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HD Maps data contents and formats standard

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HD Maps data contents and formats standard

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Foreword

This is an industry standard regulated and published by the Taiwan Association of Information and Communication Standards (TAICS) with the approval of the TAICS council.

This standard does not suggest all the safety precautions. The related safety maintenance and health operations shall be established and the relevant regulations shall be obeyed before applying this standard.

Part of this standard may involve patents, trademarks, and copyrights. The association is not responsible for the identification of any patents, trademarks, and copyrights.

Introduction

As one of the main development trends of the automobile industry in recent years, autonomous vehicles are intelligent vehicles with the functions of perception, decision and control. Autonomous vehicles have positive effects on various aspects, such as reducing car accidents and traffic jam, reducing air pollution, improving driving safety, increasing energy efficiency, assisting people who cannot drive and extending service scope. Its long-term development goals are combining intelligent transportation systems and smart cities, changing driving behaviors or business models and developing intelligent ecosystems. Governments and automobile vehicle industries of many European, American and Asian countries have invested a great deal of capital in autonomous vehicle research and development in recent years, which has created a vigorous driving force.

The autonomous vehicle industry can bring huge economic benefits. Not limited to the automobile industry itself, it widely covers the industrial chains including information and communication, chips, sensors, software, maps and electromechanical industry. For example, autonomous vehicles are highly relied on sensors for satellite positioning, gyroscopes, cameras and radars on real-time positioning and interpretation, so the research and development of high-accuracy and high-update-frequency sensor technology will be one of the key factors. A large amount of real-time data in advanced driving assistance systems must be correctly processed by intelligent real-time algorithms, decision-making mechanisms and good electromechanical and information systems. Therefore, autonomous vehicle related industries will have enormous potential for development with their technologies integrated closely together. To effectively create a development environment for cross-domain technology integration will be an important challenge for Taiwan to promote automobile vehicles in the future.

Due to the new challenges brought by the new application modes of unmanned vehicles to current modes and regulations, Taiwan issued the “Unmanned Vehicles Technology Innovative Experimentation Act” in 2019, with the regulatory sandbox as the core, through deregulation and safe experimental environment construction, to encourage domestic and foreign industries to invest in research, development and application of unmanned vehicles technology, so as to ensure technology feasibility and safety by practical verification and promote the development of new business service models. In order to actively promote the development of autonomous

vehicle technology, government departments, including the Ministry of Economic Affairs, Ministry of Science and Technology, Ministry of Interior and Ministry of Transportation and Communications, have been actively engaging in the plans associated with autonomous vehicle prototype development and testing, correction field establishment, map data specifications, standardization of traffic signals, so as to create a more competitive industrial research and development environment.

High definition maps (HD maps) are digital map data specifically designed for autonomous vehicles and have different requirements than those for human use. High definition maps have high criteria on the positioning accuracy and demands of rich, identifiable and correct map data, so as to serve as the basis for autonomous vehicles to make real-time analysis and analysis decisions. In addition to static map data presented by high definition maps, semi-static, semi-dynamic and dynamic map data are also included in the map architecture required for autonomous vehicles. The more dynamic the data are, the more real-time updates will be needed. The development of high definition maps involves at least four aspects: map data design, surveying, circulation and application.

A single vehicle company that focuses on the development of its own system may undertake all tasks, or different units or industries can play different roles and establish industrial chains through cooperation, or even the government can play a leading role to promote the overall development of related industries.

Due to the high surveying and mapping costs of high definition maps, it is advantageous for all subsequent application clients to share the HD map data. The purpose of the “HD Maps Data Content Standards” (hereinafter referred to as this standard is to build a consensus among industries to promote a cooperative development mechanism of high definition maps, so that the high definition maps from different sources can be shared to avoid unnecessarily duplicated map production. The clear definition of high definition map data can drive the subsequent development of application integration in various fields, such as sensors, emulators, decision-making mechanisms, electromechanical systems, internet of vehicles and data communication network. Therefore, the establishment of the “HD Maps Data Content Standards” plays a key role in the cross-domain connection between autonomous vehicle related industries.

This standard is established according to the OpenDRIVE standards maintained by the Association for Standardization of Automation and Measuring Systems (ASAM) and the

requirements of Taiwan. Encoded in XML format, OpenDRIVE is open and extensible, and helps to extension design as well as cross-platform circulation and exchange.

This standard clearly specifies the content and encoding formats for the data of high definition maps in Taiwan. The specific goals are summarized as follows:

- (a) To define the lane-level network map, traffic control facilities and other road facilities, lay a common foundation for the high definition map data circulation mechanism for autonomous vehicles in Taiwan, and meet the requirements on positioning and navigation planning of autonomous vehicles.
- (b) To provide standardized technique requirements on the map data and format for surveying and mapping industries in Taiwan, so as to ensure the data quality and consistency of the high-definition maps.

1. Scope

This standard defines the high definition map data and format for autonomous vehicles, including roads of all levels, road facilities, traffic signals, signs and mark lines, with the main purpose of serving as the basis for autonomous vehicles to make driving decisions. The role of this standard in the overall technical architecture of autonomous driving is shown in an orange dotted area in Figure 1. This standard does not stipulate surveying and mapping procedure, quality verification, format conversion, analysis and application of high definition maps. Please refer to the “Guideline for HD Maps v.2” for the surveying and mapping procedure of high definition maps and the “Verification Guideline for HD Maps” for the quality verification procedure of high definition maps.



Figure 1 Role of high definition maps in autonomous driving technology architecture

2. Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes the 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.

- [1] OpenGIS Implementation Standard for Geographic information- Simple feature access- Part 1: Common architecture, version 1.2.1, 2011
- [2] OpenDRIVE, version 1.5, 2019
- [3] Highway Act (2017)
- [4] Road Traffic Management and Penalty Act (2011)
- [5] The Regulations for Road Traffic Signs, Markings, and Signals (2017)

3. Terms and definitions

The following terms and definitions apply to this standard.

3.1 High Definition Maps (HD Maps)

Refers to static basic base maps data, providing reliable and robust environmental prior information for operation of autonomous driving technology to help mobile computers to make driving decisions. The mapping data, layer categories, characteristics, attributes and metadata can be fully used by vehicle navigation systems. The two-dimensional absolute accuracy should be less than 20cm, and the three-dimensional absolute accuracy should be less than 30cm.

3.2 Highway

As defined in the “Highway Act”, highways include national highways, provincial highways, city highways, county highways, district highways, country roads, special highways and any highway-related facilities.

3.3 Road

A road, as defined in the “Road Traffic Management and Penalty Act”, is a highway, street, alleyway, square, arcade, corridor or place for the public to pass through.

3.4 Lane

A lane, as defined in the “Road Traffic Management and Penalty Act”, is part of a road divided by dividers, guardrails or mark lines, and a road for vehicle traveling.

3.5 Lane Line

A lane line is used to lay out a lane and guide a driver to travel on the lane.

3.6 Lane Center Line

It is a center line determined based on the lane lines on the left and right sides of a lane.

3.7 Traffic Island

A traffic island is a special area between lanes, to distinguish traveling directions, separate slow and quick lanes, direct traffic flow, provide temporary refuge for pedestrians and lay out traffic control facilities. Raised islands, recess zones, marks, curbs, mark lines or other setting methods can be adopted. Traffic islands are classified into the following four categories according to their functions: divisional islands (also known as traffic islands), channelizing islands, refuge islands and circular central islands.

3.8 Shoulder

The roadway adjacent to the outside of a lane is a shoulder. There are asphalt pavement, stone pavement and turf pavement according to different pavement materials.

3.9 Road Edge

A road edge refers to the edge of an asphalt road. For any road with curbs, the edge of the curbs is considered as the road edge.

3.10 Sidewalk

A sidewalk is an arcade, a corridor, a surface road, an overpass and an underpass for pedestrians to pass through.

3.11 Crosswalk

It refers to a place laid out by mark lines on a road for pedestrians to cross the road.

3.12 Stop Line

It is a boundary used to instruct a moving vehicle to stop. When a vehicle stops, its front overhang shall not exceed this line.

3.13 Parking Space

It indicates the location and range for a driver to park his or her vehicle, and is marked by stop lines.

3.14 Sign

As defined in the “Rules for Setting Road Traffic Signs, Mark Lines and Signal” by the Ministry of Transportation and Communications, the signs on roads are warning signs, prohibition signs, instruction signs and assisting signs.

3.15 Signal

As defined in the “The Regulations for Road Traffic Signs, Markings, and Signals” by the Ministry of Transportation and Communications, signals are lighting facilities laid out on roads for traffic control, including traffic control signs, pedestrian signs and special traffic signs.

3.16 Mark Line

As defined in the “The Regulations for Road Traffic Signs, Markings, and Signals” by the Ministry of Transportation and Communications, mark lines are all kinds of warning, prohibition and instruction marks laid out on roads, and laid out on roads or other facilities by lines, graphs, words or other guiding devices for traffic control.

3.17 Tunnel

A tunnel is an artificial passageway, either a traffic route or water channel, under ground, such as a mountain tunnel, an underground tunnel or a subsea tunnel, with the purpose of avoiding steep slopes and excessive bending on routes and shortening the distance. The clear height of a tunnel shall be based on the maximum vehicle height, with a minimum slope of 0.2%, to facilitate drainage. Long tunnels shall be facilitated with ventilation.

3.18 Bridge

A bridge is used to span a river, waterway, railway, highway, urban road and overhead road, consisting of abutments, piers and girders.

3.19 Coordinate Reference System

A coordinate system is based on a reference datum, a coordinate reference system is used to define the location of geographic referenced data on the ground surface. Coordinate reference systems are defined by various parameters, including origins, coordinate axes and measurement units, to establish the mathematical relationship between the features and earth.

3.20 Inertial Coordinates System

An inertial coordinate system is a coordinate system in which an object remains stationary or makes uniform linear motion in space. Newton's second law of motion will be followed if the inertia of an object disappears, that is, the object's momentum change rate is proportional to its acting force and the momentum change is in the direction of this force.

3.21 Track System

As an OpenDRIVE coordinate system, track system, with a road reference line as its center, shows positions, attributes and tracks of roads and various data.

3.22 Accuracy

Accuracy refers to how close the measurement result is to the true value. Accuracy is related to both the nature of the operation conducted to obtain results and the precision of results. In other words, accuracy means precision and exactness. However, in most cases, the true value is unknown, that is, accuracy cannot be clearly recognized but can only rely on high accuracy observation in general, hoping to obtain high accuracy measurement results. Precision is related to the concept of accuracy. However, high precision measurements may but do not necessarily indicate that they are highly accurate. For example, in directly and reversely measuring a distance with a 30m steel tape, the results are 137.340m and 137.342m respectively, with a precision of 1/70,000. However, it is found afterwards that the actual length of the ruler differs

from that of the standard ruler by 0.10m, so there is an error of 0.46m in the total length. Therefore, the precision of the measurement results is high, but the accuracy is low. As a result, it is necessary to pay special attention to preventing and eliminating faults and systematic errors and make high-quality observations. In this case, the most probable value can replace the truth value, standard errors can be used to measure accuracy, and precision can be regarded as accuracy to apply to various situations.

3.23 Interoperability

Interoperability is the ability of users to understand functions, execute programs, exchange data and use information between two or more systems.

3.24 Availability

- (a) The degree to which an information system or a resource is available when data need to be processed.
- (b) The percentage of time that a network processing device correctly completes a task during a given period.

3.25 Camera

As an instrument designed for taking photographs, a camera usually consists of a box (containing a lens, a shutter and an aperture) and a camera obscura in which photographic film can be mounted. According to their purposes, there are aerial cameras, space cameras, terrestrial cameras, frame cameras, continuous-strip cameras, metric cameras, reproduction cameras and multispectral cameras.

3.26 Radar

Radar, transliterated from the abbreviation of radio detection and ranging, is an instrument that transmits radio waves and receives reflected radio waves (microwaves) to detect the presence and positions of objects. A general radar has a transmitter and a receiver. The transmitter transmits narrow impulse waves in a certain direction, and the receiver receives and amplifies the reflected signals. The distance between the transmitting antenna and the object to be

measured can be calculated by measuring the phase difference or time difference between the transmitted and reflected signals. During instruction operation, large radar installation platforms can record the azimuth and elevation in the ranging direction. Radar can calculate the relative velocity change of an object by using the Doppler shift of reflected signals.

3.27 Global Navigation Satellite System (GNSS)

Refers to a global independent timing and spatial positioning system which users obtain real-time satellite information by their satellite signal receivers to calculate their positions (longitude, latitude and altitude) and the accurate time. There are global positioning systems, such as the Global Positioning System (GPS) of the United States, the GLObal NAVigation Satellite System (GLONASS) of Russia, the Galileo of Europe and the BeiDou Navigation Satellite System (BeiDou) of China, and regional navigation satellite systems of Japan (QZSS) and India (IRNSS).

3.28 Open Geospatial Consortium (OGC)

Founded in 1994, the Open Geospatial Consortium (OGC) is an international organization for standardization with more than 490 members all over the world, including business organizations, government agencies, non-profit organizations and research institutions. By coordinating member collaboration in building consensus agreements among geospatial communities, OGC is committed to developing and implementing open geospatial data standards, geospatial data and services, to facilitate geographic information system data processing and sharing.

3.29 Transverse Mercator (TM)

Transverse mercator projection, a method used to describe maps projection, is an isometric transverse cylindrical maps projection method. Assuming that a plane is rolled into a cylinder and sleeved outside a sphere, the central axis of the cylinder passes through the center of the earth and the angle between it and the equatorial plane is zero, and a meridian on the spherical surface is tangent to the cylindrical surface. In order to reduce the deformation caused by

spreading it to a plane for projection, 2°, 3° and 6° zone-dividing projections have been developed.

3.30 Unified Modeling Language (UML)

UML, a graphic presentation mode, is used to represent the graphic architecture of software systems. UML is not a programming language, but a description way that software systems are defined and built by graphics. It is a common tool used to analyze and design object-oriented software systems. Developed by Grady Booch, James Rumbaugh and Ivar Jacobson in 1994, UML specifications are now maintained by the Object Management Group (OMG).

3.31 eXtensible Markup Language (XML)

XML is a markup language, and markup is information symbols that computers can understand. With markup, computers can process all kinds of articles and information. The extensibility of XML is that markups can be selected from internationally accepted markup languages (such as HTML), or languages freely determined by XML-related professionals.

4. Features analysis

In accordance with the data scope defined in this standard, this section analyzes the main features of the high definition maps for autonomous vehicles, to serve as a basis to design the application schema of this standard.

4.1 Coordinate reference system

In order to accurately describe the location of objects, coordinate reference systems must be clearly defined in the spatial descriptions of all high definition maps for autonomous vehicles and provided with the data when sharing. According to OpenDRIVE architecture, a track system and an inertial coordinate system are defined. The inertial coordinate system can specify a coordinate reference system, such as TWD97 coordinate system and WGS84 coordinate system, to provide spatial reference for three-dimensional coordinates. The concepts of reference line and track system are described as below:

- (a) The reference line is the critical part of the road data model. A reference line is described by one or more geometric elements. For example, in Figure 2, the red line is the reference line and recorded as a straight line.
- (b) A reference line can be comprised of one or more geometric elements. For example, 2 straight lines are linked to represent a reference line. Figure 2 shows a reference line is described by a straight line.
- (c) A reference line only considers the x and y horizontal coordinates in the inertial coordinate system. The starting point of the reference line has (x,y) coordinates in the inertial coordinate system. The elevation of the reference line is recorded in another way.
- (d) A reference line is directional, moving forward along s-axis. The starting point of the reference line can be set as $s=0$. The geometric element has a length. If the length is 10, the value of s of the end point is 10; if the value of s of the starting point of a geometric element is not 0, it implies the end point of the previous geometric element will serve as the starting point of this geometric element, the record is thus continued.
- (e) T-axis represents the horizontal direction of the reference line, and h is the vertical axis.

The system of (s, t, h) represents a right-handed coordinate system.

- (f) An azimuth (hdg) is recorded for a reference line, starting with the east, to record the direction in which the line goes. Please refer to the diagram in Figure 3.
- (g) For lanes and all other data, the value of s, t and h relative to the reference line are recorded based on the track system of the reference line. Their three-dimensional coordinates can be indirectly calculated according to the three-dimensional coordinates of the inertial coordinate system of the reference line.
- (h) The elevation information of a reference line is recorded in two ways: the elevation along the road profile and the elevation along the road transverse section.

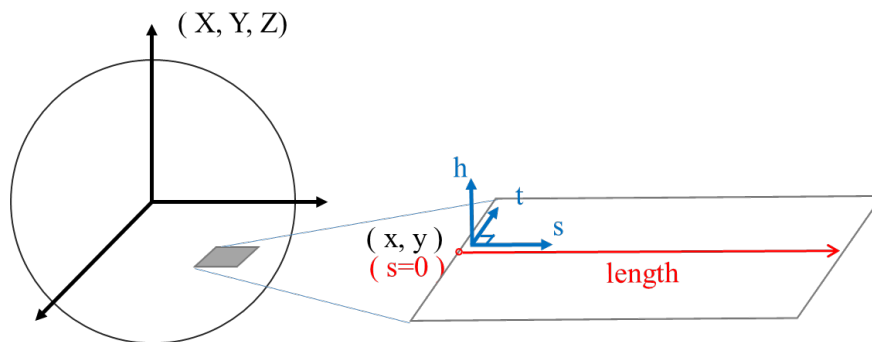


Figure 2 Inertial coordinate system and track system

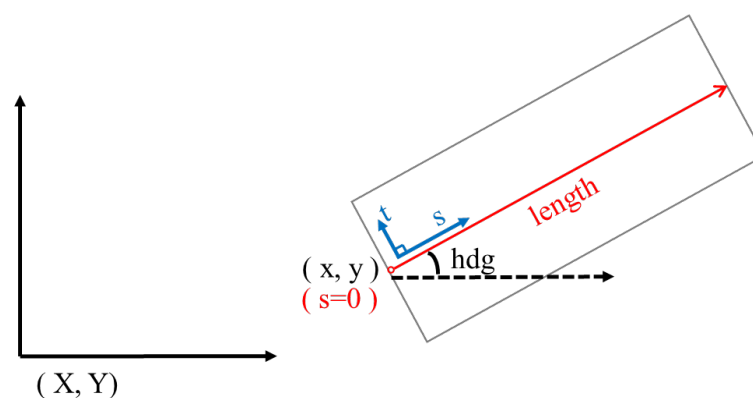


Figure 3 Track system

4.1.1 Inertial coordinate system

An inertial coordinate system can specify a coordinate reference system to represent an absolute position. It has plane coordinates (x,y) and elevation (z), where x-axis points to the east, y-axis points to the north, and z records the elevation. The three rotation angles respectively represents the information of heading, pitch and roll. Heading rotates around z-axis, pitch rotates around y-axis, and roll rotates around x-axis. In OpenDRIVE, only the reference line directly records the coordinates in the inertial coordinate system.

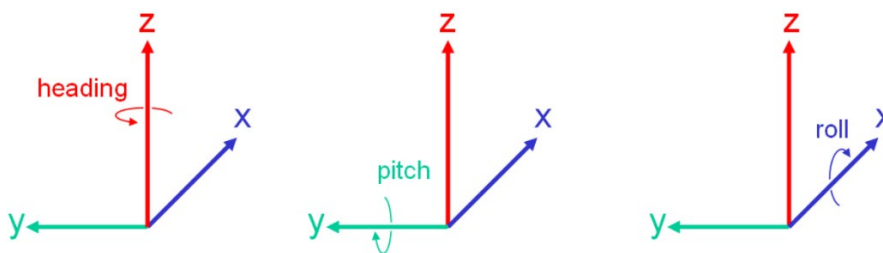


Figure 4 Rotation angles in the inertial coordinate system

4.1.2 Track system

As a right-handed coordinate system, the track system is a coordinate system defined according to the direction of the road. The reference line moves forward along s-axis, t-axis is the horizontal direction of the reference line, h is the vertical axis, and the track system (s, t, h) is a right-handed coordinate system. In OpenDRIVE, the track system is used to describe the positions of lanes and all other objects relative to the reference line. Only the reference line has the coordinates in the inertial coordinate system and all other data are recorded with the coordinates in the track system.

This design is different from the geographic coordinates or inertial coordinates commonly used in geographic information systems. Hence, this standard adopts a dual-track design, to provide extra geographic coordinates under the condition of satisfying OpenDRIVE requirements, so that users can extract appropriate data according to their needs after obtaining data. Figure 5 shows the diagrams of s-axis and t-axis in OpenDRIVE track system.

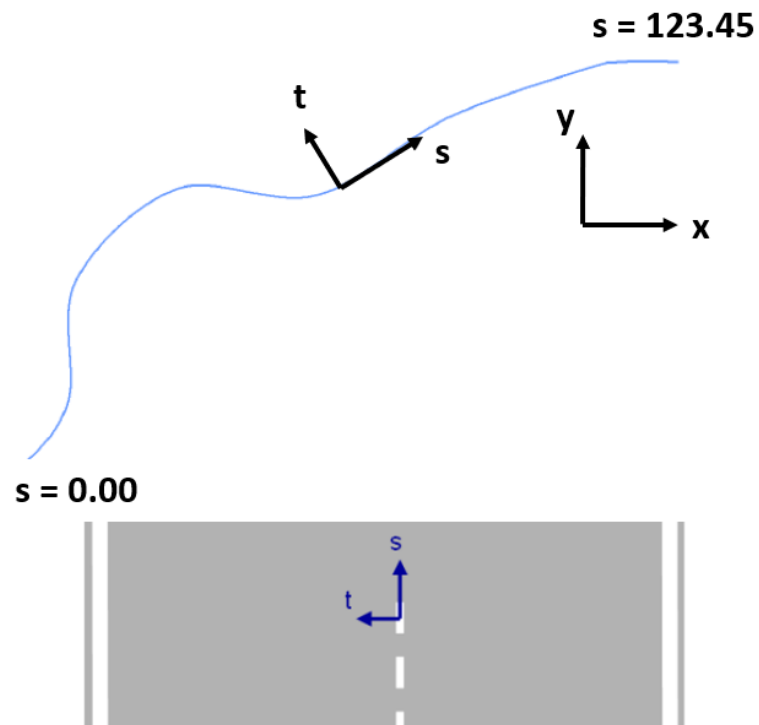


Figure 5 OpenDRIVE track system

The track system is used to describe three rotation angles in all classes, namely, heading, pitch and roll. Heading rotates around h-axis, pitch rotates around t-axis, and roll rotates around s-axis. Please refer to Figure 6.

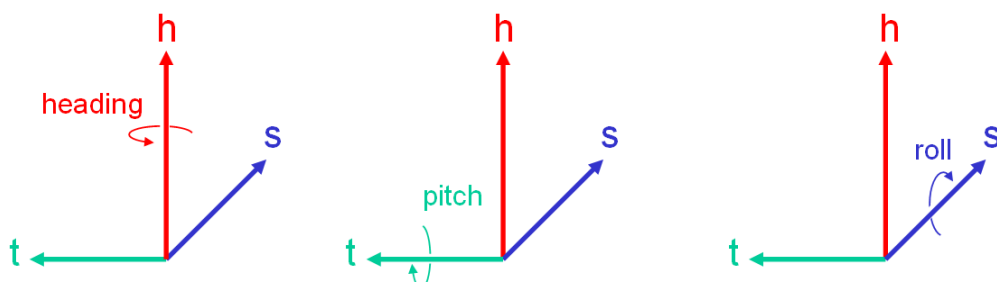


Figure 6 Rotation angles in the track system

4.2 Geometric representation

In order to describe the spatial positions of objects, this standard explains the geometrical representations and significances of objects and data.

- (a) Single point: the three-dimensional coordinates of a single point are recorded.
- (b) Representative position: a single point is used to represent the approximate position of a three-dimensional object. For example, the coordinates of the central point of a three-dimensional object.
- (c) True shape: the shape or range of an object. For example, the three-dimensional true shape of a mark line on a road, and the three-dimensional true shape of a roadside object.
- (d) Bounding range: the contour of a three-dimensional object created based on the concept of bounding only indicates an approximate position and is different from the true shape.

4.3 Road

The attributes such as three-dimensional geographical position, name, type, and pavement material shall be described for a road. A road space may cover multiple lanes and involve relevant facilities. Other objects and facilities are recorded in corresponding classes.

4.4 Lane

The attributes such as three-dimensional geographical position, speed limit, pavement material, type, length, height limit and weight limit shall be described for a lane, and recorded in the design class.

Lane lines and lane center lines shall be recorded. A lane line has width, color, and type, which can determine the lane type and traffic rules. The three-dimensional geographical position and attributes of a lane line shall be recorded in the design class. Please refer to Figure 7 for the diagram of lane line.

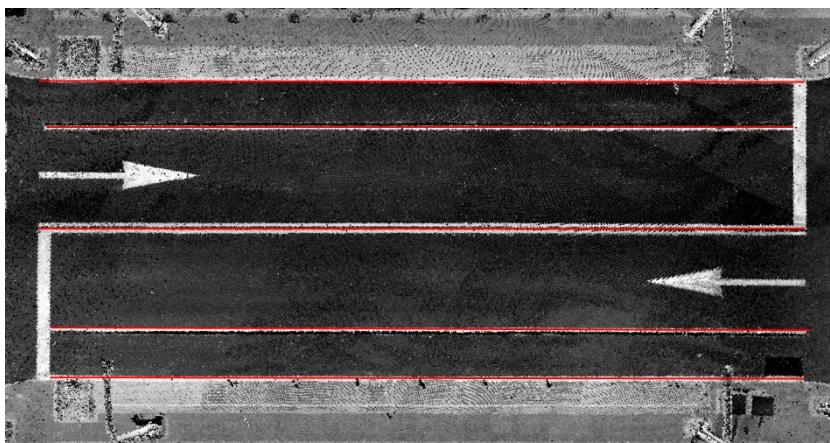


Figure 7 Diagram of lane line

In this standard, the three-dimensional geographical position and attributes of a lane are recorded according to the center line of the lane. Such center line is a directional three-dimensional spatial line. After its central point is selected, it shall be surveyed along the direction of the lane according to the lane lines on both sides of a single lane. Each center line has its starting node and end node. The nodes record the three-dimensional point coordinates and identifiers, to establish the relationship between predecessor and successor. Therefore, nodes are directional and can be used for driving control by autonomous vehicles. Please refer to Figure 8 for the diagram of the center line of lane.



Figure 8 Diagram of lane center line

4.5 Mark line

There are warning mark lines, prohibition mark lines and instruction mark lines according to their functions, and vertical mark lines, horizontal mark lines, assisting mark lines and words according to their layout ways. This standard includes the codes of all mark lines defined in the “Rules for Setting Road Traffic Signs, Mark Lines and Signal”, so that autonomous vehicles can directly identify the meanings of the mark lines. Each mark line has its color type. Please refer to Table A.3, Table A.4 and Table A.5 in Appendix A for a full list of mark line types and codes. The following examples show some different types of mark lines.

The red line in Figure 9 is a stop line. It is a prohibition mark line used to instruct a moving vehicle to stop. When a vehicle stops, its front overhang shall not exceed this line. Its geometry is represented as a three-dimensional line.

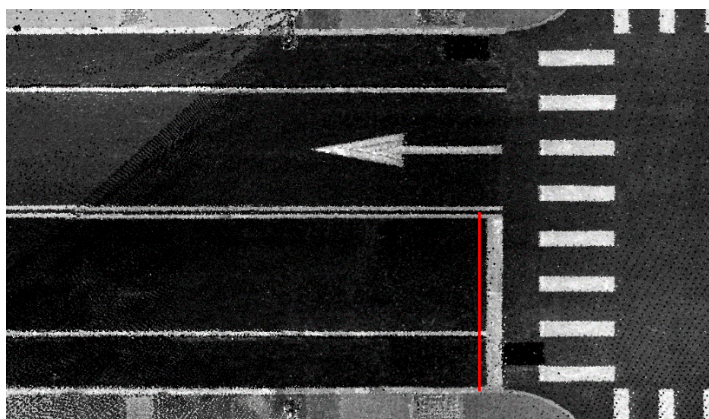


Figure 9 Stop line

The red line in Figure 10 is a dividing limit line. It is a prohibition mark line represented as double white solid lines, usually used to divide a road into two-way lanes. Vehicles are prohibited from crossing the lines and turning around. Its geometry is represented as a three-dimensional line.

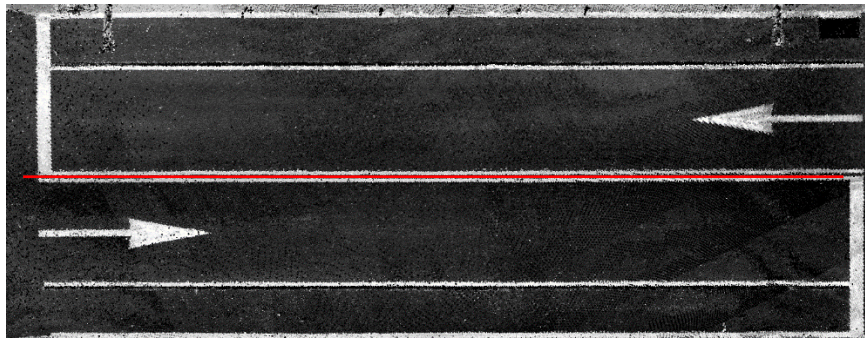


Figure 10 Dividing limit line

Figure 11 shows a guiding line. It is an instruction mark line, usually used to instruct the moving direction for vehicles. It is set on an exclusive vehicle lane in the direction of a road junction, and used with a lane change prohibition line. Vehicles must travel in the instructed direction after entering the road junction. There are four types of guiding lines: a straight line arrow indicating straight, a curved arrow indicating turning, a bifurcation arrow combining a straight and a curve indicating straight and turning, and a curved dotted arrow indicating leaving a lane. The geometry of a guiding line is represented according to its true shape, as shown in the green range in Figure 11.

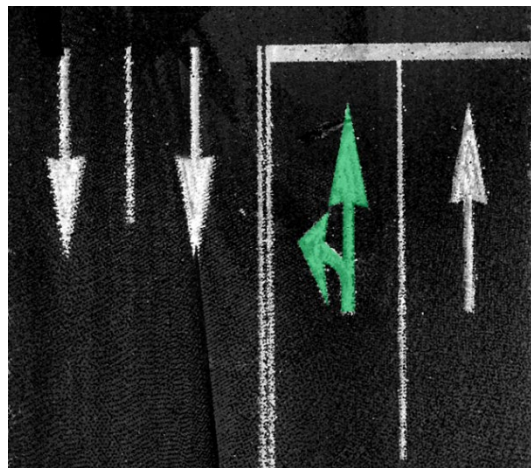


Figure 11 Guiding line

Figure 12 shows a longitudinal crosswalk line. It is an instruction mark line, and usually set at a road junction. Its geometry can be recorded by two geometric representations, namely,

bounding range and true shape. The geometry of the bounding range and its true shape are represented by a sequence of three-dimensional points, bounding range is shown by the red line and true shape is shown by the green line in Figure 12.

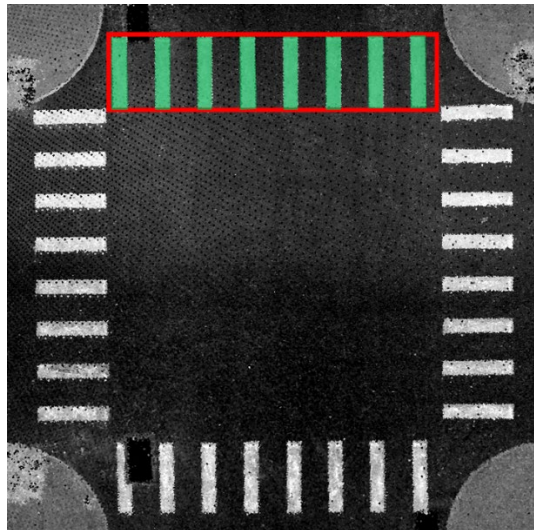


Figure 12 Longitudinal crosswalk line

4.6 Sign

A sign consists of a signboard and an object supporting the signboard. Deployed at an appropriate place, a sign is a traffic control facility to warn or control the road conditions ahead and to alert drivers and pedestrians to pay attention to and abide by. Signboards are in different colors and shapes depending on their purpose.

Figure 13 is the real picture of a single-track railroad crossing sign. It is an obeying sign belong to the category of prohibition signs, used to warn drivers and pedestrians that they must stop to look and listen to make sure it is safe and then pass. Sign data records shall contain signboards and object supporting the signboards, and classes are designed in this standard to record both types of data. The geometry of a sign includes both of its signboard and sign pole. A signboard is represented as a bounding range which is recorded as a sequence of three-dimensional points, and the orientation of the signboard shall be recorded. For a sign pole, the three-dimensional point coordinates of the representative position of the base (center point at the bottom) and the height shall be recorded.

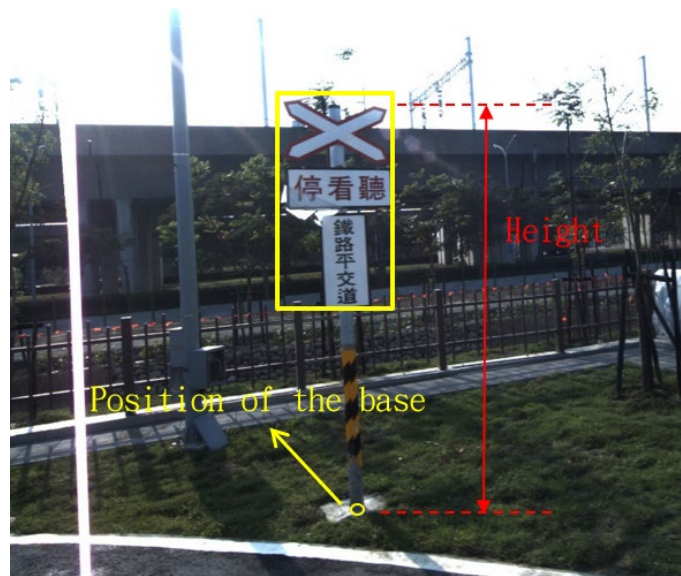


Figure 13 Single-track railroad crossing sign

Figure 14 is the real picture of a roundabout sign, mainly used to alert drivers to drive slowly and let vehicles in the inner lane go first. It is placed near the roundabout as needed.



Figure 14 Roundabout sign

As the unique code is not given for each sign in the “Rules for Setting Road Traffic Signs, Mark Lines and Signal” by the Ministry of Transportation and Communications, for the convenience of quick reference, a unique code is designed for each sign and recorded in the design class. Please refer to Table A.6 and Table A.11 in Appendix A for a full list of sign types and codes.

4.7 Signal

Signals are electrically operated traffic control devices usually deployed at road junctions or other necessary places, to instruct vehicles and pedestrians to stop, notice and move with red, yellow and green traffic lights or sound. Autonomous vehicles shall be able to identify its display status in real time to decide to stop or move. The number and type of signal faces are different for each signal. This standard includes codes of the signals defined in the “Rules for Setting Road Traffic Signs, Mark Lines and Signal”. Please refer to Table A.12 to Table A.14 in Appendix A for the full list of signal types and codes. A signal consists of a lamp cap, a lamp holder, a controller and a circuit. The data of lamp caps, lamp holders and controllers are recorded by three classes in this standard, respectively. Figure 15 shows the real picture of a traffic control signal. The attribute information and location of lamp cap of signals shall be recorded. The location of lamp cap shall be represented by three-dimensional point coordinates.

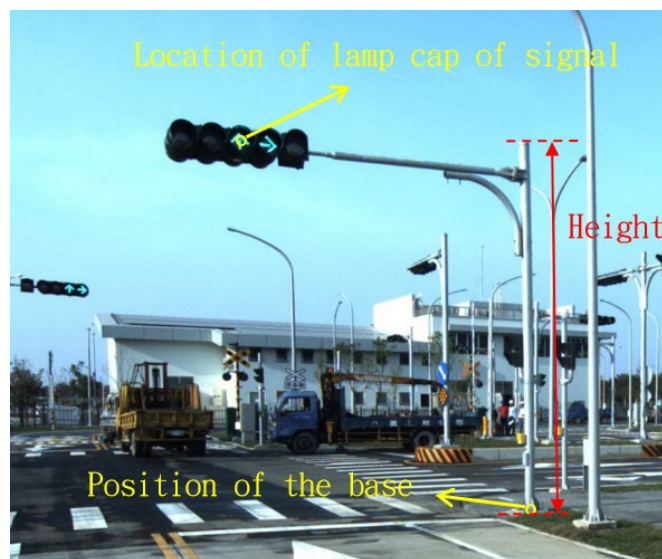


Figure 15 Traffic control signal

The composition of a lamp cap is shown in Figure 16, including a light box, a cover and a surface. All surfaces show different signal faces. The representative position of the surface, surface orientation, radius and signal face type is recorded for each signal face. The geometry of the surface is represented by three-dimensional point coordinates.

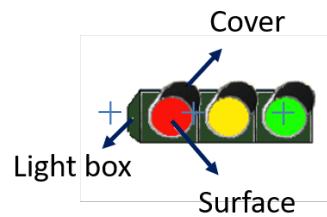


Figure 16 Composition of lamp cap

For traffic control, stop lines must be associated with signals. Signals are controlled by controllers. At road junctions, stop lines, signal controllers and lanes are integrated. Their relationship shall be built in the standard framework to provide a basis for autonomous vehicles to identify. Finally, for a lamp holder, the three-dimensional point coordinates of the representative position of the base (central point at the bottom) and the height shall be recorded.

4.8 Object

Objects can be on a road or by the side of a road, including street lamps, poles, walls and telecommunication machine boxes. For supporting poles of street lamps, poles, signals and signs, the three-dimensional coordinates of the representative positions of their bases (central points at the bottom), their length, their width and their vertex height are recorded, respectively. Complicated shapes are not processed but abstractly recorded as vertical rod-shaped objects. For walls, telecommunication machine boxes, traffic islands and other non-rod-shaped objects, their bottom areas are described by the sequence of three-dimensional points, the vertex height is recorded, and their geometric representations are simplified based on the concept of bounding box. Figure 17 shows the real picture of a street lamp.

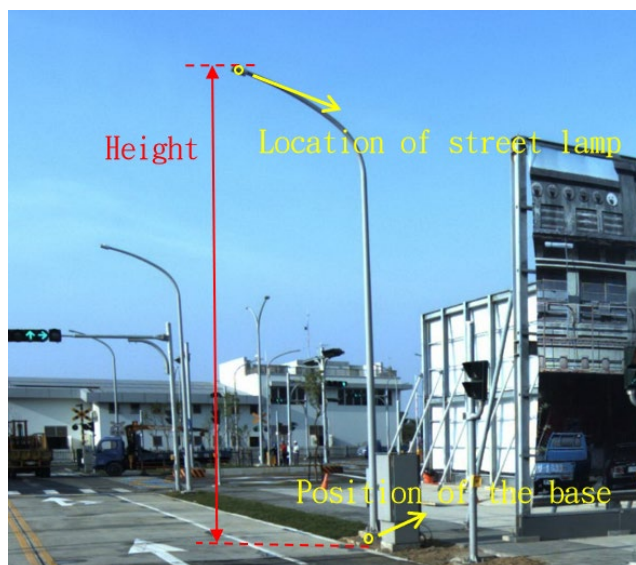


Figure 17 Street lamp

4.9 Tunnel

This standard defines classes to record the representative positions and attributes of tunnels, including name, length, height limit, lighting and vehicle type limit and other attributes. Tunnel data shall be recorded together with road data, and roads and lanes in tunnels shall be recorded in the same way as other roads. In terms of tunnel data, only simplified positions, attributes, and identifiers of lanes are recorded, so that autonomous vehicles can identify that they run on the lanes in tunnels.

4.10 Bridge

This standard defines classes to record the representative positions and attributes of bridges, including bridge name, allowable load, lane identifier and other attributes. Attributes are designed according to the “Design Specification for Highway Bridges”. Bridge data shall be recorded together with road data, and roads and lanes on bridges shall be recorded in the same way as other roads. In terms of bridge data, only simplified positions, attributes, and identifiers of lanes are recorded, so that autonomous vehicles can identify that they run on the lanes on bridges.

4.11 Road junction

As defined in the “Design Specification for Highway Alignment” by the Ministry of Transportation and Communications, road junctions are named highway intersections, including at-grade intersection and three-dimensional intersection. Three-dimensional intersection shall be adopted if motorways are intersected with roads at all levels. And three-dimensional intersection shall be recommended if highways with speed limit above 80km/hr are intersected with roads at all levels. For other highway intersections, factors such as traffic characteristics at junctions, accident rate, geometric conditions shall be considered to determine the types.

There are no road marks for lanes within the junction in the real world. But for the need of complete road network, the data comply with this standard shall recorded all roads, lanes, lane center lines, lane center line nodes, and connections between roads and lanes in the real world. Based on the model of this standard, signal controls, stop lines and lane connections shall be described with road junctions to provide information required for autonomous vehicles to integrate traffic control. Figure 18 shows the diagram of road connections at a junction, Road id 1 can be connected to Roads id 2, id 6 and id 7. Consequently, all connections at the road junction are recorded. Based on the road connections, the lane connections can be recorded.

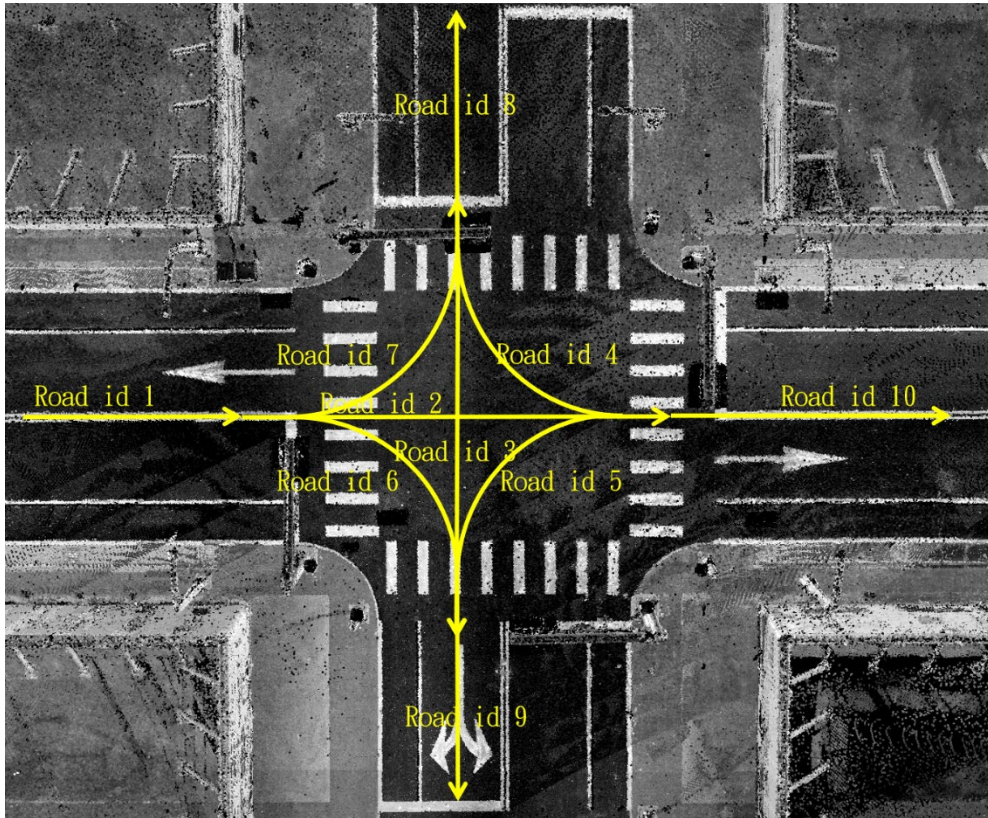


Figure 18 Road junction

5. Application schema

The purpose of this standard is to facilitate the distribution of high definition maps for autonomous vehicles, including data content and encoding format. In this section, the UML application schema of high definition maps for autonomous vehicles is provided, including designed class and attribute. The UML application schema of this standard is designed according to the XML schema in OpenDRIVE 1.5 standard, and extended according to the requirements of Taiwan.

5.1 Road application schema

The main architecture of UML in this standard complies with OpenDRIVE 1.5 standards. Roads are designed with the “road” class, which is linked to 9 classes: “link”, “type”, “planView”, “elevationProfile”, “lateralProfile”, “lanes”, “objects”, “signals” and “userdata” (Figure 19). The classes of this standard are summarized in Table 1. The link class records the predecessor and successor of the road, the type class records the type of the road class, the planView class records the line parameters of the road class, the elevationProfile class records the longitudinal elevation parameter of the road, the lateralProfile class records the lateral elevation parameter of the road class, the lane class records the lane geometry and attributes associated with the road class, the object class records the collection of many classes, including objects (object class), tunnels (tunnel class) and bridges (bridge class), and the signal class is the signal of the road class. Userdata is a class designed in OpenDRIVE for extensively recording data not defined in OpenDRIVE standard. In this standard, the design classes are extended according to the required conditions of Taiwan and recorded in userdata based on the XML schema specified herein (please refer to Appendix C).



Table 1 Class table

Class	Linkes Classes	Linked Classes
road	link	predecessor
		successor
		neighbor
	type	speed
	planView	geometry
	elevationProfile	elevation
	lateralProfile	superelevation
		crossfall
		shape
	lanes	laneOffset
		laneSection
	objects	object
		tunnel
		bridge
	signals	signal
	userdata	Sign
		SignalData
		MarkLine
		MarkArea
		MarkGraph
LaneCenterLine		
Waypoint		
StopLine		

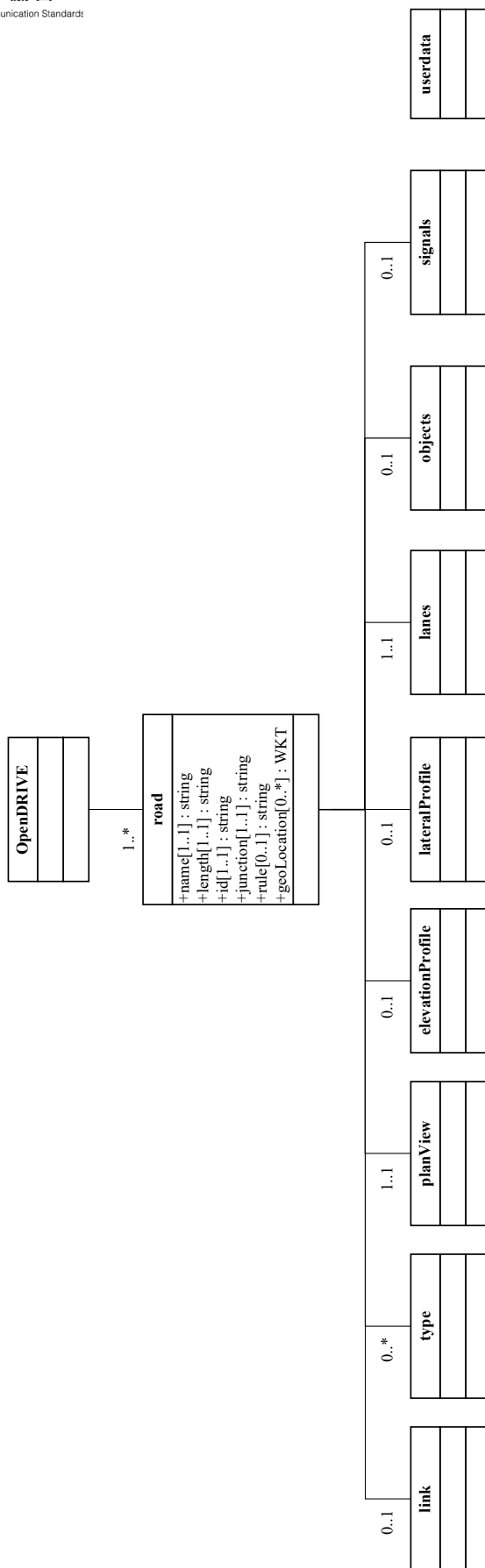


Figure 19 Application schema of high definition maps standards

The road class includes 6 attributes, namely, name, length, id, junction, rule and geoLocation, with the first 5 attributes are referred from OpenDRIVE. Name records road name, length records reference line length, id records road identifier, junction records whether a road is an ordinary road or a road junction, and rule records whether a left-hand traffic rule or right-hand traffic rule is adopted for a road. GeoLocation, an attribute extended in this standard, is an optional attribute used for recording the three-dimensional linear coordinates of reference lines in the inertial coordinate system in WKT format.

According to the architecture in Figure 19, roads can be divided into different sections, and each section is recorded by a road class. The features of the road class are described as below:

- (a) In the road class, there is only one reference line. Every reference line can be described with several geometric elements. Geometric elements are linked to the geometry class of the planView class.
- (b) In the road class, roads shall be divided at stop lines and road junctions, and the linkage between road sections in a road network shall be recorded.
- (c) In the road class, roads shall be divided at stop lines and road junctions. In Addition, roads shall be divided when the geometric element is different. For example, in Figure 20, there are 2 reference lines, one records straight lines and the other one records curved lines.
- (d) Each road class is considered as an independent track system. The starting point of the first geometric element in the reference line is set as $s=0$. If there is a second geometric element, its starting point is at the position of the end point of the previous geometric element.
- (e) Based on the track system of the reference line, roads and lanes, lane connections at road junctions, objects (street lamps, roadside trees, tunnels and bridges), and mark lines, signs and signals on roads, can describe their location with s , t coordinates and h elevations.

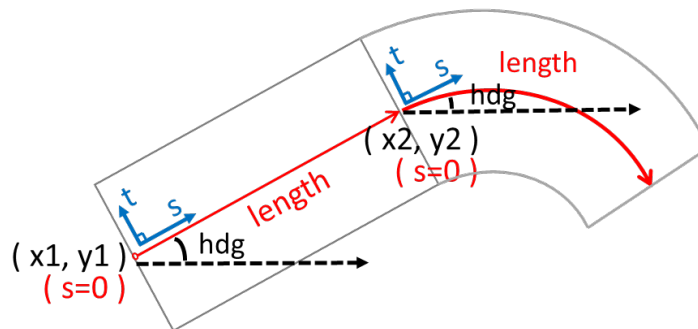


Figure 20 reference line contain different types of geometric elements

5.2 Link related(or associated) classifications

The link class records the linkage between the road class and other road classes, is referred from OpenDRIVE, as shown in Figure 21. For example, in Figure 22, 7 roads are recorded by the road class. For Road 2, Road 1 is described as the predecessor class of Road 2. Road 3, 4, and 5 are described as the successor classes of Road2. Consequently, a road network is built. Roads at junctions, such as Road 3, 4 and 5 in the figure, are called virtual roads in OpenDRIVE, and Road 1, 2, 6, 7 and 8 are physical roads. Road 3, 4 and 5 are separated because their lane lines are not clearly marked in the real world.

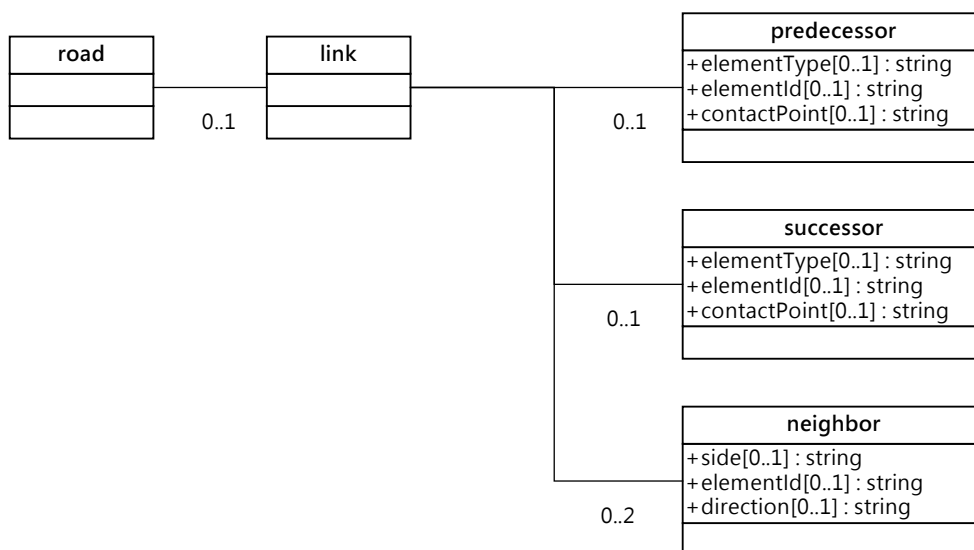


Figure 21 Link class and associated classes

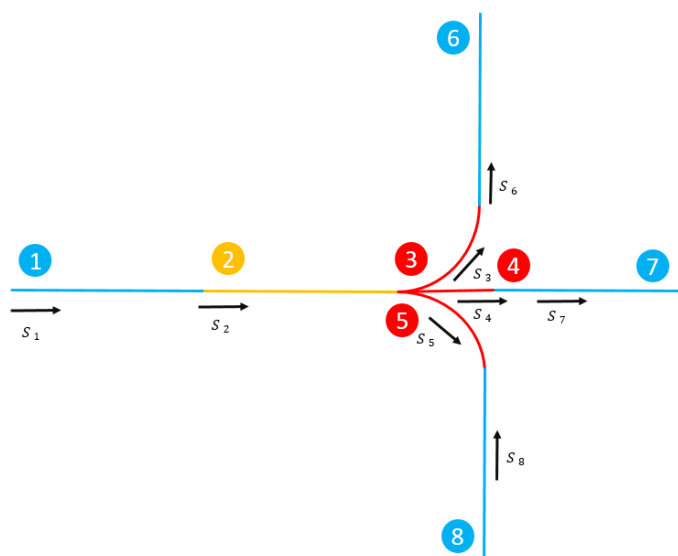


Figure 22 Successor and predecessor relationship of a road

The linkage between previous and next roads is recorded as predecessor and successor, and the linkage between left and right roads is recorded as neighbor. The previous linking element is recorded as a predecessor, and the next linking element is recorded as the successor. Both have the same attributes. ElementType records whether a road is an ordinary road or a road junction, elementId records road identifier, and contactPoint records the starting or end points of a connecting road. Neighbor records information about the neighboring road classes on the left and right sides, including side, elementId and direction. Side describes relative orientation, elementId records linking element identifier, and direction shows orientations of neighboring roads. Please refer to the data dictionary for the designed attributes.

5.3 Type related(or associated) classifications classes

The type class describe different types of roads, is referred from OpenDRIVE(Figure 23). The attributes of type class are s, type and country, all of them are mandatory. The type class can be recorded for more than one times. The type attribute of the type class is record as a codelist(Table B.1 in Appendix B), this codelist is extended from OpenDRIVE. The country attribute is country code, speed class records speed limit, max records speed limit regulation or value, and unit records units, which are optional.

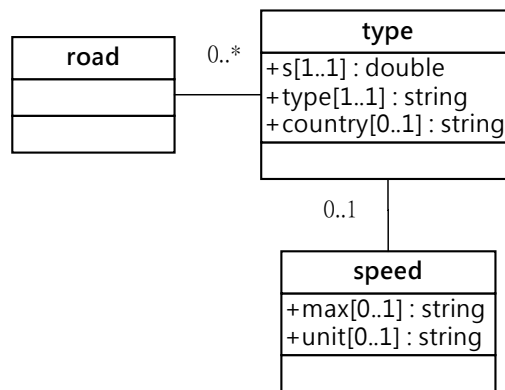


Figure 23 Type class and associated classes

5.4 Plan View related(or associated) classifications

PlanView records the position of the reference plane of the road class, is referred from OpenDRIVE. A sequence of road geometry classes defines the layout of the road's reference line in the in the x/y-plane. The geometry classes must occur in ascending order (i.e. increasing s-position). The attributes of each geometry are mandatory, including s, x, and y (x and y coordinates of the inertial coordinate system), hdg and length. Please refer to Figure 24.

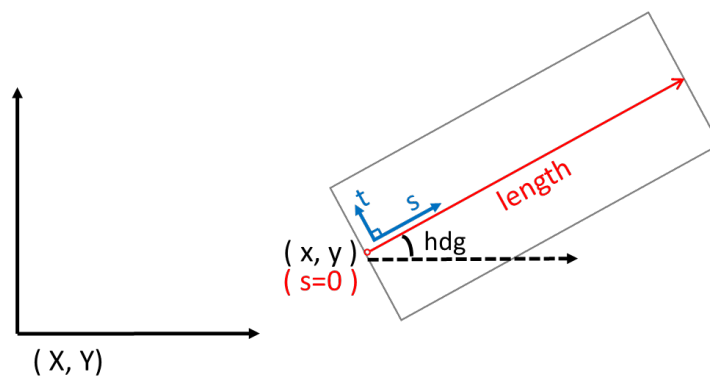


Figure 24 attributes of a reference line recorded in the geometry class

Besides straight lines, 4 other types of geometric elements can be recorded, giving a total of 5 types of geometric elements. Please refer to Figure 25. The geometry class can only choose one to record, and the 5 types of geometric elements are defined as below:

- (a) Line: Straight lines are lines with the curvature of 0. This is a mandatory attribute, and no additional information need to be recorded.

- (b) Spiral: Spiral lines are lines defined with *curvStart* (starting curvature) and *curvEnd* (end curvature), which are mandatory attributes. In addition, there is a linear relationship between starting curvature and end curvature.
- (c) Arc: Geometric element is presented by arc lines, and the curvature of an arc line is presented as curvature. This is a mandatory attribute, and its value is constant.
- (d) Cubic polynomial: Geometric element is presented by cubic polynomial curves. Starting and end points are represented by the local u/v coordinate system, and coordinates can be calculated by the following equation. The parameters of the cubic polynomial are recorded in the *a*, *b*, *c* and *d* attributes in the *poly3* class, and all attributes are mandatory:

$$v_{local} = a + b * du + c * du^2 + d * du^3 \text{-----}(1)$$

- (e) Parametric cubic polynomial: Geometric element is presented by parametric cubic polynomial curves. A parametric cubic polynomial curve consists of 2 cubic polynomials, and the common reference coefficient *p* is used to describe the local u/v coordinate system. The calculated parameters of the 2 cubic polynomials are recorded in the attributes in the *paraPoly3* class. All attributes are mandatory:

$$u_{local} = a_u + b_u * p + c_u * p^2 + d_u * p^3 \text{-----}(2)$$

$$v_{local} = a_v + b_v * p + c_v * p^2 + d_v * p^3 \text{-----}(3)$$

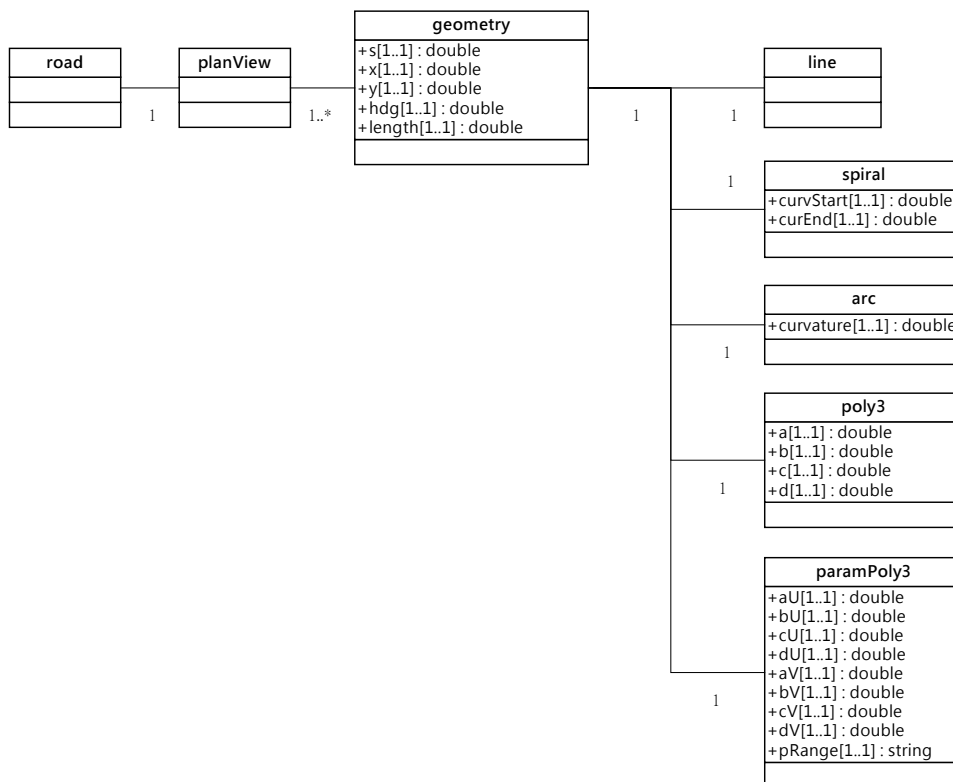


Figure 25 PlanView class and associated classes

5.5 ElevationProfile associated(or related) classifications

The elevationProfile class records the longitudinal elevation change of the road class, is referred from OpenDRIVE. Please refer to Figure 26. The elevationProfile can record multiple elevation classes, and each elevation class specifies the coordinates of the starting point *s*. The elevation elev of the traveling distance *ds* can be represented as a cubic polynomial. The parameters of the cubic polynomial are recorded in the *a*, *b*, *c* and *d* attributes in the elevation class, and all attributes are mandatory. The cubic polynomial of elev is as below:

$$\text{elev} = a + b * ds + c * ds^2 + d * ds^3 \text{-----}(4)$$

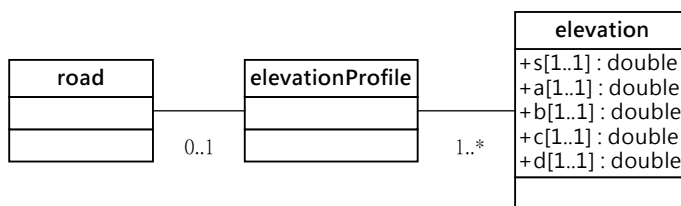


Figure 26 ElevationProfile class and associated classes

5.6 LateralProfile related(or associated) classifications

The lateralProfile class records the lateral elevation change of the road class, is referred from OpenDRIVE, including inclination angle or road plane representation. There are 3 classes, namely, superelevation, crossfall and shape. Please refer to Figure 27.

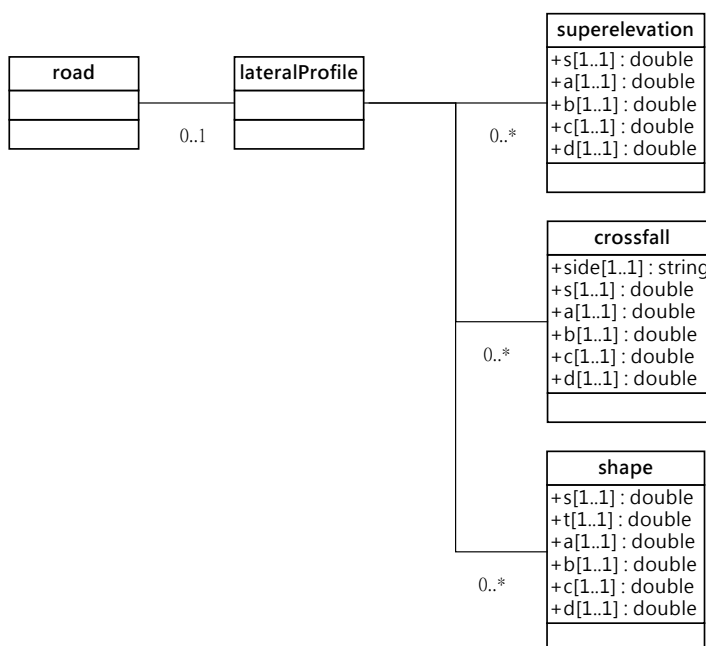


Figure 27 LateralProfile class and associated classes

The superelevation class records the inclination angle of a road plane along s-axis (roll in Figure 4). A positive angle means that a road sinks to the right; otherwise, it goes up to the left. Figure 28 is the diagram after the application of superelevation, where the superelevation is negative. Starting from the specified s coordinate, the inclination angle sElev of the traveling distance ds is represented as a cubic polynomial. The parameters of the cubic polynomial are recorded in the a, b, c and d attributes in the superelevation class, and all attributes are mandatory.

$$sElev = a + b * ds + c * ds^2 + d * ds^3 \text{-----}(5)$$

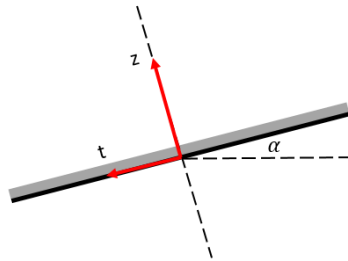


Figure 28 Diagram of superelevation

The crossfall class records the angle (radian) between road plane and t-axis, and the data of both sides of the road can be recorded respectively. For the side attribute, left means left, right means right and both means both sides. A positive value means the angle becomes smaller, as shown in Figure 29. At a specified s coordinate, the crfall angle of the traveling distance ds is described by a cubic polynomial. All attributes are mandatory.

$$crfall = a + b * ds + c * ds^2 + d * ds^3 \text{-----}(6)$$

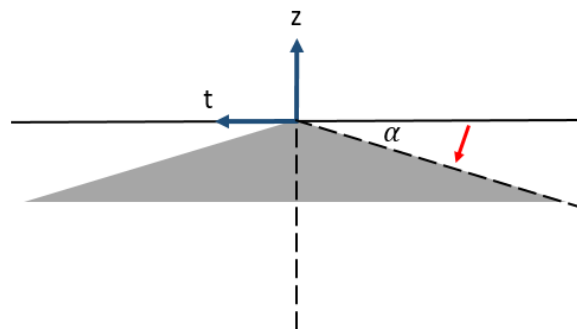


Figure 29 Diagram of crossfall

The shape class records the road curve of the road transverse section. At a specified s coordinate, the hshape of the transverse distance dt can be presented by the following cubic polynomial. Its parameters are recorded in the a, b, c and d attributes in the shape class, and all attributes are mandatory.

$$h_{shape} = a + b * dt + c * dt^2 + d * dt^3 \text{-----}(7)$$

The road transverse section change can be recorded in multiple shape classes, and shape change can be represented as interpolation. In addition, the shape class can be integrated with superelevation, but not with crossfall. Please refer to Figure 30.

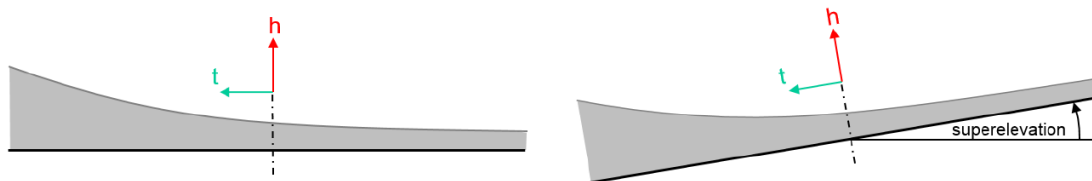


Figure 30 Diagram of shape

5.7 LaneSection related(or associated) classifications

The laneSection class can record lanes in a road section, is referred from OpenDRIVE, and a road can be recorded in multiple laneSection classes. Lanes are recorded in the lane class, and there are center, left and right lanes. A lane recorded in the center class is a reference line in OpenDRIVE. If the id of this lane is set as 0, the direction along t-axis is called left, and id in this direction is positive and rounded, increasing from 1; the opposite direction is right, and id is negative, decreasing from -1. Please refer to Figure 31 for the diagram. Please refer to Figure 32 for the diagram of UML. S starting coordinates of laneSection are recorded in the s attribute in laneSection, and the singleSide attribute records whether a laneSection is one-way or two-way.

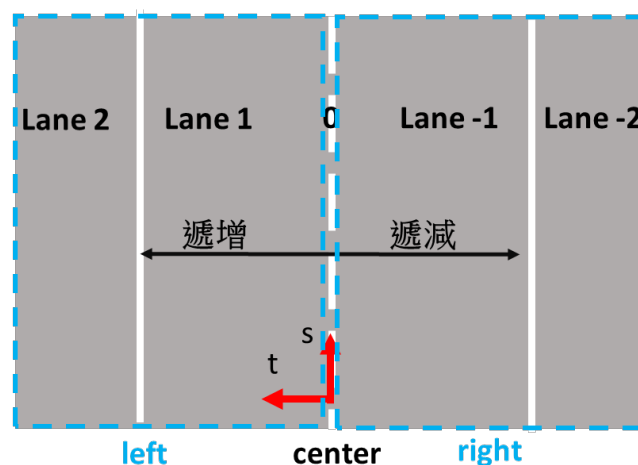


Figure 31 Diagram of laneSection

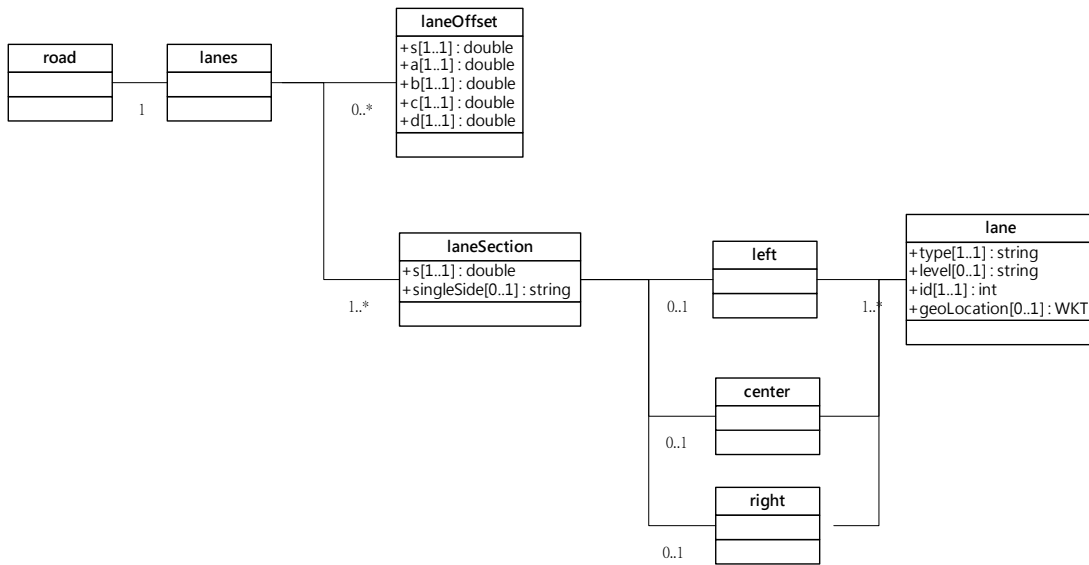


Figure 32 LaneSection class and associated classes

The road in Figure 33 is recorded in 3 laneSection classes. The reference line in section A is represented as a straight line, the reference line in section B is represented as a spiral line, and the reference line in section C is represented as a straight line. The 3 laneSections record the lane data of center, left and right, respectively.

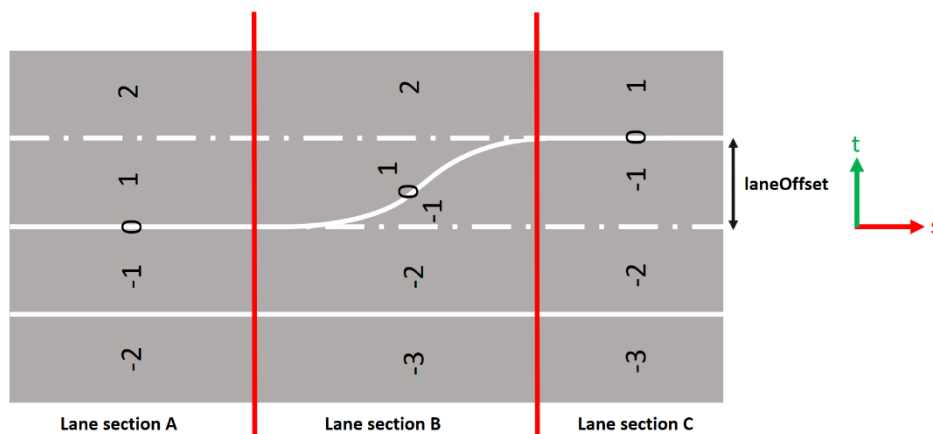


Figure 33 Diagram of 3 laneSections in a road section

The laneOffset class can be used to record lateral offset of reference lines. According to the situation in Figure 33, if the reference lines in section B and section C are recorded as broken white straight lines (extended from the reference line in section A), laneOffset can be used to

shift the reference lines to create the roads in the Figure. At a specified s coordinate, the offset of the traveling distance ds can be represented as the following cubic polynomial, and the parameters shall be recorded in the a , b , c and d attributes in the laneOffset class:

$$\text{Offset} = a + b * ds + c * ds^2 + d * ds^3 \text{-----}(8)$$

5.8 Lane related(or associated) classifications

The lane class and associated classes are used to record information of a lane, is referred from OpenDRIVE. Please refer to Figure 34. The lane class in the center class is set as reference line in OpenDRIVE, the width class cannot be recorded, but the link class, roadmark class and border class can be recorded. The lane class in the left and right classes records all classes in the lane class. The attributes of the lane class are type, level, id and geoLocation. Type records lane type, and is represented as Lane Type in OpenDRIVE, please refer to Table B.5 in Appendix B. Level records whether the lane elevation change is ignored, and id records the lane code. GeoLocation is an attribute extended in this standard, and records the three-dimensional linear coordinates of the outer boundaries of lanes in the inertial coordinate system in WKT format.

The lane class can record the linkage between single lanes in the link class. Predecessor records the code of the previous lane, and successor records the code of the next lane. The lane class can record the spatial positions of lanes with the width class or border class, and one of the classes is selected for recording to represent the spatial positions of lanes. In the width class, the t -axis offset from the outer boundary of a lane to the inner boundary is represented as a cubic polynomial (namely, lane width). In the border class, the t coordinate from the outer boundary of a lane to the reference line are represented as a cubic polynomial. Both classes can represent the spatial position of the outer boundary of the lane.

The lane width of the traveling distance ds is calculated by a cubic polynomial:

$$\text{width} = a + b * ds + c * ds^2 + d * ds^3 \text{-----}(9)$$

The cubic polynomial to calculate the lane boundary (t coordinate) of the traveling distance ds is:

$$t_{border} = a + b * ds + c * ds^2 + d * ds^3 \text{-----}(10)$$

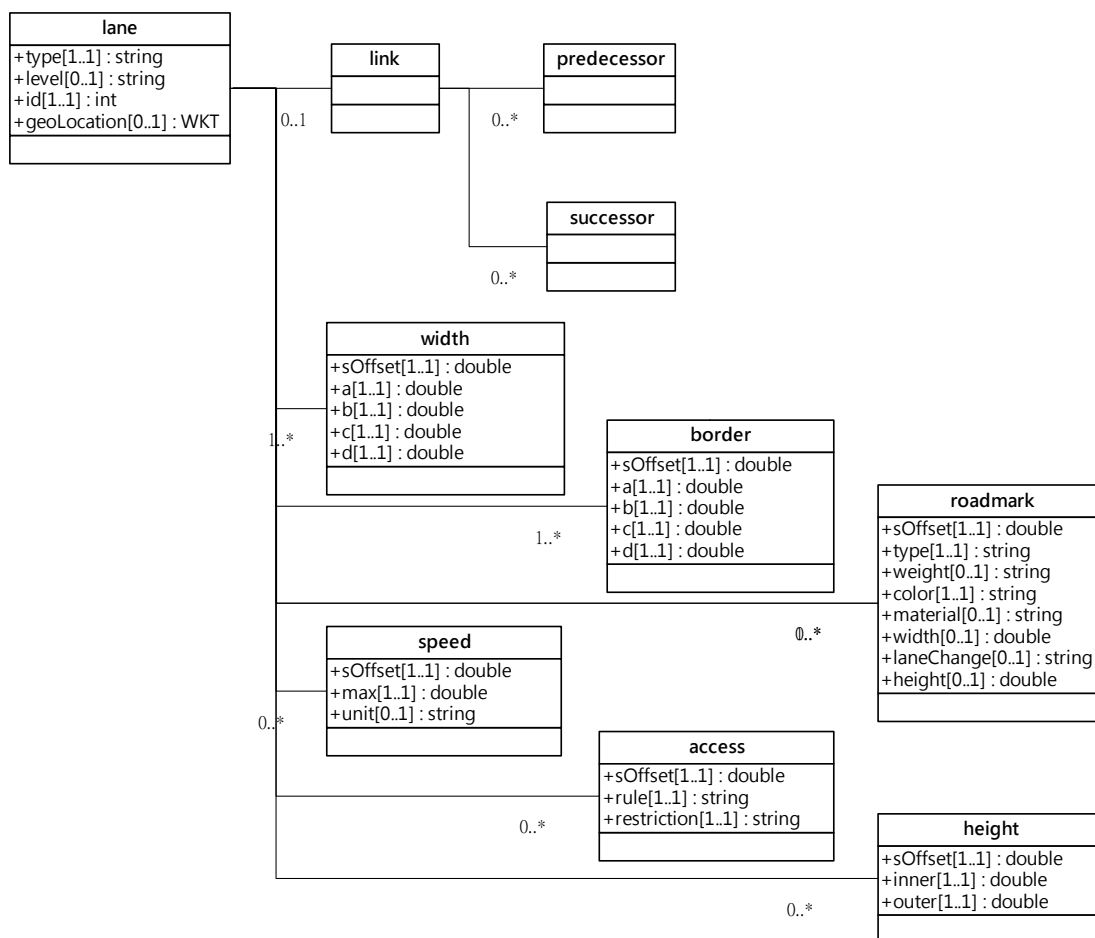


Figure 34 Lane class and associated classes

The roadmark class is used to represent the lane boundary (namely lane line) type of each lane class, and sOffset is the s-axis offset. Type is lane line type, represented as Road Mark Type, please refer to Table B.2 in Appendix B. Weight is the lane line thickness, represented as Road Mark Weight Type, please refer to Appendix B. Color is the lane line color, represented as Road Mark Color Type, please refer to Table B.4 in Appendix B. Material is the lane line material, and width is the lane line width in meter. LaneChange records whether lane change is allowed, and height records lane line height.

The speed class records speed limit, sOffset is s-axis offset, max is the maximum speed, and unit records unit. The access class records lane access limit, sOffset is s-axis offset, rule records allow or deny, and restriction records vehicle type, represented as Access Restriction Types. Please refer to Table B.9 in Appendix B. The height class records lane height, sOffset is s-axis offset, inner means inner height of a lane, and outer records outer height.

5.9 Objects related(or associated) classifications

The objects class is a collection of many classes, including object class, tunnel class and bridge class, is referred from OpenDRIVE. The object class can be used to record various objects, including objects on and beside roads. Please refer to Figure 35 for object associated classes.

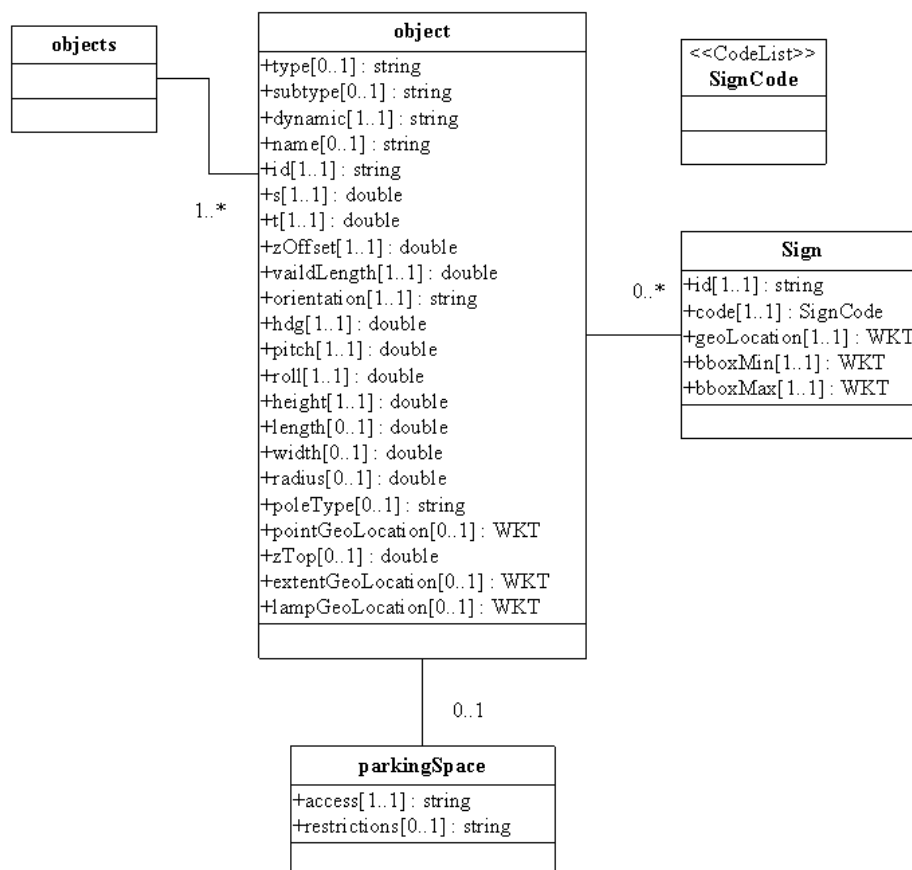


Figure 35 Object class and associated classes

The attribute type in the object class records object type and is represented as Road Mark Type, please refer to Table B.6 in Appendix B. Subtype records object subtype, dynamic records whether an object is dynamic, name records object name, id records object identifier, s is the s coordinate of an object, t is the t coordinate of an object, zOffset is the z-axis offset of an object in the track system, validLength records the length of an object projected onto the s-axis, and orientation is used to record the orientation validity of an object. Hdg records heading angle, pitch records pitch angle, and roll records roll angle, which are radians. Height records object height, length and width are used to describe the length and width of an object in the x and y planes. Radius records the radius of an object in the x and y planes.

The other 5 attributes are extended in this standard, and poleType only applies to rod-shaped objects to record pole type. The rest 4 attributes record the coordinates of an object in the inertial coordinate system and are optional. PointGeoLocation records the three-dimensional coordinates on the center at the bottom of an object in WKT format, zTop records the ellipsoidal height at the top of an object, extentGeoLocation records the position of the bottom of an object with three-dimensional corner point sequence coordinates, and lampGeoLocation records the three-dimensional point coordinates of the central point of the surface of a street lamp.

In recording a parking space in the object class, another class of parkingSpace shall be added to record parking restriction, which can record access and restrictions. Access records parking space type, and restrictions describe parking space restrictions in words.

A sign consists of a signboard and a pole. Poles can be recorded in the object class, and signboards can be recorded in the Sign class which is extended in this standard. Please refer to Figure 36. Its id attribute is identifier. The code attribute is sign code, represented as “sign code” designed in this standard. Please refer to Table A.6 to Table A.11 in Appendix A. The other 3 attributes record the coordinates of the lower left point and upper right point of the bounding rectangle of the signboard and the central point of the signboard in the inertial coordinate system. GeoLocation records the three-dimensional point coordinates of the central point of the signboard in WKT format. BboxMin records the three-dimensional coordinates of the lower left point of the bounding rectangle of the signboard, and bboxMax records the three-dimensional coordinates of the upper right point of the bounding rectangle of the signboard.



Figure 36 Sign face recorded in the MarkData class

5.10 Tunnel related(or associated) classifications

The tunnel class is used to record tunnels, extended from OpenDRIVE, and multiple tunnel classes can be recorded in the objects class. Please refer to Figure 37. The tunnel class only records representative positions, these attributes, s records the s coordinate of the starting point of a tunnel, length is the valid length of a tunnel on s-axis, name is tunnel name, id is tunnel identifier, type is tunnel type and represented as Tunnel Type in OpenDRIVE. Please refer to Table B.7 in Appendix B. Lighting records the artificial lighting in a tunnel, daylight is the natural lighting. The validity class in OpenDRIVE records the valid lane range in a tunnel, fromLane records the starting lane number (corresponding to the lane id in laneSection), and toLane records the end lane number. GeoLocation is an attribute extended in this standard, and records three-dimensional corner point coordinate sequences of the tunnel space in the inertial coordinate system in WKT format.

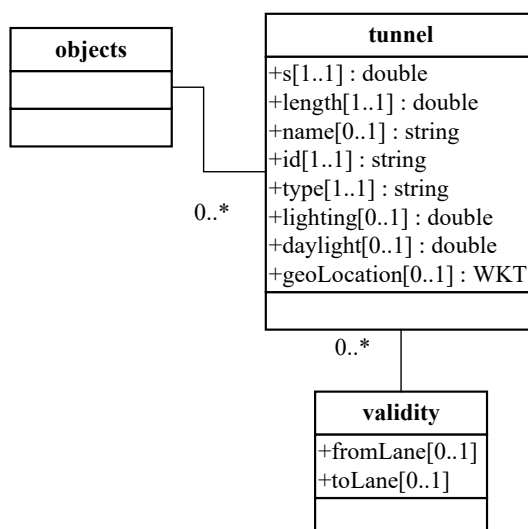


Figure 37 Tunnel class and associated classes

5.11 Bridge associated(or related) classifications

The bridge class records bridges, extended from OpenDRIVE, please refer to Figure 38. The bridge class only records representative positions, these attributes, s records the s coordinate of the starting point of a bridge, length is the valid length of a bridge on s-axis, name is bridge name, id is bridge identifier, type is bridge type and represented as Bridge Type. Please refer to Table B.8 in Appendix B. The validity class in OpenDRIVE records the valid lane range on a bridge, fromLane records the starting lane number (corresponding to the lane id in laneSection),

and toLane records the end lane number. GeoLocation is an attribute extended in this standard, and records three-dimensional corner point coordinate sequences of the bridge space in the inertial coordinate system in WKT format.

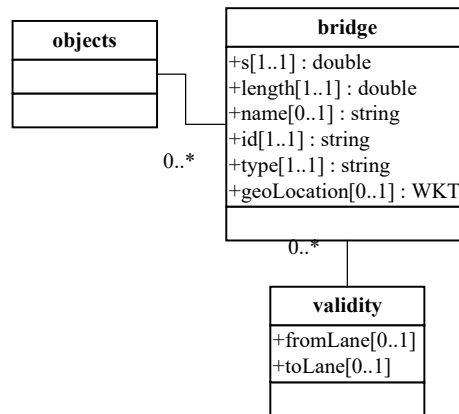


Figure 38 Bridge class and associated classes

5.12 Signal related(or associated) classifications

A signal consists of a lamp cap, a signal face and a lamp pole. Lamp poles are recorded in the object class, lamp caps are recorded in the signal class in OpenDRIVE, and signal faces are recorded in the SignalData class defined in this standard. Please refer to Figure 39 for the signal class and associated classes and Figure 40 for the diagram of the real picture.

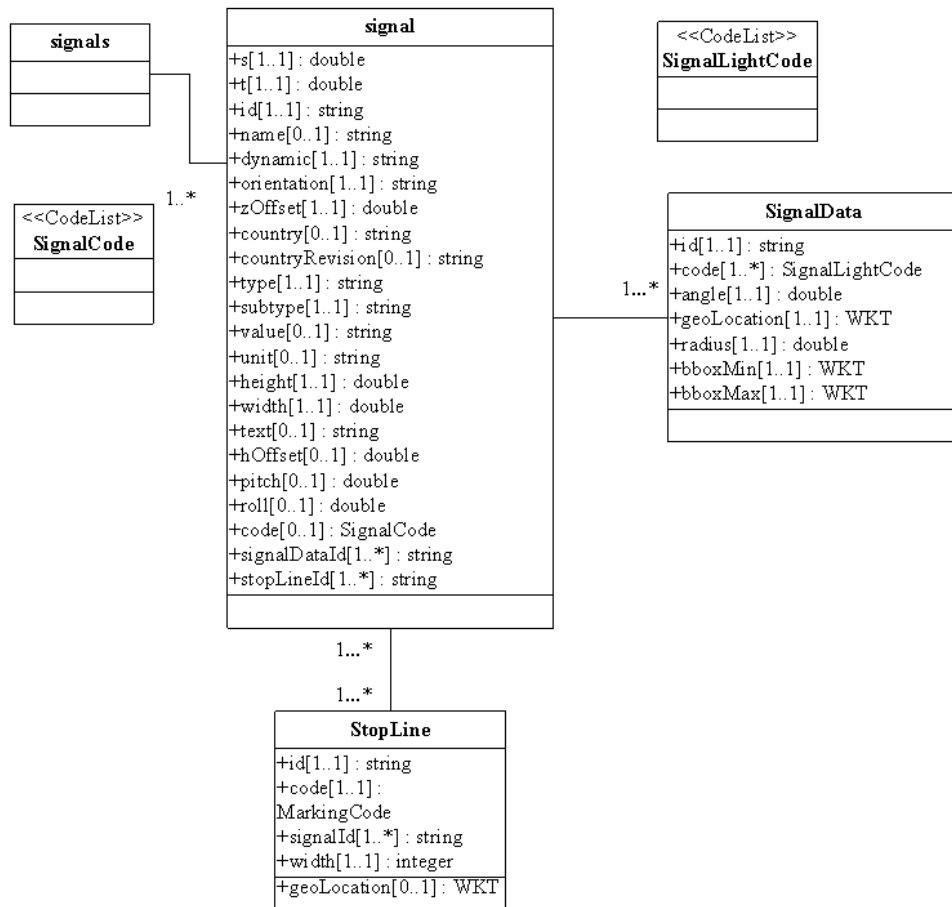


Figure 39 Signal class and associated classes

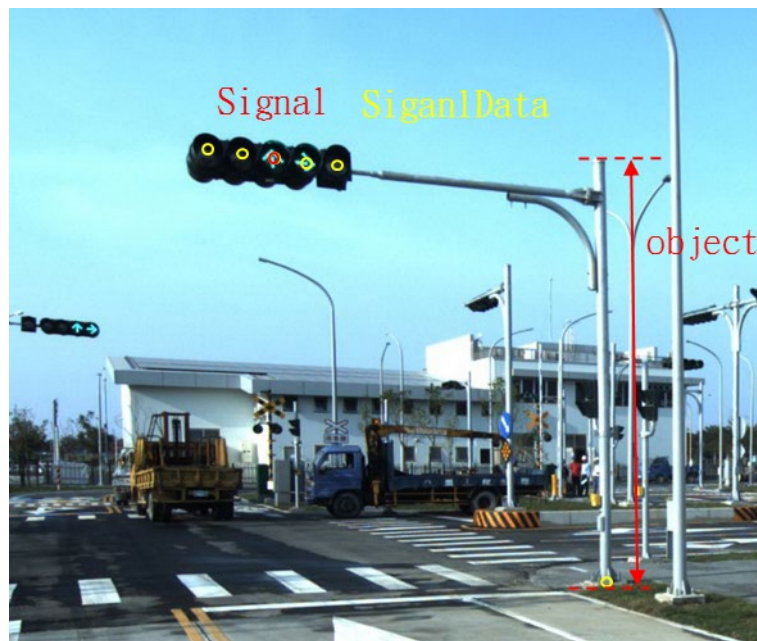


Figure 40 Signal face recorded in the SignalData class

Lamp caps are recorded in the signal class, signal faces are recorded in the SignalData class extended in this standard, and signal lamp caps can be associated with one or more signal faces. The s attribute in the signal class records s coordinates of central points of signal lamp caps, the t attribute records t coordinates of central points of signal lamp caps, and id is signal identifier. Name is signal name, dynamic records whether a signal is dynamic, orientation records the orientation of a signal lamp cap, zOffset is the z-axis offset of a signal in the track system, country is country code, countryRevision is revision, type and subtype are signal type designed in OpenDRIVE. Value and unit describe signal value, height records signal lamp cap height, width is used to describe signal width on the s and t planes, text is text description, hOffset records the radian of heading angle (based on orientation attribute), pitch records pitch angle, and roll records roll angle, which are radians.

Some faces of lamp caps are recorded in the SignalData class extended in this standard, these attributes, id is signal face identifier, code is signal face code and represented as “signal face code” designed in this standard. Please refer to Table A.2 in Appendix A. Angle records the angle between the normal vector of a signal face and the true north, geoLocation is the three-dimensional coordinates of the central point of a signal face in the inertial coordinate system. Radius records the signal face radius, bboxMin records the three-dimensional coordinates of the lower left point of the bounding rectangle of a signal face the inertial coordinate system, and

bboxMax records the three-dimensional coordinates of the upper right point of the bounding rectangle of a signal face the inertial coordinate system.

Stop lines are recorded in the StopLine class extended in this standard, these attributes, id is identifier, code is mark line code and represented as a code designed in this standard. Please refer to Table A.3 in Appendix A. SignalId records identifiers of stop line-related signals, width records stop line width, and geoLocation records the three-dimensional coordinates of the center line of a stop line in OGC WKT format.

In order to help autonomous vehicles travel or stop according to signals, the relationships between signals and stop lines shall be recorded. In this standard, the relationship between the signal class of signal lamp caps and the StopLine class of stop lines is built. Signal lamp caps can be associated with many stop lines, and stop lines can be associated with many signal lamp caps.

5.13 Controller associated classes and junction related(or associated) classifications

In OpenDRIVE, the connections between lanes at a road junction are built in the junction class, so as to construct a full road network. The controller class in the junction class provides signal control information and integrates lane connections and signal control at all road junctions, to provide complete information for autonomous vehicles. Please refer to Figure 41 for controller associated classes and junction associated classes.

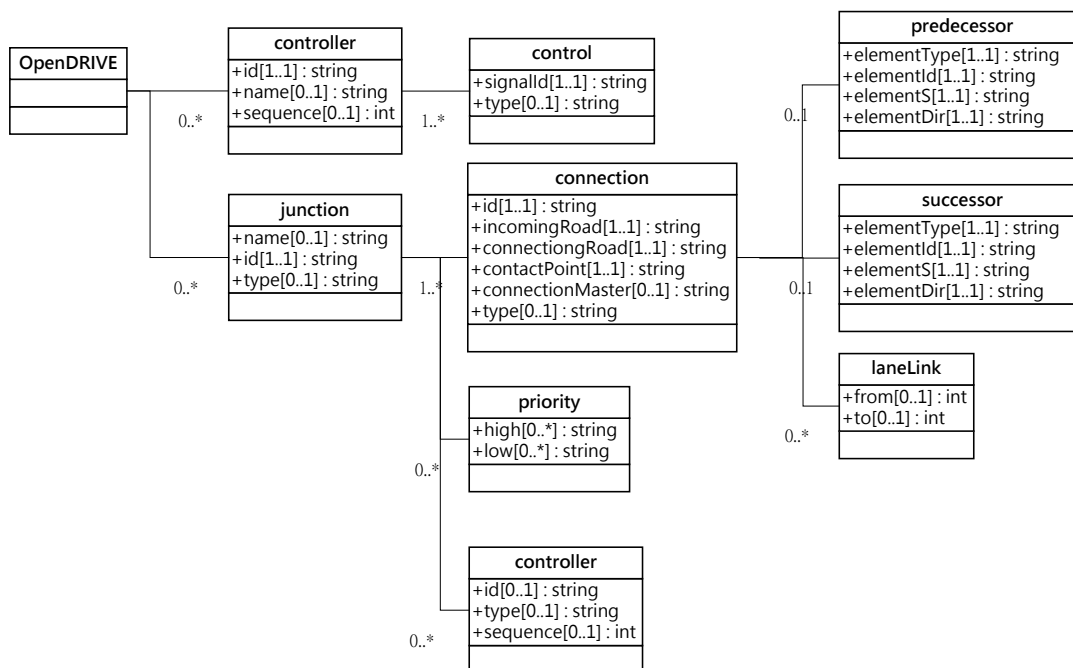


Figure 41 Junction class and associated classes

Road junctions are recorded in one or more junction classes, and the connection class is used to record the connections of all lanes on roads. These attributes in the junction class, name records road junction name, id is identifier, type is road junction type, default means a default road junction and virtual means a road junction with a private road.

These attributes in the connection class, id is identifier, incomingRoad is an incoming road of the connection, connectingRoad is a road connected, contactPoint is the contact point of a connecting road. ConnectionMaster records the identifier of a master connection, type is lane connection type, default means a default connection, and virtual means a connection between two lanes that is not formally defined but is possible.

In the connection class, the predecessor and successor classes are used to record the information of previous and next lanes, or laneLink is used to record lane connections. The attributes of predecessor and successor are designed the same. ElementType shall be recorded as “road” here, elementId identifier shall be road identifier, elementS is the s coordinates of the starting point of connection, and elementDir records orientation. LaneLink records the starting lane line number with the from attribute, and the to attribute records the connecting lane number.

Figure 42 is a connection example of roads and lanes at a road junction, and connection and laneLink are used to record the connection between Road 10 and Road 20. Therefore, connection id is identifier, incomingRoad is “Road 10”, connectionRoad is “Road 20”,

contactPoint is the contact point of connectionRoad, namely, “start”. “Default” shall be filled in Type. The lane linkage can be recorded as 2 laneLinks. For one laneLink, the from attribute is “-1” and the to attribute is “-1”; for another laneLink, the from attribute is “-2” and the to attribute is “-2”. According to the connection, Lane -1 on Road 10 is connected to Lane -1 on Road 20, and Lane -2 on Road 10 is connected to Lane -2 on Road 20.

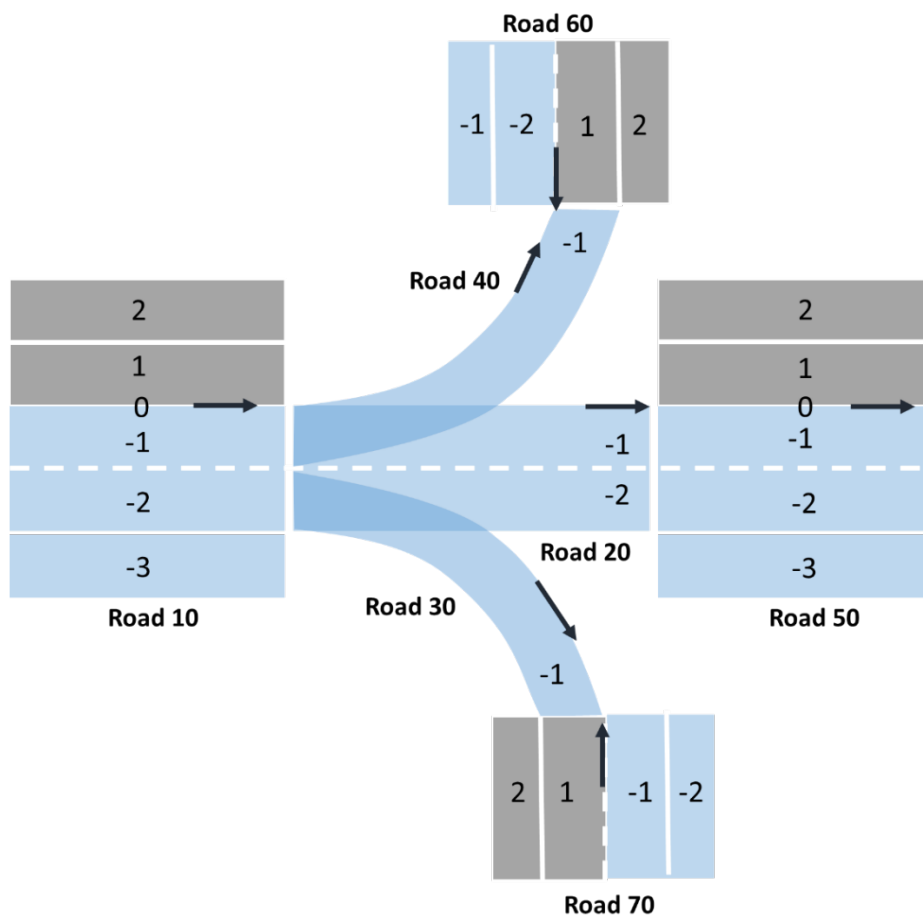


Figure 42 Example of connections between roads and lanes at a road junction

The controller class records a set of signals, and the control class records single signals, please refer to Figure 43. Controller A records a set of signals, with one control recording signal 1 and another recording signal 3. These attributes in the controller class, id records identifier, name records name, sequence is used to record the controller priority at the same road junction. These attributes, signalId in the control class records single signal identifier, and type records control type and can be used to record signal type.

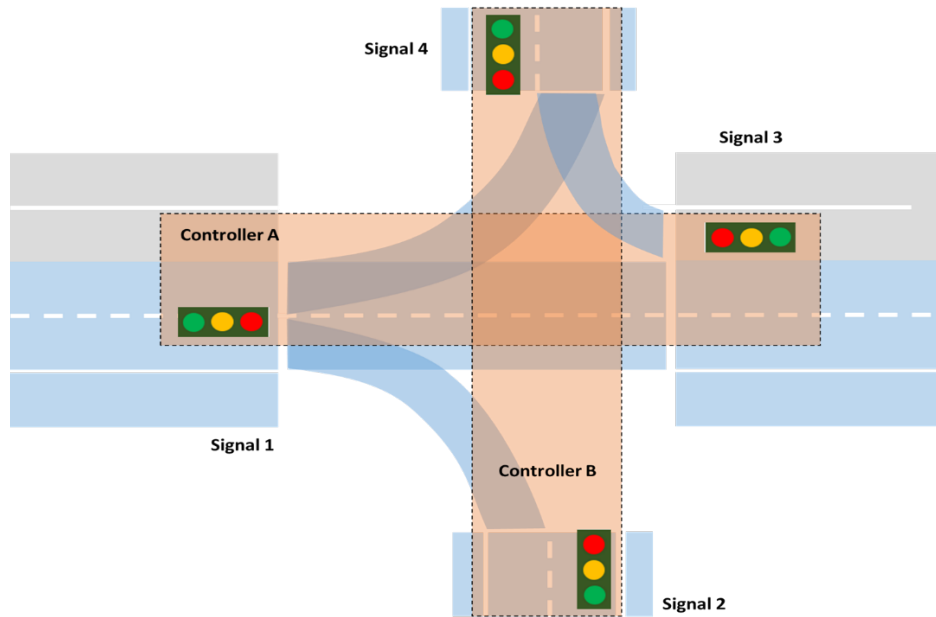


Figure 43 Diagram of controller and signal

Please refer to Figure 44 for XML examples integrating Figure 42 and Figure 43.

```

<junction name="junction1" id="25">
  <connection id="0" incomingRoad="10" connectingRoad="20" contactPoint="start">
    <laneLink from="-1" to="-1"/>
    <laneLink from="-2" to="-2"/>
  </connection>
  <connection id="1" incomingRoad="10" connectingRoad="30" contactPoint="start">
    <laneLink from="-2" to="-1"/>
  </connection>
  <connection id="2" incomingRoad="10" connectingRoad="40" contactPoint="start">
    <laneLink from="-1" to="-1"/>
  </connection>
  <connection id="3" incomingRoad="40" connectingRoad="60" contactPoint="start">
    <laneLink from="-1" to="-1"/>
  </connection>
  <connection id="1" incomingRoad="20" connectingRoad="50" contactPoint="start">
    <laneLink from="-1" to="-1"/>
    <laneLink from="-2" to="-2"/>
  </connection>
  <connection id="2" incomingRoad="30" connectingRoad="70" contactPoint="start">
    <laneLink from="-1" to="1"/>
  </connection>
  <controller id="Controller A" type="">
    <control signalId="Signal 1" type=""/>
    <control signalId="Signal 3" type=""/>
  </controller>
  <controller id="Controller B" type="">
    <control signalId="Signal 2" type=""/>
    <control signalId="Signal 4" type=""/>
  </controller>
</junction>
  
```

Figure 44 XML examples of junction, connection, controller, and control

5.14 Userdata related(or associated) classifications

Userdata is a class designed in OpenDRIVE, and can record description objects excluded in OpenDRIVE but required by users, please refer to Figure 45. In order to meet the regulations of OpenDRIVE, the classes extended in this standard are recorded in the userdata class under the road class. The extended data of each road is recorded as one piece of data under the userdata class, the code attribute is description object and “hdmap” shall be the uniform answer, the value attribute is content and “xml” shall be the uniform answer, and the any class is recorded with the XML schema of the extension design class in this standard (please refer to Appendix C).

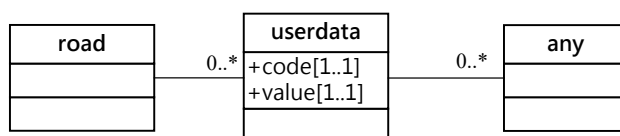


Figure 45 Userdata class

5.15 MarkLine related(or associated) classifications

Mark lines are drawn with lines, and can be divided into lines and spatial ranges according to their spatial positions. For example, the spatial position of a stop line is a three-dimensional line, and a guiding line is used to set a three-dimensional spatial range indicating the direction of a vehicle.

In this standard, the spatial position of a mark line is divided into a three-dimensional line and a three-dimensional spatial range, and the extension class is designed in this principle to record various mark lines defined by the Ministry of Transportation and Communications. As unique codes are not given for mark lines in the “Rules for Setting Road Traffic Signs, Mark Lines and Signal” by the Ministry of Transportation and Communications, the “Mark Line Code” is additionally defined in this standard. Please refer to Table A.3 in Appendix A. They are recorded in the design class, for autonomous vehicles to interpret.

According to various mark lines defined in the “Rules for Setting Road Traffic Signs, Mark Lines and Signal”, 3 relevant classes are designed in this standard, including MarkLine, MarkArea and MarkGraph classes. Please refer to Figure 46.

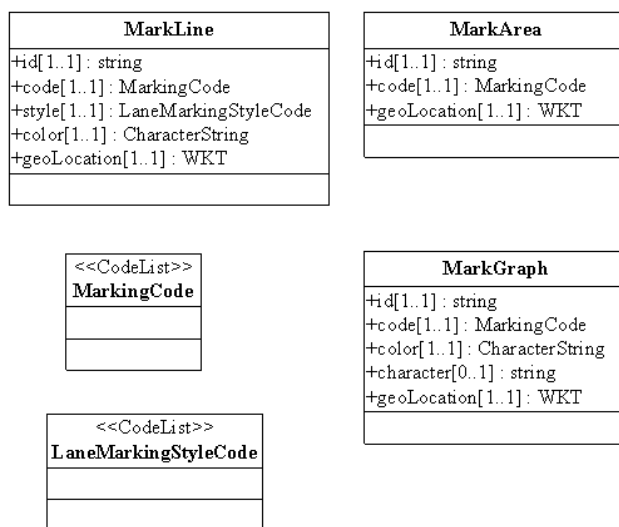


Figure 46 MarkLine class and associated classes

All mark lines are marked with lines, complicated graphics and words in different styles and colors, which shall be recorded as attributes, to provide reference to autonomous vehicles. Please refer to Table A.3 in Appendix A for all mark lines. Mark lines are designed to have width and styles, and recorded in the MarkLine class. For example, stop lines, lane lines, road edge lines and turning guide lines are recorded in the MarkLine class. MarkLine used three-dimensional lines to represent the positions of center lines of mark lines. These attributes in the MarkLine class, id records mark line identifier, code records mark line code, and the style records lane line type code, with only lane lines to be recorded. This attribute shall be filled with the codes designed in this standard, please refer to Table A.1 in Appendix A. The geoLocation attribute records the three-dimensional coordinates of the center line of a mark line in OGC WKT format.

Mark lines with complicated graphics and words are recorded in the MarkGraph class, and MarkGraph means graphics and words of mark lines with three-dimensional spaces. For example, the graphics in mark lines such as grid lines, channelizing lines, and obstruction approach mark lines, if the spaces cannot be directly represented by lines, the MarkGraph class will be used for recording. Various words, such as no temporary parking lines, are recorded in the MarkGraph class. The id attribute in the MarkGraph class is identifier, the markareaId attribute is used to associated with the MarkArea class, and geoLocation records three-dimensional corner point sequences of a true shape of a mark line or a word in WKT format.

For example, for a longitudinal crosswalk mark line, the true spaces of all mark lines are recorded in true green shape.

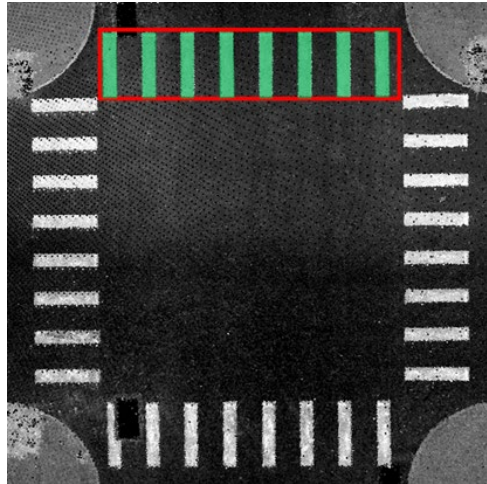


Figure 47 Longitudinal crosswalk recorded in MarkGraph class

Some types of mark lines relevant to driving behavior may appear on lanes or shoulders, and shall represent their spatial ranges to provide reference to autonomous vehicles, including parking spaces, grid lines, crosswalks and waiting areas for bicycles and scooters. In addition to being recorded in the MarkGraph class, the bounding ranges of these types of mark lines shall be recorded in the MarkArea class. Figure 48 shows a longitudinal crosswalk, with a total of 4 types of data, and the bounding range of the red polygon is recorded in the MarkArea class. These attributes in the MarkArea class, id records mark line identifier, and code records mark line code. Please refer to Table A.3 in Appendix A. The geoLocation attribute records the three-dimensional corner point sequence coordinates of the spatial range of a mark line in OGC WKT format.

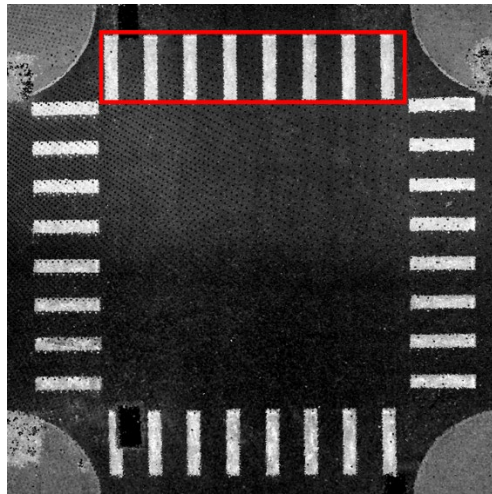


Figure 48 Longitudinal crosswalk recorded in MarkArea class

5.16 LaneCenterLine related(or associated) classifications

The LaneCenterLine class is extended in this standard, to record lane center lines. In addition, the Waypoint class is extended to record lane center line nodes. The relationship between both classes is built. Lane center lines are directional and record starting and end nodes of lane center lines, please refer to Figure 49. The StopLine class in the figure has been described in section 5.13.

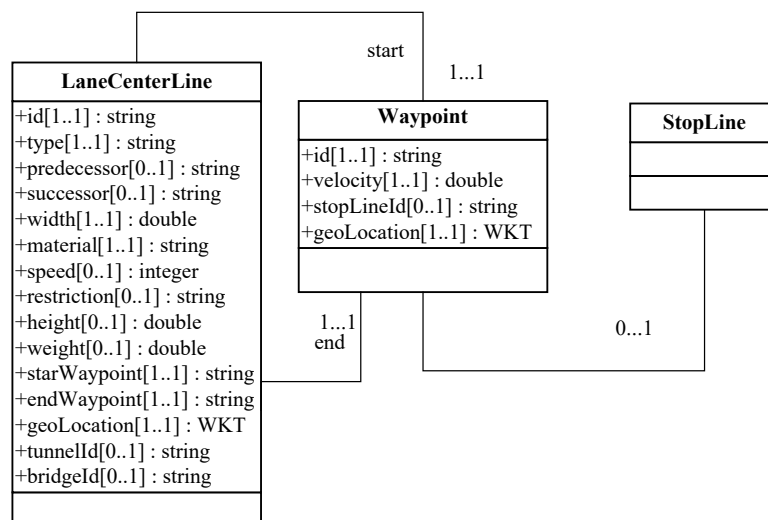


Figure 49 LaneCenterLine class and associated classes

The LaneCenterLine class records lane center lines, these attributes, id records lane center line identifier, type is lane type code, predecessor records the identifier of the previous lane center

line, successor records the identifier of the next lane center line, width records lane width, material records lane material, speed records speed limit for a lane in kilometer/hour, restriction records traffic restrictions of a lane, height records height limit in meter, and weight records weight limit in kilogram. StartWaypoint records the identifier of the node of a starting lane center line, endWaypoint records the identifier of the node end of a lane center line, and geoLocation records the three-dimensional linear coordinates of a lane center line in WKT format. TunnelID and bridgeId are used to record the identifier of the tunnel or bridge where a lane center line located.

The Waypoint class records lane center line node, these attributes, id records identifier, velocity records vehicle speed, stopLineId records the identifier of the stop line where a node is located, and geoLocation records the three-dimensional coordinates of a lane center line node in WKT format.

6. Data directory

This section describes the regulations on attribute or relationship, description, conditions, maximum frequency, data type, value range and note of each class, and condition and maximum frequency are designed in accordance with the actual data supply. Table 2 shows formats and regulations of items in the databook, and Table 3 is the databook of this standard. In the databook, the attributes with gray background are extended in this standard and others are defined in OpenDRIVE.

Table 2 Definition description in databook

Item	Description
Class	Class name.
Attribute or relationship	Attribute name of class or relationship between classes, and there are names in English and Chinese.
Description	Description of meaning of an attribute or a relationship in words.
Condition	An attribute is mandatory (m), conditional (c) or optional (o).
Maximum number of times	The maximum number of times of a single attribute or relationship.
Data type	Description of the type of an attribute or a relationship.
Value range	The value range of an attribute or a relationship.
Note	Additional description of the constraints or special conditions for an attribute or a relationship.



Table 3 Databook

Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
1.	road	name	名稱	Road name	M	1	string	Character	
2.		length	長度	Length of a reference line on the xy planes (s-axis)	M	1	string	Character	Unit: m
3.		id	識別碼	Road identifier	M	1	string	Character	
4.		junction	交叉路口	Whether a road is at a junction	M	1	string	Character	Road means a road not within the range of a junction; junction means a road at a junction
5.		rule	規則	Left-hand traffic rule or right-hand traffic rule	O	1	string	Character	RHT indicates driving on the right-hand side; LHT indicates driving on the left-hand side
6.		geoLocation	地理位置	Three-dimensional coordinates of a reference line	O	1	WKT	Character	Three-dimensional linear coordinates of a reference line in the inertial coordinate system recorded in WKT format



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
7.	predecessor	elementType	元件類型	Type of connecting road	O	1	string	Character	Road means a road not within the range of a junction; junction means a road at a junction
8.		elementId	元件識別碼	Identifier of connecting road	O	1	string	Character	
9.		contactPoint	連結端點	Contact point	O	1	string	Character	Start means connecting to the starting point; end means connecting to the end point
10.	Successor	elementType	元件類型	Type of connecting road	O	1	string	Character	Road means a road not within the range of a junction; junction means a road at a junction
11.		elementId	元件識別碼	Identifier of connecting road	O	1	string	Character	
12.		contactPoint	連結端點	Contact point	O	1	string	Character	Start means connecting to the starting point; end means connecting to the end point
13.	neighbor	side	相對方位	Relative orientation	O	1	string	Character	Left for left side, and right for right side
14.		elementId	元件識別碼	Identifier of neighboring road	O	1	string	Character	



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
15.		direction	行駛方向	The traffic direction of the neighboring road is the same or not	O	1	string	Character	Same for the same direction, and opposite the opposite direction
16.		s	s 坐標	S-axis coordinate	M	1	double	Value	Unit: m
17.	type	type	類型	Road type	M	1	string	Character	Refer to Table B.1 in Appendix B; refer to national highway, provincial highway, county highway, rural highway, town highway and local highway, according to the administrative system division in the Highway Act, or fill in unknow to represent unknow
18.		country	國家	Country code	O	1	string	Character	R.O.C. shall be filled in



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
19.	speed	max	最大限速	Maximum speed	O	1	string	Character	No limits mean no limits; undefined means undefined; speed limit is represented by value
20.		unit	單位	Unit	O	1	string	Character	Unit: km/h
21.	geometry	s	s 坐標	S-axis coordinate	M	1	double	Value	Unit: m
22.		x	x 坐標	X-axis coordinate in the inertial coordinate system	M	1	double	Value	Unit: m
23.		y	y 坐標	Y-axis coordinate in the inertial coordinate system	M	1	double	Value	Unit: m
24.		hdg	航向角	Radian with the east as the starting point	M	1	double	Value	Unit: rad
25.		length	長度	Length of a reference line on s-axis	M	1	double	Value	Unit: m
26.	spiral line	curvStart	起始曲率	Starting curvature	M	1	double	Value	Unit: 1/m
27.		curvEnd	結束曲率	End curvature	M	1	double	Value	Unit: 1/m
28.	arc line	curvature	曲率	Curvature	M	1	double	Value	Unit: 1/m
29.	Poly3	a	參數 a	Parameter a required for recording the linear geometry of a cubic polynomial	M	1	double	Value	Unit: m



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
30.		b	參數 b	Parameter b required for recording the linear geometry of a cubic polynomial	M	1	double	Value	
31.		c	參數 c	Parameter c required for recording the linear geometry of a cubic polynomial	M	1	double	Value	Unit: 1/m
32.		d	參數 d	Parameter d required for recording the linear geometry of a cubic polynomial	M	1	double	Value	Unit: 1/m ²
33.		aU	參數 aU	Parameter aU required for recording a parametric cubic polynomial curve	M	1	double	Value	Unit: m
34.	param Poly3	bU	參數 bU	Parameter bU required for recording a parametric cubic polynomial curve	M	1	double	Value	
35.		cU	參數 cU	Parameter cU required for recording a parametric cubic polynomial curve	M	1	double	Value	Unit: 1/m



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
36.		dU	參數 dU	Parameter dU required for recording a parametric cubic polynomial curve	M	1	double	Value	Unit: 1/m ²
37.		aV	參數 aV	Parameter aV required for recording a parametric cubic polynomial curve	M	1	double	Value	Unit: m
38.		bV	參數 bV	Parameter bV required for recording a parametric cubic polynomial curve	M	1	double	Value	
39.		cV	參數 cV	Parameter cV required for recording a parametric cubic polynomial curve	M	1	double	Value	Unit: 1/m
40.		dV	參數 dV	Parameter dV required for recording a parametric cubic polynomial curve	M	1	double	Value	Unit: 1/m ²
41.		pRange	參數 Range	Parameter pRange required for recording a parametric cubic polynomial curve	M	1	string	Character	arcLength normalized



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
42.	elevation	s	s 坐標	S-axis coordinate	M	1	double	Value	Unit: m
43.		a	參數 a	Parameter a required for recording elevation	M	1	double	Value	Unit: m
44.		b	參數 b	Parameter b required for recording elevation	M	1	double	Value	
45.		c	參數 c	Parameter c required for recording elevation	M	1	double	Value	Unit: 1/m
46.		d	參數 d	Parameter d required for recording elevation	M	1	double	Value	Unit: 1/m ²
47.	super elevation	s	s 坐標	S-axis coordinate	M	1	double	Value	Unit: m
48.		a	參數 a	Parameter a required for recording the inclination angle of road transverse section	M	1	double	Value	Unit: rad
49.		b	參數 b	Parameter b required for recording the inclination angle of road transverse section	M	1	double	Value	Unit: rad/m
50.		c	參數 c	Parameter c required for recording the inclination angle of road transverse section	M	1	double	Value	Unit: rad/m ²



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
51.		d	參數 d	Parameter d required for recording the inclination angle of road transverse section	M	1	double	Value	Unit: rad/m3
52.	crossfall	side	側邊	Inclination angle orientation	M	1	string	Character	Left means left, right means right and both means both sides
53.		s	s 坐標	S-axis coordinate	M	1	double	Value	Unit: m
54.		a	參數 a	Parameter a required for recording the inclination angle of road transverse section	M	1	double	Value	Unit: rad
55.		b	參數 b	Parameter b required for recording the inclination angle of road transverse section	M	1	double	Value	Unit: rad/m
56.		c	參數 c	Parameter c required for recording the inclination angle of road transverse section	M	1	double	Value	Unit: rad/m2
57.		d	參數 d	Parameter d required for recording the inclination angle of road transverse section	M	1	double	Value	Unit: rad/m3



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
58.	shape	s	s 坐標	S-axis coordinate	M	1	double	Value	Unit: m
59.		t	t 坐標	T-axis coordinate	M	1	double	Value	Unit: m
60.		a	參數 a	Parameter a required for recording a road transverse section line	M	1	double	Value	Unit: m
61.		b	參數 b	Parameter b required for recording a road transverse section line	M	1	double	Value	
62.		c	參數 c	Parameter c required for recording a road transverse section line	M	1	double	Value	Unit: 1/m
63.		d	參數 d	Parameter d required for recording a road transverse section line	M	1	double	Value	Unit: 1/m ²
64.	laneOffset	s	s 坐標	S-axis coordinate	M	1	double	Value	Unit: m
65.		a	參數 a	Parameter a required for recording laneOffset	M	1	double	Value	Unit: m
66.		b	參數 b	Parameter b required for recording laneOffset	M	1	double	Value	
67.		c	參數 c	Parameter c required for recording laneOffset	M	1	double	Value	Unit: 1/m



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
68.		d	參數 d	Parameter d required for recording laneOffset	M	1	double	Value	Unit: 1/m2
69.	laneSection	s	s 坐標	S-axis coordinate	M	1	double	Value	Unit: m
70.		singleSide	單向	A one-way road or not	O	1	string	Character	True means a one-way road; false means a two-way road
71.	lane	type	類型	Lane type	M	1	string	Character	Refer to Table B.5 in AppendixB
72.		level	水平	The lane is level or not	O	1	string	Character	True means level, making elevationProfile and lateralProfile invalid; false means that elevationProfile and lateralProfile are valid
73.		id	識別碼	Lane identifier	M	1	Int	Value	
74.		geoLocation	地理位置	Three-dimensional linear coordinates of the outer boundary of a lane (lane line)	O	1	WKT	Character	Three-dimensional linear coordinates of the outer boundary of a lane recorded in WKT format
75.	width	sOffset	s 軸位移量	S-axis offset	M	1	double	Value	Unit: m
76.		a	參數 a	Parameter a required for recording width	M	1	double	Value	Unit: m



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
77.		b	參數 b	Parameter b required for recording width	M	1	double	Value	
78.		c	參數 c	Parameter c required for recording width	M	1	double	Value	Unit: 1/m
79.		d	參數 d	Parameter d required for recording width	M	1	double	Value	Unit: 1/m ²
80.	border	sOffset	s 軸位移量	S-axis offset	M	1	double	Value	Unit: m
81.		a	參數 a	Parameter a required for recording boundary	M	1	double	Value	Unit: m
82.		b	參數 b	Parameter b required for recording boundary	M	1	double	Value	
83.		c	參數 c	Parameter c required for recording boundary	M	1	double	Value	Unit: 1/m
84.		d	參數 d	Parameter d required for recording boundary	M	1	double	Value	Unit: 1/m ²
85.	road mark	sOffset	s 軸位移量	S-axis offset	M	1	double	Value	Unit: m
86.		type	類型	Lane line type	M	1	string	Character	Refer to Table B.2 in Appendix B
87.		weight	粗細	Lane line thickness	O	1	string	Character	Refer to Table B.3 in Appendix B
88.		color	顏色	Lane line color	M	1	string	Character	Refer to Table B.4 in Appendix B
89.		material	材質	Lane line material	O	1	string	Character	



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
90.		width	寬度	Lane line width	O	1	double	Value	Unit: m
91.		laneChange	車道改變	Lane change is allowed or not	O	1	string	Character	Increase means that drivers can change lanes to the outside of a road, decrease means that drivers can change lanes to the inside of a road; both means that drivers can change lanes to either side of a road, none means that lane change is not allowed
92.		height	高度	Lane line height	O	1	double	Value	Unit: m
93.		sOffset	s 軸位移量	S-axis offset	M	1	double	Value	Unit: m
94.	speed	max	最大限速	Maximum speed for lanes	M	1	double	Value	
95.		unit	單位	Speed unit	O	1	string	Character	Unit: km/h
96.		sOffset	位移量	S-axis offset	M	1	double	Value	Unit: m
97.	access	rule	規則	Traffic rule	M	1	string	Character	Allow or deny
98.	s	restriction	限定對象	Restricted objects of the rule	M	1	string	Character	Refer to Table B.9 in Appendix B
99.	height	sOffset	s 軸位移量	S-axis offset	M	1	double	Value	Unit: m
100.		inner	內側	Inner height of a lane	M	1	double	Value	Unit: m



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
101.		outer	外側	Outer height of a lane	M	1	double	Value	Unit: m
102.	object	type	物體類型	Object type	O	1	string	Character	Refer to Table B.6 in Appendix B
103.		subtype	物體子類型	Object subtype	O	1	string	Character	If necessary, object types can be distinguished with text descriptions
104.		dynamic	動態物體	An object is dynamic or not	M	1	string	Character	Yes means that an object is dynamic; no means that an object is static
105.		name	物體名稱	Object name	O	1	string	Character	
106.		id	識別碼	Object identifier	M	1	string	Character	
107.		s	s 坐標	S coordinate of an object	M	1	double	Value	Unit: m
108.		t	t 坐標	T coordinate of an object	M	1	double	Value	Unit: m
109.		zOffset	z 軸位移量	Z-axis offset of an object in the track system	M	1	double	Value	Unit: m
110.		validLength	有效長度	Valid length of an object projected on the s-axis	M	1	double	Value	Unit: m



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
111.		orientation	方向有效性	Orientation validity of an object	M	1	string	Character	+ means that an object is valid in the same direction as s; - means that an object is valid in the opposite direction of s; none means that an object is valid in both directions
112.		hdg	航向角	Heading angle of an object	M	1	double	Value	Unit: rad
113.		pitch	俯仰角	Pitch angle of an object	M	1	double	Value	Unit: rad
114.		roll	滾動角	Roll angle of an object	M	1	double	Value	Unit: rad
115.		height	高度	Object height (z-axis)	M	1	double	Value	Unit: m
116.		length	長度	Object length (xy planes)	O	1	double	Value	Unit: m
117.		width	寬度	Object width (xy planes)	O	1	double	Value	Unit: m
118.		radius	半徑	Object radius (xy planes)	O	1	double	Value	Unit: m



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
119.		poleType	桿柱類型	Pole type	O	1	string	Character	For rod-shaped objects only, the significance of the recorded value is as follows: 01: street lamp pole; 02: sign pole; 03: signal pole; 04: telegraph pole; 05: warning pole; 06: bus stop signboard; 07: unknown
120.		pointGeo Location	點地理位置	Three-dimensional point coordinates of the central point at the bottom of an object	O	1	WKT	Character	Three-dimensional point coordinates recorded in WKT format
121.		zTop	物體頂點 z 坐標	Ellipsoidal height at the top of an object	O	1	double	Value	Unit: m
122.		extentGeo Location	底部範圍地理位置	Three-dimensional corner point sequence of the bounding range at the bottom of an object	O	1	WKT	Character	Three-dimensional corner point sequence coordinates of the bottom recorded in WKT format



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
123.		lampGeoLocation	路燈地理位置	Three-dimensional point coordinates of the central point of the surface of a street lamp	O	1	WKT	Character	Three-dimensional point coordinates recorded in WKT format
124.	Sign	id	識別碼	Sign identifier	M	1	string	Character	
125.		code	代碼	Sign code	M	1	class	Code	Refer to Table A.6 to Table A.11 in Appendix A
126.		geoLocation	地理位置	Three-dimensional point coordinates of the center of a signboard in WKT format	M	1	WKT	Character	Three-dimensional point coordinates recorded in WKT format
127.		bboxMin	包圍矩形左下點位	Three-dimensional spatial coordinates of the lower left point of the bounding rectangular of a signboard	M	1	WKT	Character	Three-dimensional point coordinates recorded in WKT format
128.		bboxMax	包圍矩形右上點位	Three-dimensional spatial coordinates of the upper right point of the bounding rectangular of a signboard	M	1	WKT	Character	Three-dimensional point coordinates recorded in WKT format



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
129.	parkingSpace	access	使用	Parking space type	M	1	string	Character	all car women handicapped bus truck electric residents
130.		restrictions	限制	Parking space restrictions in words	O	1	string	Character	
131.	tunnel	s	s 坐標	S coordinate of the starting point of a tunnel	M	1	double	Value	Unit: m
132.		length	長度	Length of a tunnel on the s-axis	M	1	double	Value	Unit: m
133.		name	名稱	Tunnel name	O	1	string	Character	
134.		id	識別碼	Tunnel identifier	M	1	string	Character	
135.		type	類型	Tunnel type	M	1	string	Character	Refer to Table B.7 in Appendix B
136.		lighting	人工照明	Artificial lighting of a tunnel	O	1	double	Value	
137.		daylight	自然照明	Natural lighting	O	1	double	Value	
138.		geoLocation	地理位置	Coordinates of the three-dimensional space of a tunnel in the inertial coordinate system	O	1	WKT	Character	Three-dimensional corner point sequence coordinates of the spatial range of a tunnel recorded in WKT format



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
139.	validity	fromLane	車道起始編號	Starting number of lanes in a tunnel	O	1	double	Value	
140.		toLane	車道結束編號	End number of lanes in a tunnel	O	1	double	Value	
141.	bridge	s	s 坐標	S coordinate of the starting point of a bridge	M	1	double	Value	Unit: m
142.		length	長度	Length of a bridge on the s-axis	M	1	double	Value	Unit: m
143.		name	名稱	Bridge name	O	1	string	Character	
144.		id	識別碼	Bridge identifier	M	1	string	Character	
145.		type	類型	Bridge type	M	1	string	Character	Refer to Table B.8 in Appendix B
146.		geoLocation	地理位置	Coordinates of the three-dimensional space of a bridge in the inertial coordinate system	O	1	WKT	Character	Three-dimensional corner point sequence coordinates of the spatial range of a bridge recorded in WKT format
147.	validity	fromLane	車道起始編號	Starting number of lanes on a bridge	O	1	double	Value	
148.		toLane	車道結束編號	End number of lanes on a bridge	O	1	double	Value	
149.	signals	s 坐標	S coordinate of the central point of a signal lamp cap	M	1	double	Value	Unit: m	



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
150.		t	t 坐標	T coordinate of the central point of a signal lamp cap	M	1	double	Value	Unit: m
151.		id	識別碼	Signal lamp cap identifier	M	1	string	Character	
152.		name	名稱	Signal lamp cap name	O	1	string	Character	
153.		dynamic	動態	Signal lamp is dynamic or not	M	1	string	Character	Yes means that a signal is dynamic; no means that a signal is static
154.		orientation	方向	Signal lamp cap orientation	M	1	string	Character	+ means that a signal is valid in the same direction as s; - means that a signal is valid in the opposite direction of s; none means that a signal is valid in both directions
155.		zOffset	z 位移量	Z-axis offset	M	1	double	Value	Unit: m
156.		country	國家	Country code	O	1	string	Character	R.O.C. shall be filled in
157.		countryRevision	版本	Country code revision	O	1	string	Character	
158.		type	類型	Signal lamp cap type	M	1	string	Character	“None” shall be filled in
159.		subtype	子類型	Signal lamp cap subtype	M	1	string	Character	“None” shall be filled in
160.		value	值	Signal attribute data	O	1	string	Character	
161.		unit	單位	Unit of signal attribute data	O	1	string	Character	



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
162.		height	高度	Signal lamp cap height	M	1	double	Value	Unit: m
163.		width	寬度	Signal lamp cap width	M	1	double	Value	Unit: m
164.		text	文字	Additional text of signal description	O	1	string	Character	
165.		hOffset	h 位移量	H-axis offset	O	1	double	Value	Unit: rad
166.		pitch	俯仰角	Signal pitch angle	O	1	double	Value	Unit: rad
167.		roll	滾動角	Signal roll angle	O	1	double	Value	Unit: rad
168.		code	代碼	Signal code	O	1	Class	Code	Refer to Table A.12 to Table A.14 in Appendix A
169.		signalDataId	燈面識別碼	Identifier of individual signal face	M	N	string	Character	
170.		stopLineId	停止線識別碼	Identifier of signal-related stop line	M	N	string	Character	
171.		SignalData	id	識別碼	Signal face identifier	M	1	string	Character
172.	code		代碼	Signal face code	M	N	class	Signal face code	Refer to Table A.2 in Appendix A
173.	angle		角度	Angle between the normal vector of a signal face and the north, calculated clockwise from the north.	M	1	double	Value	Unit: rad



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
174.		geoLocation	地理位置	Three-dimensional point coordinates of the central point of a signal face	M	1	WKT	Character	Three-dimensional point coordinates recorded in WKT format
175.		radius	半徑	Signal face radius	M	1	double	Value	Radius of a three-dimensional space
176.		bboxMin	包圍矩形左下點位	Three-dimensional spatial coordinates of the lower left point of the bounding rectangular of a signal face	M	1	WKT	Character	Three-dimensional point coordinates recorded in WKT format
177.		bboxMax	包圍矩形右上點位	Three-dimensional spatial coordinates of the upper right point of the bounding rectangular of a signal face	M	1	WKT	Character	Three-dimensional point coordinates recorded in WKT format
178.	StopLine	id	識別碼	Stop line identifier	M	1	string	Character	
179.		code	代碼	Mark line code	M	1	class	Character	Refer to Table A.3 in Appendix A
180.		signalId	號誌識別碼	Corresponding signal identifier	M	N	string	Character	
181.		width	寬度	Stop line width	M	1	double	Value	Unit: m



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
182.		geoLocation	地理位置	Three-dimensional linear coordinates of a stop line	M	1	WKT	Character	Three-dimensional linear coordinates recorded in WKT format
183.	controller	id	識別碼	Signal controller identifier	M	1	string	Character	
184.		name	名稱	Signal controller name	O	1	string	Character	
185.		sequence	序列	Signal controller sequence	O	1	int	Value	
186.	control	signalid	號誌識別碼	Control-signal identifier	M	1	string	Character	
187.		type	號誌類型	Control-signal type	O	1	string	Character	
188.	junction	id	識別碼	Junction identifier	M	1	string	Character	
189.		name	名稱	Junction name	O	1	string	Character	
190.		type	類型	Junction type	O	1	string	Character	Default means a default junction; virtual means a junction with a private road, such as a junction to home yard or parking lot
191.	connection	id	識別碼	Identifier	M	1	string	Character	
192.		incomingRoad	連結之來源道路	Connection-incoming road identifier	M	1	string	Character	
193.		connectionRoad	連結之目標道路	Connection-target road identifier	M	1	string	Character	



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
194.		contactPoint	連結點	Contact point of an incoming road	M	1	string	Character	Start means connecting to the starting point; end means connecting to the end point
195.		connectionMaster	主要連結	Master connection identifier	O	1	string	Character	
196.		type	類型	Connection type	O	1	string	Character	Default means a default connection; virtual means a connection between two lanes that is not formally defined but is possible.
197.	predecessor	elementType	元件類型	Connecting road type	M	1	string	Character	Road
198.		elementId	元件識別碼	Connecting road identifier	M	1	string	Character	
199.		elementS	元件 s 起始點	S coordinate of the starting point of a connecting road	M	1	string	Character	
200.		elementDir	元件方向	Traffic direction of a connecting road	M	1	string	Character	+ means in the same direction as s; - means in the opposite direction of s
201.	successor	elementType	元件類型	Connecting road type	M	1	string	Character	Road
202.		elementId	元件識別碼	Connecting road identifier	M	1	string	Character	



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
203.		elementS	元件 s 起始點	S coordinate of the starting point of a connecting road	M	1	string	Character	
204.		elementDir	元件方向	Traffic direction of a connecting road	M	1	string	Character	+ means in the same direction as s; - means in the opposite direction of s
205.	laneline	from	從	From a certain lane	O	1	int	Value	Lane code
206.		to	至	To a certain lane	O	1	int	Value	Lane code
207.	priority	high	高	High priority	O	N	string	Value	Road identifier
208.		low	低	Low priority	O	N	string	Value	Road identifier
209.	controller	id	識別碼	Controller identifier	M	1	string	Character	
210.		type	類型	Controller type	M	1	string	Character	
211.		sequence	序列	Controller sequence	M	1	int	Value	
212.	userdata	code	名稱	Name	M	1	string	Character	“hdmap” shall be filled in
213.		value	內容	Content	M	1	string	Character	“xml” shall be filled in
214.	Markline	id	識別碼	Mark line identifier	M	1	string	Character	
215.		code	代碼	Mark line code	M	1	Class	Code	Refer to Table A.3 in Appendix A
216.		style	車道線代碼	Lane line style code	C	1	Class	Lane line style code	Only lane lines need to be recorded, as shown in Table A.1 in Appendix A



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
217.		geoLocation	地理位置	Three-dimensional linear coordinates of a mark line	M	1	WKT	Character	Three-dimensional linear coordinates recorded in WKT format
218.	Mark Area	id	識別碼	Mark area identifier	M	1	string	Character	
219.		code	代碼	Mark line code	M	1	Class	Code	Refer to Table A.3 in Appendix A
220.		geoLocation	地理位置	Three-dimensional corner point sequence coordinates of the spatial range or bounding range of a mark line	M	1	WKT	Character	Three-dimensional corner point sequence coordinates recorded in WKT format
221.	Mark Graph	id	識別碼	Mark graph identifier	M	1	string	Character	
222.		code	代碼	Mark line code	M	1	Class	Code	Refer to Table A.3 in Appendix A
223.		markAreaId	標線範圍代碼	Associated mark area identifier	M	1	string	Character	
224.		geoLocation	地理位置	Three-dimensional corner point sequence coordinates of the spatial range of a mark graph	M	1	WKT	Character	Three-dimensional corner point sequence coordinates recorded in WKT format
225.	Lane CenterLine	id	車道識別碼	Lane identifier	M	1	string	Character	
226.		type	車道類型	Lane type	M	1	string	Character	Refer to Table B.5 in Appendix B



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
227.		predecessor	前一車道識別碼	Identifier of the previous lane	O	1	string	Character	
228.		successor	下一車道識別碼	Identifier of the next lane	O	1	string	Character	
229.		width	車道寬度	Lane width	M	1	double	Value	Unit: m
230.		material	車道路面材質	Lane surface material	M	1	string	Character	
231.		speed	車道速限	Speed limit for lanes	O	1	integer	Value	Unit: km/h
232.		restriction	車道使用限制	Driving and use limit for lanes	O	1	string	Character	
233.		height	高度限制	Height limit for lanes	O	1	double	Value	Unit: m
234.		weight	重量限制	Weight limit for lanes	O	1	double	Value	Unit: kg
235.		startWaypoint	起始節點	Starting node identifier of a lane center line.	M	1	string	Character	
236.		endWaypoint	結束節點	End node identifier of a lane center line.	M	1	string	Character	
237.		geoLocation	地理位置	Three-dimensional linear coordinates of a lane center line	M	1	WKT	Character	Three-dimensional linear coordinates recorded in WKT format, and shall be recorded as a straight line connecting 2 points
238.		tunnelId	隧道識別碼	Identifier of the tunnel where a lane center line is located	O	1	string	Character	



Item No.	Class	Attribute or relationship		Description	Condition	Maximum number of times	Data type	Value range	Note
		English Name	Chinese Name						
239.		bridgeId	橋梁識別碼	Identifier of the bridge where a lane center line is located	O	1	string	Character	
240.	Waypoint	id	識別碼	Node identifier	M	1	string	Character	
241.		velocity	速度	Driving speed	M	1	double	Value	Unit: km/h
242.		stopLineId	停止線識別碼	Stop line identifier	O	1	string	Character	
243.		geoLocation	地理位置	Three-dimensional point coordinates of a node	M	1	WKT	Character	Three-dimensional point coordinates recorded in WKT format

7. Format

This standard follows the format specification in “OpenDRIVE version 1.5” with the format being XML and the extension being .xodr. XML Schema in OpenDRIVE 1.5 is adopted in this standard. Please write the extended data and attributes of this standard to the data file by the method specified in this section.

7.1 Extended attributes

This standard, the extended attributes based on the classes defined in OpenDRIVE, is recorded in userdata within the corresponding class., for example, the extended attributes of road are recorded in the userdata of the road class. The XML element is assigned to the extended attribute of each class with the same name, and data types are given, as summarized in Table 4. In data recording, data can be written to xodr files according to this table. Please refer to Appendix C for the XML schema of extended attributes.

Table 4 Record of extended classes and attributes

UML class	UML class attribute	XML elements assigned		XML data type
road	geoLocation	geoLocation		string
lane	geoLocation	geoLocation		string
object	poleType	objectAtts	poleType	string
	pointGeoLocation		pointGeoLocation	string
	zTop		zTop	double
	extentGeoLocation		extentGeoLocation	string
	lampGeoLocation		lampGeoLocation	string
tunnel	geoLocation	geoLocation		string
bridge	geoLocation	geoLocation		string
signal	code	signalAtts	code	string
	signalDataId		signalDataId	string
	stopLineId		stopLineId	string

7.2 Extended classifications

The extended classes of this standard are recorded in the userdata of the road class, to replace the any class. This section specifies the XML data types for all extended classes in order to record data. As shown in Figure 50, XML data types and XML elements with the same names are designed for all extended classes. A root element HDMap is designed as the main schema,

in which all elements are optional and can be filled for many times but must be arranged in the order of XML schema. Please refer to Appendix C for the XML schema of extended classes.

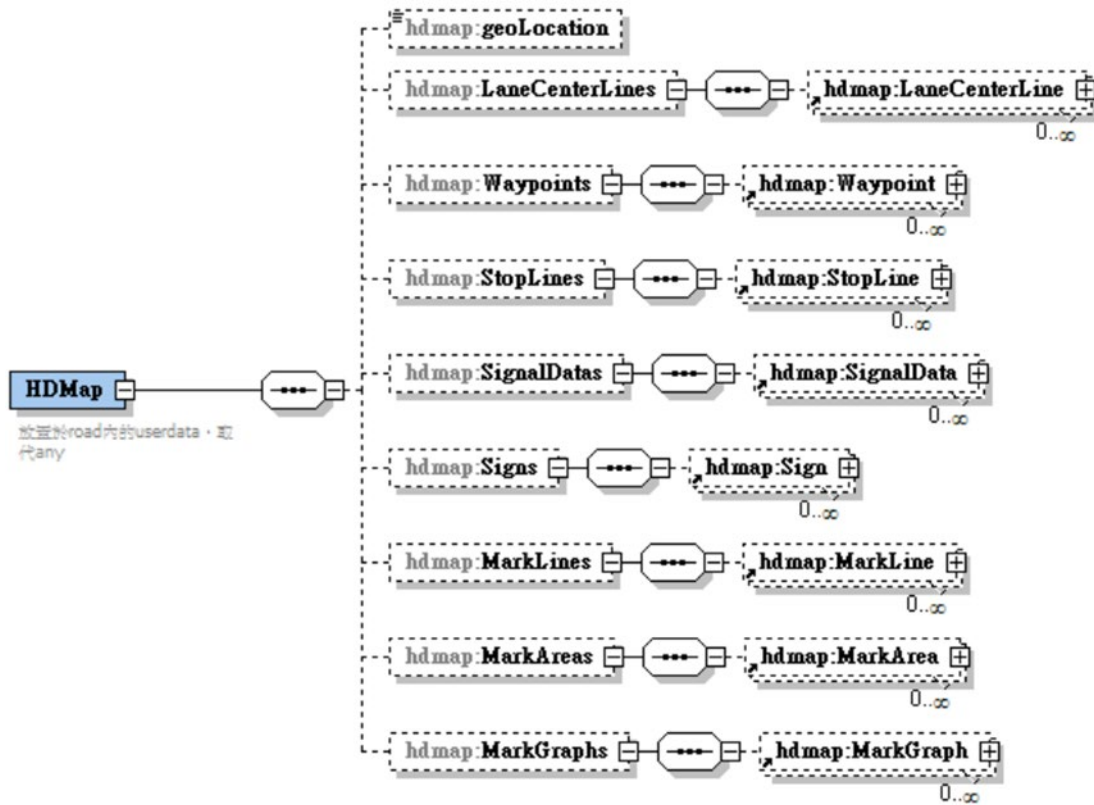


Figure 50 Extended XML schema

Annex A (Normative) Custom codes

A.1 Custom codes

Table A.1 Lane line style code

Item No.	Code	Definition
1.	L01	Broken white line
2.	L02	Broken yellow line
3.	L03	Solid white line
4.	L04	Solid yellow line
5.	L05	Solid red line
6.	L06	Double broken white lines
7.	L07	Double solid white lines
8.	L08	Double solid yellow lines
9.	L09	Broken yellow line parallel with solid yellow line
10.	L10	Broken white line parallel with solid white line

Table A.2 Signal face code

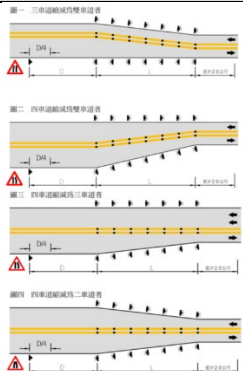
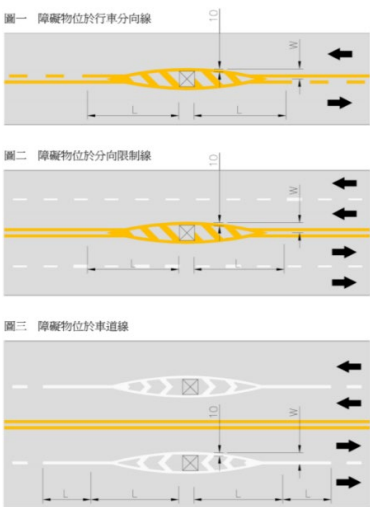
Item No.	Code	Definition	Signal type
1.	S01	Circular green light	Traffic control signal
2.	S02	Left-turn green arrow light	Traffic control signal
3.	S03	Straight-through green arrow light	Traffic control signal
4.	S04	Right-turn green arrow light	Traffic control signal
5.	S05	Flashing green light	Traffic control signal
6.	S06	Circular yellow light	Traffic control signal
7.	S07	Circular red light	Traffic control signal
8.	S08	Pedestrian walking green signal	Pedestrian signal
9.	S09	Pedestrian standing red signal	Pedestrian signal
10.	S10	Downward green arrow light	Lane control signal
11.	S11	X-shaped red light	Lane control signal
12.	S12	Diagonal down-left yellow arrow light	Lane control signal
13.	S13	Diagonal down-right yellow arrow light	Lane control signal
14.	S14	Double red lights	Railroad crossing signal
15.	S15	Twin flashing yellow lights	Crosswalk signal
16.	S16	Flashing yellow light	Special flashing light signal
17.	S17	Flashing red light	Special flashing light signal
18.	S18	Countdown	Uncategorized

A.2 Warning mark line code

Table A.3 Warning mark line code

Class I: Warning mark line: Warning/ Prohibition mark line: Prohibit/ Instruction mark line: Instruction

Class II: Vertical mark line: Vertical/ Horizontal mark line: Horizontal/ Assisting mark line: Assist / Marked with words: Word

Code	Class	Diagram	Description	Color	Line type	Size(meter)		Note
WV001	Pavement-width transition line		Warn drivers to drive carefully and not to overtake, due to reduced pavement-width or number of lanes.	yellow	Solid line	Line width	0.1	
				yellow	Broken line			
				yellow	Solid line	Bidirectional spacing	0.1	
WV002	Obstruction approach mark line		On an overtaking-prohibited line or a lane-dividing line	yellow	Solid line Zigzag line	Line width	0.1	
			On a dividing limit line	yellow	Double solid lines Zigzag line			
			On a lane line	white	Solid line Zigzag line	Bidirectional spacing	0.1	
			Obstruction block	yellow / white	Twill line			
Line width	0.2							
Spacing	0.3							
Inclination way	Unidirectional inclination							



Code	Class	Diagram	Description	Color	Line type	Size(meter)	Note	
						Unidirectional inclination Bidirectional inclination		
WV003	Near-railroad crossing line		Indicate that there a railroad crossing ahead	white	Solid line, X-type	Line width	0.4	In addition to cross lines and transverse broken lines, this mark line contains overtaking-prohibited lines, stop lines and the word "railroad", as shown in the figure.
						Line segment length	6.0	
	Crossing angle			37°				
	white			Broken line	Line width	0.6		
Line segment length		0.6						
						Spacing	0.4	
WV004	Reversible lane line		Generally regarded as a lane line, and used to warn drivers to drive according to	White	Double broken lines	Line segment length	4.0	
						Line segment spacing	6.0	

Code	Class	Diagram	Description	Color	Line type	Size(meter)		Note
			the control regulations of signals, signs and mark lines			Line width	0.1	
						Interval	0.1	
WH001	Speed reduction line		Warn drivers to slow down due to special road conditions ahead	White	Solid line	Line width	0.1	* In groups of six *
						Interval	0.2	Thickness no more than 0.6cm
WA001	Objects-within-roadway line		Indicate an obstruction in the way	Yellow and black	Twill line	Line width	0.1 ~ 0.3	
WA002	Roadside obstruction line		Indicate a roadside obstruction	Yellow and black	Twill line	Line width	0.1 ~ 0.3	



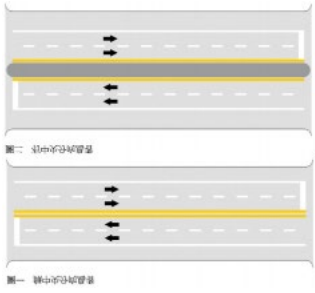
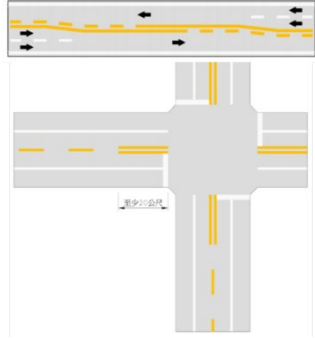
Code	Class	Diagram	Description	Color	Line type	Size(meter)		Note
WW001	“Railroad”		Painted on “near-railroad crossing lines”	White	As shown in the figure	Length	2.0	
						Width	0.7	
						Interval	0.1	
WW002	“Slow”		Painted 1. near gated railroad crossings 2. near zebra-stripe crosswalks 3. near pavement-width transition lines 4. near narrow bridges 5. near dangerous seaside roads 6. near other necessary points	White	As shown in the figure	Length	2.5	
						Width	1.0	
						Width	0.3	
						Spacing	0.3	

A.3 Prohibition mark line code

Table A.4 Prohibition mark line code

Class I: Warning mark line:Warning / Prohibition mark line:Prohibit / Instruction mark line:Instruction

Class II: Vertical mark line:Vertical / Horizontal mark line: Horizontal/ Assisting mark line: Assist /Marked with words: Word

Code	Class	Diagram	Description	Color	Line type	Size(meter)		Note				
						Line width	Interval					
PV00 1	Dividing limit line		Divide a road into two-way lanes, to prohibit vehicles from crossing and turning around	yellow	Double solid lines	Line width	0.1					
						Interval	0.1					
PV00 2	Over taking-prohibited line		Indicate prohibition of overtaking, including two-way overtaking-prohibited lines and one-way overtaking-prohibited line	yellow	Double solid lines	Line width	0.1	* Overtaking is prohibited on the side of the solid line, and allowed on the side of the broken line				
						Interval	0.1					
					On e-way				yellow	Solid line Broken line	Line width	0.1
											Interval	0.1

Code	Class	Diagram	Description	Color	Line type	Size(meter)		Note
PV003	Lane change prohibition line	Bilateral	Indicate lane change prohibition, including bilateral lane change prohibition lines and unilateral lane change prohibition line	white	Double solid lines	Line width	0.1	* Overtaking is prohibited on the side of the solid line, and allowed on the side of the broken line
		Interval				0.1		
	Unilateral	white		Solid line Broken line	Line width	0.1		
					Interval	0.1		
PV004	No parking line		Indicate a section where no parking is allowed	yellow	Solid line	Line width	None	
						From the road edge	0.3	
PV005	No temporary parking line		Indicate a section where temporary parking is prohibited	red	Solid line	Line width	None	
						From the road edge	0.3	
PH001	Stop line		A boundary used to instruct all moving vehicles to stop. When a vehicle stops, its front overhang shall not exceed this line.	white	Solid line	Line width	0.3 ~0.4	

Code	Class	Diagram	Description	Color	Line type	Size(meter)		Note
						Line width	0.15	
PA001	Channelizing line		Guide drivers to drive on the designated routes and not to cross	Same as the lane-dividing line, dividing limit line or lane line to which it is connected	Solid line	Line width	0.15	
					Y-shaped line	Line width	0.15	
					Twill line	Peripheral line width	0.15	
						Line width	0.2	
					Spacing	0.3		
PA002	Give-way line		Warn drivers to slow down, due to a main road ahead	white	Inverted triangle	As shown in the figure, the unit is cm		
PA003	Grid line		Instruct drivers not to stop temporarily within the area of this mark line to avoid traffic jams	yellow	Rectangle	Peripheral line width	0.2	
						Inner line width	0.1	
						Inner line Interval	1~5	


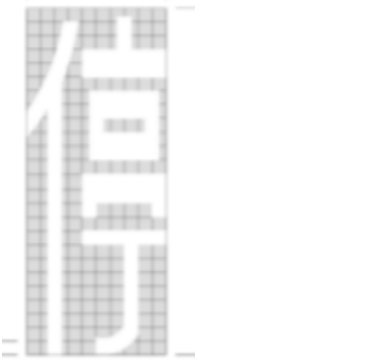
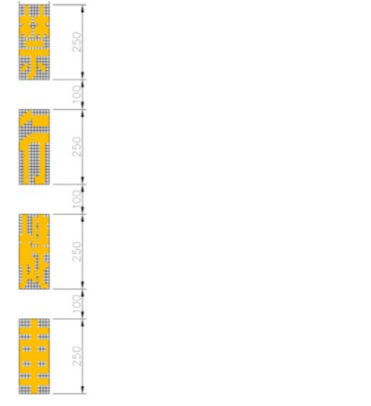
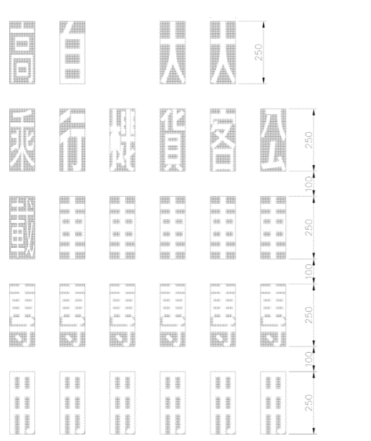


Code	Class	Diagram	Description	Color	Line type	Size(meter)		Note
						Line width	Longitudinal long of the diagonal	
PA004	Exclusive vehicle lane line		An exclusive lane for a certain type of vehicles only whilst no other vehicles and pedestrians are allowed to enter	white	Diamond	0.15	2.5	Between every two diamonds, the words of exclusive vehicle lane are marked longitudinally in white or used together with graphics
						Lateral long of the diagonal	1.0	

Code	Class	Diagram	Description	Color	Line type	Size(meter)	Note
PA005	Exclusive motorcycle lane line		An exclusive lane for scooters excluding motorcycles. Other types of vehicles shall not cross or occupy except for starting, preparing to stop, stopping temporarily or turning.	white	Motorcycle graphics	As shown in the figure, the unit is m	Between the two motorcycle graphics, the words "exclusive motorcycle lane" are marked longitudinally in white to use together with graphics
PA006	Waiting area line for bicycles and scooters		An area where scooter and bicycle drivers other than motorcycle drivers can stop when red lights are on. Other types of vehicles are not allowed to stay in the waiting area.	white	Rectangle	Lateral (front and back) line width: 0.2 Longitudinal (both sides) line width: 0.1 ~ 0.15 Longitudinal length: 2.5 ~ 6.0	Paint motorcycle and bicycle graphics or white letters in a waiting area for bicycles and scooters, if necessary

Code	Class	Diagram	Description	Color	Line type	Size(meter)		Note
PA007	Sidewalk		A sidewalk mark line used to indicate the exclusive way for pedestrians only, and vehicles are not allowed to enter. Sidewalks marked with sidewalk marks are separated from lanes by boundary lines.	Green	Sidewalk graphics	As shown in the figure, the unit is cm		Paint words or graphics from the starting points of a sidewalk, and paint the spacing according to the actual situation of a road
PW001	“No lane change”		Painted on “no traffic changing lanes”	Yellow	As shown in the figure	Length	2.5	
						Width	1.0	
						Spacing	1.0	
PW002	“No parking”		Painted on “no parking sections”	Yellow	As shown in the figure	Length	0.3	Paint laterally every 20m to 50m
						Width	0.3	
						Spacing	0.3	
PW003	“No temporary parking”		Painted on “no temporary parking sections”	Red	As shown in the figure	Length	0.3	Paint laterally every 20m to 50m
						Width	0.3	
						Spacing	0.3	



Code	Class	Diagram	Description	Color	Line type	Size(meter)		Note
PW004	“Penalty for crossing the line”		Painted in front of “stop lines”	yellow	As shown in the figure	None		圖片來源： https://news.tvbs.com.tw/world/1046961
PW005	“Stop”		Painted at places where stop lines will end, and used to indicate that vehicles must stop here before starting again	White	As shown in the figure	Length	2.5	
PW006	“No scooters”		To warn that scooters are forbidden to enter the lanes, except motorcycles.	yellow	As shown in the figure	Length	2.5	
						Width	1.0	
						Spacing	1.0	
PW007	Words for exclusive vehicle lanes		Used to indicate an exclusive lane for certain types of vehicles, and marked according to the names of the specified types of vehicles	white	As shown in the figure	Length	2.5	
						Width	1.0	
						Spacing	1.0	



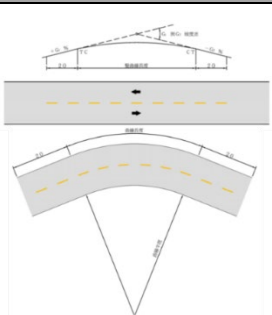
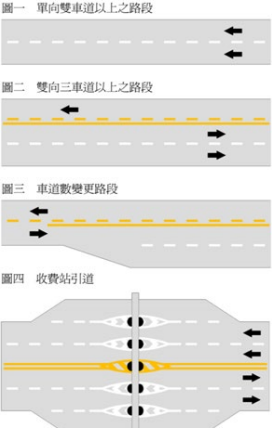
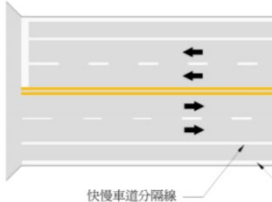
Code	Class	Diagram	Description	Color	Line type	Size(meter)		Note
PW008	Special lane words for traffic directions		Set on an exclusive lane for a specific traffic direction near a junction, and used to instruct that vehicles in the lane shall turn left, turn right or go straight in the specified direction when coming to the junction.	white	As shown in the figure	Length	2.5	
						Width	1.0	
						Spacing	1.0	
PW009	Words for speed limit		Set at the starting point of any section with the maximum speed specified by signs or mark lines and at a place with an appropriate distance from the traffic control signal	yellow	As shown in the figure	Length	2.5	
						Width	1.0	

A.4 Instruction mark line code

Table A.5 Instruction mark line code

Class I: Warning mark line:Warning / Prohibition mark line:Prohibit / Instruction mark line:Instruction

Class II: Vertical mark line:Vertical / Horizontal mark line: Horizontal/ Assisting mark line: Assist / Marked with words: Word

Code	Class	Diagram	Description	Color	Line type	Size(meter)		Note
						Line segment length	Line width	
IV001	Lane-dividing line		Divide a road into two-way lanes, and instruct drivers to keep to the right and drive in their directions	Yellow	Broken line	Line segment length	4.0	
						Spacing	6.0	
						Line width	0.1	
IV002	Lane line		Divide a road into lanes, and instruct drivers to drive in their lanes	White	Broken line	Line segment length	4.0	
						Spacing	6.0	
						Line width	0.1	
IV003	Boundary line		Indicate any shoulder or the boundary of the outer edge of any road	White	Solid line	Line width	0.15	



Code	Class	Diagram	Description	Color	Line type	Size(meter)		Note
IV004	Fast/slow lane divider		Indicate the position of the outer edge of any fast lane, and divide fast and slow lanes	White	Solid line	Line width	0.1	
IV005	Left-turn waiting area line		Indicate that any left-turn vehicle can enter a waiting area during straight-through time phase, to wait to turn left. Vehicles are not allowed to stay in the waiting area when the left-turn time phase ends.	White	Double broken lines	Line segment length	0.5	Paint the words of "left-turn waiting area" in white variant in a waiting area, to indicate its range
						Spacing	0.5	
						Line width	0.1	
IH001	Longitudinal crosswalk line		At any junction	White	Solid line * Longitudinal	Line segment length	2.0 ~ 8.0	
						Spacing	0.4 ~ 0.8	
						Line width	0.4	
IH002	Diagonal crosswalk line		At any junction with pedestrian scramble	White	Solid line	Line width	0.15	



Code	Class	Diagram	Description	Color	Line type	Size(meter)		Note
					* X-shaped parallel	Interval	3.0 ~ 5.0	
IH003	Zebra-stripe crosswalk line	<p>Unit: cm</p>	Set at any place in the middle of a road where many pedestrians cross	White	Double solid lines	Line width	0.1	
						Interval	3.0 ~ 8.0	
IH004	Bicycle crossing line		Indicate the driving range for any bicycle to cross a road at the junction or in the section	White	Solid line	Line width	0.1	Paint bicycle graphics at entrances and exits of crossing lines
						Interval	> 1.2	
IH005	Traffic safety distance identification line		Provide reference for drivers to keep a safe driving distance. Set on any	White	Broken line	Line segment length	0.5	Every 50 meters there is a line, every
						Spacing	0.5	
						Line width	0.15	



Code	Class	Diagram	Description	Color	Line type	Size(meter)		Note
						Interval		
IH00 5	Wedge-shaped safety distance identification line		Set in any tunnel on motorways and expressways based on traffic safety needs	White	Wedge line	Line width	0.25	3 lines for a group. The number of groups shall be increased as needed.
						Outer edge length	3.0	
						Outer edge width	1.4	
						Interval	50	
IA00 1	Guiding line	<p>圖一 直線箭頭</p>	Indicate the direction of traffic - straight through ahead	White	Straight arrow	As shown in the figure, the unit is cm		



Code	Class	Diagram	Description	Color	Line type	Size(meter)	Note
IA00 2	Guiding line	<p>圖二 弧形箭頭</p>	Indicate the direction of traffic - left turn	White	Curved arrow	As shown in the figure, the unit is cm	
IA00 3	Guiding line		Indicate right turn				
IA00 4	Guiding line	<p>圖三 分岔箭頭</p>	Indicate the direction of traffic - straight through ahead and left turn	White	Bifurcation arrow combining a straight and a curve	As shown in the figure, the unit is cm	
IA00 5	Guiding line		Indicate straight through ahead and right turn				
IA00 6	Guiding line	<p>圖四 分岔箭頭</p>	Indicate the direction of traffic - left turn and right turn	White	Bifurcation arrow combining two curves	As shown in the figure, the unit is cm	



Code	Class	Diagram	Description	Color	Line type	Size(meter)	Note
IA00 7	Guiding line	<p>圖五 分岔箭頭</p>	Indicate the direction of traffic - straight through ahead, left turn and right turn	White	Bifurcation arrow combining a straight and two curves	As shown in the figure, the unit is cm	
IA00 8	Guiding line	<p>圖六 弧形虛線箭頭</p>	Indicate exiting a lane	White	Broken curved arrow	As shown in the figure	
IA00 9	Lane reduction mark line		Indicate lane reduction ahead and guide to enter an adjacent lane	White	Arrow	As shown in the figure	



Code	Class	Diagram	Description	Color	Line type	Size(meter)		Note
		<p>(單位：公分)</p>				Interval	30 ~ 50	
IA0010	Bicycle path indicator	<p>(單位：公尺)</p>	Indicate information of numbered bicycle path, and direction and distance of forwarding stations and supply stations	Background: white Pattern: blue	Rectangle	Line width	0.2	
						Interval	1.5	



Code	Class	Diagram	Description	Color	Line type	Size(meter)		Note
IA0011	Turning guide line		Indicate boundaries for turning vehicles, and set according to actual needs	White	Broken line	Line segment length	0.1	
						Spacing	0.5	
						Line width	0.5	
IA012	Broken crossing line		Divide the main lane from other lanes for vehicles to enter and exit, and vehicles in other lanes shall give way to those in the main lane	White	Broken line	Line segment length	1.0	
						Spacing	2.0	
						Line width	0.15 或 0.3	
IA013	MRT driving boundary		Provide driving boundaries for MRT vehicles, and instruct vehicles and pedestrians to avoid. Set at junctions where MRT vehicles pass, if necessary.	White	Broken line	Line segment length	1.0	
						Spacing	2.0	
						Line width	0.1	



Code	Class	Diagram	Description	Color	Line type	Size(meter)		Note
IA01 4	Parking line	<p>小型車及 大型重型機車停放線</p>	Indicate locations and areas where vehicles shall be parked	White	Solid line	Line width	0.1	There are parking spaces for motor cycles, roadside motor buses and disabilities as well as special parking spaces other than those for motor cycles.
IA01 5	Left-turn (right-turn) waiting area line for bicycles and scooters		Instruct motorcycle and bicycle drivers to drive in sections, except for large-capacity motorcycle drivers	White	Rectangle	Line width	0.15	














Code	Class	Diagram	Description	Color	Line type	Size(meter)		Note
						Length	Width	
IW00 1	“Left-turn waiting area”		Marked in any “left-turn waiting area” to indicate its range	White	As shown in the figure	Length	1.5	
						Width	1.0	
						Spacing	0.5	
IW00 2	Words for place name, road name and direction		Indicate any place where a lane leads to and the direction of a road. Set in the middle of a section or any place near a junction.	White	As shown in the figure	Length	2.5	
						Width	1.0	
						Spacing	1.0	

A.5 Warning sign code

Table A.6 Warning sign code












Class: Warning sign: Warning /Obeying sign: Obey / Prohibition sign: Prohibit / Restriction sign: Restrict / Instruction sign: Instruction / Assisting sign: Assist











Code	Canonical coding	Class	Diagram	Shape	Color	Description
W001	Warning 1	“Right-turn”		Equilateral triangle	White background and red border Black graphic	
W002	Warning 2	“Left-turn”		Equilateral triangle	White background and red border	
W003	Warning 3	“Winding road ahead”		Equilateral triangle	Black graphic	Where the first turning is to the right
W004	Warning 4	“Winding road ahead”		Equilateral triangle	White background and red border	Where the first turning is to the left
W005	Warning 5	“Steep ascent”		Equilateral triangle	Black graphic	
W006	Warning 6	“Steep descent”		Equilateral triangle	White background and red border	
W007	Warning 7	“Narrow road”		Equilateral triangle	Black graphic	
W008	Warning 8	“Right lane reduction”		Equilateral triangle	White background and red border	Set a
W009	Warning 9	“Left lane reduction”		Equilateral triangle	Black graphic	signboard to indicate its distance
W010	Warning 10	“Narrow bridge”		Equilateral triangle	White background and red border	
W011	Warning 11	“Crossroad”		Equilateral triangle	White background and red border Black graphic	Nine types of crossroads

右前
道二
終〇
止〇
公
尺

Code	Canonical coding	Class	Diagram	Shape	Color	Description
W012	Warning 12	“Crossroad”		Equilateral triangle	White background and red border Black graphic	
W013	Warning 13	“Crossroad”		Equilateral triangle	White background and red border Black graphic	
W014	Warning 14	“Crossroad”		Equilateral triangle	White background and red border Black graphic	
W015	Warning 15	“Crossroad”		Equilateral triangle	White background and red border Black graphic	
W016	Warning 16	“Crossroad”		Equilateral triangle	White background and red border Black graphic	
W017	Warning 17	“Crossroad”		Equilateral triangle	White background and red border Black graphic	
W018	Warning 18	“Crossroad”		Equilateral triangle	White background and red border Black graphic	
W019	Warning 19	“Crossroad”		Equilateral triangle	White background and red border Black graphic	
W020	Warning 20	“Right hand fork”		Equilateral triangle	White background and red border Black graphic	Set a
W021	Warning 21	“Left hand fork”		Equilateral triangle	White background and red border Black graphic	signboard to indicate “traffic coming in from the right (left)”
W022	Warning 22	“Split road ahead”		Equilateral triangle	White background and red border Black graphic	

Code	Canonical coding	Class	Diagram	Shape	Color	Description
W023	Warning 23	“Signal ahead”		Equilateral triangle	White background and red border Red, yellow, green, and black graphic	
W024	Warning 24	“Roundabout”		Equilateral triangle	White background and red border Black graphic	
W025	Warning 25	“Gated railroad crossing sign”		Equilateral triangle	White background and red border Black graphic	
W026	Warning 26	“Ungated railroad crossing sign”		Equilateral triangle	White background and red border Black graphic	
W027	Warning 27	“Near-railroad crossing”		Equilateral triangle	White background and red border Black graphic	Set at an appropriate place 150m to 200m from the entrance
W028	Warning 28	“Near-railroad crossing”		Equilateral triangle	White background and red border Black graphic	Set at a place near two thirds of the distance above
W029	Warning 29	“Near-railroad crossing”		Equilateral triangle	White background and red border Black graphic	Set at a place near one third of the distance above
W030	Warning 30	“Rough road ahead”		Equilateral triangle	White background and red border Black graphic	
W031	Warning 31	“Bumpy road ahead”		Equilateral triangle	White background and red border Black graphic	
W032	Warning 32	“Low-lying road ahead”		Equilateral triangle	White background and red border Black graphic	












Code	Canonical coding	Class	Diagram	Shape	Color	Description
W033	Warning 33	“Slippery road ahead”		Equilateral triangle	White background and red border Black graphic	
W034	Warning 34	“Caution, pedestrians ahead”		Equilateral triangle	White background and red border Black graphic	
W035	Warning 35	“Caution, children ahead”		Equilateral triangle	White background and red border Black graphic	
W036	Warning 36	“Caution, disabilities ahead”		Equilateral triangle	White background and red border Black graphic	
W037	Warning 37	“Caution, animals may attack”		Equilateral triangle	White background and red border Black graphic	
W038	Warning 38	“Caution, machine ahead”		Equilateral triangle	White background and red border Black graphic	
W039	Warning 39	“Caution, bicycle ahead”		Equilateral triangle	White background and red border Black graphic	
W040	Warning 40	“Caution, plane”		Equilateral triangle	White background and red border Black graphic	
W041	Warning 41	“Tunnel”		Equilateral triangle	White background and red border Black graphic	
W042	Warning 42	“Two-way traffic”		Equilateral triangle	White background and red border Black graphic	
W043	Warning 43	“Beware of wharf and embankment”		Equilateral triangle	White background and red border Black graphic	

Code	Canonical coding	Class	Diagram	Shape	Color	Description
W044	Warning 44	“Attention for cliff on the right side”		Equilateral triangle	White background and red border Black graphic	
W045	Warning 45	“Attention for cliff on the left side”		Equilateral triangle	White background and red border Black graphic	
W046	Warning 46	“Attention for rocks falling from the right side”		Equilateral triangle	White background and red border Black graphic	
W047	Warning 47	“Attention for rocks falling from the left side”		Equilateral triangle	White background and red border Black graphic	
W048	Warning 48	“Beware of strong wind”		Equilateral triangle	White background and red border Black graphic	
W049	Warning 49	“Slow down”		Equilateral triangle	White background and red border Black graphic	Set a signboard in English or to  explain the reason for slow traffic
W050	Warning 50	“Danger”		Equilateral triangle	White background and red border Black graphic	
W051	Warning 51	“Caution, MRT vehicle”		Equilateral triangle	White background and red border Black graphic	
W052	Warning 52	“Speed measurement ahead”		Equilateral triangle	White background and red border Black graphic	

A.6 Obeying sign code

Table A.7 Obeying sign code

Class: Warning sign: Warning /Obeying sign: Obey / Prohibition sign: Prohibit / Restriction sign: Restrict / Instruction sign: Instruction / Assisting sign: Assist

O001	Obey 1	“Stop and proceed”		Octagon	Red background and thin white border White graphic	If necessary, use a signboard to give a description in English 
O002	Obey 2	“Yield”		Inverted equilateral triangle	White background and red border Black graphic	If necessary, use a signboard to give a description in English 
O003	Obey 3	“Stop for inspection”		Round	White background and red border Black graphic	
O004	Obey 4	“Checkpoint ahead”		Round	White background and red border Black graphic	
O005	Obey 5	“Stop to pay”		Round	White background and red border Black graphic	
O006	Obey 6	“Truck weighing”		Round	White background and red border Black graphic	
O007	Obey 7	“Going straight only”		Round	Blue background White graphic	The directions to be followed only apply only to designated vehicles, and vehicle graphics shall
O008	Obey 8	“Right turn only”		Round	Blue background White graphic	
O009	Obey 9	“Left turn only”		Round	Blue background White graphic	
















O010	Obey 10	“Right turn and left turn only”		Round	Blue background White graphic	be painted in the sign The graphic is that only trucks are allowed to turn right
O011	Obey 11	“Straight-through only lane”		Square	Blue background White graphic	
O012	Obey 12	“Right-turn only lane”		Square	Blue background White graphic	
O013	Obey 13	“Left-turn only lane”		Square	Blue background White graphic	
O014	Obey 14	“Straight-through and right-turn only lane”		Square	Blue background White graphic	
O015	Obey 15	“Straight-through and left-turn only lane”		Square	Blue background White graphic	
O016	Obey 16	“One-way street”		Square	Blue background White graphic	Where a signboard is parallel to a one-way street
O017	Obey 17	“One-way street”		Square	Blue background White graphic	Where a signboard is perpendicular to a one-way street
O018	Obey 18	“Keep right”		Round	Blue background White graphic	
O019	Obey 19	“Keep left”		Round	Blue background White graphic	
O020	Obey 20	“Two-stage left-turn for scooters and bicycles”		Round	Blue background White graphic	
O021	Obey 20.1	“Two-stage right-turn for scooters and bicycles”		Round	Blue background White graphic	
O022	Obey 21	“Move with traffic”		Round	Blue background White graphic	



O023	Obey 22	“Pedestrians only”		Round	Blue background White graphic		
O024	Obey 22-1	“Pedestrians and bicycles only”		Round	Blue background White graphic	Any other traffic rules shall be described in the signboard 	
O025	Obey 23	“Vehicles with more than four wheels only”		Round	Blue background White graphic	E x c l u s i v e r o a d s i g n s	
O026	Obey 23.1	“Vehicles with more than four wheels and motorcycles only”		Round	Blue background White graphic		Any large-capacity motorcycle with a total cylinder displacement more than 550cm ³
O027	Obey 23.2	“Vehicles with more than four wheels and motorcycles only”		Round	Blue background White graphic		
O028	Obey 24	“Scooters and bicycles only”		Round	Blue background White graphic		
O029	Obey 25	“Buses only”		Square	Blue background White graphic		
O030	Obey 26	“Vehicles with more than four wheels only”		Round	Blue background White graphic		
O031	Obey 26.1	“Vehicles with more than four wheels and motorcycles only”		Square	Blue background White graphic	E x c l u s i v e r o a d s i g n e	Any large-capacity motorcycle with a total cylinder displacement more than 550cm ³
O032	Obey 26.2	“Vehicles with more than four wheels and motorcycles only”		Square	Blue background White graphic	h i c l e	







O033	Obey 27	“Scooter and bicycles only”		Square	Blue background White graphic	lane signs	
O034	Obey 28	“Buses only”		Square	Blue background White graphic		
O035	Obey 28.1	“Bicycles only”		Square	Blue background White graphic		
O036	Obey 28.2	“Bicycles only”		Square	Blue background White graphic		Erected on any road near a place where the lane will be entered
O037	Obey 28.3	“MRT vehicles only”		Square	Blue background White graphic		
O038	Obey 28.4	“High occupancy vehicles only”		Square	Blue background White graphic		
O039	Obey 29	“Tire chain installation”		Round	Blue background White graphic		
O040	Obey 30	“Honk”		Round	Blue background White graphic		
O041	Obey 30-1	“Turn on the headlights”		Round	Blue background White graphic		
O042	Obey 31	“Single-track railroad crossing”		X-shaped	White background and red border		
				Square	White background and black border Red graphic		
O043	Obey 32	“Crossing of railroad with more than two tracks”		X-shaped	White background and red border		
				Square	White background and black border Red graphic		

O044	Obey 33	“Single-track electrified railroad crossing”		X-shaped	White background and red border	
				Round	White background Red graphic	
				Square	White background and black border Red graphic	
O045	Obey 34	“Crossing of electrified railroad with more than two tracks”		X-shaped	X-shaped	
				Round	Round	
				Square	Square	













A.7 Prohibition sign code

Table A.8 Prohibition sign code













Class: Warning sign: Warning /Obeying sign: Obey / Prohibition sign: Prohibit / Restriction sign: Restrict / Instruction sign: Instruction / Assisting sign: Assist

P001	Prohibition 1	“No entry”		Round	Red background White graphic	
P002	Prohibition 2	“No cars”		Round	White background and red border Black graphic	
P003	Prohibition 2.1	“No motorcycles”		Round	White background and red border Black graphic	Any large-capacity motorcycle with a total cylinder displacement more than 550cm ³
P004	Prohibition 2.2	“No motorcycles”		Round	White background and red border Black graphic	



P005	Prohibition 3	“No scooters and bicycles”		Round	White background and red border Black graphic	
P006	Prohibition 3.1	“No buses”		Round	White background and red border Black graphic	
P007	Prohibition 4	“No trucks and tractor trailers”		Round	White background and red border Black graphic	
P008	Prohibition 5	“No tractor trailers”		Round	White background and red border Black graphic	
P009	Prohibition 6	“No buses, trucks and tractor trailers”		Round	White background and red border Black graphic	
P010	Prohibition 7	“No unload taxis”		Round	White background and red border Black graphic	
P011	Prohibition 9	“No tricycles”		Round	White background and red border Black graphic	
P012	Prohibition 10	“No bicycles”		Round	White background and red border Black graphic	
P013	Prohibition 11	“No electric bicycles”		Round	White background and red border Black graphic	
P014	Prohibition 12	“No animal-drawn vehicles”		Round	White background and red border Black graphic	
P015	Prohibition 13	“No tricycles and animal-drawn vehicles”		Round	White background and red border Black graphic	
P016	Prohibition 15	“No scooters, motorcycle and cars”		Round	White background and red border Black graphic	










P017	Prohibition 16	“Do not enter”		Square	White background Red graphic	
P018	Prohibition 17	“No right turn”		Round	White background and red border Black graphic	
P019	Prohibition 18	“No left turn”		Round	White background and red border Black graphic	
P020	Prohibition 19	“No left or right turn”		Round	White background and red border Black graphic	
P021	Prohibition 20	“No right turn or straight through”		Round	White background and red border Black graphic	
P022	Prohibition 21	“No left turn or straight through”		Round	White background and red border Black graphic	
P023	Prohibition 22	“No U-turn”		Round	White background and red border Black graphic	
P024	Prohibition 23	“No overtaking”		Round	White background and red border Black graphic	
P025	Prohibition 24	“No pedestrians”		Round	White background and red border Black graphic	
P026	Prohibition 25	“No parking”		Round	White background and red border Black graphic	
P027	Prohibition 26	“No temporary parking”		Round	Blue background and red border Red graphic	
P028	Prohibition 27	“No meeting”		Round	White background and red border Red and black graphics	

A.8 Restriction sign code

Table A.9 Restriction sign code







Class: Warning sign: Warning /Obeying sign: Obey / Prohibition sign: Prohibit / Restriction sign: Restrict / Instruction sign: Instruction / Assisting sign: Assist

R001	Restriction 1	“Vehicle gross weight limit”		Round	White background and red border Black graphic	
R002	Restriction 2	“Vehicle width limit”		Round	White background and red border	
R003	Restriction 3	“Vehicle height limit”		Round	Black graphic	
R004	Restriction 4	“Vehicle length limit”		Round	White background and red border	
R005	Restriction 4-1	“Safe distance limit”		Round	Black graphic	
R006	Restriction 5	“Maximum speed limit”		Round	White background and red border	
R007	Restriction 6	“Minimum speed limit”		Round	Blue background and white border White graphic	









A.9 Instruction sign code

Table A.10 Instruction sign code

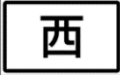





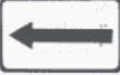


Class: Warning sign: Warning /Obeying sign: Obey / Prohibition sign: Prohibit / Restriction sign: Restrict / Instruction sign: Instruction / Assisting sign: Assist

I001	0	“Sightseeing area”		Square	Brown background and white border White graphic	Set in front of a junction to indicate the direction to a tourist attraction
I002	0.1	“Sightseeing area”		Square	Brown background and white border White graphic	Set at an upper reach of “instruction 0” to indicate the traffic direction
I003	0.2	“Sightseeing area”		Square	Brown background and white border White graphic	Set behind a junction or in the middle of a section to confirm the traffic direction and distance
I004	0.3	“Sightseeing area”		Square	Brown background and white border White graphic	Set at an appropriate place where a tourist attraction will be reached and used to indicate the location
I005	0.4	“Bikeway sign”		Square	Brown background and white border White graphic	
I006	0.5	“Bikeway sign”		Square	Brown background and white border White graphic	














I007	Instruction 1	“National highway number”		Quincunx	White background and green border Black graphic	
I008	Instruction 2	“Provincial highway number”		Peltate	Blue background, blue single border and white double borders White border	
I009	Instruction 2.1	“Provincial route number of expressways”		Peltate	Red background, blue single border and white double borders White border	
I010	Instruction 3	“County highway number”		Square	White background and black border Black graphic	Some branches are square
I011	Instruction 4	“Rural highway number”		Square	White background and black border Black graphic	Some branches are square
I012	Instruction 4.1	“Bikeway number sign”		Round	Brown background and white border White graphic	
I013	Instruction 7	“Highway direction”		Square	White background and black border Black graphic	
I014	Instruction 8	“Highway direction”		Square	White background and black border Black graphic	



I015	Instruction 9	“Highway direction”		Square	White background and black border Black graphic	
I016	Instruction 10	“Highway direction”		Square	White background and black border Black graphic	
I017	Instruction 11	“Go straight”		Square	White background and black border Black graphic	
I018	Instruction 12	“Turn left or right”		Square	White background and black border Black graphic	
I019	Instruction 13	“Turn right”		Square	White background and black border Black graphic	
I020	Instruction 14	“Turn right”		Square	White background and black border Black graphic	
I021	Instruction 15	“Turn left”		Square	White background and black border Black graphic	
I022	Instruction 16	“Turn left”		Square	White background and black border Black graphic	
I023	Instruction 17	“Go straight and turn right”		Square	White background and black border Black graphic	



I024	Instruction 18	“Go straight and turn right”		Square	White background and black border Black graphic	
I025	Instruction 19	“Go straight and turn left”		Square	White background and black border Black graphic	
I026	Instruction 20	“Go straight and turn left”		Square	White background and black border Black graphic	
I027	Instruction 21	“Place name”		Square	Green background and white border White graphic	
I028	Instruction 21.1	“Place name”		Square	Green background and white border White graphic	
I029	Instruction 22	“Place name and direction”		Square	Green background and white border White graphic	Graphics and colors indicating traffic directions and lane numbers are the same as number signs of highways at all levels
I030	Instruction 22.1	“Place name and direction”		Square	Green background and white border White graphic	Graphics and colors notifying traffic directions and lane numbers are the same as number signs of highways at all levels

I031	Instruction 22.2	“Place name and direction”		Square	Green background and white border White graphic	Graphics and colors indicating traffic directions and lane numbers are the same as number signs of highways at all levels
I032	Instruction 22.3	“Place name and direction”		Square	Green background and white border White graphic	Graphics and colors notifying traffic directions and lane numbers are the same as number signs of highways at all levels
I033	Instruction 22.4	“Place name and direction”		Square	Green background and white border White graphic	Graphics and colors indicating traffic directions and lane numbers are the same as number signs of highways at all levels
I034	Instruction 22.5	“Place name and direction”		Square	Green background and white border White graphic	Adopted vertical or suspension installation according to the road conditions, and graphics and colors of lane numbers are the same as number signs of highways at all levels







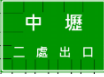

I035	Instruction 23	“Place name and mileage”		Square	Green background and white border White graphic	
I036	Instruction 23.1	“Place name and mileage”		Square	Green background and white border White graphic	
I037	Instruction 23.2	“Place name and mileage”		Square	Green background and white border White graphic	
I038	Instruction 24	“Direction and mileage”		Arrow	Green background and white border White graphic	If necessary, lane numbers shall be painted. Patterns and colors of lane numbers are the same as number signs of highways at all levels
I039	Instruction 25	“Road name”		Square	Green background and white border White graphic	Graphics and colors of lane numbers are the same as number signs of highways at all levels. Set signs at the following locations if there is a traffic island.

I040	Instruction 25.1	“Road name”		Square	Green background and white border White graphic	Graphics and colors of lane numbers are the same as number signs of highways at all levels.
I041	Instruction 26	“Climbing lane ahead”		Square	White background, black border and black graphic	
I042	Instruction 27	“Slow vehicles keep right”		Square	White background, black border and black graphic	
I043	Instruction 28	“Large vehicles keep right”		Square	White background, black border and black graphic	
I044	Instruction 29	“Lane guide”		Square	Green background, white border and white graphic	
I045	Instruction 30	“Freeway (expressway) guide”		Square	Green background, white border and white graphic	
I046	Instruction 30.1	“Freeway (expressway) guide”		Square	Green background, white border and white graphic	
I047	Instruction 30.2	“Freeway (expressway) guide”		Square	Green background, white border and white graphic	



I048	Instruction 31	“Freeway (expressway) exit ahead”		Square	Green background, white border and white graphic	Set at an appropriate place 2 km ahead of an interchange exit
I049	Instruction 32	“Freeway (expressway) exit ahead”		Square	Green background, white border and white graphic	Set at an appropriate place 1 km ahead of an interchange exit
I050	Instruction 33	“Freeway (expressway) exit ahead”		Square	Green background, white border and white graphic	Set at an appropriate place between the starting point of the exit deceleration lane and the nose, which is necessary
I051	Instruction 33.1	“Freeway (expressway) exit ahead”		Square		Where exit routes are complicated or it is necessary to mark the indirect access
I052	Instruction 33.2	“Freeway (expressway) exit ahead”		Square	Green background, white border and white graphic	Where it is necessary to mark the indirect access
I053	Instruction 33-1	“Distance from the freeway (expressway) exit”		Square	Green background, white border and white graphic	
I054	Instruction 33-1.1	“Distance from the freeway (expressway) exit”		Square	Green background, white border and white graphic	













I055	Instruction 33-1.2	“Distance from the freeway (expressway) exit”		Square	Green background, white border and white graphic	
I056	Instruction 33-2.1	“Freeway (expressway) HOV lane start (end) point ahead”		Square	Green background, white border and white graphic	
I057	Instruction 33-2.2	“Freeway (expressway) HOV lane start (end) point ahead”		Square	Green background, white border and white graphic	Set at an appropriate place 1km ahead of the starting point of a HOV lane
I058	Instruction 33-2.3	“Freeway (expressway) HOV lane start (end) point ahead”		Square	Green background, white border and white graphic	Set at an appropriate place 500m ahead of the starting point of a HOV lane, which is necessary
I059	Instruction 33-3.1	“Freeway (expressway) HOV lane start (end) point ahead”		Square	Green background, white border and white graphic	
I060	Instruction 33-3.2	“Freeway (expressway) HOV lane start (end) point ahead”		Square	Green background, white border and white graphic	
I061	Instruction 34	“Number of freeway exits”		Square	Green background, white border and white graphic	
I062	Instruction 35	“Street name and mileage at freeway exit”		Square	Green background, white border and white graphic	



I063	Instruction 36	“Freeway (expressway) interchange name”		Square	Yellow background and black border Black graphic		
I064	Instruction 37	“Freeway (expressway) exit”		Square	Green background and white border White graphic		
I065	Instruction 38	“Freeway service area ahead”		Square			
I066	Instruction 39	“Direction of freeway service area entrance”		Square			
I067	Instruction 40	“Gas food lodging ahead”		Square			
I068	Instruction 41	“Direction of gas food lodging entrance”		Square			
I069	Instruction 42	“Toll station ahead”		Square			
I070	Instruction 43	“Highway advisory radio”		Square			
I071	Instruction 44	“Milestone”		Square	Upper row	White background and Black graphic	Set on an ordinary highway
					Lower row	Black background and White graphic	
I072	Instruction 45	“Milestone”		Square	Green background and white graphic	Set on a freeway or an ordinary highway	
I073	Instruction 46	“Parking lot”		Square	Blue background and White graphic	Use a signboard to describe the	

I074	Instruction 47	“Parking lot”		Square	Blue background White graphic	instruction direction, vehicle type, charge time, charge way and parking lot name.
I075	Instruction 48	“Parking lot”		Square	Blue background White graphic	Set at an appropriate place within 500m of the parking lot as required
I076	Instruction 48.1	“Parking lot”		Square	Blue background White graphic	
I077	Instruction 49	“Parking space for disabilities”		Square	Blue background White graphic	
I078	Instruction 52	“Vehicle impound lot”		Square	Blue background White graphic	
I079	Instruction 53	“Transport station”		Square	Blue background White and black graphic	MRT station
I080	Instruction 53.1	“Transport station”		Square	Blue background White and black graphic	Airport
I081	Instruction 53.2	“Transport station”		Square	Blue background White and black graphic	Port
I082	Instruction 53.3	“Transport station”		Square	Blue background White and black graphic	Railway station
I083	Instruction 53.4	“Transport station”		Square	Blue background White and black graphic	High speed railway station
I084	Instruction 53.5	“Transport station”		Square	Blue background White and black graphic	Bus station or forwarding station




I085	Instruction 53-5.1	“Transport station”		Square	Blue background White and black graphic	Cable car station
I086	Instruction 53-5.2	“Transport station”		Square	Blue background White and black graphic	If different carriers share the station yard, it can be set in a coplanar way
I087	Instruction 53-5.3	“Transport station”		Square	Blue background White and black graphic	Type or name of the station yard can be described in words
I088	Instruction 53-1	“Agency (institution)”		Square	Blue background White graphic	
I089	Instruction 54	“Pedestrian overpass”		Square	Blue background White graphic	
I090	Instruction 55	“Pedestrian underpass”		Square	Blue background White graphic	
I091	Instruction 56	“Aid station”		Square	White background and blue border Red graphic	
I092	Instruction 57	“Repair station”		Square	White background and blue border Black graphic	
I093	Instruction 58	“Petrol station”		Square	White background and blue border Red and black graphic	
I094	Instruction 58-1	“Natural gas station”		Square	White background and blue border Red and black graphic	



I095	Instruction 58-2	“Charging station”		Square	White background and blue border Red and black graphic	
I096	Instruction 59	“Phone”		Square	White background and blue border Black graphic	White background and red graphic for “emergency call”
I097	Instruction 60	“Ferry”		Square	White background and blue border Black graphic	
I098	Instruction 61	“Catering service”		Square	White background and blue border Black graphic	
I099	Instruction 62	“School”		Square	Blue background White graphic	
I100	Instruction 63	“Hospital”		Square	Blue background White graphic	
I101	Instruction 64	“Passing bay”		Square	Blue background White graphic	
I102	Instruction 65	“No through road”		Square	Blue background Red and white graphic	
I103	Instruction 66	“Turning lane”		Square	Green background and white border White graphic	
I104	Instruction 67	“Detour”		Square	Green background White and black graphic	Graphics and colors of control signs shall be the same as those of the original control signs

I105	Instruction 68	“Road obstruction indication”		Square	Unblocked	Green background White graphic	<p>Signboard (1) shall be painted “unblocked” in white on green background, and painted “closed” in white on red background when the road is blocked.</p> <p>Signboard (2) shall be with white background, to indicate the matters to be paid attention to on roads, such as small graphics of “maximum speed”, “attention for falling rocks” and “tire chain installation”.</p> <p>Signboard (3) shall be painted “fully opened” in black on white background when the road is clear, and painted “through to × ×” when the road is closed.</p>
					Closed	Red background White graphic	
					Remark	White background Black graphic	
I106	Instruction 69	“Alternative route guide”		Square	Fluorescent yellow-green background, black border and black graphic	Indicate the direction to a specified place, and set at the upper	











I107	Instruction 69.1	“Alternative route guide”		Square	Fluorescent yellow-green background, black border and black graphic	reach of a junction
I108	Instruction 69.2	“Alternative route guide”		Square	Fluorescent yellow-green background, black border and black graphic	Indicate the mileage to a specified place, and set at the lower reach of a junction or in the middle of a section. The mileage shall be in round figures.
I109	Instruction 69.3	“Alternative route guide”		Square	Fluorescent yellow-green background, black border and black graphic	Indicate the mileage to a specified place, and set at the lower reach of a junction or in the middle of a section. The mileage shall be in round figures.

A.10 Assisting sign code

Table A.11 Assisting sign code









Class: Warning sign: Warning /Obeying sign: Obey / Prohibition sign: Prohibit / Restriction sign: Restrict / Instruction sign: Instruction / Assisting sign: Assist

A001	Assisting 1	“Lane ahead”		Square	Blue background White graphic	
A002	Assisting 2	“Safe direction guide”		Square	Yellow background Black graphic	
A003	Assisting 3	“Reversible lane line guide”		Square	Yellow background and black border Black graphic	
A004	Rejection 1	“Road works ahead”		Square	Orange background and thin black border Black graphic	
A005	Rejection 2	“Slow down”		Square	Orange background and thin black border Black graphic	
A006	Rejection 3	“Road closed”		Square	Orange background and thin black border Black graphic	
A007	Rejection 4	“Traffic diversion”		Square	Orange background and thin black border Black graphic	
A008	Rejection 5	“Traffic control”		Square	Orange background and thin black border Black graphic	





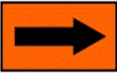






A009	Rejection 6	“Traffic diversion”		Square	Orange background and thin black border Black and white graphic	Right diversion
A010	Rejection 7	“Traffic diversion”		Square	Orange background and thin black border Black and white graphic	Left diversion
A011	Construction 1	“Road work ahead”		Diamond	Orange background and thin black border Black graphic	1km ahead
A012	Construction 2	“Road work ahead”		Diamond	Orange background and thin black border Black graphic	300m ahead
A013	Construction 3	“Road work ahead”		Diamond	Orange background and thin black border Black graphic	
A014	Construction 4	“Road closed ahead”		Diamond	Orange background and thin black border Black and white graphic	1km ahead
A015	Construction 5	“Road closed ahead”		Diamond	Orange background and thin black border Black and white graphic	300m ahead
A016	Construction 6	“Road closed ahead”		Diamond	Orange background and thin black border Black and white graphic	



A017	Construction 7	“Right lane closed ahead”		Diamond	Orange background and thin black border Black and white graphic	1km ahead
A018	Construction 8	“Right lane closed ahead”		Diamond	Orange background and thin black border Black and white graphic	300m ahead
A019	Construction 9	“Right lane closed ahead”		Diamond	Orange background and thin black border Black and white graphic	
A020	Construction 10	“Left lane closed ahead”		Diamond	Orange background and thin black border Black and white graphic	1km ahead
A021	Construction 11	“Left lane closed ahead”		Diamond	Orange background and thin black border Black and white graphic	300m ahead
A022	Construction 12	“Left lane closed ahead”		Diamond	Orange background and thin black border Black and white graphic	
A023	Construction 13	“Road closed in the middle”		Diamond	Orange background and thin black border Black and white graphic	1km ahead
A024	Construction 14	“Road closed in the middle”		Diamond	Orange background and thin black border Black and white graphic	300m ahead





A025	Construction 15	“Road closed in the middle”		Diamond	Orange background and thin black border Black and white graphic	
A026	Construction 16	“Traffic diversion”		Diamond	Orange background and thin black border Black and white graphic	Left diversion
A027	Construction 17	“Traffic diversion”		Diamond	Orange background and thin black border Black and white graphic	Right diversion
A028	Construction 18	“Diversion indication”		Square	Orange background and thin black border Black graphic	Left diversion
A029	Construction 19	“Diversion indication”		Square	Orange background and thin black border Black graphic	Right diversion
A030	Construction 20	“Single lane working”		Diamond	Orange background and thin black border Black and white graphic	
A031	None	Fixed barricade		Square	Orange and white background or White background and black graphic	
A032	None	Traffic cone		Conical	Orange or Orange and white twill	

A033	None	Breakdown warning triangle		Equilateral triangle	Red hollow	Removable
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A.11 Signal code

Table A.12 Traffic control signal code

Class: Traffic control signal: Vehicle / Pedestrian signal: Pedestrian / Special traffic signal: Special

Code	Canonical coding	Diagram	Description	color	Light shape	Size (m)	
						Diameter	Thickness
V001	Pretimed signal	<p>橫排者</p> 	Used in any place with steady or regularly changing traffic volume, to display various signals in the order specified in the schedule.	Red Yellow Green Green arrow	Round	Diameter	0.2 or 0.25 or 0.3
V002	Traffic responsive signal	<p>直排者</p> 	Used in any place where traffic volume changes significantly and irregularly, or where traffic volume of trunk and branch roads differs greatly	Red Yellow Green Green arrow	Round	Diameter	0.2 or 0.25 or 0.3

Code	Canonical coding	Diagram	Description	color	Light shape	Size (m)	
V003	Traffic-adjusted signal		Detectors are used to collect traffic data such as straight-going and turning traffic volume, driving speed, to calculate the optimal control program, so that the signal control can react to traffic changes in real time.				

Table A.13 Pedestrian signal code

Class: Traffic control signal: Vehicle / Pedestrian signal: Pedestrian / Special traffic signal: Special






P001	Pretimed signal	 	Used in any place with steady or regularly changing traffic volume, to display various signals in the order specified in the schedule.	Red Green	Square	Length of side	0.2 or 0.25 or 0.3
P002	Pedestrian push-button signal		Indicate button positions and usage methods.				

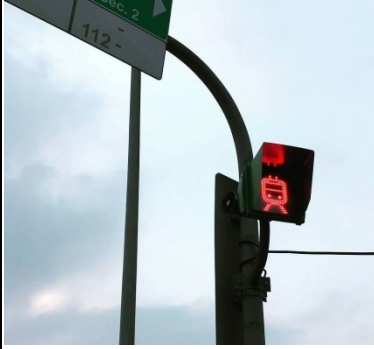
Table A.14 Special traffic signal code

Class: Traffic control signal: Vehicle / Pedestrian signal: Pedestrian / Special traffic signal: Special

S001	Lane control signal		Assign the right to use lanes, and set in the middle of roads or at toll stations. In addition, square yellow signals with arrow patterns can be added on roads to warn approaching vehicles to change their lanes.	Red Green	Square	Length of side	0.3
S002	Railroad crossing signal		Pedestrians and vehicles are not allowed to cross railroad crossings. The signals shall be set in front of railroad crossings.	Red	Round	Diameter	0.2 or 0.25 or 0.3
S003	Pedestrian crossing signal		Warn approaching vehicles to slow down. If pedestrians are crossing, stop and give priority to pedestrians to cross streets. The signals shall be set in front of zebra-stripe crosswalk lines.	Yellow	Round	Diameter	0.2 or 0.25 or 0.3

S004	Special flashing signal		<p>Warn approaching vehicles to pay attention to the traffic conditions ahead. Vehicles shall stop or slow down, and then proceed according to the traffic conditions. The signals shall be set in front of junctions or dangerous areas.</p>	Red Yellow	Round	Diameter	0.2 or 0.25 or 0.3
S005	Audible pedestrian signal		<p>Use acoustics to inform blind people of passable roads and to warn drivers of passing blind people. Set at junctions or sections near places with concentrated blind people, if necessary.</p>	None	None	None	None
S006	Ramp metering signal		<p>Control vehicles on entrance ramps, to restrict access to freeway (expressway) mainlines. Set at connections between entrance ramps and acceleration lanes.</p>	Red Green	Round	Diameter	0.2 or 0.25 or 0.3



S007	MRT audible and visual signal		Warn approaching vehicles and pedestrians to give way to MRT vehicles. Set at places near junctions or sections where MRT vehicles pass by.	Red	Square	None	None
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Annex B (Normative) OpenDRIVE code

This section lists the codes in OpenDRIVE 1.5 in tables, and extensions in this standard are shown in gray background.

Table B.1 Road type code

Item No.	Code	Definition
1.	unknown	Unknown
2.	rural	Rural highway
3.	motorway	Motorway ¹
4.	town	Town highway
5.	lowSpeed	Low road ²
6.	pedestrian	Sidewalk
7.	bicycle	Exclusive bicycle lane
8.	townExpressway	Expressway
9.	townCollector	Collector street
10.	townArterial	Urban arterial road
11.	townPrivate	Private road
12.	townLocal	Local highway
13.	townPlaystreet	Play street ³
14.	national highway	National highway
15.	provincial highway	Provincial highway
16.	county highway	County highway

¹ There are different types of freeways in abroad, including motorway and TownExpressway. The national highways mentioned in Item 14 are those under the jurisdiction of the Highway Bureau of the Ministry of Transportation and Communications.

² The term “low road”, a noun translated from a foreign language, refers to a road with no lane lines, lane-dividing lines or dividing limit lines in accordance with Article 93 of the *Road Traffic Safety Regulations*.

³ It is a special type of roads used in abroad and is not applicable in our country.

Table B.2 Road mark type code

Item No.	Code	Definition
1	none	None
2	solid	Solid line
3	broken	Broken line
4	solid	Double solid lines
5	solid broken	A solid line and a broken line
6	broken solid	A broken line and a solid line
7	broken broken	Double broken lines
8	botts dots	Dot
9	grass	Grass edge
10	curb	Curb
11	custom	Custom, detailed in the subtag
12	edge	Road edge

Table B.3 Road mark weight type code

Item No.	Code	Definition
1	standard	Standard
2	bold	Bold

Table B.4 Road mark color type code

Item No.	Code	Definition
1	standard	Standard, usually white
2	blue	Blue
3	green	Green
4	red	Red
5	white	White
6	yellow	Yellow
7	orange	Orange

Table B.5 Lane type code, with those in gray background extended in this standard

Item No.	Code	Definition
1	none	None
2	driving	Lane
3	stop	No entry
4	shoulder	Shoulder
5	biking	Exclusive bicycle lane
6	sidewalk	Sidewalk
7	border	Border, boundary between lanes
8	restricted	Restriction
9	parking	Curb parking lot
10	bidirectional	Two-way lane, usually narrow roads
11	median	Median divider
12	special1	Special 1
13	special2	Special 2
14	special3	Special 3
15	roadWorks	Road works
16	tram	Exclusive light tram lane
17	rail	Railroad
18	entry	Entry
19	exit	Exit
20	offRamp	Off ramp
21	onRamp	On ramp
22	connectingRamp	Connecting ramp
23	bus	Exclusive bus lane
24	taxi	Exclusive taxi lane
25	HOV	High occupancy vehicle lane
26	slow	Slow road, speed limit of 40km
27	barrier	Barrier
28	inner shoulder	Inner shoulder
29	outer shoulder	Outer shoulder
30	trafficIsland	Traffic island
31	bus parking	Bus parking lot
32	public utilities	Public utilities

Table B.6 Object type code, with those in gray background extended in this standard

Item No.	Code	Definition
1	none	Unknown
2	obstacle	Obstacle, any object not classified
3	pole	Telegraph pole
4	tree	Tree
5	vegetation	Vegetation
6	barrier	Barrier
7	building	Building
8	parkingspace	Parking space
9	patch	Patch
10	railing	Railing
11	trafficIsland	Traffic island
12	crosswalk	Crosswalk
13	streetLamp	Street lamp
14	gantry	gantry (gantry)
15	soundBarrier	Sound barrier
16	deceleration	Deceleration (speed hump)
17	drainCover	Drain cover
18	manholeCover	Manhole over
19	hydrant	Hydrant
20	speedCamera	Speed camera
21	redLightCamera	Red light camera
22	trafficPole	Traffic pole
23	delineator	Delineator
24	danger	Danger label

Table B.7 Tunnel type code

Item No.	Code	Definition
1	standard	General condition
2	underpass	Underpass

Table B.8 Bridge type code

Item No.	Code	Definition
1	concrete	Concrete
2	steel	Steel
3	brick	Brick
4	wood	Wood

Table B.9 Access restriction type code

Item No.	Code	Definition
1	simulator	Simulator
2	autonomousTraffic	Exclusive autonomous vehicle lane
3	pedestrian	Pedestrian
4	passengerCar	Passenger car
5	bus	Bus
6	delivery	Delivery
7	emergency	Emergency
8	taxi	Taxi
9	throughTraffic	Through traffic
10	truck	Truck
11	bicycle	Bicycle
12	motorcycle	Motorcycle
13	none	No traffic restrictions

Table B.10 Border type code

Item No.	Code	Definition
1	concrete	Concrete
2	curb	Curb

Annex C (Normative) XML schema of extended design

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XMLSpy v2013 (http://www.altova.com) by () -->
<xs:schema xmlns:hdmap="https://www.land.moi.gov.tw/hdmap/1.0"
xmlns:xs="http://www.w3.org/2001/XMLSchema"
targetNamespace="https://www.land.moi.gov.tw/hdmap/1.0"
elementFormDefault="qualified" attributeFormDefault="unqualified">
  <xs:element name="HDMMap">
    <xs:annotation>
      <xs:documentation>放置於 road 內的 userdata，取代 any</xs:documentation>
    </xs:annotation>
    <xs:complexType>
      <xs:sequence>
        <xs:element name="geoLocation" type="xs:string" minOccurs="0"/>
        <xs:element name="LaneCenterLines" minOccurs="0">
          <xs:complexType>
            <xs:sequence>
              <xs:element ref="hdmap:LaneCenterLine" minOccurs="0"
maxOccurs="unbounded"/>
            </xs:sequence>
          </xs:complexType>
        </xs:element>
        <xs:element name="Waypoints" minOccurs="0">
          <xs:complexType>
            <xs:sequence>
              <xs:element ref="hdmap:Waypoint" minOccurs="0"
maxOccurs="unbounded"/>
            </xs:sequence>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>
```



```

</xs:element>
<xs:element name="StopLines" minOccurs="0">
  <xs:complexType>
    <xs:sequence>
      <xs:element ref="hdmap:StopLine" minOccurs="0"
maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:complexType>
</xs:element>
<xs:element name="SignalDatas" minOccurs="0">
  <xs:complexType>
    <xs:sequence>
      <xs:element ref="hdmap:SignalData" minOccurs="0"
maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:complexType>
</xs:element>
<xs:element name="Signs" minOccurs="0">
  <xs:complexType>
    <xs:sequence>
      <xs:element ref="hdmap: Sign" minOccurs="0"
maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:complexType>
</xs:element>
<xs:element name="MarkLines" minOccurs="0">
  <xs:complexType>
    <xs:sequence>
      <xs:element ref="hdmap:MarkLine" minOccurs="0"
maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:complexType>

```

```

</xs:element>
<xs:element name="MarkAreas" minOccurs="0">
  <xs:complexType>
    <xs:sequence>
      <xs:element ref="hdmap:MarkArea" minOccurs="0"
maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:complexType>
</xs:element>
<xs:element name="MarkGraphs" minOccurs="0">
  <xs:complexType>
    <xs:sequence>
      <xs:element ref="hdmap:MarkGraph" minOccurs="0"
maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:complexType>
</xs:element>
</xs:sequence>
</xs:complexType>
</xs:element>
<xs:element name="Sign" type="hdmap:MarkArea"/>
<xs:element name="SignalData" type="hdmap:SignalData"/>
<xs:element name="StopLine" type="hdmap:StopLine"/>
<xs:element name="MarkLine" type="hdmap:MarkLine"/>
<xs:element name="MarkArea" type="hdmap:MarkArea"/>
<xs:element name="MarkGraph" type="hdmap:MarkGraph"/>
<xs:element name="LaneCenterLine" type="hdmap:LaneCenterLine"/>
<xs:element name="Waypoint" type="hdmap:Waypoint"/>
<xs:complexType name="Sign">
  <xs:sequence>
    <xs:element name="id" type="xs:string"/>
    <xs:element name="code" type="xs:string"/>

```

```
<xs:element name="geoLocation" type="xs:string"/>
<xs:element name="bboxMin" type="xs:string"/>
<xs:element name="bboxMax" type="xs:string"/>
</xs:sequence>
</xs:complexType>
<xs:complexType name="SignalData">
  <xs:sequence>
    <xs:element name="id" type="xs:string"/>
    <xs:element name="code" type="xs:string" maxOccurs="unbounded"/>
    <xs:element name="angle" type="xs:double"/>
    <xs:element name="geoLocation" type="xs:string"/>
    <xs:element name="radius" type="xs:double"/>
    <xs:element name="bboxMin" type="xs:string"/>
    <xs:element name="bboxMax" type="xs:string"/>
  </xs:sequence>
</xs:complexType>
<xs:complexType name="StopLine">
  <xs:sequence>
    <xs:element name="id" type="xs:string"/>
    <xs:element name="code" type="xs:string"/>
    <xs:element name="signalId" type="xs:string" maxOccurs="unbounded"/>
    <xs:element name="width" type="xs:double"/>
    <xs:element name="geoLocation" type="xs:string"/>
  </xs:sequence>
</xs:complexType>
<xs:complexType name="MarkLine">
  <xs:sequence>
    <xs:element name="id" type="xs:string"/>
    <xs:element name="code" type="xs:string"/>
    <xs:element name="geometry" type="xs:string"/>
  </xs:sequence>
</xs:complexType>
```

```
<xs:complexType name="MarkArea">
  <xs:sequence>
    <xs:element name="id" type="xs:string"/>
    <xs:element name="code" type="xs:string"/>
    <xs:element name="geometry" type="xs:string"/>
  </xs:sequence>
</xs:complexType>
<xs:complexType name="MarkGraph">
  <xs:sequence>
    <xs:element name="id" type="xs:string"/>
    <xs:element name="code" type="xs:string"/>
    <xs:element name="markAreaId" type="xs:string"/>
    <xs:element name="geometry" type="xs:string"/>
  </xs:sequence>
</xs:complexType>
<xs:complexType name="LaneCenterLine">
  <xs:sequence>
    <xs:element name="id" type="xs:string"/>
    <xs:element name="type" type="xs:string"/>
    <xs:element name="predecessor" type="xs:string" minOccurs="0"/>
    <xs:element name="successor" type="xs:string" minOccurs="0"/>
    <xs:element name="width" type="xs:string"/>
    <xs:element name="material" type="xs:string"/>
    <xs:element name="speed" type="xs:integer" minOccurs="0"/>
    <xs:element name="restriction" type="xs:string" minOccurs="0"/>
    <xs:element name="height" type="xs:double" minOccurs="0"/>
    <xs:element name="weight" type="xs:double" minOccurs="0"/>
    <xs:element name="startWaypoint" type="xs:string"/>
    <xs:element name="endWaypoint" type="xs:string"/>
    <xs:element name="geoLocation" type="xs:string"/>
    <xs:element name="tunnelId" type="xs:string" minOccurs="0"/>
    <xs:element name="bridgeId" type="xs:string" minOccurs="0"/>
  </xs:sequence>
</xs:complexType>
```



```
</xs:sequence>
</xs:complexType>
<xs:complexType name="Waypoint">
  <xs:sequence>
    <xs:element name="id" type="xs:string"/>
    <xs:element name="velocity" type="xs:double"/>
    <xs:element name="stoplineId" type="xs:string" minOccurs="0"/>
    <xs:element name="geoLocation" type="xs:string"/>
  </xs:sequence>
</xs:complexType>
<xs:element name="geoLocation" type="xs:string">
  <xs:annotation>
    <xs:documentation>放置於 lane、tunnel、bridge 內的 userdata，取代
any</xs:documentation>
  </xs:annotation>
</xs:element>
<xs:element name="objectAtts">
  <xs:annotation>
    <xs:documentation>放置於 object 內的 userdata，取代 any</xs:documentation>
  </xs:annotation>
  <xs:complexType>
    <xs:sequence>
      <xs:element name="poleType" type="xs:string"/>
      <xs:element name="pointGeoLocation" type="xs:string"/>
      <xs:element name="zTop" type="xs:double"/>
      <xs:element name="extentGeoLocation" type="xs:string"/>
      <xs:element name="lampGeoLocation" type="xs:string"/>
    </xs:sequence>
  </xs:complexType>
</xs:element>
<xs:element name="signalAtts">
  <xs:annotation>
```



```
<xs:documentation>放置於 signal 內的 userdata，取代 any</xs:documentation>
</xs:annotation>
<xs:complexType>
  <xs:sequence>
    <xs:element name="code" type="xs:string"/>
    <xs:element name="signalDataId" type="xs:string"/>
    <xs:element name="stopLineId" type="xs:string"/>
  </xs:sequence>
</xs:complexType>
</xs:element>
</xs:schema>
```

References

- (1) Highway Route Design Specifications，民國 104 年 12 月 4 日。
- (2) Highway Tunnel Design Specifications，民國 107 年 2 月 6 日。
- (3) Highway Bridge Design Specifications 公路橋梁設計規範，民國 98 年 12 月 31 日。
- (4) 市區道路及附屬工程設計規範，民國 104 年 7 月 22 日。
- (5) 交通工程規範，民國 104 年 12 月 9 日。
- (6) TAICS TR-0010 v2.0 高精地圖製圖作業指引 v2，民國 108 年 10 月 17 日。

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