1
arrayType = 2

Figure 21 — RoadEquipment sub-package

7.3.4.4.2 RoadEquipment

The RoadEquipment class is an abstract class and is defined as the root class for the RoadEquipment package.

Table 109 defines the details of the RoadEquipment class.

Table 109 — RoadEquipment class

Class<<featureType>>: RoadEquipment				
Definition	Pieces of road equipment, used for traffic operation and/or road management, installed either on the road or near the outside of the road.			
Role/Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
role: BusStopBoard	Specifies a bus stop board.			
	BusStopBoard			Generalization relationship
role: Delineator	Specifies a delineator.			
	Delineator			Generalization relationship
role: DistanceMarker	Specifies a distance marker.			
	DistanceMarker			Generalization relationship
role: Fence	Specifies a fence.			
	Fence			Generalization relationship
role: Gate	Specifies a gate.			
	Gate			Generalization relationship
role: Guardrail	Specifies a guardrail.			
	Guardrail			Generalization relationship
role: IslandNose	Specifies a device installed at a traffic island nose to absorb collision shock.			
	IslandNose			Generalization relationship
role: RisingBollard	Specifies a rising bollard.			
	RisingBollard			Generalization relationship
role: RoadLighting	Specifies a road lighting.			
	RoadLighting			Generalization relationship
role: RoadSign	Specifies a road sign.			
	RoadSign			Generalization relationship
role: RoadStud	Specifies a road stud.			
	RoadStud			Generalization relationship
role: SpeedBump	Specifies a speed bump.			
	SpeedBump			Generalization relationship
role: SupportPole	Specifies a support pole.			
	SupportPole			Generalization relationship
role: InformationBoard	Specifies an information board.			
	InformationBoard			Generalization relationship
role: TrafficPole	Specifies a traffic pole.			
	TrafficPole			Generalization relationship
role: TrafficSignaHeadl	Specifies a traffic signal head.			
	TrafficSignalHead			Generalization relationship
role: UtilityPole	Specifies a utility pole.			
	UtilityPole			Generalization relationship

7.3.4.4.3 BusStopBoard

A BusStopBoard is located along a RoadBeltElement, or set onto either a TrafficIsland or a TrafficIslandMarking on a RoadBeltElement.

Depending on the FeatureExistenceEnum, a BusStopBoard is either a point or a line. If busStopTypeEnum is "line", then a BusStopBoard is expressed as an RSELineShape using a projection line. The projection points of a BusStopBoard are located on a representative point or both end points of a projection line and are related to a side line of the RoadBeltElement. If a bus stop board is installed with a pole, it is separated into a BusStopBoard feature and a SupportPost feature.

Table 110 defines the details of the BusStopBoard class.

Table 110 — BusStopBoard class

Class<<featureType>>: BusStopBoard				
Definition	Board and/or equipment indicating the location of a bus stop, and if there are bus stop boards in a line, the properties of the first bus stop board and the positions of the others are defined.			
Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
featureExistenceType	Bus stop arrangement type.			
	FeatureExistenceTypeEnum	[1]		
representativePoint	Representative point of the bus stop board.			
	RSEPointShape	[0..1]		
lineShapeOfArray	A line linking multiple bus stop boards to the series.			
	RSELineShape	[0..1]		{occurs when Feature ExistenceType = 2}
boardShapeType	Shape type of the bus stop board.			
	BoardShapeTypeList	[1]		
boardLength	Measure of the rectangular length or the major axis of the bus stop board.			
	Length	[1]		
boardWidth	Measure of the rectangular width or the minor axis of the bus stop board.			
	Length	[1]		
topHeight	Height from road surface to top of the bus stop board.			
	Length	[1]		
projectionPoint	Point that represents the location of the bus stop board that is projected onto the road feature.			
	ProjectionPoint	[0..1]		{occurs when Feature Existence Type = 1}
projectionLine	Line that represents the array line of the bus stop board that is projected onto the road feature.			
	ProjectionLine	[0..1]		{occurs when Feature ExistenceType = 2}

7.3.4.4.4 Delineator

A Delineator is a marker device installed on traffic poles and other pieces of road equipment and road structures.

A Delineator is located along the edge of a RoadBeltElement, an IntersectionBelt, or a LaneBeltElement.

A Delineator is either a point or line. Projection points of a Delineator are located on a representative point or at both end points of a projection line and are related to a side line of the RoadBeltElement. If the delineator is installed with the traffic pole, it is separated into a Delineator feature and a TrafficPole feature. If there are the delineators in a row, the properties of the first delineator and the positions of other delineators are defined.

Table 111 defines the details of the Delineator class.

Table 111 — Delineator class

Class<<featureType>>: Delineator				
Definition	Marker device to provide caution to driver.			
Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
delineatorExistenceType	Delineator type.			
	FeatureExistenceTypeE-num	[1]		
representativePoint	Representative point of the delineator.			
	RSEPointShape	[0..1]		
lineShapeOfArray	A line linking multiple delineators to the series.			
	RSELineShape	[0..1]		{occurs when Feature ExistenceType=2}
length	Length of the delineator.			
	Length	[1]		
width	Width of the delineator.			
	Length	[1]		
height	Height of the delineator.			
	Length	[1]		
topHeight	Height from road surface to the top of the delineator.			
	Length	[1]		
arreayInformation	Array information of the delineators.			
	FeatureArrayInfo	[0..1]		{it occurs when Feature ExistenceType = 2
projectionPoint	Point that represents the location of the delineator that is projected onto the road feature.			
	ProjectionPoint	[0..1]		{it occurs when Feature ExistenceType = 1
projectionLine	Line that represents the array line of the delineator that is projected onto the road feature.			
	ProjectionLine	[0..1]		{it occurs when Feature ExistenceType = 2

7.3.4.4.5 DistanceMarker

A DistanceMarker is a distance sign panel installed by the road management authority, not a road sign indicating traffic regulation. A DistanceMarker is positioned outside the RoadBeltElement or IntersectionBelt.

A DistanceMarker is a point shape, and a projection point of a DistanceMarker is located on a representative point. A projection point of a DistanceMarker is related to a side line of a RoadBeltElement and an IntersectionBelt. A DistanceMarker can be defined on a side line of a LaneBeltElement. If the distance marker is installed with a traffic pole, they are recorded separately as a DistanceMarker feature and a TrafficPole feature.

Table 112 defines the details of the DistanceMarker class.

Table 112 — DistanceMarker class

Class<<featureType>>: DistanceMarker				
Definition	Board to indicate the value of the distance from an origin point installed by the road management organization, not a road sign. Indicator presenting a measure of distance on the road.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
representativePoint	Representative and projection point of the distance marker.			
	RSEPointShape	[1]		
shapeType	Panel shape of the distance markers.			
	BoardShapeTypeList	[0..1]		
lengthwise	Measure of the rectangular length or the major axis of the distance marker.			
	Length	[1]		
crosswise	Measure of the rectangular width or the minor axis of the distance marker.			
	Length	[1]		
topHeight	Height from road surface to top of the distance marker.			
	Length	[1]		
hasFoundation	Determines if the distance marker has a foundation (true) or not (false).			
	Boolean	[0..1]		{true: have}
projectionPoint	Point that represents the location of the distance marker that is projected onto the road feature.			
	ProjectionPoint	[1]		

7.3.4.4.6 Fence

A Fence is a piece of road equipment located along the carriageway or lane to prevent the entry on to or exit away from the road by pedestrians, animals and vehicles.

A Fence is located along the side line of a RoadBeltElement, an IntersectionBelt or across both a RoadBeltElement and an IntersectionBelt. The Fence class contains various kinds of fences installed with specific purposes such as separation fence, windbreak fence, snow fence and noise barrier.

A Fence is represented by an RSELineShape as a projection line. A projection line of a Fence is related to the side line of a RoadBeltElement and IntersectionBelt. If Fence is related to two or more sequential RoadBeltElement and/or IntersectionBelt, Fence can have an intermediate ProjectionPoint in a ProjectionLine at a location corresponding to a terminal line of a RoadBeltElement, and its ProjectionPointMarker is defined as "intermediate".

If a Fence exists along a LaneBeltElement, the Fence can optionally relate to the LaneBeltElement.

Table 113 defines the details of the Fence class.

Table 113 — Fence class

Class<<featureType>>: Fence				
Definition	Road equipment installed along the carriageway or lane to prevent the entry of pedestrians, animals and vehicles.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint

Table 113 *(continued)*

planarOutline	Planar geometry data of the fence outline.			
	RSEAreaShape	[1]		
lengthwise	Measure of the rectangular length or the major axis of the fence.			
	Length	[1]		
crosswise	Measure of the rectangular width or the minor axis of the fence.			
	Length	[1]		
topHeight	Height from road surface to top of the fence.			
	Length	[1]		
material	Construction material of the fence.			
	MaterialTypeList	[0..1]		
haveFoundation	Determines if the fence has a foundation (true) or not (false).			
	Boolean	[0..1]		{true: have}
projectionLine	Line that represents the lateral edge of the fence that is projected onto the road feature.			
	ProjectionLine	[1]		

7.3.4.4.7 Gate

A Gate is located transversely in a RoadBeltElement and a LaneBeltElement. Gate is a line shape across a lane, and the projection line of Gate is crossed at both sides of a lane.

Table 114 defines the details of the Gate class.

Table 114 — Gate class

Class<<featureType>>: Gate				
Definition	Road equipment that controls the vehicle traffic by opening or closing access to the road.			
Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
planarOutline	Planar geometry data of the gate outline.			
	RSELineShape	[1]		
gateType	Type of the gate component.			
	GateTypeList	[1]		
lengthwise	Measure of the rectangular length or the major axis of the gate component.			
	Length	[0..1]		
crosswise	Measure of the rectangular width or the minor axis of the gate component.			
	Length	[1]		
height	Height of the gate.			
	Length	[1]		
topHeight	Height from the road surface to the gate component in the open position.			
	Length	[0..1]		
projectionLine	Line that represents the lateral edge of the gate that is projected onto the road feature.			
	ProjectionLine	[1]		

7.3.4.4.8   Guardrail

A Guardrail is located along a RoadBeltElement, an IntersectionBelt or across both a RoadBeltElement and an IntersectionBelt.

A Guardrail is represented by a RSELineShape as a projection line. If Guardrail is related to two or more sequential RoadBeltElement and/or IntersectionBelt, Guardrail can have intermediate ProjectionPoint in ProjectionLine at a location corresponding to a terminal line of RoadBeltElement, and its ProjectionPointMarker is defined as 'intermediate'.

In the real world, a guard rail is installed with support posts, but the Guardrail does not contain the posts on which a guard rail is installed. If support posts are needed, a SupportPost class is used.

If a Guardrail exists along a LaneBeltElement, a Guardrail can optionally relate to the LaneBeltElement.

NOTE   Common synonyms for a Guardrail are safety rail and safety fence.

Table 115 defines the details of the Guardrail class.

Table 115 — Guardrail class

Class<<featureType>>: Guardrail				
Definition	Road equipment installed along the carriageway side line or on the central reserve of roads for restricting and cushioning abnormal vehicle movement.			
Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
planarOutlin	Planar geometry data of the guardrail outline.			
	RSELineShape	[1]		
guardrailType	Type of the guardrail structure.			
	GuardrailTypeList	[1]		
material	Construction material of the guardrail.			
	MaterialTypeList	[0..1]		
length	Length of the guardrail.			
	Length	[1]		
verticalWidth	Vertical width of the guardrail			
	Length	[1]		
topHeight	Height from road surface to the top of the guardrail.			
	Length	[1]		
projectionLine	Line that represents the lateral edge of the guardrail that is projected onto the road feature.			
	ProjectionLine	[1]		

7.3.4.4.9   IslandNose

An IslandNose is a device installed at a traffic island nose to absorb collision shock. An IslandNose is located along a RoadBeltElement or an IntersectionBelt.

An IslandNose is a representative point shape and the projection point of IslandNose is located on the representative point.

Table 116 defines the details of the IslandNose class.

Table 116 — IslandNose class

Class<<featureType>>: IslandNose				
Definition	Road equipment, referred to as a "crash cushion", placed at the rounded extremity of a traffic island that is used to separate or merge two lines of traffic.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
representativePoint	Representative point and projection point of the road equipment at the island nose.			
	RSEPointShape	[1]		
material	Construction material of the road equipment at the island nose.			
	MaterialTypeList	[0..1]		
profileViewShape	Geometry data of the road equipment profile at the island nose.			
	LineData	[0..*]		
lengthwise	Measure of the rectangular length or the major axis of the road equipment at the island nose.			
	Length	[1]		
crosswise	Measure of the rectangular width or the minor axis of the road equipment at the island nose.			
	Length	[1]		
height	Height of the road equipment on the island nose.			
	Length	[1]		
topHeight	Height from road surface to the top of the road equipment at the island nose			
	Length	[1]		
projectionPoint	Point that represents the location of the island nose that is projected onto the road feature.			
	ProjectionPoint	[1]		

7.3.4.4.10 RisingBollard

A RisingBollard represents a retractable bollard installed on the entrance or intermediate side of the lane for restricting and controlling access of vehicles. Bollards installed outside the lane and fixed bollards are not included.

A RisingBollard is installed inside the LaneBeltElement and is only related to the LaneBeltElement.

The position of a RisingBollard is expressed by a representative point. If there are consecutive rising bollards, multiple RisingBollards can be expressed by a projection line as one feature and each RisingBollard is located on projection points of a projection line.

Table 117 defines the details of the RisingBollard class.

Table 117 — RisingBollard class

Class<<featureType>>: RisingBollard				
Definition	Road equipment in the form of a well-built, short, retractable post installed on the entrance or intermediate side of the lane for restricting and controlling the access of vehicles.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
risingBollardExistence-Type	Distinction of whether the rising bollard is a single unit or in an array.			
	FeatureExistenceTypeE-num	[1]		

Table 117 *(continued)*

representativePoint	Representative point of the rising bollard.			
	RSEPointShape	[0..1]		
lineShapeOfArray	A line linking multiple rising bollards to the series.			
	RSELineShape	[0..1]		{it occurs when Feature-ExistenceType = 2}
lengthwise	Measure of the rectangular length or the major axis of the rising bollard.			
	Length	[1]		
crosswise	Measure of the rectangular width or the minor axis of the rising bollard.			
	Length	[1]		
height	Height of the rising bollard.			
	Length	[1]		
profileShape	Geometry data of the rising bollard profile.			
	LineData	[0..*]		
arrayInformation	Information describing the rising bollard array.			
	FeatureArrayInfo	[0..1]		{it occurs when Feature-ExistenceType = 2
projectionPoint	Point that represents the location of the rising bollard that is projected onto the road feature.			
	ProjectionPoint	[0..1]		{it occurs when Feature-ExistenceType = 1
projectionLine	Line that represents the array line of the rising bollard array that is projected onto the road feature.			
	ProjectionLine	[0..1]		{it occurs when Feature-ExistenceType = 2

7.3.4.4.11 RoadLighting

A RoadLighting exists in the upper or side space of a RoadBeltElement, an IntersectionBelt and a LaneBeltElement.

RoadLighting does not contain support equipment such as utility poles, support poles or a gantry, where the road lighting is installed. The support equipment is optionally defined by another feature if needed.

The position of a RoadLighting is represented by a representative point, and a projection point of the RoadLighting is located on a representative point.

Table 118 defines the details of the RoadLighting class.

Table 118 — RoadLighting class

Class<<featureType>>: RoadLighting				
Definition	Source of light in the space above a road, not requiring a support pole.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
representativePoint	Representative and projection point of the road lighting.			
	RSEPointShape	[1]		
roadLightingInstallType	Installation types of road lighting.			
	RoadLightingInstall-TypeList	[1]		
planeShape	Planar geometry data of the road lighting outline.			
	RSEAreaShape	[0..1]		

Table 118 *(continued)*

lengthwise	Measure of the rectangular length, diameter or the major axis of the road lighting.			
	Length	[1]		
crosswise	Measure of the rectangular width or the minor axis of the road lighting.			
	Length	[0..1]		
height	Height of the road lighting.			
	Length	[0..1]		
topHeight	Height from road surface to the top of the road lighting.			
	Length	[1]		
projectionPoint	Point that represents the location of the road lighting that is projected onto the road feature.			
	ProjectionPoint	[1]		

7.3.4.4.12 RoadSign

A RoadSign exists in the upper or side space of a RoadBeltElement, an IntersectionBelt and a LaneBeltElement.

A RoadSign does not contain support equipment such as utility poles, support poles or a gantry where the road sign is installed. If a RoadSign is installed with the support post, it is separated into a RoadSign feature and a SupportPost feature. The auxiliary sign board of a RoadSign is provided by another RoadSign. A RoadSign can associate with a StopLine.

A RoadSign specifies a position, shape and pictogram code of sign board for referencing. Traffic regulations applied to a road are provided in a separate data class as attributes of a roadway.

The position of a RoadSign is represented by a representative point, and a projection point of a RoadSign is located on a representative point.

NOTE   A synonym of a RoadSign is a traffic sign.

Table 119 defines the details of the RoadSign class.

Table 119 — RoadSign class

Class<<featureType>>: RoadSign				
Definition	Sign board for the road used to convey information and safety messages to the users and to facilitate traffic flow.			
Role/Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
role: stoppingLocation	Specifies a stop line when the road sign represents a requirement for stopping vehicles.			
	StopLine	[0..1]		Association relationship
representativePoint	Representative and projection point of the road sign.			
	RSEPointShape	[1]		
roadSignShapeType	Outline type of the road sign.			
	BoardShapeTypeList	[1]		
lengthwise	Measure of the rectangular length or the major axis of the road sign.			
	Length	[1]		
crosswise	Measure of the rectangular width or the minor axis of the road sign.			
	Length	[0..1]		

Table 119 *(continued)*

topHeight	Height from road surface to the top of the road sign.			
	Length	[1]		
roadSignCode	Code for describing the road sign pictogram.			
	RoadSignCode	[0..1]		
projectionPoint	Point that represents the location of the road sign that is projected onto the road feature.			
	ProjectionPoint	[1]		

7.3.4.4.13 RoadStud

A RoadStud is located at a RoadBeltElement, an IntersectionBelt and a LaneBeltElement.

The position of a RoadStud is expressed by a representative point.

If there are consecutive road studs, multiple RoadStuds can be represented by a projection line as one feature and each RoadStud is located on the projection points of a projection line.

In the real world, consecutive road studs are sometimes used as road markings. However, RoadStud does not contain data regarding the road markings.

Table 120 defines the details of the RoadStud class.

Table 120 — RoadStud class

Class<<featureType>>: RoadStud				
Definition	Device projecting above the road surface normally containing a reflector.			
Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
roadStudExistenceType	Distinction of whether a road stud is a single line.			
	FeatureExistenceTypeE-num	[1]		
representativePoint	Representative point of the road stud.			
	RSEPointShape	[0..1]		
lineShapeOfArray	A line linking multiple road studs to the series.			
	RSELineShape	[0..1]		{occurs when FeatureEx-istenceType = 2}
roadStudType	Type of the road stud.			
	RoadStudTypeList	[1]		
roadStudColour	Colour of the road stud.			
	ColourTypeList	[0..1]		Default colour is colour-less
lengthwise	Measure of the rectangular length or the major axis of the road stud.			
	Length	[1]		
crosswise	Measure of the rectangular width, diameter, or the minor axis of the road stud.			
	Length	[0..1]		
height	Height of the road stud.			
	Length	[1]		
arrayInformation	Information describing the road studs.			
	FeatureArrayInfo	[0..1]		{occurs when FeatureEx-istenceType = 2}

Table 120 *(continued)*

projectionPoint	Point that represents the location of the road stud that is projected onto the road feature.			
	ProjectionPoint	[0..1]		{occurs when FeatureExistenceType = 1}
projectionLine	Line that represents the array of the road stud that is projected onto the road feature.			
	ProjectionLine	[0..1]		{occurs when FeatureExistenceType = 2}

7.3.4.4.14 SpeedBump

A SpeedBump is located on one or more LaneBeltElements.

A SpeedBump is a planar area consisting of multiple lines classified as projection lines and side lines. Projection lines of a SpeedBump are located across a lane. A SpeedBump is only related to LaneBeltElement.

If a SpeedBump crosses multiple lanes, the SpeedBump can have intermediate ProjectionPoints in a ProjectionLine at a location crossing the side line of a LaneBeltElement, and its ProjectionPointMarker is defined as "intermediate".

Table 121 defines the details of the SpeedBump class.

Table 121 — SpeedBump class

Class<<featureType>>: SpeedBump				
Definition	Vehicle speed deceleration device designed as a short ridge spanning the width of the carriageway.			
Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
deviceType	The type of the speed bump.			
	BumpTypeList	[1]		
planarOutline	Planar geometry data of the speed bump outline.			
	RSEAreaShape	[1]		
Lengthwise	Measure of the rectangular length or the major axis of the speed bump.			
	Length	[1]		
Crosswise	Measure of the rectangular width or the minor axis of the speed bump.			
	Length	[1]		
Height	Height of the speed bump.			
	Length	[1]		
projectionLine	Line that represents the side edge of the speed bump that is projected onto the road feature.			
	ProjectionLine	[2]		

7.3.4.4.15 SupportPost

A SupportPost is located along a RoadBeltElement, an IntersectionBelt and a LaneBeltElement and is used for installing guardrails, road sign board, information board, road lighting, and traffic signal head.

The position of a SupportPost is represented by a representative point, and a projection point of a SupportPost is located on a representative point.

Table 122 defines the details of the SupportPost class.

Table 122 — SupportPost class

Class<<featureType>>: SupportPost				
Definition	A pole or a post located along the carriageway for installing guardrails, road sign boards, information boards, road lighting, and traffic signals.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
representativePoint	Representative and projection point of the support post.			
	RSEPointShape	[1]		
lengthwise	Measure of the rectangular length, diameter, or the major axis of the support post.			
	Length	[1]		
crosswise	Measure of the rectangular width or the minor axis of the support post.			
	Length	[0..1]		
height	Height of the support post.			
	Length	[1]		
haveFoundation	Determines if the support post has a foundation (true) or not (false).			
	Boolean	[0..1]		{true: have}
projectionPoint	Point that represents the location of the support post that is projected onto the road feature.			
	ProjectionPoint	[1]		

7.3.4.4.16 InformationBoard

An InformationBoard exists in the space above or space beside a RoadBeltElement, an IntersectionBelt and a LaneBeltElement. There are two types of InformationBoards; variable message sign (VMS) and changeable message sign (CMS).

An InformationBoard is located on a representative point, and the projection point of an InformationBoard is located on a representative point. An InformationBoard can project to a RoadBeltElement and an IntersectionBelt.

Table 123 defines the details of the InformationBoard class.

Table 123 — InformationBoard class

Class<<featureType>>: InformationBoard				
Definition	Sign capable of either displaying predefined or freely programmable messages (VMS) or only predefined messages (CMS).			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
informationBoardType	Type of the information board.			
	BoardTypeList	[1]		
representativePoint	Representative point of the information board.			
	RSEPointShape	[1]		
boardShapeType	Distinction of the type of the information board outline.			
	BoardShapeTypeList	[1]		
boardShape	Geometry data of the information board profile.			
	LineData	[0..*]		
lengthwise	Measure of the rectangular length of the information board.			
	Length	[1]		

Table 123 *(continued)*

crosswise	Transverse length of the information board.			
	Length	[1]		
topHeight	Height from the road surface to the top of the information board			
	Length	[1]		
haveFoundation	Determines if the information board has a foundation (true) or not (false).			
	Boolean	[0..1]		{true: have}
projectionPoint	Point that represents the location of the traffic information board that is projected onto the road feature.			
	ProjectionPoint	[1]		

7.3.4.4.17 TrafficPole

A TrafficPole is located along a RoadBeltElement, an IntersectionBelt and a LaneBeltElement and is a device for traffic control.

A TrafficPole can be applied to:

— pole cones,

— bollards,

— pylons, and

— piles.

However, a TrafficPole is not applicable to poles for utilities nor for the installation of:

— guardrails,

— fences,

— signage,

— signposts,

— lightings,

— traffic signs,

— traffic signal heads, and

— measurement devices.

If there are consecutive traffic poles, a TrafficPole is represented by a RSELineShape as a projection line. A TrafficPole is a point or line shape depending on the poleExistenceType. Projection points of TrafficPole are located on a representative point or both end points of a projection line, and are related to a RoadBeltElement, an IntersectionBelt and a LaneBeltElement.

Table 124 defines the details of the TrafficPole class.

Table 124 — TrafficPole class

Class<<featureType>>: TrafficPole	
Definition	Devices of different shapes (cylindrical, prism, cone, etc.) used for traffic control and installed along the carriageway, lane, or on road markings (longitudinal along carriageways or lanes, on traffic islands, other markings without islands, and diverging lanes).

Table 124 *(continued)*

Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
poleExistenceType	Distinction whether the pole is a single unit or an array.			
	FeatureExistenceTypeEnum	[1]		
representativePoint	Representative point of the traffic pole.			
	RSEPointShape	[0..1]		
lineShapeOfArray	A line linking multiple traffic poles to the series.			
	RSELineShape	[0..1]		{it occurs when Feature ExistenceType = 2}
trafficPoleType	Type of the traffic pole.			
	TrafficPoleTypeList	[1]		
lengthwise	Measure of the rectangular length, diameter, or the major axis of the traffic pole.			
	Length	[1]		
crosswise	Measure of the rectangular width or the minor axis of the traffic pole.			
	Length	[0..1]		
height	Height of the traffic pole.			
	Length	[1]		
arrayInformation	Information of the traffic poles in array.			
	FeatureArrayInfo	[0..1]		{it occurs when Feature ExistenceType = 2}
projectionPoint	Point that represents the location of the traffic pole that is projected onto the road feature.			
	ProjectionPoint	[0..1]		{it occurs when Feature ExistenceType = 1}
projectionLine	Line that represents the array line of the traffic pole that is projected onto the road feature.			
	ProjectionLine	[0..1]		{it occurs when Feature ExistenceType = 2}

7.3.4.4.18 TrafficSignalHead

A TrafficSignalHead should be defined depending on the traffic direction of the roadway and/or lane where it is installed.

A TrafficSignalHead exists in the in the space above or space beside a RoadBeltElement, an IntersectionBelt or a LaneBeltElement. The TrafficSignalHead does not include a support pole and attachment devices. The support equipment can be optionally defined by another class.

A TrafficSignalHead for vehicles can be associated with a StopLine. A TrafficSignalHead for pedestrians can be associated with a PedestrianCrossing.

A TrafficSignalHead has a representative point, and a projection point of TrafficSignalHead is located on a representative point. A TrafficSignalHead can provide a RoadBeltElement or a LaneBeltElement with which the traffic signal head status is associated.

Table 125 defines the details of the TrafficSignalHead class.

Table 125 — TrafficSignalHead class

Class<<featureType>>: TrafficSignalHead				
Definition	Road equipment which controls road traffic using coloured lamp(s) (red, yellow, and green lights, arrows or similar).			
Role/Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
role: stoppingLocation	Specifies a stop line.			
	StopLine	[0..1]		Association relationship
role: relevantPedCrossing	Specifies a pedestrian crossing associated to the traffic signal head.			
	PedestrianCrossing	[0..1]		Association relationship
representativePoint	Representative point of the traffic signal head.			
	RSEPointShape	[1]		
planarOutline	Planar geometry data of the traffic signal head outline (i.e. transverse-depth face).			
	LineData	[0..*]		
height	Measure of the rectangular height or the major axis of the traffic signal head.			
	Length	[1]		
width	Measure of the rectangular width or the minor axis of the traffic signal head.			
	Length	[1]		
depth	Measured depth of traffic signal head.			
	Length	[1]		
topHeight	Height from road surface to the traffic signal head.			
	Length	[1]		
lampLayout	Layout of the lamps contained in the traffic signal head.			
	LampLayoutList	[1]		
numberOfLamps	The number of lamps contained in the traffic signal head.			
	Integer	[1]		
associatedRoadBeltElementID	Road belt element ID to which the traffic signal head is associated.			
	ID	[0..1]		
associatedTrafficDirectionOfRBE	Traffic direction of a road belt element to which the traffic signal is associated.			
	TrafficDirectionEnum	[0..1]		
associatedLaneBeltElementID	Lane belt element ID to which the traffic signal head is associated.			
	ID	[0..1]		
associatedTrafficDirectionOfLBE	Traffic direction of a lane belt element to which the traffic signal head is associated.			
	TrafficDirectionEnum	[0..1]		
projectionPoint	Point that represents the location of the traffic signal that is projected onto the road feature.			
	ProjectionPoint	[1]		
NOTE Signal lamps are located on a lengthwise-crosswise surface.				

7.3.4.4.19 UtilityPole

A UtilityPole is located along a RoadBeltElement and an IntersectionBelt.

A UtilityPole has is representative point, and a projection point of a UtilityPole is located on a representative point.

Table 126 defines the details of the UtilityPole class.

Table 126 — UtilityPole class

Class<<featureType>>: UtilityPole				
Definition	Road equipment of various shapes (cylindrical, prism, tower/pylon) used for utilities (power pole, telecommunication poles, etc.) located beside the carriageway.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
representativePoint	Representative point of the utility pole.			
	RSEPointShape	[1]		
lengthwise	Measure of the rectangular length, diameter, polygonal, pyramidal or the major axis of the utility pole.			
	Length	[1]		
crosswise	Measure of the rectangular width, polygonal, pyramidal or the minor axis of the utility pole.			
	Length	[0..1]		
height	Height of the utility pole.			
	Length	[1]		
utilityPoleType	Type of the utility pole.			
	UtilityPoleTypeList	[1]		
haveFoundation	Determines if the utility pole has a foundation (true) or not (false).			
	Boolean	[0..1]		{true: have}
projectionPoint	Point that represents the location of the utility pole that is projected onto the road feature.			
	ProjectionPoint	[1]		

7.3.4.4.20 RoadEquipmentFeatureProperties package

7.3.4.4.20.1 BoardShapeTypeList

Table 127 defines the details of the BoardShapeTypeList class.

Table 127 — BoardShapeTypeList class

Class<<CodeList>>: BoardShapeTypeList		
Definition	Available list of enumerations for the shape of the board used to convey information located along a road.	
Code	Value	Definition
1	rectangleWithHorizontal-LongSide	The shape is rectangular with a long horizontal side.
2	rectangleWithVertical-LongSide	The shape is rectangular with long vertical side.
3	triangle	The shape is triangular, with the vertex at the top (▲).
4	invertedTriangle	The shape is triangular, with the vertex below the base (▼).
5	circle	The shape is circular.
6	ellipse	The shape is an ellipse.
7	pentagon	The shape is a pentagon.
8	hexagon	The shape is a hexagon.
9	octagon	The shape is an octagon.
10	diamond	The shape is a diamond.

7.3.4.4.20.2 BoardTypeList

Table 128 defines the details of the BoardTypeList class.

Table 128 — BoardTypeList class

Class<<CodeList>>: BoardTypeList		
Definition	Available list of enumerations for type of information board.	
Code	Value	Definition
1	cms-Board	A changeable message sign board.
2	vms-Board	A variable message sign board.

7.3.4.4.20.3 BumpTypeList

Table 129 defines the details of the BumpTypeList class.

Table 129 — BumpTypeList class

Class<<CodeList>>: BumpTypeList		
Definition	Available list of enumerations for vehicle speed deceleration devices.	
Code	Value	Definition
1	speedBump	A speed bump.
2	roundRoadHump	A rounded road hump.
3	flatTopRoadHump	A flat-topped road hump.

7.3.4.4.20.4 FeatureArrayInfo

Table 130 defines the details of the FeatureArrayInfo class.

Table 130 — FeatureArrayInfo class

Class<<dataType>>: FeatureArrayInfo				
Definition	Configuration data of an array of road structures or pieces of road equipment.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
numberOfFeatures	The number of features in the array.			
	Integer	[1]		
intervalDistance	Distance interval between the features.			
	Length	[1]		

7.3.4.4.20.5 FeatureExistenceTypeEnum

Table 131 defines the details of the FeatureExistenceTypeEnum class.

Table 131 — FeatureExistenceTypeEnum class

Class<<enumeration>>: FeatureExistenceTypeEnum		
Definition	Available list of enumerations defining whether the road equipment is a single or array.	
Code	Value	Definition
1	pointType	A single feature on a point.
2	lineType	Multiple features stored in an array.

7.3.4.4.20.6 GateTypeList

Table 132 defines the details of the GateTypeList class.

Table 132 — GateTypeList class

Class<<CodeList>>: GateTypeList		
Definition	Available list of enumerations for gate components.	
Code	Value	Definition
1	bar	The gate components are bars/poles.
2	door	The gate components are doors.
3	chains	The gate components are chains.
4	ropes	The gate components are ropes.

7.3.4.4.20.7 GuardrailTypeList

Table 133 defines the details of the GuardrailTypeList class.

Table 133 — GuardrailTypeList class

Class<<CodeList>>: GuardrailTypeList		
Definition	Available list of enumerations for type of the guardrails.	
Code	Value	Definition
1	rail	The guardrail components are rails/elongated boards
2	pipe	The guardrail components are pipes.
3	wire	The guardrail components are wires.
4	netting	The guardrail components are netting.
5	concreteBlock	The guardrail components are concrete blocks (concrete barriers).

7.3.4.4.20.8 LampLayoutList

Table 134 defines the details of the LampLayoutList class.

Table 134 — LampLayoutList class

Class<<CodeList>>: LampLayoutList		
Definition	Available list of enumerations for the lamp layout of traffic signal heads.	
Code	Value	Definition
1	horizontal	Lamps are positioned horizontally.
2	vertical	Lamps are positioned vertically.

7.3.4.4.20.9 MaterialTypeList

Table 135 defines the details of the MaterialTypeList class.

Table 135 — MaterialTypeList class

Class<<CodeList>>: MaterialTypeList		
Definition	Available list of enumerations for the construction material used in road structure or road equipment.	
Code	Value	Definition
1	brick	Brick.

Table 135 *(continued)*

2	concrete	Concrete.
3	plaster	Plaster.
4	plastic	Plastic.
5	rubber	Rubber.
6	sandbag	Composed of sandbags in a specific arrangement.
7	steel	Steel.
8	steelPlate	Steel plate.
9	steelPipe	Steel pipe.
10	steelWire	Steel wire.
11	stoneOrRock	Stone or rock.
12	wood	Wood.

7.3.4.4.20.10 RoadLightingInstallTypeList

Table 136 defines the details of the RoadLightingInstallTypeList class.

Table 136 — RoadLightingInstallTypeList class

Class<<CodeList>>: RoadLightingInstallTypeList		
Definition	Available list of enumerations for the installation location of road lighting.	
Code	**Value**	**Definition**
1	standAlone	Road lighting is independently installed.
2	withinSupportPole	Road lighting is installed on a support pole.
3	withinGantry	Road lighting is installed on a gantry.
4	ceilingBuilt-in	Road lighting is built into the ceiling.
5	wallBuilt-in	Road lighting is built into the wall.
6	wallAttachedTo	Road lighting is attached to the wall (e.g. building).
7	onCable	Road lighting is fixed to a cable.

7.3.4.4.20.11 RoadSignCode

Table 137 defines the details of the RoadSignCode class.

Table 137 — RoadSignCode class

Class<<dataType>>:RoadSignCode				
Definition	Code for specifying the traffic sign.			
Attribute name	**Definition**			
	Value type	**Multiplicity**	**Stereotypes**	**Note/Constraint**
referenceOfRoadSign System	The reference of the road sign code list.			
	Any	[1]		
codeOfRoadSign	Code data of the road sign.			
	Any	[1]		

7.3.4.4.20.12 RoadStudTypeList

Table 138 defines the details of the RoadStudTypeList class.

Table 138 — RoadStudTypeList class

Class<<CodeList>>: RoadStudTypeList		
Definition		Available list of enumerations for the material of the road studs.
Code	Value	Definition
1	stoneStud	The road studs are made from stone.
2	reflectiveStud	The road studs are a reflective material.
3	trafficButton	The road studs are made from steel.
4	bottsDot	The road studs are Botts' dots.

7.3.4.4.20.13 TrafficPoleTypeList

Table 139 defines the details of the TrafficPoleTypeList class.

Table 139 — TrafficPoleTypeList class

Class<<CodeList>>: TrafficPoleTypeList		
Definition		Available list of enumerations for type of the traffic poles.
Code	Value	Definition
1	cylindrical	A cylindrical-shaped pole.
2	prism	A prism-shaped pole.
3	cone	A cone-shaped pole.
4	pyramid	A pyramid-shaped pole.
5	other	Any shape other than the above.

7.3.4.4.20.14 UtilityPoleTypeList

Table 140 defines the details of the UtilityPoleTypeList class.

Table 140 — UtilityPoleTypeList class

Class<<CodeList>>: UtilityPoleTypeList		
Definition		Available list of enumerations for utility poles.
Code	Value	Definition
1	lowVoltagePole	Utility pole used for a low voltage power supply.
2	highVoltagePole	Utility pole used for a high voltage power supply.
3	telecommunicationPole	Utility pole used for communication lines.
4	aerialPole	Utility pole that carries radio or telecommunication transmitters.

7.3.4.5 RoadMarking sub-package

7.3.4.5.1 Contents of RoadMarking sub-package

The RoadMarking sub-package contains the following features:

— RoadMarking,

— BusStopClearway,

— CarriagewayEdgeMarking,

— ClearwayArea,

— LaneEdgeMarking,

— LayByMarking,

— PedestrianCrossing,

— RegulatoryMarking,

— RoadCentreMarking,

— StopLine,

— SymbolRoadMarking,

— TextRoadMarking,

— TrafficChannelizingMarking,

— TrafficIslandMarking.

The RoadMarking sub-package also contains a property package for road marking features.

In the real world, the road markings represent traffic regulations that apply to roads, but in the MHAD data model, a RoadMarking specifies the position on the road surface and is not intended to contain traffic regulations. Traffic regulations are provided in a separate data class as attributes of roadway.

Figure 22 shows class diagrams for the RoadMarking sub-package (see https://standards.iso.org/iso/ts/22726/-1/ed-1/en for an enlarged version of this figure).
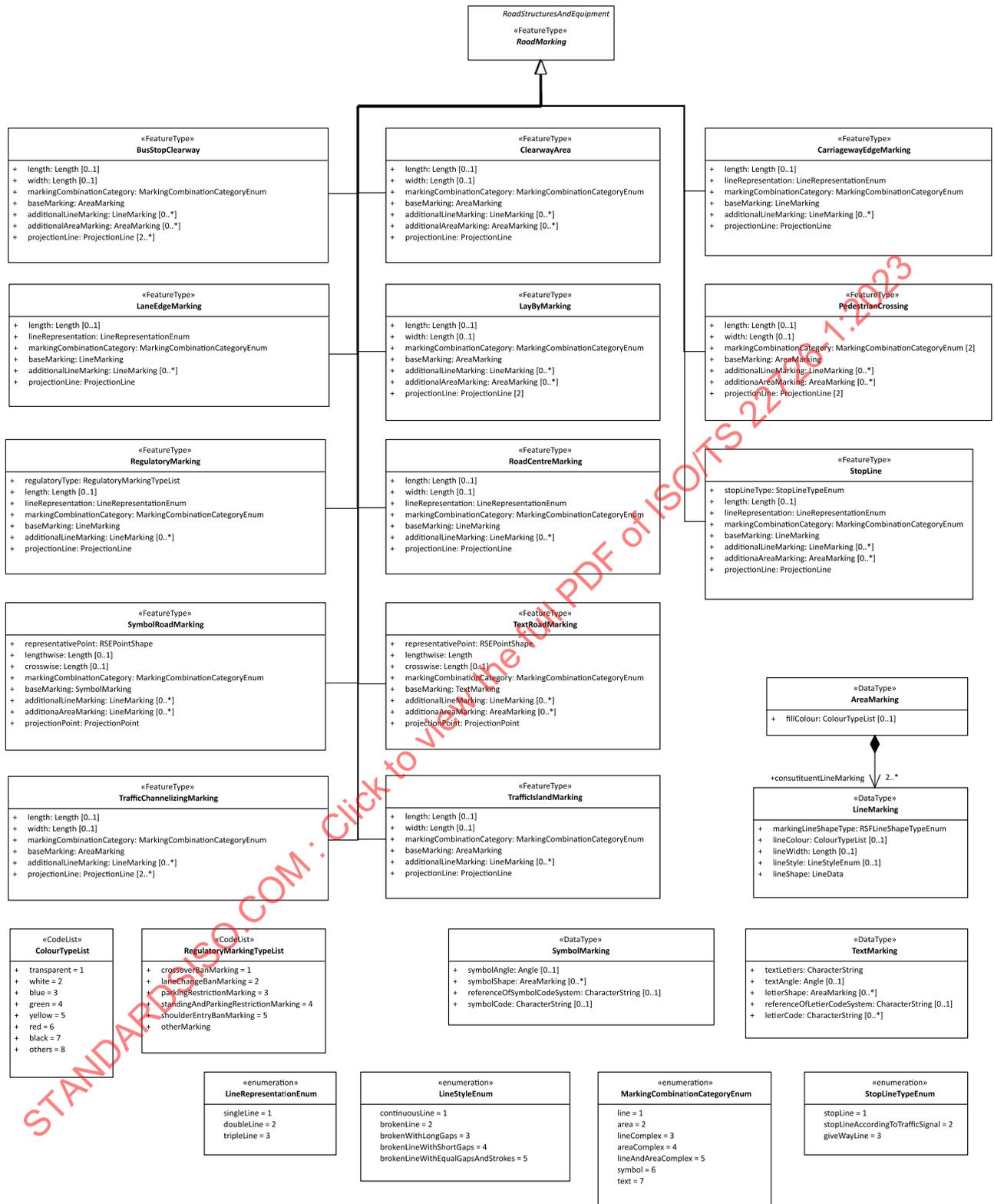
Figure 22 — RoadMarking sub-package

7.3.4.5.2   RoadMarking

A RoadMarking class is an abstract class defined as the root class for the RoadMarking sub-package.

Table 141 defines the details of the RoadMarking class.

Table 141 — RoadMarking class

Class<<featureType>>: RoadMarking				
Definition	Any kind of coloured device or material that is located on a road surface in order to convey official prescriptions or indications to road users.			
Role/Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
role: BusStopClearway	Specifies a bus stop clearway.			
	BusStopClearway			Generalization relationship
role: CarriagewayEdge-Marking	Specifies a carriageway edge marking.			
	CarriagewayEdgeMark-ing			Generalization relationship
role: ClearwayArea	Specifies a clearway area.			
	ClearwayArea			Generalization relationship
role: LaneEdgeMarking	Specifies a lane edge marking.			
	LaneEdgeMarking			Generalization relationship
role: LayByMarking	Specifies a lay-by marking.			
	LayByMarking			Generalization relationship
role: PedestrianCross-ing	Specifies a pedestrian crossing.			
	PedestrianCrossing			Generalization relationship
role: RegulatoryMark-ing	Specifies a regulatory marking.			
	RegulatoryMarking			Generalization relationship
role: RoadCentreMark-ing	Specifies a road centre marking.			
	RoadCentreMarking			Generalization relationship
role: StopLine	Specifies sub class StopLine.			
	StopLine			Generalization relationship
role: SymbolRoadMark-ing	Specifies a symbol road marking.			
	SymbolRoadMarking			Generalization relationship
role: TextRoadMarking	Specifies a text road marking.			
	TextRoadMarking			Generalization relationship
role: TrafficChanneliz-ingMarking	Specifies a traffic channelizing marking.			
	TrafficChannelizing-Marking			Generalization relationship
role: TrafficIslandMark-ing	Specifies a traffic island marking.			
	TrafficIslandMarking			Generalization relationship

Road Marking feature has properties consisting of the shape data of the base marking and any additional marking.

The shape data of a base marking corresponds to their respective feature and is defined one of the following data types:

— LineMarking for line road markings,

— AreaMarking for area road markings,

— SymbolMarking for symbol road markings, and

— TextMarking for text road markings.

Additional marking shape data are either LineMarking data and/or AreaMarking data and are added to match the actual shape. MarkingCombinationCategory defines a combined configuration of marking data such as base 'LineMarking' with an additional 'LineMarking'.

AreaMarking data is constructed by connecting LineMarking data in a clockwise order. LineMarking data has a markingLineShapeType (the same as RSELineShapeType) for classifying the role of a marking line. A Projection line defined in a markingLineShapeType defines two projection points at both ends.

LineMarking data contains line colour, line width, line style and line shape data.

EXAMPLE   A road marking made up of multiple lines such as dual road centrelines are represented by BaseMarking (LineMarking) and AdditionalLineMarking.

If a specific road marking is composed of multiple colours, widths and line styles, each LineMarkings corresponds to a combination of the required colour/width/line style.

7.3.4.5.3   BusStopClearway

A BusStopClearway is located inside of a LaneBeltElement along one side of a RoadBeltElement, and is related to a LaneBeltElement.

A BusStopClearway is a marked area feature consisting of multiple marking lines classified as entrance/exit lines and projection lines. The BaseMarking type of a BusStopClearway is an AreaMarking and contains one or more projection lines. The projection lines of a BusStopClearway are located along the side lines of the LaneBeltElement. A BusStopClearway can contain an additionalLineMarking and an additionalAreaMarking to enable the formation of an entire BusStopClearway such as chevron mark, zebra mark and so on.

If a BusStopClearway crosses plural lanes, then an intermediate ProjectionPoint in the ProjectionLine for the LaneBeltElement is additionally defined.

Table 142 defines the details of the BusStopClearway class.

Table 142 — BusStopClearway class

Class<<featureType>>: BusStopClearway				
Definition	Road marking which indicates an area of regulation on the carriageway or lane where vehicles other than public buses are prohibited to stop.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
length	Length of the bus stop clearway.			
	Length	[0..1]		
width	Width of the bus stop clearway.			
	Length	[0..1]		
markingCombinationCat-egory	Combination of marking components (i.e., area-shaped and line-shaped) of the bus stop clearway which is expressed by several marking lines.			
	MarkingCombination-CategoryEnum	[1]		
baseMarking	Base marking containing the projection lines of the bus stop clearway which is a quadrangle.			
	AreaMarking	[1]		
additionalLineMarking	Additional line markings, such as zebra lines, in the bus stop clearway.			
	LineMarking	[0..*]		
additionalAreaMarking	Additional area markings, such as a triangle, of the bus stop clearway.			
	AreaMarking	[0..*]		
projectionLine	Line that represents the side edge of the bus stop clearway that is projected onto the road feature.			
	ProjectionLine	[2..*]		

7.3.4.5.4 CarriagewayEdgeMarking

A CarriagewayEdgeMarking is located along the side line of a RoadBeltElement, and is related to a RoadBeltElement.

A BaseMarking type of the CarriagewayEdgeMarking is a LineMarking which is used as a projection line.

If a CarriagewayEdgeMarking is related to two or more sequential RoadBeltElements, CarriagewayEdgeMarking can have an intermediate ProjectionPoint in a ProjectionLine at a location corresponding to LaneBeltJoint, and its ProjectionPointMarker is defined as 'intermediate'.

Table 143 defines the details of the CarriagewayEdgeMarking class.

Table 143 — CarriagewayEdgeMarking class

Class<<featureType>>: CarriagewayEdgeMarking				
Definition	Road marking which indicates the edge of a carriageway and is situated between the carriageway and the road shoulder space, or at an intersection to highlight the side edge of the carriageway.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
length	Length of the carriageway edge marking.			
	Length	[0..1]		
lineRepresentation	Characteristics of the lines defining the carriageway edge marking.			
	LineRepresentationEnum	[1]		
markingCombination-Category	Combination of marking components (i.e. area-shaped and line-shaped) of the clearway area which is expressed by several marking lines.			
	MarkingCombinationCat-egoryEnum	[1]		
baseMarking	Base marking containing the projection line of the carriageway edge marking.			
	LineMarking	[1..*]		
additionalLineMarking	Additional line geometry data of the carriageway edge marking.			
	LineMarking	[0..*]		
projectionLine	Line that represents the side edge of the carriageway edge marking that is projected onto the road feature.			
	ProjectionLine	[1]		

7.3.4.5.5 ClearwayArea

A ClearwayArea is located inside of a LaneBeltElement along one side of the RoadBeltElement.

A ClearwayArea consists of multiple marking lines classified as entrance/exit lines and projection lines. The BaseMarking type of a ClearwayArea is an AreaMarking and it contains one or more projection lines. The projection lines of a ClearwayArea are located along the side lines of a LaneBeltElement. A ClearwayArea can have an AdditionalLineMarking and an AdditionalAreaMarking to enable the formation of an entire marking. A ClearwayArea is related to the LaneBeltElement.

If a ClearwayArea crosses multiple lanes, an intermediate ProjectionPoint in the ProjectionLine can be defined.

Table 144 defines the details of the ClearwayArea class.

Table 144 — ClearwayArea class

Class<<featureType>>: ClearwayArea				
Definition	Road marking which indicates an area of regulation for the carriageway or lane where vehicles are prohibited to stop, for example, in front of the exit and entrance of a fire station or police station.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
length	Length of the clearway area.			
	Length	[0..1]		
width	Width of the clearway area.			
	Length	[0..1]		
markingCombinationCategory	Combination of marking components (i.e. area-shaped, and line-shaped) of the clearway area which is expressed by several marking lines.			
	MarkingCombinationCategoryEnum	[1]		
baseMarking	Base marking containing projection lines of clearway area which is a quadrangle.			
	AreaMarking	[1]		
additionalLineMarking	Additional line shape, such as zebra lines, in the clearway area.			
	LineMarking	[0..*]		
additionalAreaMarking	Additional area such as triangle, of clearway area.			
	AreaMarking	[0..*]		
projectionLine	Line that represents the side edge of the clearway area that is projected onto the road feature.			
	ProjectionLine	[2..*]		

7.3.4.5.6 LaneEdgeMarking

A LaneEdgeMarking is located at the edge of a LaneBeltElement.

The BaseMarking type of a LaneEdgeMarking is a LineMarking which uses a projection line located along a side line of the LaneBeltElement.

If the lineRepresentationEnum is "double line", the first lane edge line is expressed by BaseMarking and the second lane edge line is expressed by an AdditionalLineMarking.

A LaneEdgeMarking is related to a LaneBeltElement.

If a LaneEdgeMarking lies along sequential LaneBeltElementa, a LaneEdgeMarking can have an intermediate ProjectionPoint in the ProjectionLine at a location corresponding to the LaneBeltJoint, and its ProjectionPointMarker is defined as "intermediate".

Table 145 defines the details of the LaneEdgeMarking class.

Table 145 — LaneEdgeMarking class

Class<<featureType>>: LaneEdgeMarking				
Definition	Road marking which indicates a boundary located between the lanes.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
length	Length of the lane edge marking.			
	Length	[0..1]		

Table 145 *(continued)*

lineRepresentation	Characteristics of lines defining the lane edge marking.			
	LineRepresentationEnum	[1]		
markingCombination-Category	Combination of marking components (i.e. line-shaped marking) of lane edge marking which can be expressed by several line markings.			
	MarkingCombination-CategoryEnum	[1]		
baseMarking	Base marking containing the projection line of the lane edge marking expressed by the line.			
	LineMarking	[1]		
additionalLineMarking	Additional line geometry data of lane edge marking.			
	LineMarking	[0..*]		
projectionLine	Line that represents the side edge of the lane edge marking that is projected onto the road feature.			
	ProjectionLine	[1]		

7.3.4.5.7 LayByMarking

A LayByMarking is expressed by the road marking and is in the area equivalent to lay-by lane.

A LayByMarking applies to street parking and emergency parking area.

A LayByMarking is an area feature consisting of multiple marking lines classified as entrance/exit lines and projection lines. The BaseMarking type of a LayByMarking is an AreaMarking, and contains one or more projection lines, with the projection lines located along the side line of the LaneBeltElement and RoadBeltElement.

If LayByMarking lies along LaneBeltElement sequentially, LayByMarking can have intermediate ProjectionPoint in ProjectionLine at a location corresponding to LaneBeltJoint, and its ProjectionPointMarker is defined as "intermediate".

If a lay-by lane and similar areas exist between the forward traffic direction of the lane and reverse direction, a LayByMarking can have an intermediate ProjectionPoint in the ProjectionLine at the location corresponding to the LaneBeltJoint.

Table 146 defines the details of the LayByMarking class.

Table 146 — LayByMarking class

Class<<featureType>>: LayByMarking				
Definition	Road marking which indicates a part of the roadway set aside for vehicles to draw out of the traffic lanes and wait or parking, depending on local restrictions.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
length	Length of the lay-by marking.			
	Length	[0..1]		
width	Width of the lay-by marking.			
	Length	[0..1]		
markingCombinationCategory	Combination of marking components (i.e. area-shaped and line-shaped) of the lay-by marking which is expressed by several marking lines.			
	MarkingCombination-CategoryEnum	[1]		

Table 146 *(continued)*

baseMarking	Base marking containing projection lines of lay-by marking which is a quadrangle.			
	AreaMarking	[1]		
additionalLineMarking	Additional line markings, such as zebra lines, in the lay-by marking.			
	LineMarking	[0..*]		
additionalAreaMarking	Additional area marking, such as triangle, of the lay-by marking.			
	AreaMarking	[0..*]		
projectionLine	Line that represents the side edge of the lay-by marking that is projected onto the road feature.			
	ProjectionLine	[1..*]		

7.3.4.5.8 PedestrianCrossing

PedestrianCrossings are road structures and/or equipment that is located inside of a RoadBeltElement, a LaneBeltElement or an IntersectionBelt. A PedestrianCrossing can also be associated with a TrafficSignalHead for pedestrians.

A PedestrianCrossing is an area marking feature consisting of multiple marking lines classified as projection lines and other lines. The BaseMarking type of a PedestrianCrossing is an AreaMarking and contains two or more projection lines. The projection lines are located across a carriageway and/or intersection. A PedestrianCrossing can contain an additionalLineMarking and/or an additionalAreaMarking to enable the formation of an entire road marking such as chevron mark, zebra mark, etc.

At a parallel LaneBeltElement, a PedestrianCrossing can have an intermediate ProjectionPoint in a ProjectionLine at a location corresponding to the LaneBeltElement.

Table 147 defines the details of the PedestrianCrossing class.

Table 147 — PedestrianCrossing class

Class<<featureType>>: PedestrianCrossing				
Definition	Road marking expressed by paintings and/or studs which defines an area where pedestrians are allowed to cross a road or intersection.			
Attribute name	Definition			
	Value type	Multiplicity	Stereotypes	Note/Constraint
length	Length of the pedestrian crossing.			
	Length	[0..1]		
width	Width of the pedestrian crossing.			
	Length	[0..1]		
markingCombinationCategory	Combination of marking components (i.e. area-shaped and line-shaped) of the pedestrian crossing marking which is expressed by several marking lines.			
	MarkingCombination-CategoryEnum	[1]		
baseMarking	Base marking containing projection lines of pedestrian crossing which is a quadrangle.			
	AreaMarking	[1]		
additionalLineMarking	Additional line markings of the pedestrian crossing.			
	LineMarking	[0..*]		
additionalAreaMarking	Additional area marking of the pedestrian crossing.			
	AreaMarking	[0..*]		