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Data Encoding Specification of i-Urban Revitalization

- Urban Planning ADE –

ver.1.3

Contents

Introduction

Urban planning has been contributing to the formation of healthy urban environments, preventing disorganized urban sprawl and encouraging infrastructure development in Japan. However, urban areas in Japan, which is facing depopulation and aging society, are at a big turning point. New social issues such as a rapid increase of empty apartments and lands, and non-universal design of facilities lie heavily on their sustainable development, especially regional area. Efficient urban management is required, and municipalities recognize the significance and importance of compact urban development from the perspective of administrative costs.

From this kind of circumstance, the Japanese government strongly promotes i) formation of a high-quality urban revitalization project for regional hub cities, ii) consensus building among those concerned, and iii) investor's understanding, according to the concepts *"Selection and Concentration"* and "*Respect for Local Intention*".

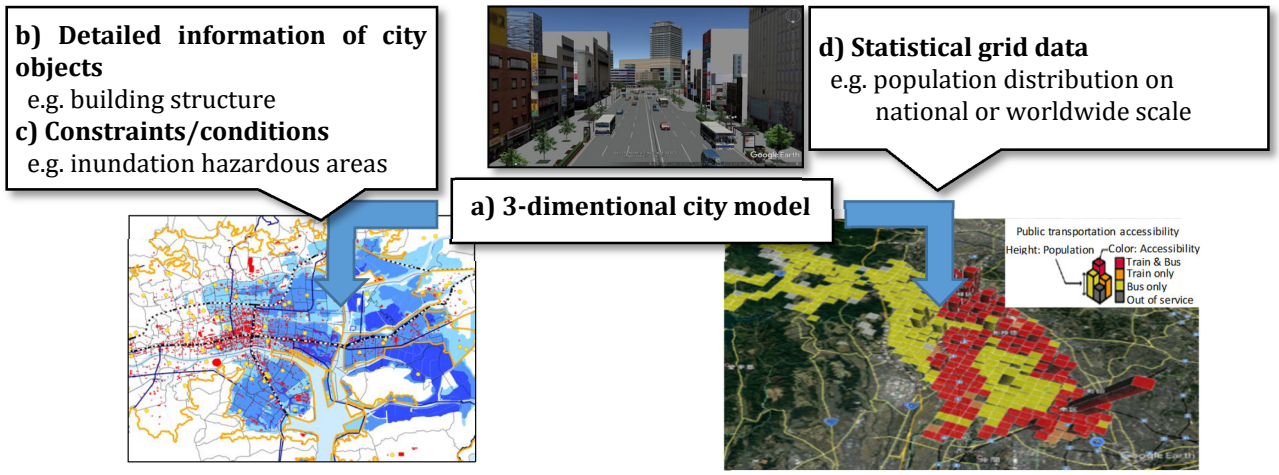
Recently, the investment climate has changed dramatically with the expansion of the Internet and the development of information communication technologies such as "Fin-Tech". Information-intensive activities are very important to call for investment.

The "i-UR" is an information infrastructure for urban revitalization. It allows people to analyse and to visualize the situation and problems of urban areas according to the future vision of each area using geospatial information and virtual reality technologies. The quantitative analysis and visualization clearly show the cash-flow and spatial plan of the city and promotes understanding and encourages consensus building among relevant players, e.g. investors, citizens, and developers.

This document defines the encoding specification of the data for i-UR (which is called "i-UR Data"), and aims to assist the formation of social agreement and to improve the quality of urban investment in order to contribute to urban revitalization.

The i-UR Data is the combination of following data:

a) 3-dimentional city objects and city model
b) Detailed information of city objects for analysis
c) Constraints/conditions (e.g. regulation) related to urban revitalization
d) Statistical grid data for global analysis and visualization



Example of analysis: Damage estimation by flood

Example of analysis: Overhaul of transportation network

Figure 1 Structure of i-UR Data

The i-UR Data Encoding Specification targets on b) to d) data, as a) is already defined in City Geography Markup Language (CityGML). CityGML is an XML/GML based 3D data standard developed by Open Geospatial Consortium (OGC) for the representation, storage and exchange of 3D city models and is widely used in the application fields related to urban areas.

The i-UR Data Encoding Specification is composed of three parts listed below. Each encoding specification is tied up with each component and is an extension of CityGML according to the rules of the Application Domain Extensions (ADE) to ensure data interoperability. Thus i-UR Data aims to be utilized in various application fields, such as disaster prevention, tourism and to carry out urban revitalization.

Part 1: Urban Object Data Encoding Specification
This document targets on *b) Detailed information of city objects for analysis* and defines them as properties of CityGML object.

Part 2: Urban Function Data Encoding Specification
This document targets on *c) Constraints/conditions related to urban revitalization* and defines constraints and conditions as subclasses of the root class in CityGML.

Part 3: Statistical Grid Data Encoding Specification
This document targets on *d) Statistical grid data for global analysis and visualization,* and defines a statistical grid as subclasses of the root class in CityGML and new Levels of Detail (LOD) for a broad description of city models. CityGML already supports different LODs. LODs are required to reflect independent data collection processes with differing application requirements. This document extends LODs to describe rough city models which do not have to be detailed but should be described with a unified unit among cities. This enables users to analyse and visualise cities under the same conditions.

Part 1. Urban Object Data Encoding Specification

1. Scope

Detailed information of buildings, roads, and other objects which constitute urban areas are necessary for the quantitative assessment of the current situation and problems in urban areas.

This document defines additional information of urban objects which is necessary for urban assessment as attributes of urban objects and specifies the encoding format of the information.

2. Normative references

Followings are normative references of this document.

- OpenGIS® OGC City Geography Markup Language (CityGML) Encoding Standard, Version 2.0, OGC document 12-019

3. Conventions

3.1 Terms and definitions

No terms and definitions are listed in this document.

3.2 Abbreviated terms

ADE Application Domain Extensions

CityGML City Geography Markup Language

GML Geography Markup Language

LOD Levels Of Details

OGC Open Geospatial Consortium

UML Unified Modeling Language

4. Urban Object Data Encoding

4.1 Overview

The Urban Object Data Encoding is an extension of CityGML. This document defines the elements and types according to the rules of the Application Domain Extensions (ADE) which are necessary for urban assessment and planning, but not defined in CityGML. Those already defined in CityGML are imported without any inconsistency.

Figure 1-1 shows the structure of Urban Object Data. The package Urban Object imports some modules defined in CityGML, including Building, LandUse, Transportation and CityObjectGroup.

Note: The CityGML extension UtilityNetwork ADE will be imported to this specification in future. The UtilityNetwork ADE defines concepts which allow for modelling different types of networks in the context of 3D city models, such as electricity, freshwater, wastewater, gas or telecommunication networks.

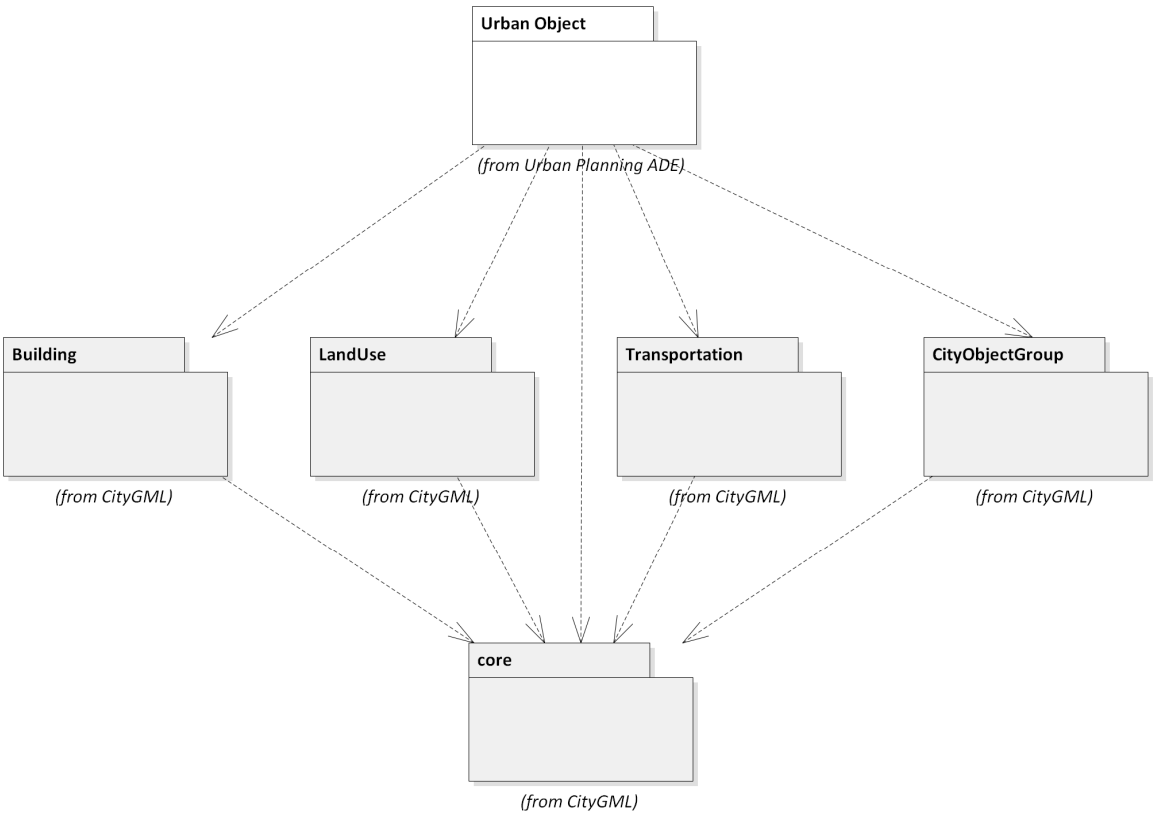


Figure 1-1 Package diagram of Urban Object Data

Module name	Urban Object
XML namespace identifier	http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/uro/1.3
XMLSchema location	http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/schemas/uro/1.3/urbanObject.xsd
Recommended namespace prefix	uro
Description	This module defines additional thematic and spatial aspects of city objects which enables users to examine and to analyse current situation and issues of urban areas. This module is the extension of the existing modules for city objects such as *building*, *land use*, *transportation* and *cityObjectGroup.*

4.2 Object definition

4.2.1 Extended properties of Building

This module defines two classes which describe the detailed information of a building which is the extension of the Building module in CityGML. These elements are declared as a member of the general property of *bldg::AbstractBuilding* shown in Figure 1-2 and the XMLSchema Definition is attached in Annex A.

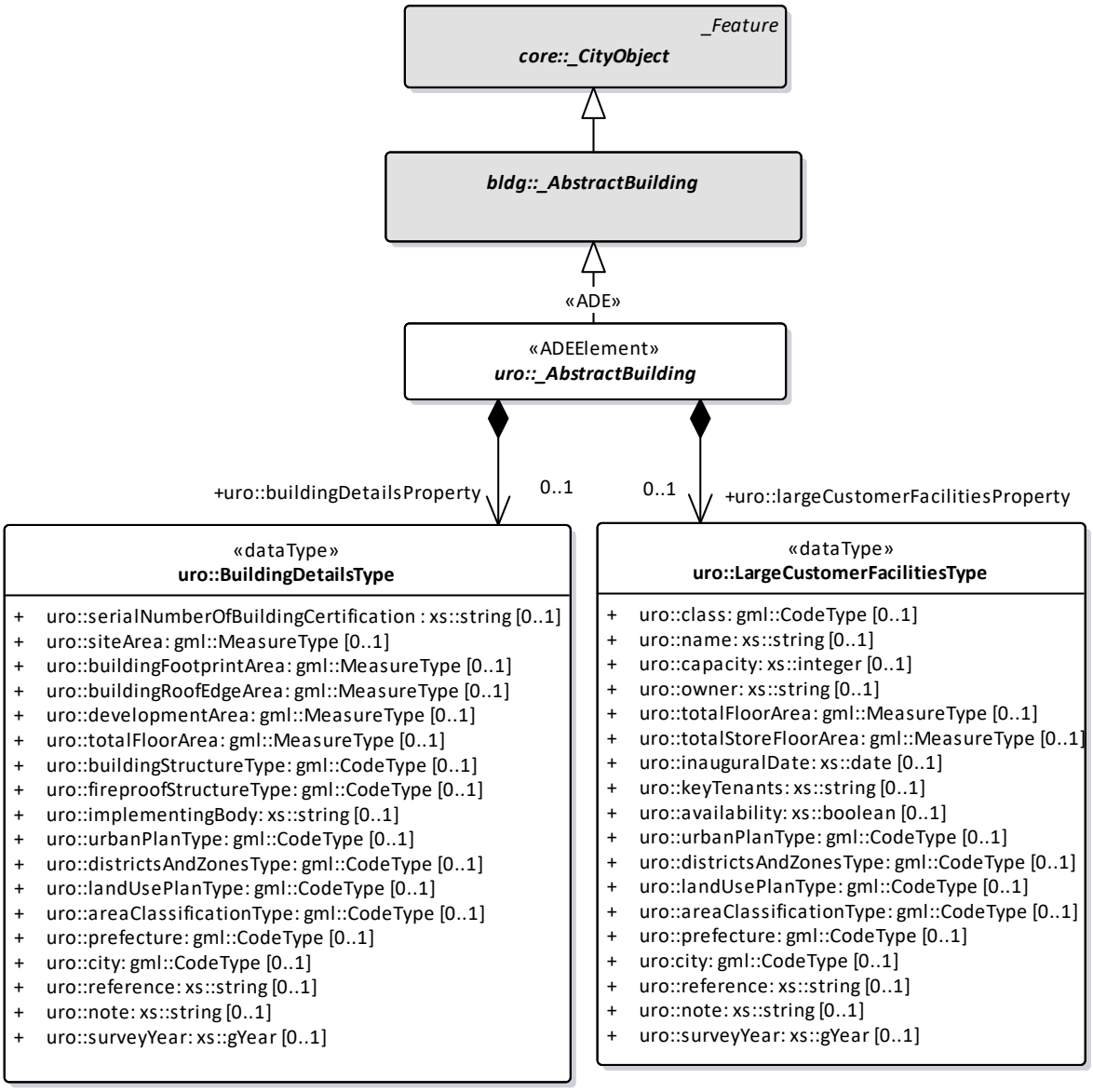


Figure 1-2 UML diagram of extended properties of AbstractBuilding. Element names with the prefix uro are defined within this module.

Extended properties of _AbstractBuilding

Property	Definition
uro::buildingDetailsProperty	Detailed descriptions of the building, e.g. building structure and total floor area
uro::largeCustomerFacilities Property	Current status of the building when if the building is a large customer facility

```
 <xs:element name="buildingDetails" type="BuildingDetailsPropertyType"
substitutionGroup="bldg:_GenericApplicationPropertyOfAbstractBuilding"/>
 <xs:element name="largeCustomerFacilities" type="LargeCustomerFacilitiesPropertyType"
substitutionGroup="bldg:_GenericApplicationPropertyOfAbstractBuilding"/>
```

A *uro::buildingDetailsProperty* contains detailed information of a building. A *uro:: largeCustomerFacilitiesProperty* contains detailed information for large customer facilities, such as shopping malls, hospitals and universities.

BuildingDetailsType

Type	**Definition**
uro::BuildingDetailsType	Detailed information of a building
Property	**Definition**
uro::serialNumberOfBuildingCertification	Serial number of the building certification
uro::siteArea	Site area of a building
uro::buildingFootprintArea	Building area of a footprint polygon
uro::buildingRoofEdgeArea	Building area of a roof edge polygon
uro::developmentArea	Development area
uro::totalFloorArea	Total floor area
uro::buildingStructureType	Structure type of the building
uro::fireproofStructureType	Fireproof structure type of the building
uro::implementingBody	Implement body of the building
uro::urbanPlanType	Type of the building location designated by Urban Plan
uro::districtAndZoneType	Type of the building location designated by Districts and Zones
uro::landUsePlanType	Type of the building location designated by Land Use Plan
uro::areaClassificationType	Type of the building location designated by Area classification
uro::prefecture	Prefecture name of the building location
uro::city	City name of the building location
uro::reference	Reference information of the building
uro::note	Additional information of the building
uro::surveyYear	Year of the survey

```
<xs:complexType name="BuildingDetailsType">
 <xs:sequence>
  <xs:element name="serialNumberOfBuildingCertification" type="xs:string" minOccurs="0"/>
  <xs:element name="siteArea" type="gml:MeasureType" minOccurs="0"/>
  <xs:element name="buildingFootprintArea" type="gml:MeasureType" minOccurs="0"/>
  <xs:element name="buildingRoofEdgeArea" type="gml:MeasureType" minOccurs="0"/>
  <xs:element name="developmentArea" type="gml:MeasureType" minOccurs="0"/>
  <xs:element name="totalFloorArea" type="gml:MeasureType" minOccurs="0"/>
  <xs:element name="buildingStructureType" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="fireproofStructureType" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="implementingBody" type="xs:string" minOccurs="0"/>
  <xs:element name="urbanPlanType" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="districtsAndZonesType" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="landUsePlanType" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="areaClassificationType" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="prefecture" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="city" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="reference" type="xs:string" minOccurs="0"/>
  <xs:element name="note" type="xs:string" minOccurs="0"/>
  <xs:element name="surveyYear" type="xs:gYear" minOccurs="0"/>
 </xs:sequence>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="BuildingDetails" type="BuildingDetailsType"/>
<!-- ========================================================================== -->
<xs:complexType name="BuildingDetailsPropertyType">
 <xs:sequence>
  <xs:element ref="BuildingDetails"/>
 </xs:sequence>
</xs:complexType>
```

LargeCustomerFacilitiesType

Type	**Definition**
uro:: LargeCustomerFacilitiesType	Detailed information of large-scale facilities which draw attention of customers
Property	**Definition**
uro::class	Type of the facilities
uro::name	Name of the facilities
uro::capacity	Capacity of the facilities
uro::owner	Name of the facilities' owner
uro::totalFloorArea	Total floor area
uro::totalStoreFloorArea	Total store floor area
uro::inauguralDate	Inaugural date of the facilities
uro::keyTenants	Name of the key tenants in the facilities
uro::availability	Service availability of the facilities
uro::urbanPlanType	Type of the facilities location designated by Urban Plan
uro::districtAndZoneType	Type of the facilities location designated by Districts and Zones
uro::landUsePlanType	Type of the facilities location designated by Land Use Plan
uro::areaClassificationType	Type of the facilities location designated by Area classification
uro::prefecture	Prefecture name of the facilities location
uro::city	City name of the facilities location
uro::reference	Reference information of the building
uro::note	Additional information of the building
uro::surveyYear	Year of the survey

```
<xs:complexType name="LargeCustomerFacilitiesType">
 <xs:sequence>
  <xs:element name="class" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="name" type="xs:string" minOccurs="0"/>
  <xs:element name="capacity" type="xs:integer" minOccurs="0"/>
  <xs:element name="owner" type="xs:string" minOccurs="0"/>
  <xs:element name="totalFloorArea" type="gml:MeasureType" minOccurs="0"/>
  <xs:element name="totalStoreFloorArea" type="gml:MeasureType" minOccurs="0"/>
  <xs:element name="inauguralDate" type="xs:date" minOccurs="0"/>
  <xs:element name="keyTenants" type="xs:string" minOccurs="0"/>
  <xs:element name="availability" type="xs:boolean" minOccurs="0"/>
  <xs:element name="urbanPlanType" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="districtsAndZonesType" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="landUsePlanType" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="areaClassificationType" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="prefecture" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="city" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="reference" type="xs:string" minOccurs="0"/>
  <xs:element name="note" type="xs:string" minOccurs="0"/>
  <xs:element name="surveyYear" type="xs:gYear" minOccurs="0"/>
 </xs:sequence>
</xs:complexType>
<!-- ========================================================================== -->
 <xs:element name="LargeCustomerFacilities" type="LargeCustomerFacilitiesType"/>
<!-- ========================================================================== -->
 <xs:complexType name="LargeCustomerFacilitiesPropertyType">
  <xs:sequence>
   <xs:element ref="LargeCustomerFacilities"/>
  </xs:sequence>
 </xs:complexType>
```

4.2.2 Extended properties of LandUse

This module defines one extended attribute of *luse::LandUse* as a member of the substitution group *luse::_GenericApplicationPropertyOfLandUse.*

Figure 1-3 shows the extended properties for LandUse module and the XMLSchema Definition is attached in Annex A.

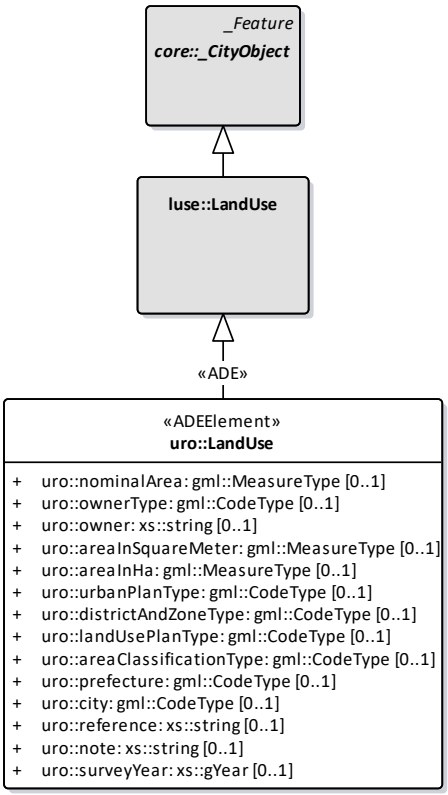


Figure 1-3 UML diagram of LandUse. An element name with the prefix uro is defined within this module.

Extended property of LandUse

Property	Definition
uro::nominalArea	Nominal area of the land
uro::ownerType	Type of the land owner
uro::owner	Name of the land owner
uro::areaInSquareMeter	Area of the land (m2)
uro::areaInHa	Area of the land (ha)
uro::urbanPlanType	Type of the land location designated by Urban Plan
uro::districtAndZoneType	Type of the land location designated by Districts and Zones
uro::landUsePlanType	Type of the land location designated by Land Use Plan
uro::areaClassificationType	Type of the land location designated by Area classification
uro::prefecture	Prefecture name of the land location
uro::city	City name of the land location
uro::reference	Reference information of the landuse
uro::note	Additional information of the land
uro::surveyYear	Year of the survey

```
 <xs:element name="nominalArea" type="gml:MeasureType"
substitutionGroup="luse:_GenericApplicationPropertyOfLandUse"/>
 <xs:element name="ownerType" type="gml:CodeType"
substitutionGroup="luse:_GenericApplicationPropertyOfLandUse"/>
 <xs:element name="owner" type="xs:string" substitutionGroup="luse:_GenericApplicationPropertyOfLandUse"/>
 <xs:element name="areaInSquareMeter" type="gml:MeasureType"
substitutionGroup="luse:_GenericApplicationPropertyOfLandUse"/>
 <xs:element name="areaInHa" type="gml:MeasureType"
substitutionGroup="luse:_GenericApplicationPropertyOfLandUse"/>
 <xs:element name="urbanPlanType" type="gml:CodeType"
substitutionGroup="luse:_GenericApplicationPropertyOfLandUse"/>
 <xs:element name="districtsAndZonesType" type="gml:CodeType"
substitutionGroup="luse:_GenericApplicationPropertyOfLandUse"/>
 <xs:element name="landUsePlanType" type="gml:CodeType"
substitutionGroup="luse:_GenericApplicationPropertyOfLandUse"/>
 <xs:element name="areaClassificationType" type="gml:CodeType"
substitutionGroup="luse:_GenericApplicationPropertyOfLandUse"/>
 <xs:element name="prefecture" type="gml:CodeType"
substitutionGroup="luse:_GenericApplicationPropertyOfLandUse"/>
 <xs:element name="city" type="gml:CodeType" substitutionGroup="luse:_GenericApplicationPropertyOfLandUse"/>
 <xs:element name="reference" type="xs:string" substitutionGroup="luse:_GenericApplicationPropertyOfLandUse"/>
 <xs:element name="note" type="xs:string" substitutionGroup="luse:_GenericApplicationPropertyOfLandUse"/>
 <xs:element name="surveyYear" type="xs:gYear" substitutionGroup="luse:_GenericApplicationPropertyOfLandUse"/>
```

4.2.3 Extended properties of Transportation

Transportation objects in i-UR describe a linear network of transportation. Therefore transportation features in the CityGML Transportation module with LOD0 geometry are applied. Some elements are added as members of the substitution group *tarn::_GenericApplicationPropertyOfRoad* and *tran::_GenericApplicationPropertyOfRailway* to describe detailed information of roads and railways. The data structure of the transportation objects is shown in Figure 1-4 and the XMLSchema Definition is attached in Annex A.

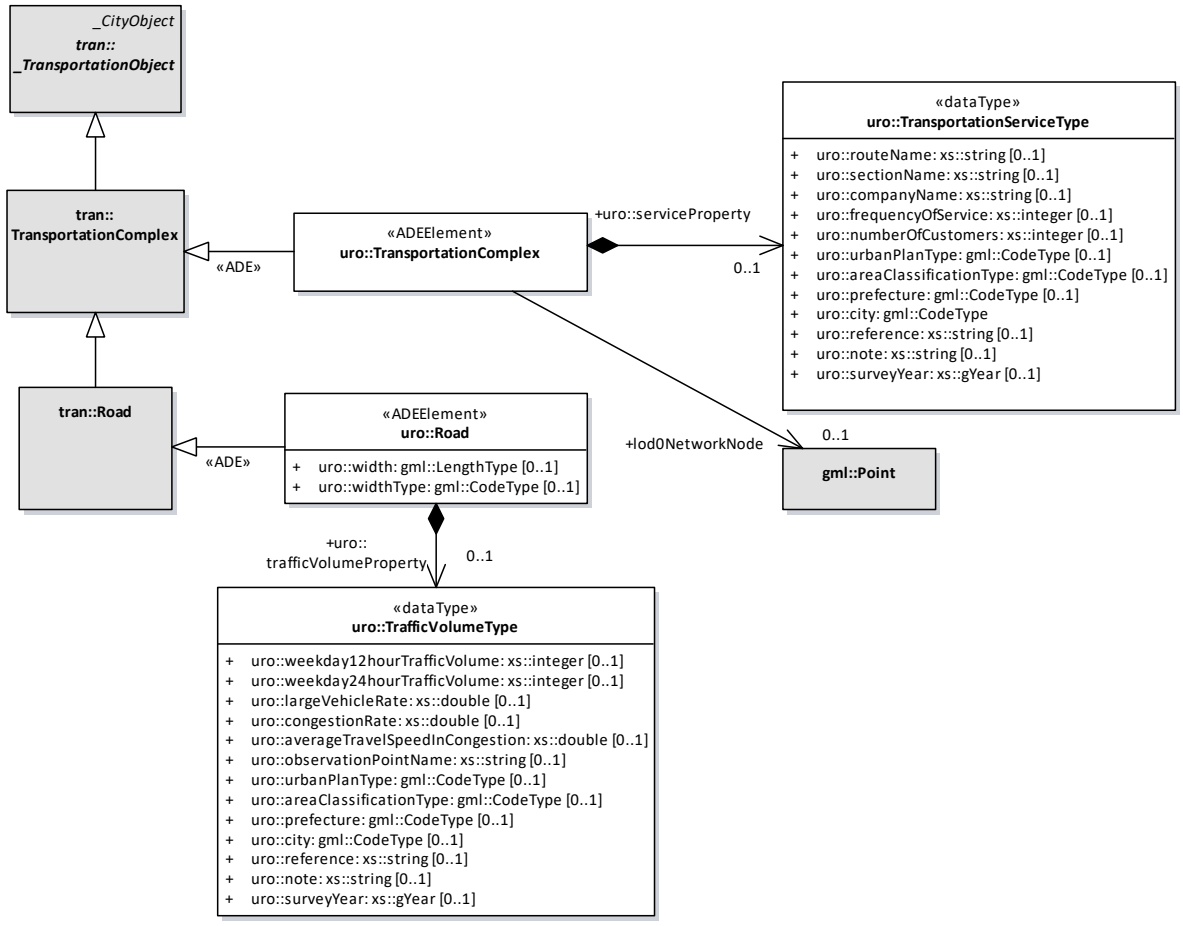


Figure 1-4 UML diagram of Transportation. Element names with the prefix uro are defined within this module.

Extended property of Transportation

Property	Definition
uro::lod0NetworkNode	A node in a linear network
uro::serviceProperty	Detailed information of the transportation service

```
 <xs:element name="lod0NetworkNode" type="gml:PointPropertyType"
substitutionGroup="tran:_GenericApplicationPropertyOfTransportationComplex"/>
 <xs:element name="serviceProperty" type="TransportationServicePropertyType"
substitutionGroup="tran:_GenericApplicationPropertyOfTransportationComplex"/>
```

A uro::serviceProperty describes the operation and service status of transportation. This element works as a type of uro::serviceProperty which is a member of the substitution group *tran::TransportationComplex*.

TransportationServiceType

Type	Definition
uro::TransportationServiceType	Detailed information of the transportation service
Property	**Definition**
uro::routeName	Name of the route
uro::sectionName	Name of the section
uro::companyName	Name of the operating company
uro::frequencyOfService	Number of times for operation per day

uro::numberOfCustomers	Total number of customers per day
uro::urbanPlanType	Type of the transportation service location designated by Urban Plan
uro::areaClassificationType	Type of the transportation service location designated by Area classification
uro::prefecture	Prefecture name of the transportation service location
uro::city	City name of the transportation service location
uro::reference	Reference information of the transportation service
uro::note	Other additional information
uro::surveyYear	Year of the survey

```
 <xs:complexType name="TransportationServiceType">
  <xs:sequence>
    <xs:element name="routeName" type="xs:string" minOccurs="0"/>
    <xs:element name="sectionName" type="xs:string" minOccurs="0"/>
    <xs:element name="companyName" type="xs:string" minOccurs="0"/>
    <xs:element name="frequencyOfService" type="xs:integer" minOccurs="0"/>
    <xs:element name="numberOfCustomers" type="xs:double" minOccurs="0"/>
    <xs:element name="urbanPlanType" type="gml:CodeType" minOccurs="0"/>
    <xs:element name="areaClassificationType" type="gml:CodeType" minOccurs="0"/>
    <xs:element name="prefecture" type="gml:CodeType" minOccurs="0"/>
    <xs:element name="city" type="gml:CodeType" minOccurs="0"/>
    <xs:element name="reference" type="xs:string" minOccurs="0"/>
    <xs:element name="note" type="xs:string" minOccurs="0"/>
    <xs:element name="surveyYear" type="xs:gYear" minOccurs="0"/>
  </xs:sequence>
 </xs:complexType>
<!-- ====================================================================== -->
 <xs:element name="TransportationService" type="TransportationServiceType"/>
<!-- ====================================================================== -->
 <xs:complexType name="TransportationServicePropertyType">
  <xs:sequence>
    <xs:element ref="TransportationService"/>
  </xs:sequence>
 </xs:complexType>
```

Extended Properties of Road

Property	**Definition**
uro::width	Typical road width
uro::widthType	Code allotted to road width
uro::trafficVolumeProperty	Traffic volume

```
  <xs:element name="width" type="gml:LengthType" substitutionGroup="tran:_GenericApplicationPropertyOfRoad"/>
  <xs:element name="widthType" type="gml:CodeType" substitutionGroup="tran:_GenericApplicationPropertyOfRoad"/>
  <xs:element name="trafficVolume" type="TrafficVolumePropertyType"
substitutionGroup="tran:_GenericApplicationPropertyOfRoad"/>
```

A type *uro::TrafficVolumeType* is a class which describes the number of vehicles crossing a section of road per unit time.

TrafficVolumeType

Type	**Definition**
uro::TrafficVolumeType	The number of vehicles crossing a section of road per unit time
Property	**Definition**
uro::weekday12hourTrafficVolume	The number of vehicles crossing a section of road per 12 hours on average weekday

uro::weekday24hourTrafficVolume	The number of vehicles crossing a section of road per 24 hours on average weekday
uro::largeVehicleRate	The percentage of the number of large vehicles within the total traffic volume
uro::congestionRate	The ratio of 24-hour traffic volume to the design criteria
uro::averageTravelSpeedInCongestion	Average travel speed druing the congestion period.
uro::observationPointName	Name of the observation location.
uro::urbanPlanType	Type of the road location designated by Urban Plan
uro::areaClassificationType	Type of the road location designated by Area classification
uro::prefecture	Prefecture name of the road location
uro::city	City name of the road location
uro::reference	Reference information of the observation point
uro::note	Other additional information
uro::surveyYear	The year when the traffic survey was performed.

```
<xs:complexType name="TrafficVolumeType">
 <xs:sequence>
  <xs:element name="weekday12hourTrafficVolume" type="xs:integer" minOccurs="0"/>
  <xs:element name="weekday24hourTrafficVolume" type="xs:integer" minOccurs="0"/>
  <xs:element name="largeVehicleRate" type="xs:double" minOccurs="0"/>
  <xs:element name="congestionRate" type="xs:double" minOccurs="0"/>
  <xs:element name="averageTravelSpeedInCongestion" type="xs:double" minOccurs="0"/>
  <xs:element name="observationPointName" type="xs:string" minOccurs="0"/>
  <xs:element name="urbanPlanType" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="areaClassificationType" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="prefecture" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="city" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="reference" type="xs:string" minOccurs="0"/>
  <xs:element name="note" type="xs:string" minOccurs="0"/>
  <xs:element name="surveyYear" type="xs:gYear" minOccurs="0"/>
 </xs:sequence>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="TrafficVolume" type="TrafficVolumeType"/>
<!-- ========================================================================== -->
<xs:complexType name="TrafficVolumePropertyType">
 <xs:sequence>
  <xs:element ref="TrafficVolume"/>
 </xs:sequence>
</xs:complexType>
```

4.2.4 Extended properties of CityObjectGroup

CityObjectGroups are defined as special *CityObjects* and aggregate *CityObjects* as shown in Figure 1-5. A *grp::CityObjectGroup* inherits attributes from the parent class *core::_CityObject*. The attribute core::creationDate shows the date of dataset creation.

The *groupMember* property of *grp::CityObjectGroup* may contain a *core::_CityObject* element inline or an XLink reference to a remote *core::_CityObject* element, therefore extended city objects defined in this spacification may also be contained in or referred from a *grp::CityObjectGroup*. XLink reference prevents data duplication and enables multiple use of the *CityObjects*.

Two elements, *uro::fiscalYearOfPublication* and *uro::language* are added as members of the substitution group *grp::_GenericApplicationPropertyOfCityObjectGroup*. A *uro::fiscalYear* is used to describe the year when the result of data collection has been published and a *uro*::language clarifies the language used in the city objects.

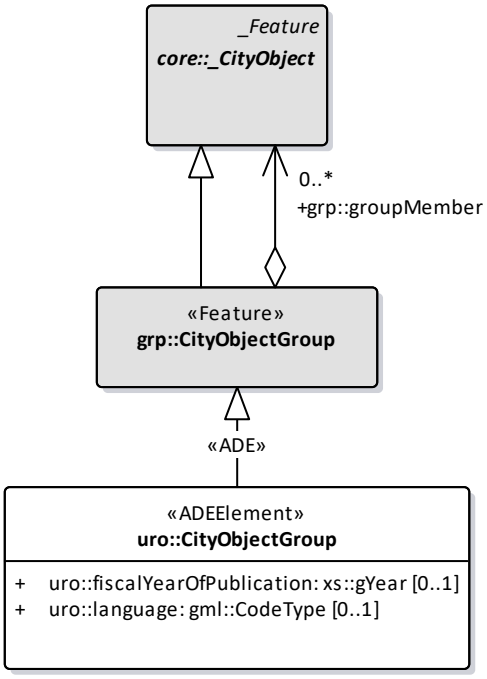


Figure 1-5 UML diagram of City Object Group

Extended properties of CityObjectGroup

Property	Definition
uro::fiscalYearOfPublication	Fiscal year when the group has been published
uro::language	Language used in the group

```
 <xs:element name="fiscalYearOfPublication" type="xs:gYear"
substitutionGroup="grp:_GenericApplicationPropertyOfCityObjectGroup"/>
 <xs:element name="language" type="gml:CodeType"
substitutionGroup="grp:_GenericApplicationPropertyOfCityObjectGroup"/>
```

Annex A
(normative)

XMLSchema Definition

A.1 XMLSchema

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:uro="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/uro/1.3" xmlns:core="http://www.opengis.net/citygml/2.0" xmlns:luse="http://www.opengis.net/citygml/landuse/2.0" xmlns:bldg="http://www.opengis.net/citygml/building/2.0" xmlns:tran="http://www.opengis.net/citygml/transportation/2.0" xmlns:grp="http://www.opengis.net/citygml/cityobjectgroup/2.0" xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:gml="http://www.opengis.net/gml" targetNamespace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/uro/1.3" elementFormDefault="qualified" attributeFormDefault="unqualified" version="1.3.0">
 <xs:annotation>
  <xs:documentation>XML Schema for Urban Object module</xs:documentation>
 </xs:annotation>
 <xs:import namespace="http://www.opengis.net/gml" schemaLocation="http://schemas.opengis.net/gml/3.1.1/base/gml.xsd"/>
 <xs:import namespace="http://www.opengis.net/citygml/2.0" schemaLocation="http://schemas.opengis.net/citygml/2.0/cityGMLBase.xsd"/>
 <xs:import namespace="http://www.opengis.net/citygml/transportation/2.0" schemaLocation="http://schemas.opengis.net/citygml/transportation/2.0/transportation.xsd"/>
 <xs:import namespace="http://www.opengis.net/citygml/building/2.0" schemaLocation="http://schemas.opengis.net/citygml/building/2.0/building.xsd"/>
 <xs:import namespace="http://www.opengis.net/citygml/landuse/2.0" schemaLocation="http://schemas.opengis.net/citygml/landuse/2.0/landUse.xsd"/>
 <xs:import namespace="http://www.opengis.net/citygml/cityobjectgroup/2.0" schemaLocation="http://schemas.opengis.net/citygml/cityobjectgroup/2.0/cityObjectGroup.xsd"/>
 <!-- ================================================================== -->
 <!-- ======================   CityGML CityFeature module  ================= -->
 <!-- ================================================================== -->
 <!-- ================== Extended attribute for Building ================= -->
 <xs:element name="buildingDetails" type="uro:BuildingDetailsPropertyType" substitutionGroup="bldg:_GenericApplicationPropertyOfAbstractBuilding"/>
 <xs:element name="BuildingDetails" type="uro:BuildingDetailsType"/>
 <xs:complexType name="BuildingDetailsType">
  <xs:sequence>
   <xs:element name="serialNumberOfBuildingCertification" type="xs:string" minOccurs="0"/>
   <xs:element name="siteArea" type="gml:MeasureType" minOccurs="0"/>
   <xs:element name="buildingFootprintArea" type="gml:MeasureType" minOccurs="0"/>
   <xs:element name="buildingRoofEdgeArea" type="gml:MeasureType" minOccurs="0"/>
   <xs:element name="developmentArea" type="gml:MeasureType" minOccurs="0"/>
   <xs:element name="totalFloorArea" type="gml:MeasureType" minOccurs="0"/>
   <xs:element name="buildingStructureType" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="fireproofStructureType" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="implementingBody" type="xs:string" minOccurs="0"/>
   <xs:element name="urbanPlanType" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="districtsAndZonesType" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="landUsePlanType" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="areaClassificationType" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="prefecture" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="city" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="reference" type="xs:string" minOccurs="0"/>
   <xs:element name="note" type="xs:string" minOccurs="0"/>
   <xs:element name="surveyYear" type="xs:gYear" minOccurs="0"/>
  </xs:sequence>
```

```
 </xs:complexType>
 <xs:complexType name="BuildingDetailsPropertyType">
  <xs:sequence>
   <xs:element ref="uro:BuildingDetails"/>
  </xs:sequence>
 </xs:complexType>
 <!-- ========================================================================== -->
 <xs:element name="largeCustomerFacilities" type="uro:LargeCustomerFacilitiesPropertyType" substitutionGroup="bldg:
_GenericApplicationPropertyOfAbstractBuilding"/>
 <!-- ========================================================================== -->
 <xs:element name="LargeCustomerFacilities" type="uro:LargeCustomerFacilitiesType"/>
 <xs:complexType name="LargeCustomerFacilitiesType">
  <xs:sequence>
   <xs:element name="class" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="name" type="xs:string" minOccurs="0"/>
   <xs:element name="capacity" type="xs:integer" minOccurs="0"/>
   <xs:element name="owner" type="xs:string" minOccurs="0"/>
   <xs:element name="totalFloorArea" type="gml:MeasureType" minOccurs="0"/>
   <xs:element name="totalStoreFloorArea" type="gml:MeasureType" minOccurs="0"/>
   <xs:element name="inauguralDate" type="xs:date" minOccurs="0"/>
   <xs:element name="keyTenants" type="xs:string" minOccurs="0"/>
   <xs:element name="availability" type="xs:boolean" minOccurs="0"/>
   <xs:element name="urbanPlanType" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="districtsAndZonesType" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="landUsePlanType" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="areaClassificationType" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="prefecture" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="city" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="reference" type="xs:string" minOccurs="0"/>
   <xs:element name="note" type="xs:string" minOccurs="0"/>
   <xs:element name="surveyYear" type="xs:gYear" minOccurs="0"/>
  </xs:sequence>
 </xs:complexType>
 <xs:complexType name="LargeCustomerFacilitiesPropertyType">
  <xs:sequence>
   <xs:element ref="uro:LargeCustomerFacilities"/>
  </xs:sequence>
 </xs:complexType>
 <!-- ==================== Extended attribute for Land Use ============== -->
 <xs:element name="nominalArea" type="gml:MeasureType" substitutionGroup="luse:_GenericApplicationPropertyOfLand
Use"/>
 <xs:element name="ownerType" type="gml:CodeType" substitutionGroup="luse:_GenericApplicationPropertyOfLandUse"
/>
 <xs:element name="owner" type="xs:string" substitutionGroup="luse:_GenericApplicationPropertyOfLandUse"/>
 <xs:element name="areaInSquareMeter" type="gml:MeasureType" substitutionGroup="luse:_GenericApplicationProperty
OfLandUse"/>
 <xs:element name="areaInHa" type="gml:MeasureType" substitutionGroup="luse:_GenericApplicationPropertyOfLandUse
"/>
 <xs:element name="urbanPlanType" type="gml:CodeType" substitutionGroup="luse:_GenericApplicationPropertyOfLand
Use"/>
 <xs:element name="districtsAndZonesType" type="gml:CodeType" substitutionGroup="luse:_GenericApplicationProperty
OfLandUse"/>
 <xs:element name="landUsePlanType" type="gml:CodeType" substitutionGroup="luse:_GenericApplicationPropertyOfLan
dUse"/>
 <xs:element name="areaClassificationType" type="gml:CodeType" substitutionGroup="luse:_GenericApplicationProperty
OfLandUse"/>
 <xs:element name="prefecture" type="gml:CodeType" substitutionGroup="luse:_GenericApplicationPropertyOfLandUse"
/>
 <xs:element name="city" type="gml:CodeType" substitutionGroup="luse:_GenericApplicationPropertyOfLandUse"/>
```

```
 <xs:element name="reference" type="xs:string" substitutionGroup="luse:_GenericApplicationPropertyOfLandUse"/>
 <xs:element name="note" type="xs:string" substitutionGroup="luse:_GenericApplicationPropertyOfLandUse"/>
 <xs:element name="surveyYear" type="xs:gYear" substitutionGroup="luse:_GenericApplicationPropertyOfLandUse"/>
 <!-- ========= Extended objects and attributes for Transportation ======= -->
 <xs:element name="lod0NetworkNode" type="gml:PointPropertyType" substitutionGroup="tran:_GenericApplicationProp
ertyOfTransportationComplex"/>
 <xs:element name="serviceProperty" type="uro:TransportationServicePropertyType" substitutionGroup="tran:_GenericA
pplicationPropertyOfTransportationComplex"/>
 <!-- ====================================================================== -->
 <xs:element name="TransportationService" type="uro:TransportationServiceType"/>
 <xs:complexType name="TransportationServiceType">
  <xs:sequence>
   <xs:element name="routeName" type="xs:string" minOccurs="0"/>
   <xs:element name="sectionName" type="xs:string" minOccurs="0"/>
   <xs:element name="companyName" type="xs:string" minOccurs="0"/>
   <xs:element name="frequencyOfService" type="xs:integer" minOccurs="0"/>
   <xs:element name="numberOfCustomers" type="xs:double" minOccurs="0"/>
   <xs:element name="urbanPlanType" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="areaClassificationType" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="prefecture" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="city" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="reference" type="xs:string" minOccurs="0"/>
   <xs:element name="note" type="xs:string" minOccurs="0"/>
   <xs:element name="surveyYear" type="xs:gYear" minOccurs="0"/>
  </xs:sequence>
 </xs:complexType>
 <xs:complexType name="TransportationServicePropertyType">
  <xs:sequence>
   <xs:element ref="uro:TransportationService"/>
  </xs:sequence>
 </xs:complexType>
 <!-- ==================== Extended attribute for Road  ================ -->
 <xs:element name="width" type="gml:LengthType" substitutionGroup="tran:_GenericApplicationPropertyOfRoad"/>
 <xs:element name="widthType" type="gml:CodeType" substitutionGroup="tran:_GenericApplicationPropertyOfRoad"/>
 <xs:element name="trafficVolume" type="uro:TrafficVolumePropertyType" substitutionGroup="tran:_GenericApplication
PropertyOfRoad"/>
 <!-- ====================================================================== -->
 <xs:element name="TrafficVolume" type="uro:TrafficVolumeType"/>
 <xs:complexType name="TrafficVolumeType">
  <xs:sequence>
   <xs:element name="weekday12hourTrafficVolume" type="xs:integer" minOccurs="0"/>
   <xs:element name="weekday24hourTrafficVolume" type="xs:integer" minOccurs="0"/>
   <xs:element name="largeVehicleRate" type="xs:double" minOccurs="0"/>
   <xs:element name="congestionRate" type="xs:double" minOccurs="0"/>
   <xs:element name="averageTravelSpeedInCongestion" type="xs:double" minOccurs="0"/>
   <xs:element name="observationPointName" type="xs:string" minOccurs="0"/>
   <xs:element name="urbanPlanType" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="areaClassificationType" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="prefecture" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="city" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="reference" type="xs:string" minOccurs="0"/>
   <xs:element name="note" type="xs:string" minOccurs="0"/>
   <xs:element name="surveyYear" type="xs:gYear" minOccurs="0"/>
  </xs:sequence>
 </xs:complexType>
 <xs:complexType name="TrafficVolumePropertyType">
  <xs:sequence>
   <xs:element ref="uro:TrafficVolume"/>
  </xs:sequence>
 </xs:complexType>
```

```
 <!-- ================== Extended attribute for CityObjectGroup ================ -->
 <xs:element name="fiscalYearOfPublication" type="xs:gYear" substitutionGroup="grp:_GenericApplicationPropertyOfCityObjectGroup"/>
 <xs:element name="language" type="gml:CodeType" substitutionGroup="grp:_GenericApplicationPropertyOfCityObjectGroup"/>
</xs:schema>
```

A.2 Sample data (informative)

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- sample data edited by i-Urban Revitalization Promotion Committe Specification WG / source Fundamental Geospatial Data of GSI -->
<core:CityModel xmlns:uro="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/uro/1.3" xmlns:core="http://www.opengis.net/citygml/2.0" xmlns:luse="http://www.opengis.net/citygml/landuse/2.0" xmlns:bldg="http://www.opengis.net/citygml/building/2.0" xmlns:tran="http://www.opengis.net/citygml/transportation/2.0" xmlns:grp="http://www.opengis.net/citygml/cityobjectgroup/2.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:gml="http://www.opengis.net/gml" xmlns:xlink="http://www.w3.org/1999/xlink" xsi:schemaLocation="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/uro/1.3 http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/schemas/uro/1.3/urbanObject.xsd
http://www.opengis.net/citygml/2.0 http://schemas.opengis.net/citygml/2.0/cityGMLBase.xsd
http://www.opengis.net/citygml/landuse/2.0 http://schemas.opengis.net/citygml/landuse/2.0/landUse.xsd
http://www.opengis.net/citygml/building/2.0 http://schemas.opengis.net/citygml/building/2.0/building.xsd

http://www.opengis.net/citygml/transportation/2.0 http://schemas.opengis.net/citygml/transportation/2.0/transportation.xsd
http://www.opengis.net/citygml/cityobjectgroup/2.0 http://schemas.opengis.net/citygml/cityobjectgroup/2.0/cityObjectGroup.xsd
http://www.opengis.net/gml http://schemas.opengis.net/gml/3.1.1/base/gml.xsd">
 <gml:boundedBy>
  <gml:Envelope srsName="http://www.opengis.net/def/crs/EPSG/0/6697">
   <gml:lowerCorner srsDimension="3">35.8434 130.488 0</gml:lowerCorner>
   <gml:upperCorner srsDimension="3">33.8459 130.494 50</gml:upperCorner>
  </gml:Envelope>
 </gml:boundedBy>
 <core:cityObjectMember>
  <bldg:Building gml:id="building503063191001">
   <bldg:class codeSpace=" http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Building_class.xml">2000</bldg:class>
   <bldg:function>公益施設用地</bldg:function>
   <bldg:usage>小・中・高等学校等</bldg:usage>
   <bldg:yearOfConstruction>1997</bldg:yearOfConstruction>
   <bldg:storeysAboveGround>3</bldg:storeysAboveGround>
   <bldg:storeysBelowGround>1</bldg:storeysBelowGround>
   <bldg:lod1Solid>
     <gml:Solid>
     <gml:exterior>
      <gml:CompositeSurface>
       <gml:surfaceMember>
        <gml:Polygon>
         <gml:exterior>
          <gml:LinearRing>
           <gml:pos>33.805525 130.545234 17.9</gml:pos>
           <gml:pos>33.805410 130.5452 17.9</gml:pos>
           <gml:pos>33.805398 130.545255 17.9</gml:pos>
           <gml:pos>33.805416 130.545260 17.9</gml:pos>
           <gml:pos>33.805399 130.545347 17.9</gml:pos>
           <gml:pos>33.805496 130.545375 17.9</gml:pos>
           <gml:pos>33.805525 130.545234 17.9</gml:pos>
          </gml:LinearRing>
```

```
    </gml:exterior>
   </gml:Polygon>
  </gml:surfaceMember>
  <gml:surfaceMember>
   <gml:Polygon>
    <gml:exterior>
     <gml:LinearRing>
      <gml:pos>33.805525 130.545234 17.9</gml:pos>
      <gml:pos>33.805496 130.545375 17.9</gml:pos>
      <gml:pos>33.805496 130.545375 5.9</gml:pos>
      <gml:pos>33.805525 130.545234 5.9</gml:pos>
      <gml:pos>33.805525 130.545234 17.9</gml:pos>
     </gml:LinearRing>
    </gml:exterior>
   </gml:Polygon>
  </gml:surfaceMember>
  <gml:surfaceMember>
   <gml:Polygon>
    <gml:exterior>
     <gml:LinearRing>
      <gml:pos>33.80539922 130.545347 17.9</gml:pos>
      <gml:pos>33.80541694 130.5452606 17.9</gml:pos>
      <gml:pos>33.80541694 130.5452606 5.9</gml:pos>
      <gml:pos>33.80539922 130.545347 5.9</gml:pos>
      <gml:pos>33.80539922 130.545347 17.9</gml:pos>
     </gml:LinearRing>
    </gml:exterior>
   </gml:Polygon>
  </gml:surfaceMember>
                                          <-- omitted -->
  <gml:surfaceMember>
   <gml:Polygon>
    <gml:exterior>
     <gml:LinearRing>
      <gml:pos>33.80549653 130.5453755 17.9</gml:pos>
      <gml:pos>33.80539922 130.545347 17.9</gml:pos>
      <gml:pos>33.80539922 130.545347 5.9</gml:pos>
      <gml:pos>33.80549653 130.5453755 5.9</gml:pos>
      <gml:pos>33.80549653 130.5453755 17.9</gml:pos>
     </gml:LinearRing>
    </gml:exterior>
   </gml:Polygon>
  </gml:surfaceMember>
  <gml:surfaceMember>
   <gml:Polygon>
    <gml:exterior>
     <gml:LinearRing>
      <gml:pos>33.8055255 130.5452343 5.9</gml:pos>
      <gml:pos>33.80549653 130.5453755 5.9</gml:pos>
      <gml:pos>33.80539922 130.545347 5.9</gml:pos>
      <gml:pos>33.80541694 130.5452606 5.9</gml:pos>
      <gml:pos>33.80539897 130.5452553 5.9</gml:pos>
      <gml:pos>33.80541022 130.5452004 5.9</gml:pos>
      <gml:pos>33.8055255 130.5452343 5.9</gml:pos>
     </gml:LinearRing>
    </gml:exterior>
   </gml:Polygon>
  </gml:surfaceMember>
 </gml:CompositeSurface>
</gml:exterior>
```

```
      </gml:Solid>
    </bldg:lod1Solid>
    <uro:buildingDetails>
      <uro:BuildingDetails>
      <uro:serialNumberOfBuildingCertification>福ワ-182039-a1</uro:serialNumberOfBuildingCertification>
      <uro:siteArea uom="m2">3300</uro:siteArea>
      <uro:buildingFootprintArea uom="m2">50</uro:buildingFootprintArea>
      <uro:buildingRoofEdgeArea uom="m2">56.3</uro:buildingRoofEdgeArea>
      <uro:developmentArea uom="m2">10.5</uro:developmentArea>
      <uro:buildingStructureType codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Building_buildingStructureType.xml">9020</uro:buildingStructureType>
      <uro:fireproofStructureType codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Building_fireproofStructureType.xml">9020</uro:fireproofStructureType>
      <uro:implementingBody>片岡建設</uro:implementingBody>
      <uro:urbanPlanType codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Common_uro:urbanPlanType.xml">1010</uro:urbanPlanType>
      <uro:districtsAndZonesType codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Common_districtsAndZones.xml">1000</uro:districtsAndZonesType>
      <uro:landUsePlanType>5070</uro:landUsePlanType>
      <uro:areaClassificationType codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Common_areaClassification.xml">1030</uro:areaClassificationType>
      <uro:prefecture codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Common_uro:prefecture.xml">40</uro:prefecture>
      <uro:city codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Common_localPublicAuthorities.xml">220</uro:city>
      <uro:reference>ア 1</uro:reference>
      <uro:note>なし</uro:note>
      <uro:surveyYear>2016</uro:surveyYear>
      </uro:BuildingDetails>
    </uro:buildingDetails>
  </bldg:Building>
 </core:cityObjectMember>
</core:CityModel>
```

Annex B
(informative)

Code lists for Urban Object Data

This annex exemplifies the specification of code lists for enumerative attributes of type *gml:CodeType* in Urban Planning ADE and provides proposals for selected attributes. Please note that this annex is non-normative and the presented code lists are neither mandatory nor complete.

Some of code lists in this annex extends the code lists proposed by the SIG 3D shown in Annex C of CityGML.

Code lists for Building

Code list for the *_AbstractBuilding* attribute *class*			
http:// http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Building_class.xml			
1000	habitation	1090	agriculture, forestry
1001	house	1091	agriculture, forestry and fisheries
1002	apartment	1100	school, education, research
1003	dwelling with shop	1110	maintenance and waste management
1004	apartment withshop	1120	healthcare
1005	office with whop	1130	communicating
1010	sanitation	1140	security
1020	administration	1150	storage
1030	business, trade	1160	industry
1031	business	1170	traffic
1032	commercial	1180	function
1033	commercial complex		
1034	hotel	2000	education, welfare
1040	catering	2010	Transportation
1050	recreation		
1060	sport	8000	other
1070	culture	9000	unexamined
1080	church institution	9010	exception
		9020	unknown
Code values in grey cells are defined in the Code lists proposed by the SIG 3D in CityGML.			

Code list of the *BuildingDetails* attribute *buildingStructureType*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Building_buildingStructureType.xml			
1010	wooden	9000	unexamined
1020	non-wooden	9010	exception
1030	reinforced concrete	9020	unknown

Code list of the *BuildingDetails* attribute *fireproofStructureType*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Building_fireproofStructureType.xml			
1010	fireproof	9000	unexamined
1020	semi-fireproof	9010	exception
1030	others	9020	unknown

Code list for the *LargeCustomerFacilities* attribute *class*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/LargeCustomerFacilities_class.xml			
1010	large entertainment and commercial facilities	1040	hospital

1020	middle sized entertainment and commercial facilities	1050	welfare facilities
1030	public facilities	1060	university and college

Code list of the *BuildingDetails* and the *LargeCustomerFacilities* attribute *urbanPlanType*
See Code list for the *UrbanPlan* attribute *class* in part 2

Code list of the *BuildingDetails* and the *LargeCustomerFacilities* attribute *districtsAndZonesType*
See Code list for the *DistrictsAndZones* attribute *class* in part 2

Code list of the *BuildingDetails* and the *LargeCustomerFacilities* attribute *landUsePlanType*
See Code list for the *LandUsePlan* attribute *class* in part 2

Code list of the *BuildingDetails* and the *LargeCustomerFacilities* attribute *areaClassificationType*
See Code list for the *AreaClassification* attribute *class* in part 2

Code list of the *BuildingDetails* and the *LargeCustomerFacilities* attribute *prefecture*
See Code list for the *Administration* attribute *prefecture* in part 2

Code list of the *BuildingDetails* and the *LargeCustomerFacilities* attribute *city*
See Code list for the *Administration* attribute *city* in part 2

Code lists for LandUse

Code list of the *LandUse* attributes *function*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/LandUse_function.xml			
1010	Residential	2050	Track
1020	Industry and business	2060	Square
1030	MixedUse	2010	Grassland
1040	Special Function Area	3020	Agriculure
1050	Monument	3030	Forest
1060	Dump	3040	Grove
1070	Mining	3050	heath
1100	Park	3060	Moor
1120	Cemetary	3070	Marsh
1130	Sports, leisure and recreation	3080	Untilled land
1140	Open pit, quarry	4010	River
2010	Road	4020	Standing Waterbody
2020	Railway	4030	Harbour
2030	Airfield	4040	Sea
2040	Shipping		
5010	Industry	5110	Public land
5020	Business (retail)	5120	Public open space 1
5030	Business (other)	5130	Public open space 2
5040	Water	5140	Other communal facilities
5050	Natural area 1	5150	Other open space
5060	Natural area 2	5160	Residential not in use
5070	Communal facilities	5170	Agriculture, Forestry and Fisheries
5080	Rice paddy	9000	Unexamined
5090	Field	9010	Exception
5100	Transportation	9020	Unknown

Code values in grey cells are defined in the Code lists proposed by the SIG 3D in CityGML.

Code list of the *LandUse* attributes *ownerType*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/LandUse_ownerType.xml			
1010	National government	9000	Unexamined
1020	prefectural government	9010	Exception
1030	Municipality	9020	Unknown
1040	Public corperatoin		

Code list of the *LandUse* attribute *urbanPlanType*
See Code list for the *UrbanPlan* attribute *class* in part 2

Code list of the *LandUse* attribute *districtsAndZonesType*
See Code list for the *DistrictsAndZones* attribute *class* in part 2

Code list of the *LandUse* attribute *landUsePlanType*
See Code list for the *LandUsePlan* attribute *class* in part 2

Code list of the *LandUse* attribute *areaClassificationType*
See Code list for the *AreaClassification* attribute *class* in part 2

Code list of the *LandUse* attribute *prefecture*
See Code list for the *Administration* attribute *prefecture* in part 2

Code list of the *LandUse* attribute *city*
See Code list for the *Administration* attribute *city* in part 2

Code lists for Transportation service and Road

Code list of the *Road* attributes *function*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Road_function.xml			
1010	freeway/motorway	1050	municipal road
1020	highway/national primary road	2700	others
3010	prefectural road		
Code values in grey cells are defined in the Code lists proposed by the SIG 3D in CityGML.			

Code list of the *Road* attributes *widthType*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Road_widthType.xml			
1010	12m -	9000	Unexamined
1020	4m – 12m	9010	Exception
1030	- 4m	9020	Unknown

Code list of the *TransportationSrvice* and *Road* attribute *urbanPlanType*
See Code list for the *UrbanPlan* attribute *class*

Code list of the *TransportationSrvice* and *Road* attribute *districtsAndZonesType*
See Code list for the *DistrictsAndZones* attribute *class*

Code list of the *TransportationSrvice* and *Road* attribute *landUsePlanType*
See Code list for the *LandUsePlan* attribute *class* in part 2

Code list of the *TransportationSrvice* and *Road* attribute *areaClassificationType*
See Code list for the *AreaClassification* attribute *class* in part 2

Code list of the *TransportationSrvice* and *Road* attribute *prefecture*
See Code list for the *Administration* attribute *prefecture* in part 2

Code list of the *TransportationSrvice* and *Road* attribute *city*
See Code list for the *Administration* attribute *city* in part 2

Code lists for CityObjectGroup

Code list of the *CityObjectGroup* attribute *usage*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/CityObjectGroup_usage.xml			
1000	lod1Storey	2000	urban planning
1010	lod2Storey		
1020	lod3Storey		
1040	lod4Storey		
Code values in grey cells are defined in the Code lists proposed by the SIG 3D in CityGML.			

Code list of the *CityObjectGroup* attribute *language*
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Common_language.xml
ISO 639-1:2002, Codes for the representation of names of languages — Part 1: Alpha-2 code

Part 2. Urban Function Data Encoding Specification

1. Scope

Plans and regulations are important information in urban development, landscape preservation, and disaster management. Information related to plans and regulation, such as administrative boundaries and zoning works, are conditions or constraints for spatial planning and are conceptual and virtual objects in urban areas.

This document defines conceptual and virtual objects in urban areas as “urban function objects” and specifies the encoding format of these objects.

2. Normative references

Followings are normative references of this document.

- OpenGIS® OGC City Geography Markup Language (CityGML) Encoding Standard, Version 2.0, OGC document 12-019

3. Conventions

3.1 Terms and definitions

No terms and definitions are listed in this document.

3.2 Abbreviated terms

ADE Application Domain Extensions

CityGMLCity Geography Markup Language

GML Geography Markup Language

OGC Open Geospatial Consortium

UML Unified Modeling Language

4. Urban Function Data Encoding

4.1 Overview

The Urban Function Data Encoding is an extension of CityGML. This document defines the elements and types according to the rules of the Application Domain Extensions (ADE) which are necessary for describing urban functions but not defined in CityGML. Those already defined in CityGML are imported without any inconsistency.

Figure 2-1 shows the structure of the Urban Function Data and the XMLSchema Definition is attached in Annex A.

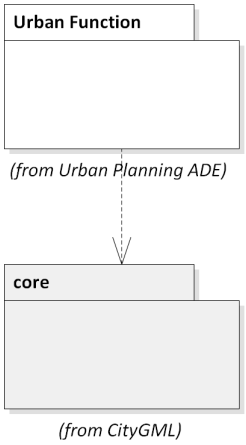


Figure 2-1 Package diagram of Urban Function Data

Urban function module defines conceptual and virtual objects such as administrative boundaries and zoning in urban areas. These objects (hereafter "urban function objects") are not visible in the real world, but guide and lead city objects such as land use and building to what they should be. The urban function objects have associations with visible city object/objects to add them new functions.

Module name	Urban Function
XML namespace identifier	http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/urf/1.3
XMLSchema location	http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/schemas/urf/1.3/urbanFunction.xsd
Recommended namespace prefix	urf
Description	This module defines conceptual or virtual objects in the urban areas which give a meaning to specific area, boundary or position. e.g. Administration area, Urban planning area

4.2 Object definition

4.2.1 UrbanFunctionType, _UrbanFunction

An *urf::_UrbanFunction* is a root class of this module and inherits from *core::_CityObjets*. The *urf::_UrbanFunction* and its child elements can obtain its geometry directly or indirectly through associations. When it has an association with a city object, the city object is added enriched with a new function. For example, a substantial well-constructed public building (e.g. school) is designated as an evacuation shelter when a disaster occurs. Figure 2-2 shows the structure of *urf::_UrbanFunction*.

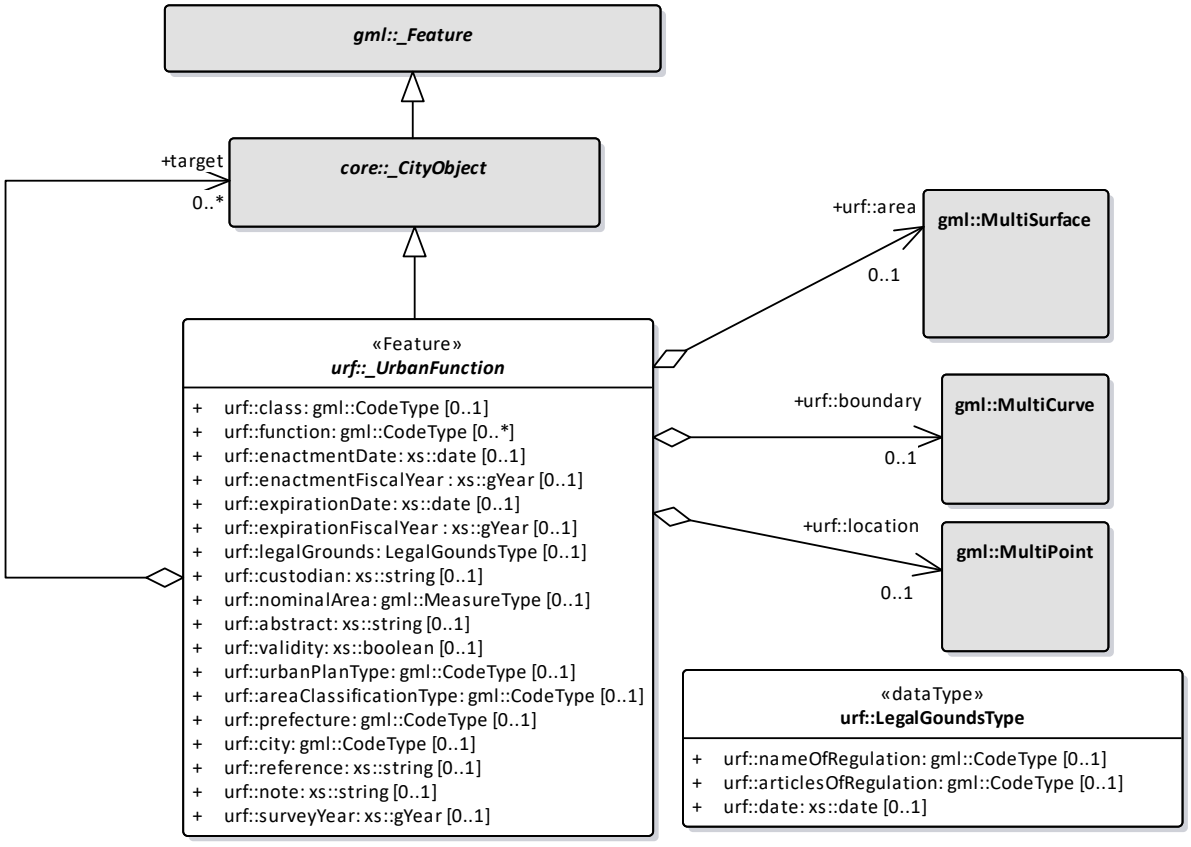


Figure 2-2 UML diagram of *urf::_UrbanFunction*

Object	Definition
urf::_UrbanFunction	Conceptual and virtual objects which give a function to city objects.
Property	**Definition**
urf::class	Type of urban function
urf::function	Usage of urban function
urf::enactmentDate	Enactment date
urf::enactmentFiscalYear	Fiscal year of enactment
urf::expirationDate	Expiration date
urf::expirationFiscalYear	Fiscal year of expiration
urf::legalGrounds	Legal basis of the designation
urf::custodian	name of the party who designated the urban function
urf::nominalArea	nominal area of the designated area
urf::abstract	abstract description of the designated area
urf::validity	validity of the designation; valid, lapse or abolish valid : true, lapse or abolish : false
urf::urbanPlanType	Type of the location designated by Urban Plan
urf::areaClassificationType	Type of the location designated by Area classification
urf::prefecture	Prefecture name of the location
urf::city	City name of the location
urf::reference	reference information of the urban function
urf::note	Additional remarks
urf::surveyYear	The year when the traffic survey was performed.
urf::area	A specific area or extent which someone may find useful or interesting
urf::boundary	A specific boundary location which someone may find useful or interesting.

urf::location	A specific point location which someone may find useful or interesting.
urf::target	Reference to more than one city objects

```
<xs:complexType name="UrbanFunctionType" abstract="true">
 <xs:complexContent>
  <xs:extension base="core:AbstractCityObjectType">
    <xs:sequence>
    <xs:element name="class" type="gml:CodeType" minOccurs="0"/>
    <xs:element name="function" type="gml:CodeType" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="enactmentDate" type="xs:date" minOccurs="0"/>
    <xs:element name="enactmentFiscalYear" type="xs:gYear" minOccurs="0"/>
    <xs:element name="expirationDate" type="xs:date" minOccurs="0"/>
    <xs:element name="expirationFiscalYear" type="xs:gYear" minOccurs="0"/>
    <xs:element name="legalGrounds" type="LegalGroundsPropertyType" minOccurs="0"/>
    <xs:element name="custodian" type="xs:string" minOccurs="0"/>
    <xs:element name="nominalArea" type="gml:MeasureType" minOccurs="0"/>
    <xs:element name="abstract" type="xs:string" minOccurs="0"/>
    <xs:element name="validity" type="xs:boolean" minOccurs="0"/>
    <xs:element name="urbanPlanType" type="gml:CodeType" minOccurs="0"/>
    <xs:element name="areaClassificationType" type="gml:CodeType" minOccurs="0"/>
    <xs:element name="prefecture" type="gml:CodeType" minOccurs="0"/>
    <xs:element name="city" type="gml:CodeType" minOccurs="0"/>
    <xs:element name="reference" type="xs:string" minOccurs="0"/>
    <xs:element name="note" type="xs:string" minOccurs="0"/>
    <xs:element name="surveyYear" type="xs:gYear" minOccurs="0"/>
    <xs:element name="area" type="gml:MultiSurfacePropertyType" minOccurs="0"/>
    <xs:element name="boundary" type="gml:MultiCurvePropertyType" minOccurs="0"/>
    <xs:element name="location" type="gml:MultiPointPropertyType" minOccurs="0"/>
    <xs:element name="target" type="TargetPropertyType" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element ref="_GenericApplicationPropertyOfUrbanFunction" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
 <xs:element name="_UrbanFunction" type="UrbanFunctionType" abstract="true"
substitutionGroup="core:_CityObject"/>
 <!-- ========================================================================== -->
 <xs:element name="_GenericApplicationPropertyOfUrbanFunction" type="xs:anyType" abstract="true"/>
<!-- ========================================================================== -->
 <xs:complexType name="TargetPropertyType">
  <xs:sequence minOccurs="0">
   <xs:element ref="core:_CityObject"/>
  </xs:sequence>
  <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
 </xs:complexType>
 <!-- ========================================================================== --> <xs:complexType
```

The type “TargetPropertyType” is used for an association with a *core:_CityObject*.

The element “_GenericApplicationPropertyOfUrbanFunction” is reserved for future extension and not used in this document. For each subclass of *urf::_UrbanFunction*, the elements “_GenericApplicationPropertyOf…” are declared for the same reason.

4.2.2 LegalGroundsType

Type	Definition
urf::LegalGroundsType	Legal grounds of the urban function

Property	Definition
urf::nameOfRegulation	Name of the related regulation
urf::articlesOfRegulation	Articles number of the regulation
urf::date	Issued date

```
<xs:complexType name="LegalGroundsType">
 <xs:sequence>
  <xs:element name="nameOfRegulation" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="articlesOfRegulation" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="date" type="xs:date" minOccurs="0"/>
 </xs:sequence>
</xs:complexType>
<!-- ========================================================================== -->
 <xs:element name="LegalGrounds" type="LegalGroundsType"/>
<!-- ========================================================================== -->
 <xs:complexType name="LegalGroundsPropertyType">
  <xs:sequence minOccurs="0">
   <xs:element ref="LegalGrounds"/>
  </xs:sequence>
 </xs:complexType>
```

Specific objects such as administrative boundary and land use regulation are defined as subclasses of *urf:_UrbanFunction* (Figure 2-3).

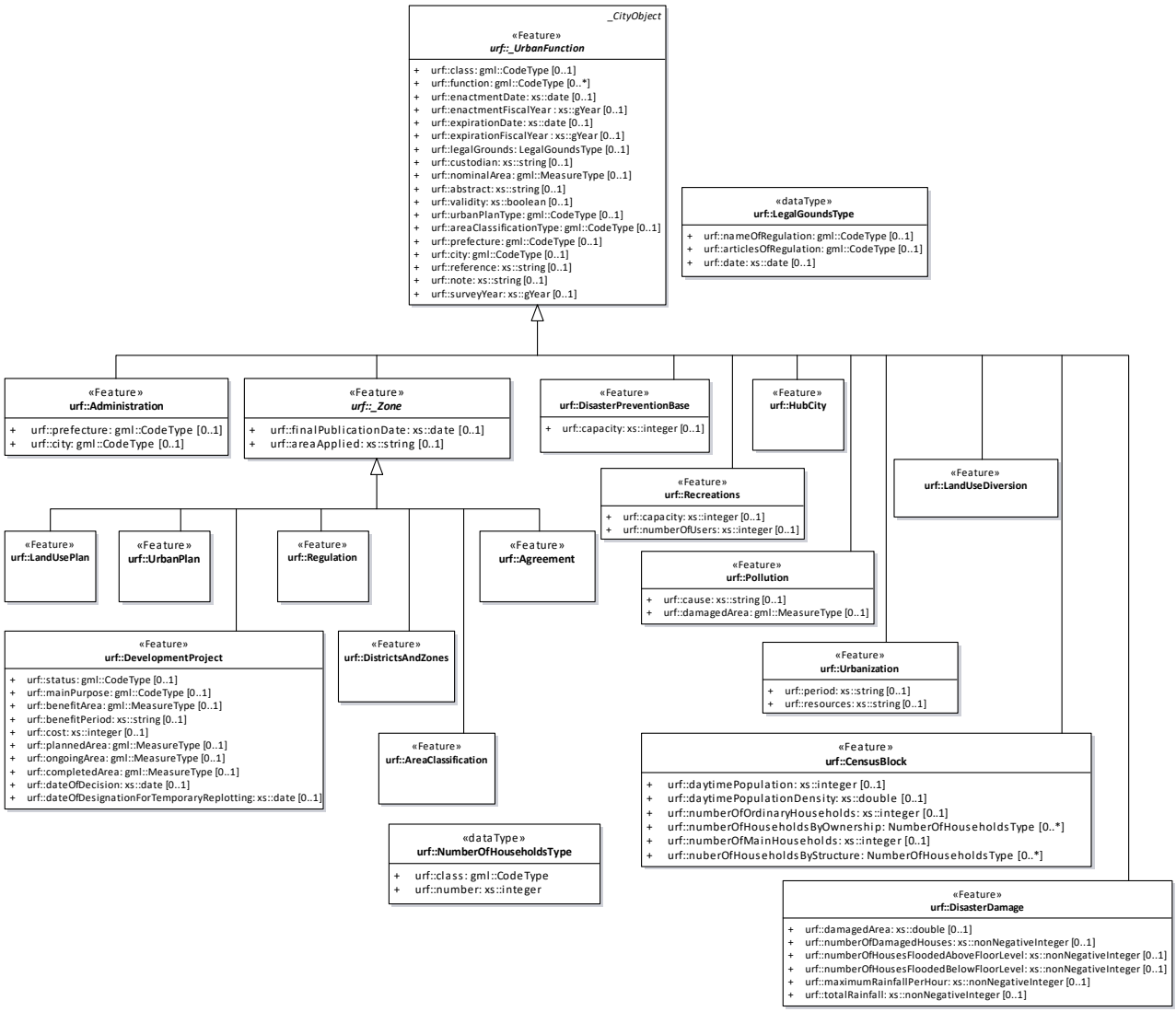


Figure 2-3 Subclasses of *urf::_UrbanFunction*

4.2.3 AdministrationType, Administration

Object	Definition
urf::Administration	Territorial units which an administrative section is divided into

```
<xs:complexType name="AdministrationType">
 <xs:complexContent>
  <xs:extension base="UrbanFunctionType">
     <xs:sequence>
     <xs:element ref="_GenericApplicationPropertyOfAdministrationArea" minOccurs="0" maxOccurs="unbounded"/>
     </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<xs:element name="Administration" type="AdministrationType" substitutionGroup="_UrbanFunction"/>
<xs:element name="_GenericApplicationPropertyOfAdministration" type="xs:anyType" abstract="true"/>
```

4.2.4 ZoneType, _Zone

Object	Definition
urf:: _Zone	Root class of designated area

Property	Definition
urf::finalPublicationDate	Final publication date of the zone designation
urf::areaApplied	Name of the area applied

```
<xs:complexType name="ZoneType" abstract="true">
 <xs:annotation>
  <xs:documentation>zoning district</xs:documentation>
 </xs:annotation>
 <xs:complexContent>
  <xs:extension base="UrbanFunctionType">
     <xs:sequence>
     <xs:element name="finalPublicationDate" type="xs:date" minOccurs="0"/>
     <xs:element name="areaApplied" type="xs:string" minOccurs="0"/>
     <xs:element ref="_GenericApplicationPropertyOfZone" minOccurs="0" maxOccurs="unbounded"/>
     </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<xs:element name="_Zone" type="ZoneType" abstract="true" substitutionGroup="_UrbanFunction"/>
 <xs:element name="_GenericApplicationPropertyOfZone" type="xs:anyType" abstract="true"/>
```

4.2.5 LandUsePlanType, LandUsePlan

Object	Definition
urf::LandUsePlan	Land use plan designated in accordance with land use regulation

```
<xs:complexType name="LandUsePlanType">
 <xs:complexContent>
  <xs:extension base="ZoneType">
     <xs:sequence>
     <xs:element ref="_GenericApplicationPropertyOfLandUsePlan" minOccurs="0" maxOccurs="unbounded"/>
     </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<xs:element name="LandUsePlan" type="LandUsePlanType" substitutionGroup="_Zone"/>
<xs:element name="_GenericApplicationPropertyOfLandUsePlan" type="xs:anyType" abstract="true"/>
```

4.2.6 UrbanPlanType, UrbanPlan

Object	Definition
urf::UrbanPlan	An area designated in accordance with City Planning Act

```
<xs:complexType name="UrbanPlanType">
 <xs:complexContent>
  <xs:extension base="ZoneType">
     <xs:sequence>
     <xs:element ref="_GenericApplicationPropertyOfUrbanPlan" minOccurs="0" maxOccurs="unbounded"/>
     </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<xs:element name="UrbanPlan" type="UrbanPlanType" substitutionGroup="_Zone"/>
<xs:element name="_GenericApplicationPropertyOfUrbanPlan" type="xs:anyType" abstract="true"/>
```

4.2.7 AgreementType, Agreement

Object	Definition

urf:: Agreement	An area specified by the agreement between the parties upon negotiated in order to avoid conflict, competition, etc.,

```
<xs:complexType name="AgreementType" abstract="true">
 <xs:complexContent>
  <xs:extension base="ZoneType">
    <xs:sequence>
    <xs:element ref="_GenericApplicationPropertyOfAgreement" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<xs:element name="Agreement" type="AgreementType" substitutionGroup="_Zone"/>
<xs:element name="_GenericApplicationPropertyOfAgreement" type="xs:anyType" abstract="true"/>
```

4.2.8 RegulationType, Regulation

Object	Definition
urf:: Regulation	A specified area or location which is regulated.

```
<xs:complexType name="RegulationType" abstract="true">
 <xs:complexContent>
  <xs:extension base="ZoneType">
    <xs:sequence>
    <xs:element ref="_GenericApplicationPropertyOfRegulation" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<xs:element name="Regulation" type="RegulationType" substitutionGroup="_Zone"/>
<xs:element name="_GenericApplicationPropertyOfRegulation" type="xs:anyType" abstract="true"/>
```

4.2.9 DevelopmentProjectType, DevelopmentProject

Object	Definition
urf:: DevelopmentProject	Scheduled or developed areas by development project
Property	**Definition**
urf::status	Status of the project
urf::mainPurpose	Purpose of the project
urf::benefitArea	Benefit area by the project
urf::benefitPeriod	Benefit period by the project
urf::cost	Project cost
urf::plannedArea	Planned area in the project
urf::ongoingArea	Ongoing area in the project
urf::completedArea	Completed area in the project
urf::dateOfDecision	Date on which project implementation was decided
urf::dateOfDesignationForTemporaryReplotting	Date on which temporary replotting was designated

```
<xs:complexType name="DevelopmentProjectType">
 <xs:complexContent>
  <xs:extension base="ZoneType">
    <xs:sequence>
    <xs:element name="status" type="gml:CodeType" minOccurs="0"/>
    <xs:element name="mainPurpose" type="gml:CodeType" minOccurs="0"/>
    <xs:element name="benefitArea" type="gml:MeasureType" minOccurs="0"/>
    <xs:element name="benefitPeriod" type="xs:string" minOccurs="0"/>
```

```
      <xs:element name="cost" type="xs:integer" minOccurs="0"/>
      <xs:element name="plannedArea" type="gml:MeasureType" minOccurs="0"/>
      <xs:element name="ongoingArea" type="gml:MeasureType" minOccurs="0"/>
      <xs:element name="completedArea" type="gml:MeasureType" minOccurs="0"/>
      <xs:element name="dateOfDecision" type="xs:date" minOccurs="0"/>
      <xs:element name="dateOfDesignationForTemporaryReplotting"  type="xs:date" minOccurs="0"/>
      <xs:element ref="_GenericApplicationPropertyOfDevelopmentProject" minOccurs="0" maxOccurs="unbounded"/>
      </xs:sequence>
   </xs:extension>
 </xs:complexContent>
</xs:complexType>
<xs:element name="DevelopmentProject" type="DevelopmentProjectType" substitutionGroup="_Zone"/>
<xs:complexType name="DevelopmentProjectPropertyType">
 <xs:sequence minOccurs="0">
   <xs:element ref="DevelopmentProject"/>
 </xs:sequence>
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<xs:element name="_GenericApplicationPropertyOfDevelopmentProject" type="xs:anyType" abstract="true"/>
```

4.2.10 AreaClassificationType, AreaClassification

Object	Definition
urf::AreaClassification	Classification between urbanization promotion areas and urbanization control areas

```
<xs:complexType name="AreaClassificationType">
 <xs:complexContent>
   <xs:extension base="ZoneType">
      <xs:sequence>
      <xs:element ref="_GenericApplicationPropertyOfAreaClassification" minOccurs="0" maxOccurs="unbounded"/>
      </xs:sequence>
   </xs:extension>
 </xs:complexContent>
</xs:complexType>
<xs:element name="AreaClassification" type="AreaClassificationType" substitutionGroup="_Zone"/>
<xs:element name="_GenericApplicationPropertyOfAreaClassification" type="xs:anyType" abstract="true"/>
```

4.2.11 DistrictsAndZonesType, DistrictsAndZones

Object	Definition
urf::DistrictsAndZones	Districts, zones and blocks established as necessary regarding urban planning area

```
<xs:complexType name="DistrictsAndZonesType">
 <xs:complexContent>
   <xs:extension base="ZoneType">
      <xs:sequence>
      <xs:element ref="_GenericApplicationPropertyOfDistrictsAndZones" minOccurs="0" maxOccurs="unbounded"/>
      </xs:sequence>
   </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================= -->
<xs:element name="DistrictsAndZones" type="DistrictsAndZonesType" substitutionGroup="_Zone"/>
<!-- ========================================================================= -->
<xs:element name="_GenericApplicationPropertyOfDistrictsAndZones" type="xs:anyType" abstract="true"/>
```

4.2.12 CensusBlockType, CensusBlock

Object	Definition
urf::CensusBlock	Census survey unit
Property	**Definition**
urf::daytimePopulation	Daytime population
urf::daytimePopulationDensity	Daytime population density
urf::numberOfOrdinaryHousehold	Total number of ordinary households those who dwell under the same roof and compose a family
urf::numberOfHouseholdsByOwnership	Number of households by house ownership
urf::numberOfMainHouseholds	Number of main households except households living in lodgings
urf::numberOfHouseholdsByStructure	Number of households by house structure

```
<xs:complexType name="CensusBlockType">
 <xs:annotation>
  <xs:documentation>Block for census survey</xs:documentation>
 </xs:annotation>
 <xs:complexContent>
  <xs:extension base="UrbanFunctionType">
   <xs:sequence>
    <xs:element name="daytimePopulation" type="xs:integer" minOccurs="0"/>
    <xs:element name="daytimePopulationDensity" type="xs:double" minOccurs="0"/>
    <xs:element name="numberOfOrdinaryHouseholds" type="xs:integer" minOccurs="0"/>
    <xs:element name="numberOfHouseholdsByOwnership" type="NumberOfHouseholdsPropertyType" minOccurs="0"
maxOccurs="unbounded"/>
    <xs:element name="numberOfMainHouseholds" type="xs:integer" minOccurs="0"/>
    <xs:element name="numberOfHouseholdsByStruture" type="NumberOfHouseholdsPropertyType" minOccurs="0"
maxOccurs="unbounded"/>
    <xs:element ref="_GenericApplicationPropertyOfCensusBlock" minOccurs="0" maxOccurs="unbounded"/>
   </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="CensusBlock" type="CensusBlockType" substitutionGroup="_UrbanFunction"/>
<xs:complexType name="CensusBlockPropertyType">
 <xs:sequence minOccurs="0">
  <xs:element ref="CensusBlock"/>
 </xs:sequence>
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfCensusBlock" type="xs:anyType" abstract="true"/>
```

NumberOfHouseholdsType

Type	Definition
urf:: NumberOfHouseholdsType	Number of households by house type
Property	**Definition**
urf::class	Type of house ownership
urf::number	Number of households

```
<xs:element name="NumberOfHouseholds" type="NumberOfHouseholdsType"/>
<xs:complexType name="NumberOfHouseholdsType">
```

```
 <xs:sequence>
   <xs:element name="class" type="gml:CodeType"/>
   <xs:element name="number" type="xs:integer"/>
 </xs:sequence>
</xs:complexType>
<xs:complexType name="NumberOfHouseholdsPropertyType">
 <xs:sequence>
   <xs:element ref="NumberOfHouseholds"/>
 </xs:sequence>
</xs:complexType>
```

4.2.13 DisasterDamageType, DisasterDamage

Object	Definition
urf::DisasterDamage	Damaged area or location of disaster
Property	**Definition**
urf::damagedArea	Area of the disaster affected area
urf::numberOfDamagedHouses	Number of houses damaged by the disaster
urf::numberOfHousesFloodedAboveFloorLevel	Number of houses flooded above floor level
urf::numberOfHousesFloodedBelowFloorLevel	Number of houses flooded below floor level
urf::maximumRainfallPerHour	Maximum rainfall per hour
urf::totalRainfall	Total rainfall

```
 <xs:complexType name="DisasterDamageType">
 <xs:complexContent>
   <xs:extension base="UrbanFunctionType">
     <xs:sequence>
     <xs:element name="damagedArea" type="gml:MeasureType" minOccurs="0"/>
     <xs:element name="numberOfDamagedHouses" type="xs:nonNegativeInteger" minOccurs="0"/>
     <xs:element name="numberOfHousesFloodedAboveFloorLevel" type="xs:nonNegativeInteger" minOccurs="0"/>
     <xs:element name="numberOfHousesFloodedBelowFloorLevel" type="xs:nonNegativeInteger" minOccurs="0"/>
     <xs:element name="maximumRainfallPerHour" type="xs:nonNegativeInteger" minOccurs="0"/>
     <xs:element name="totalRainfall" type="xs:nonNegativeInteger" minOccurs="0"/>
     <xs:element ref="_GenericApplicationPropertyOfDisasterDamage" minOccurs="0" maxOccurs="unbounded"/>
     </xs:sequence>  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="DisasterDamage" type="DisasterDamageType" substitutionGroup="_UrbanFunction"/>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfDisasterDamage" type="xs:anyType" abstract="true"/>
```

4.2.14 PollutionType, Pollution

Object	Definition
urf:: Pollution	Pollution source
Property	**Definition**
urf::cause	Description of the pollution source
urf::damagedArea	Area of the disaster affected area

```
<xs:complexType name="PollutionType">
 <xs:annotation>
   <xs:documentation>Source of pollution</xs:documentation>
 </xs:annotation>
 <xs:complexContent>
   <xs:extension base="UrbanFunctionType">
```

```
    <xs:sequence>
    <xs:element name="damagedArea" type="gml:MeasureType" minOccurs="0"/>
    <xs:element name="cause" type="xs:string" minOccurs="0"/>
    <xs:element ref="_GenericApplicationPropertyOfPollution" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="Pollution" type="PollutionType" substitutionGroup="_UrbanFunction"/>
<xs:complexType name="PollutionPropertyType">
 <xs:sequence minOccurs="0">
  <xs:element ref="Pollution"/>
 </xs:sequence>
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfPollution" type="xs:anyType" abstract="true"/>
```

4.2.15 DisasterPreventionBaseType, DisasterPreventionBase

Object	Definition
urf:: DisasterPreventionBase	Off-site center and shelter during disaster
Property	**Definition**
urf::capacity	Maximum number of people who can be accommodated

```
<xs:complexType name="DisasterPreventionBaseType">
 <xs:complexContent>
  <xs:extension base="UrbanFunctionType">
    <xs:sequence>
    <xs:element name="capacity" type="xs::integer" minOccurs=”0”/>
    <xs:element ref="_GenericApplicationPropertyOfDisasterPreventionBase" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="DisasterPreventionBase" type="DisasterPreventionBaseType" substitutionGroup="_UrbanFunction"/>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfDisasterPreventionBase" type="xs:anyType" abstract="true"/>
```

4.2.16 RecreationsType, Recreations

Object	Definition
urf::Recreations	Facilities for recreation
Property	**Definition**
urf::capacity	Total area of the facilities
urf::numberOfUsers	Number of annual users of the facilities

```
<xs:complexType name="RecreationsType">
 <xs:complexContent>
  <xs:extension base="urf:UrbanFunctionType">
    <xs:sequence>
    <xs:element name="capacity" type="xs:integer" minOccurs="0"/>
    <xs:element name="numberOfUsers" type="xs:integer" minOccurs="0"/>
    <xs:element ref="urf:_GenericApplicationPropertyOfRecreations" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:extension>
```

```
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="Recreations" type="urf:RecreationsType" substitutionGroup="urf:_UrbanFunction"/>
<xs:complexType name="RecreationsPropertyType">
 <xs:sequence minOccurs="0">
  <xs:element ref="urf:Recreations"/>
 </xs:sequence>
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfRecreations" type="xs:anyType" abstract="true">
 <xs:annotation>
  <xs:documentation>This element is reserved for future use.</xs:documentation>
 </xs:annotation>
</xs:element>
```

4.2.17 HubCityType, HubCity

Object	Definition
urf:: HubCity	Regional core urban areas or cities

```
<xs:complexType name="HubCityType">
 <xs:complexContent>
  <xs:extension base="UrbanFunctionType">
     <xs:sequence>
     <xs:element ref="_GenericApplicationPropertyOfHubCity" minOccurs="0" maxOccurs="unbounded"/>
     </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="HubCity" type="HubCityType" substitutionGroup="_UrbanFunction"/>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfHubCity" type="xs:anyType" abstract="true"/>
```

4.2.18 LandUseDiversionType, LandUseDiversion

Object	Definition
urf::LandUseDiversion	Change of the landuse

```
<xs:complexType name="LandUseDiversionType">
 <xs:complexContent>
  <xs:extension base="UrbanFunctionType">
     <xs:sequence>
     <xs:element ref="_GenericApplicationPropertyOfLandUseDiversion" minOccurs="0" maxOccurs="unbounded"/>
     </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="LandUseDiversion" type="LandUseDiversionType" substitutionGroup="_UrbanFunction"/>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfLandUseDiversion" type="xs:anyType" abstract="true"/>
```

4.2.19 UrbanizationType, Urbanization

Object	Definition
urf::Urbanization	Change of the urban area

Property	Definition
urf::period	Name of ege or era of the urban area
urf::resources	Name of the resources

```
<xs:complexType name="UrbanizationType">
 <xs:complexContent>
  <xs:extension base="UrbanFunctionType">
     <xs:sequence>
     <xs:element name="period" type="xs:string" minOccurs="0"/>
     <xs:element name="resources" type="xs:string" minOccurs="0"/>
     <xs:element ref="_GenericApplicationPropertyOfUrbanization" minOccurs="0" maxOccurs="unbounded"/>
     </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="Urbanization" type="UrbanizationType" substitutionGroup="_UrbanFunction"/>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfUrbanization" type="xs:anyType" abstract="true"/>
```

Annex A
(normative)

XMLSchema Definition

A.1 XMLSchema

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:urf="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/urf/1.3"
xmlns:core="http://www.opengis.net/citygml/2.0" xmlns:grp="http://www.opengis.net/citygml/cityobjectgroup/2.0"
xmlns:xs="http://www.w3.org/2001/XMLSchema"  xmlns:gml="http://www.opengis.net/gml"
targetNamespace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/urf/1.3"
elementFormDefault="qualified" attributeFormDefault="unqualified" version="1.3.0">
 <xs:annotation>
  <xs:documentation>XML Schema for Urban Function module</xs:documentation>
 </xs:annotation>
 <xs:import namespace="http://www.opengis.net/gml"
schemaLocation="http://schemas.opengis.net/gml/3.1.1/base/gml.xsd"/>
 <xs:import namespace="http://www.opengis.net/citygml/2.0"
schemaLocation="http://schemas.opengis.net/citygml/2.0/cityGMLBase.xsd"/>
 <xs:import namespace="http://www.opengis.net/citygml/cityobjectgroup/2.0"
schemaLocation="http://schemas.opengis.net/citygml/cityobjectgroup/2.0/cityObjectGroup.xsd"/>
 <!-- ========================================================================= -->
 <!-- ====================== CityGML UrbanFunction module ================== -->
 <!-- ========================================================================= -->
 <xs:complexType name="UrbanFunctionType" abstract="true">
  <xs:annotation>
   <xs:documentation>The root type for urban function. As subclass of _CityObject, an
      _UrbanFunction inherits all attributes and relations, in particular description, an
      id, names and description from _AbstractFeature. </xs:documentation>
  </xs:annotation>
  <xs:complexContent>
   <xs:extension base="core:AbstractCityObjectType">
      <xs:sequence>
      <xs:element name="class" type="gml:CodeType" minOccurs="0"/>
      <xs:element name="function" type="gml:CodeType" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="enactmentDate" type="xs:date" minOccurs="0"/>
      <xs:element name="enactmentFiscalYear" type="xs:gYear" minOccurs="0"/>
      <xs:element name="expirationDate" type="xs:date" minOccurs="0"/>
      <xs:element name="expirationFiscalYear" type="xs:gYear" minOccurs="0"/>
      <xs:element name="legalGrounds" type="urf:LegalGroundsPropertyType" minOccurs="0"/>
      <xs:element name="custodian" type="xs:string" minOccurs="0"/>
      <xs:element name="nominalArea" type="gml:MeasureType" minOccurs="0"/>
      <xs:element name="abstract" type="xs:string" minOccurs="0"/>
      <xs:element name="validity" type="xs:boolean" minOccurs="0"/>
      <xs:element name="urbanPlanType" type="gml:CodeType" minOccurs="0"/>
      <xs:element name="areaClassificationType" type="gml:CodeType" minOccurs="0"/>
      <xs:element name="prefecture" type="gml:CodeType" minOccurs="0"/>
      <xs:element name="city" type="gml:CodeType" minOccurs="0"/>
      <xs:element name="reference" type="xs:string" minOccurs="0"/>
      <xs:element name="note" type="xs:string" minOccurs="0"/>
      <xs:element name="surveyYear" type="xs:gYear" minOccurs="0"/>
      <xs:element name="area" type="gml:MultiSurfacePropertyType" minOccurs="0"/>
      <xs:element name="boundary" type="gml:MultiCurvePropertyType" minOccurs="0"/>
      <xs:element name="location" type="gml:MultiPointPropertyType" minOccurs="0"/>
      <xs:element name="target" type="urf:TargetPropertyType" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element ref="urf:_GenericApplicationPropertyOfUrbanFunction" minOccurs="0" maxOccurs="unbounded"/>
```

```
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
 </xs:complexType>
 <!-- ====================================================================== -->
 <xs:element name="_UrbanFunction" type="urf:UrbanFunctionType" abstract="true"
substitutionGroup="core:_CityObject"/>
 <!-- ====================================================================== -->
 <xs:element name="_GenericApplicationPropertyOfUrbanFunction" type="xs:anyType" abstract="true">
  <xs:annotation>
    <xs:documentation>This element is reserved for future use.</xs:documentation>
  </xs:annotation>
 </xs:element>
 <!-- ====================================================================== -->
 <xs:element name="LegalGrounds" type="urf:LegalGroundsType"/>
 <xs:complexType name="LegalGroundsType">
  <xs:sequence>
    <xs:element name="nameOfRegulation" type="gml:CodeType" minOccurs="0"/>
    <xs:element name="articlesOfRegulation" type="gml:CodeType" minOccurs="0"/>
    <xs:element name="date" type="xs:date" minOccurs="0"/>
  </xs:sequence>
 </xs:complexType>
 <!-- ====================================================================== -->
 <xs:complexType name="LegalGroundsPropertyType">
  <xs:sequence minOccurs="0">
    <xs:element ref="urf:LegalGrounds"/>
  </xs:sequence>
 </xs:complexType>
 <!-- ====================================================================== -->
 <xs:complexType name="TargetPropertyType">
  <xs:sequence minOccurs="0">
    <xs:element ref="core:_CityObject"/>
  </xs:sequence>
  <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
 </xs:complexType>
 <!-- ====================================================================== -->
 <xs:complexType name="AdministrationType">
  <xs:complexContent>
    <xs:extension base="urf:UrbanFunctionType">
      <xs:sequence>
      <xs:element ref="urf:_GenericApplicationPropertyOfAdministration" minOccurs="0" maxOccurs="unbounded"/>
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
 </xs:complexType>
 <!-- ====================================================================== -->
 <xs:element name="Administration" type="urf:AdministrationType" substitutionGroup="urf:_UrbanFunction"/>
 <!-- ====================================================================== -->
 <xs:element name="_GenericApplicationPropertyOfAdministration" type="xs:anyType" abstract="true">
  <xs:annotation>
    <xs:documentation>This element is reserved for future use.</xs:documentation>
  </xs:annotation>
 </xs:element>
 <!-- ====================================================================== -->
 <xs:complexType name="ZoneType" abstract="true">
  <xs:annotation>
    <xs:documentation>zoning district</xs:documentation>
  </xs:annotation>
  <xs:complexContent>
```

```
  <xs:extension base="urf:UrbanFunctionType">
    <xs:sequence>
    <xs:element name="finalPublicationDate" type="xs:date" minOccurs="0"/>
    <xs:element name="areaApplied" type="xs:string" minOccurs="0"/>
    <xs:element ref="urf:_GenericApplicationPropertyOfZone" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="_Zone" type="urf:ZoneType" abstract="true" substitutionGroup="urf:_UrbanFunction"/>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfZone" type="xs:anyType" abstract="true"/>
<!-- ========================================================================== -->
<xs:complexType name="LandUsePlanType">
 <xs:complexContent>
  <xs:extension base="urf:ZoneType">
    <xs:sequence>
    <xs:element ref="urf:_GenericApplicationPropertyOfLandUsePlan" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="LandUsePlan" type="urf:LandUsePlanType" substitutionGroup="urf:_Zone"/>
<xs:complexType name="LandUsePlanPropertyType">
 <xs:sequence minOccurs="0">
  <xs:element ref="urf:LandUsePlan"/>
 </xs:sequence>
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfLandUsePlan" type="xs:anyType" abstract="true">
 <xs:annotation>
  <xs:documentation>This element is reserved for future use.</xs:documentation>
 </xs:annotation>
</xs:element>
<!-- ========================================================================== -->
<xs:complexType name="UrbanPlanType">
 <xs:annotation>
  <xs:documentation>Urban planning area</xs:documentation>
 </xs:annotation>
 <xs:complexContent>
  <xs:extension base="urf:ZoneType">
    <xs:sequence>
    <xs:element ref="urf:_GenericApplicationPropertyOfUrbanPlan" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="UrbanPlan" type="urf:UrbanPlanType" substitutionGroup="urf:_Zone"/>
<xs:complexType name="UrbanPlanPropertyType">
 <xs:sequence minOccurs="0">
  <xs:element ref="urf:UrbanPlan"/>
 </xs:sequence>
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfUrbanPlan" type="xs:anyType" abstract="true">
```

```
 <xs:annotation>
  <xs:documentation>This element is reserved for future use.</xs:documentation>
 </xs:annotation>
</xs:element>
<!-- ========================================================================== -->
<xs:complexType name="AgreementType">
 <xs:annotation>
  <xs:documentation>Area specified area by the agreement between the parties agreed upon
     and negotiated in order to avoid conflict, competition, etc.,</xs:documentation>
 </xs:annotation>
 <xs:complexContent>
  <xs:extension base="urf:ZoneType">
     <xs:sequence>
     <xs:element ref="urf:_GenericApplicationPropertyOfAgreement" minOccurs="0" maxOccurs="unbounded"/>
     </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="Agreement" type="urf:AgreementType" substitutionGroup="urf:_Zone"/>
<xs:complexType name="AgreementPropertyType">
 <xs:sequence minOccurs="0">
  <xs:element ref="urf:Agreement"/>
 </xs:sequence>
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfAgreement" type="xs:anyType" abstract="true">
 <xs:annotation>
  <xs:documentation>This element is reserved for future use.</xs:documentation>
 </xs:annotation>
</xs:element>
<!-- ========================================================================== -->
<xs:complexType name="RegulationType">
 <xs:complexContent>
  <xs:extension base="urf:ZoneType">
     <xs:sequence>
     <xs:element ref="urf:_GenericApplicationPropertyOfRegulation" minOccurs="0" maxOccurs="unbounded"/>
     </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="Regulation" type="urf:RegulationType" substitutionGroup="urf:_Zone"/>
<xs:complexType name="RegulationPropertyType">
 <xs:sequence minOccurs="0">
  <xs:element ref="urf:Regulation"/>
 </xs:sequence>
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfRegulation" type="xs:anyType" abstract="true">
 <xs:annotation>
  <xs:documentation>This element is reserved for future use.</xs:documentation>
 </xs:annotation>
</xs:element>
<!-- ========================================================================== -->
<xs:complexType name="AreaClassificationType">
 <xs:complexContent>
```

```
  <xs:extension base="urf:ZoneType">
    <xs:sequence>
    <xs:element ref="urf:_GenericApplicationPropertyOfAreaClassification" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="AreaClassification" type="urf:AreaClassificationType" substitutionGroup="urf:_Zone"/>
<xs:complexType name="AreaClassificationPropertyType">
 <xs:sequence minOccurs="0">
  <xs:element ref="urf:AreaClassification"/>
 </xs:sequence>
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfAreaClassification" type="xs:anyType" abstract="true">
 <xs:annotation>
  <xs:documentation>This element is reserved for future use.</xs:documentation>
 </xs:annotation>
</xs:element>
<!-- ========================================================================== -->
<xs:complexType name="DistrictsAndZonesType">
 <xs:complexContent>
  <xs:extension base="urf:ZoneType">
    <xs:sequence>
    <xs:element ref="urf:_GenericApplicationPropertyOfDistrictsAndZones" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="DistrictsAndZones" type="urf:DistrictsAndZonesType" substitutionGroup="urf:_Zone"/>
<xs:complexType name="DistrictsAndZonesPropertyType">
 <xs:sequence minOccurs="0">
  <xs:element ref="urf:DistrictsAndZones"/>
 </xs:sequence>
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfDistrictsAndZones" type="xs:anyType" abstract="true">
 <xs:annotation>
  <xs:documentation>This element is reserved for future use.</xs:documentation>
 </xs:annotation>
</xs:element>
<!-- ========================================================================== -->
<xs:complexType name="DevelopmentProjectType">
 <xs:complexContent>
  <xs:extension base="urf:ZoneType">
    <xs:sequence>
    <xs:element name="status" type="gml:CodeType" minOccurs="0"/>
    <xs:element name="mainPurpose" type="gml:CodeType" minOccurs="0"/>
    <xs:element name="benefitArea" type="gml:MeasureType" minOccurs="0"/>
    <xs:element name="benefitPeriod" type="xs:string" minOccurs="0"/>
    <xs:element name="cost" type="xs:integer" minOccurs="0"/>
    <xs:element name="plannedArea" type="gml:MeasureType" minOccurs="0"/>
    <xs:element name="ongoingArea" type="gml:MeasureType" minOccurs="0"/>
    <xs:element name="completedArea" type="gml:MeasureType" minOccurs="0"/>
    <xs:element name="dateOfDecision" type="xs:date" minOccurs="0"/>
    <xs:element name="dateOfDesignationForTemporaryReplotting" type="xs:date" minOccurs="0"/>
```

```
      <xs:element ref="urf:_GenericApplicationPropertyOfDevelopmentProject" minOccurs="0"
maxOccurs="unbounded"/>
      </xs:sequence>
   </xs:extension>
 </xs:complexContent>
 </xs:complexType>
 <!-- ========================================================================== -->
 <xs:element name="DevelopmentProject" type="urf:DevelopmentProjectType" substitutionGroup="urf:_Zone"/>
 <xs:complexType name="DevelopmentProjectPropertyType">
  <xs:sequence minOccurs="0">
   <xs:element ref="urf:DevelopmentProject"/>
  </xs:sequence>
  <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
 </xs:complexType>
 <!-- ========================================================================== -->
 <xs:element name="_GenericApplicationPropertyOfDevelopmentProject" type="xs:anyType" abstract="true">
  <xs:annotation>
   <xs:documentation>This element is reserved for future use.</xs:documentation>
  </xs:annotation>
 </xs:element>
 <!-- ========================================================================== -->
 <xs:complexType name="CensusBlockType">
  <xs:annotation>
   <xs:documentation>Block for census survey</xs:documentation>
  </xs:annotation>
  <xs:complexContent>
   <xs:extension base="urf:UrbanFunctionType">
      <xs:sequence>
      <xs:element name="daytimePopulation" type="xs:integer" minOccurs="0"/>
      <xs:element name="daytimePopulationDensity" type="xs:double" minOccurs="0"/>
      <xs:element name="numberOfOrdinaryHouseholds" type="xs:integer" minOccurs="0"/>
      <xs:element name="numberOfHouseholdsByOwnership" type="urf:NumberOfHouseholdsPropertyType"
minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="numberOfMainHouseholds" type="xs:integer" minOccurs="0"/>
      <xs:element name="numberOfHouseholdsByStruture" type="urf:NumberOfHouseholdsPropertyType" minOccurs="0"
maxOccurs="unbounded"/>
      <xs:element ref="urf:_GenericApplicationPropertyOfCensusBlock" minOccurs="0" maxOccurs="unbounded"/>
      </xs:sequence>
   </xs:extension>
  </xs:complexContent>
 </xs:complexType>
 <!-- ========================================================================== -->
 <xs:element name="CensusBlock" type="urf:CensusBlockType" substitutionGroup="urf:_UrbanFunction"/>
 <xs:complexType name="CensusBlockPropertyType">
  <xs:sequence minOccurs="0">
   <xs:element ref="urf:CensusBlock"/>
  </xs:sequence>
  <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
 </xs:complexType>
 <!-- ========================================================================== -->
 <xs:element name="_GenericApplicationPropertyOfCensusBlock" type="xs:anyType" abstract="true">
  <xs:annotation>
   <xs:documentation>This element is reserved for future use.</xs:documentation>
  </xs:annotation>
 </xs:element>
 <!-- ========================================================================== -->
 <xs:element name="NumberOfHouseholds" type="urf:NumberOfHouseholdsType"/>
 <xs:complexType name="NumberOfHouseholdsType">
  <xs:sequence>
```

```
  <xs:element name="class" type="gml:CodeType"/>
  <xs:element name="number" type="xs:integer"/>
 </xs:sequence>
</xs:complexType>
<xs:complexType name="NumberOfHouseholdsPropertyType">
 <xs:sequence>
  <xs:element ref="urf:NumberOfHouseholds"/>
 </xs:sequence>
</xs:complexType>
<!-- ========================================================================== -->
<xs:complexType name="DisasterDamageType">
 <xs:complexContent>
  <xs:extension base="urf:UrbanFunctionType">
     <xs:sequence>
     <xs:element name="damagedArea" type="gml:MeasureType" minOccurs="0"/>
     <xs:element name="numberOfDamagedHouses" type="xs:nonNegativeInteger" minOccurs="0"/>
     <xs:element name="numberOfHousesFloodedAboveFloorLevel" type="xs:nonNegativeInteger" minOccurs="0"/>
     <xs:element name="numberOfHousesFloodedBelowFloorLevel" type="xs:nonNegativeInteger" minOccurs="0"/>
     <xs:element name="maximumRainfallPerHour" type="xs:nonNegativeInteger" minOccurs="0"/>
     <xs:element name="totalRainfall" type="xs:nonNegativeInteger" minOccurs="0"/>
     <xs:element ref="urf:_GenericApplicationPropertyOfDisasterDamage" minOccurs="0" maxOccurs="unbounded"/>
     </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="DisasterDamage" type="urf:DisasterDamageType" substitutionGroup="urf:_UrbanFunction"/>
<xs:complexType name="DisasterDamagePropertyType">
 <xs:sequence minOccurs="0">
  <xs:element ref="urf:DisasterDamage"/>
 </xs:sequence>
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfDisasterDamage" type="xs:anyType" abstract="true">
 <xs:annotation>
  <xs:documentation>This element is reserved for future use.</xs:documentation>
 </xs:annotation>
</xs:element>
<!-- ========================================================================== -->
<xs:complexType name="PollutionType">
 <xs:annotation>
  <xs:documentation>Source of pollution</xs:documentation>
 </xs:annotation>
 <xs:complexContent>
  <xs:extension base="urf:UrbanFunctionType">
     <xs:sequence>
     <xs:element name="damagedArea" type="gml:MeasureType" minOccurs="0"/>
     <xs:element name="cause" type="xs:string" minOccurs="0"/>
     <xs:element ref="urf:_GenericApplicationPropertyOfPollution" minOccurs="0" maxOccurs="unbounded"/>
     </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="Pollution" type="urf:PollutionType" substitutionGroup="urf:_UrbanFunction"/>
<xs:complexType name="PollutionPropertyType">
 <xs:sequence minOccurs="0">
  <xs:element ref="urf:Pollution"/>
 </xs:sequence>
```

```
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
 </xs:complexType>
 <!-- ========================================================================== -->
 <xs:element name="_GenericApplicationPropertyOfPollution" type="xs:anyType" abstract="true">
  <xs:annotation>
   <xs:documentation>This element is reserved for future use.</xs:documentation>
  </xs:annotation>
 </xs:element>
 <!-- ========================================================================== -->
 <xs:complexType name="DisasterPreventionBaseType">
  <xs:complexContent>
   <xs:extension base="urf:UrbanFunctionType">
    <xs:sequence>
     <xs:element name="capacity" type="xs:integer" minOccurs="0"/>
     <xs:element ref="urf:_GenericApplicationPropertyOfDisasterPreventionBase" minOccurs="0"
maxOccurs="unbounded"/>
    </xs:sequence>
   </xs:extension>
  </xs:complexContent>
 </xs:complexType>
 <!-- ========================================================================== -->
 <xs:element name="DisasterPreventionBase" type="urf:DisasterPreventionBaseType"
substitutionGroup="urf:_UrbanFunction"/>
 <xs:complexType name="DisasterPreventionBasePropertyType">
  <xs:sequence minOccurs="0">
   <xs:element ref="urf:DisasterPreventionBase"/>
  </xs:sequence>
  <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
 </xs:complexType>
 <!-- ========================================================================== -->
 <xs:element name="_GenericApplicationPropertyOfDisasterPreventionBase" type="xs:anyType" abstract="true">
  <xs:annotation>
   <xs:documentation>This element is reserved for future use.</xs:documentation>
  </xs:annotation>
 </xs:element>
 <!-- ========================================================================== -->
 <xs:complexType name="RecreationsType">
  <xs:complexContent>
   <xs:extension base="urf:UrbanFunctionType">
    <xs:sequence>
     <xs:element name="capacity" type="xs:integer" minOccurs="0"/>
     <xs:element name="numberOfUsers" type="xs:integer" minOccurs="0"/>
     <xs:element ref="urf:_GenericApplicationPropertyOfRecreations" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
   </xs:extension>
  </xs:complexContent>
 </xs:complexType>
 <!-- ========================================================================== -->
 <xs:element name="Recreations" type="urf:RecreationsType" substitutionGroup="urf:_UrbanFunction"/>
 <xs:complexType name="RecreationsPropertyType">
  <xs:sequence minOccurs="0">
   <xs:element ref="urf:Recreations"/>
  </xs:sequence>
  <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
 </xs:complexType>
 <!-- ========================================================================== -->
 <xs:element name="_GenericApplicationPropertyOfRecreations" type="xs:anyType" abstract="true">
  <xs:annotation>
   <xs:documentation>This element is reserved for future use.</xs:documentation>
```

```
 </xs:annotation>
</xs:element>
<!-- ========================================================================== -->
<xs:complexType name="HubCityType">
 <xs:complexContent>
  <xs:extension base="urf:UrbanFunctionType">
     <xs:sequence>
     <xs:element ref="urf:_GenericApplicationPropertyOfHubCity" minOccurs="0" maxOccurs="unbounded"/>
     </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="HubCity" type="urf:HubCityType" substitutionGroup="urf:_UrbanFunction"/>
<xs:complexType name="HubCityPropertyType">
 <xs:sequence minOccurs="0">
  <xs:element ref="urf:HubCity"/>
 </xs:sequence>
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfHubCity" type="xs:anyType" abstract="true">
 <xs:annotation>
  <xs:documentation>This element is reserved for future use.</xs:documentation>
 </xs:annotation>
</xs:element>
<!-- ========================================================================== -->
<xs:complexType name="LandUseDiversionType">
 <xs:complexContent>
  <xs:extension base="urf:UrbanFunctionType">
     <xs:sequence>
     <xs:element ref="urf:_GenericApplicationPropertyOfLandUseDiversion" minOccurs="0" maxOccurs="unbounded"/>
     </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="LandUseDiversion" type="urf:LandUseDiversionType" substitutionGroup="urf:_UrbanFunction"/>
<xs:complexType name="LandUseDiversionPropertyType">
 <xs:sequence minOccurs="0">
  <xs:element ref="urf:LandUseDiversion"/>
 </xs:sequence>
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfLandUseDiversion" type="xs:anyType" abstract="true">
 <xs:annotation>
  <xs:documentation>This element is reserved for future use.</xs:documentation>
 </xs:annotation>
</xs:element>
<!-- ========================================================================== -->
<xs:complexType name="UrbanizationType">
 <xs:complexContent>
  <xs:extension base="urf:UrbanFunctionType">
     <xs:sequence>
     <xs:element name="period" type="xs:string" minOccurs="0"/>
     <xs:element name="resources" type="xs:string" minOccurs="0"/>
     <xs:element ref="urf:_GenericApplicationPropertyOfUrbanization" minOccurs="0" maxOccurs="unbounded"/>
     </xs:sequence>
  </xs:extension>
```

```
 </xs:complexContent>
 </xs:complexType>
 <!-- ========================================================================== -->
 <xs:element name="Urbanization" type="urf:UrbanizationType" substitutionGroup="urf:_UrbanFunction"/>
 <xs:complexType name="UrbanizationPropertyType">
  <xs:sequence minOccurs="0">
   <xs:element ref="urf:Urbanization"/>
  </xs:sequence>
  <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
 </xs:complexType>
 <!-- ========================================================================== -->
 <xs:element name="_GenericApplicationPropertyOfUrbanization" type="xs:anyType" abstract="true">
  <xs:annotation>
   <xs:documentation>This element is reserved for future use.</xs:documentation>
  </xs:annotation>
 </xs:element>
</xs:schema>
```

A.2 Sample data (informative)

```
<?xml version="1.0" encoding="UTF-8"?>
<core:CityModel xmlns:urf="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/urf/1.3"
 xmlns:core="http://www.opengis.net/citygml/2.0"
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xmlns:gml="http://www.opengis.net/gml"
 xmlns:xlink="http://www.w3.org/1999/xlink"
 xsi:schemaLocation="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/urf/1.3 http://www.kantei.g
o.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/schemas/urf/1.3/urbanFunction.xsd
http://www.opengis.net/citygml/2.0 http://schemas.opengis.net/citygml/2.0/cityGMLBase.xsd
http://www.opengis.net/gml http://schemas.opengis.net/gml/3.1.1/base/gml.xsd">
 <core:cityObjectMember>
  <urf:Administration gml:id="admin001">
   <urf:prefecture codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Comm
on_prefecture.xml">40</urf:prefecture>
   <urf:city codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Common_loca
lPublicAuthorities.xml">40220</urf:city>
   <urf:surveyYear>2017</urf:surveyYear>
   <urf:area>
     <gml:MultiSurface srsName="http://www.opengis.net/def/crs/EPSG/0/6697">
     <gml:surfaceMember>
      <gml:Polygon>
       <gml:exterior>
        <gml:LinearRing>
         <gml:pos>33.84252833 130.4901808 0</gml:pos>
         <gml:pos>33.84259361 130.4903153 0</gml:pos>
<-- omitted -->
         <gml:pos>33.84251389 130.4900461 0</gml:pos>
         <gml:pos>33.84252833 130.4901808 0</gml:pos>
        </gml:LinearRing>
       </gml:exterior>
      </gml:Polygon>
     </gml:surfaceMember>
     <gml:surfaceMember>
      <gml:Polygon>
       <gml:exterior>
        <gml:LinearRing>
         <gml:pos>33.8638502 130.4732692 0</gml:pos>
         <gml:pos>33.86385347 130.473259 0</gml:pos>
<-- omitted  -->
```

```
        <gml:pos>33.86384941 130.4732781 0</gml:pos>
        <gml:pos>33.8638502 130.4732692 0</gml:pos>
       </gml:LinearRing>
      </gml:exterior>
     </gml:Polygon>
    </gml:surfaceMember>
    </gml:MultiSurface>
  </urf:area>
 </urf:Administration>
</core:cityObjectMember>
</core:CityModel>
```

Annex B
(informative)

Code lists for Urban Function Data

This annex exemplifies the specification of code lists for enumerative attributes of type *gml:CodeType* in Urban Planning ADE and provides proposals for selected attributes. Please note that this annex is non-normative and the presented code lists are neither mandatory nor complete.

Code lists for UrbanFunction

Code list of the subclasses of *UrbanFunction* attribute *urbanPlanType*
See Code list for the *UrbanPlan* attribute *class*

Code list of the subclasses of *UrbanFunction* attribute *areaClassificationType*
See Code list for the *AreaClassification* attribute *class*

Code list of the subclasses of *UrbanFunction* attribute *prefecture*
See Code list for the *Administration* attribute *prefecture* in Part 2

Code list of the subclasses of *UrbanFunction* attribute *city*
See Code list of the *Administration* attribute *city* in Part 2

Code lists for Administration

Code list of the *Administration* attribute *prefecture*
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Common_prefecture.xml
Prefecture code defined in international/domestic standard should be used. e.g. JIS X 0401:1973 – Todofuken (prefecture) identification code (in Japan)

Code list of the *Administration* attribute *city*
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Common_localPublicAuthorities.xml
Municipality code defined in international/domestic standard should be used. e.g. JIS X0402:2010 – Identification code for cities, towns and villages (in Japan)

Code lists for LandUsePlan

Code list for the *LandUsePlan* attribute *class*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Common_landUsePlanType.xml			
1010	special use districts	1140	scenic district
1020	exceptional floor area ratio district	1150	parking place development zone
1030	special use restriction districts	1160	port zone
1040	high-rise residential attraction district	1170	special historic natural features conservation zone
1050	hight control district	1180	category 1 special historic natural features conservation zone

1060	high-level use district	1190	category 2 special historic natural features conservation zone
1070	specified blocks	1200	special green space conservation district
1080	special urban renaissance district	1210	distribution business zone
1090	fire prevention district	1220	productive green zone
1100	quasi-fire prevention district	1230	conservation zone for clusters of traditional structures
1110	specified disaster prevention block improvement zone	1240	aircraft noise control zone
1120	landscape zone	1250	aircraft noise control special zone
1130	quasi-landscape zone		

Code lists for UrbanPlan

Code list for the *UrbanPlan* attribute *class*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Common_urbanPlanType.xml			
1010	urban planning area	1090	area outside of urban planning area
1020	quasi urban planning area		

Code lists for Agreement

Code list for the *Agreement* attribute *class*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Agreement_class.xml			
1010	building agreement	1030	landscape agreement
1020	green space agreement	1040	development permit

Code lists for DevelopmentProject

Code list for the *DevelopmentProject* attribute *class*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/DevelopmentProject_class.xml			
1010	housing	1030	urban fucilities
1020	agricultural facilities		

Code list for the *DevelopmentProject* attribute *function*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/DevelopmentProject_function.xml			
1010	urban redevelopment project	3010	urban highway
1020	residential area improvement project	3020	road
1030	land readjustment project	3030	water supply
1040	new residential urban development project	3040	sewage
1050	industrial construction project	3050	park
1060	distribution business complex reclamation project	3060	river
1070	housing facility construction project	3070	other urban facilities
1080	public water surface landfill project		
1090	new urban infrastructure development project		
1100	residential area development project		
1110	disaster control area development project		
1120	other public residential development project		
2010	irrigation and drainage project		
2020	field development project	9000	unexamined
2030	farm road improvement project	9010	exception
2040	other agricultural project	9020	unknown

Code list for the *DevelopmentProject* attribute *usage*
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/DevelopmentProject_usage.xml

1010	residential	9000	unexamined
1020	commertial	9010	exception
1030	industrial	9020	unknown
1040	agriculture, foresty and fisheries		
1050	public		
1060	other		

Code list for the *DevelopmentProject* attribute *status*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/DevelopmentProject_status.xml			
1010	completed	9000	unexamined
1020	under construction or approved	9010	exception
		9020	unknown

Code lists for AreaClassification

Code list for AreaClassification attribute *class*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Common_areaClassification.xml			
1010	undesignated area within an undivided use district	1040	undivided use district
1020	urbanization area	1050	quasi- urban planning area
1003	urbanization control area	1090	area outside of urban planning area

Code lists for DistrictsAndZones

Code list for the *DistrictsAndZones* attribute *class*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Common_districtsAndZones.xml			
1000	undesignated area	1070	quasi-residential district
1010	category 1 low-rise exclusive residential district	1080	neighbourhood commercial district
1020	category 2 low-rise exclusive residential district	1090	commercial district
1030	category 1 medium-to-high-rise exclusive residential district	1100	quasi-industrial district
1040	category 2 medium-to-high-rise exclusive residential district	1110	industrial district
1050	category 1 residential district	1120	exclusive industrial district
1060	category 2 residential district	1130	rural residential district

Code lists for CensusBlock

Code list for the *CensusBlock* attribute *numberOfHouseholdsByOwnership* (attribute *class* of the datatype *NumberOfHouseholdsType*)			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Households_ownershipType.xml			
1000	own occupation	1030	issued house
1010	leased house (public)	1040	lodging
1020	leased house (private)	1050	others

Code list for the *CensusBlock* attribute *numberOfHouseholdsByStructure* (attribute *class* of the datatype *NumberOfHouseholdsType*)			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Households_houseType.xml			
1000	single-familiy home	1040	apartment (6-10 floors)
1010	tenement house	1050	apartment (more than 11 floors)
1020	apartment (1-2 floors)	1060	others
1030	apartment (3-5 floors)		

Code lists for DisasterDamage

Code list for the *DisasterDamage* attribute *class*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/DisasterDamage_class.xml			
1010	flood	1020	landslide

Code list for the *DisasterDamage* attribute *function*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/DisasterDamage_function.xml			
1000	external water damage area	2010	rock slide
1020	internal water damage area	2020	landslide
		2030	mudflow

Code lists for Pollution

Code list for *Pollution* attribute *class*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Pollution_class.xml			
1010	air pollution	1050	ground subsidence
1020	water pollution	1060	odious smell
1030	noise	1070	soil contamination
1040	shocks, tremors or vibrations	1080	other

Code lists for DisasterPreventionBase

Code list for the *DisasterPreventionBase* attribute *class*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/DisasterPreventionBase_class.xml			
1010	designated emergency evacuation place	1030	disaster prevention base
1020	designated evacuation place	1040	water supply for fire defense

Code lists for Recreations

Code list for the *Recreations* attribute *class*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Recreation_class.xml			
1010	nature	1100	life / industry
1020	history / culture	1120	view
		2000	other recreation

Code list for the *Recreations* attribute *function*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Recreation_function.xml			
1010	baseball studium	1110	pleasure land
1020	athletic field	1120	zoo
1030	soccer field, rugby playground	1130	botanical garden
1040	tennis court	1140	cycling stadium, turf
1050	golf course	1150	sightseeing toll road
1060	swimming pool	1160	cycling course
1070	other sports facilities	1170	hiking trail, trail
1080	speedboat racecourse	1180	nature trail
1090	yacht basin	1190	camping ground
1100	beach, clam digging area	1200	others

Code lists for HubCity

Code list for the *HubCity* attribute *class*

http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/HubCity_class.xml			
1010	Regional hub city	1020	Hub city

Code lists for LandUseDiversion

Code list for the *LandUseDiversion* attribute *class*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/LandUseDiversion_class.xml			
1010	conversion of agricultural land	1030	new building
1020	conversion of forestry		

Code list for the *LandUseDiversion* attribute *usage*
See Code list for the DevelopmentProject attribute *usage*

Code lists for Urbanization

Code list for the *Urbanization* attribute *class*			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Urbanization_class.xml			
1010	mid-Meiji era (1880's)	1040	befor World War II
1020	early Taisho era (1910's)	1050	after World War II
1030	early Showa era (1930's)	1060	30's of Showa era (1950's)

Part 3. Statistical Grid Data Encoding Specification

1. Scope

To grasp the current situation and issues of urban areas, comparing urban growth from the past to the present and also comparing between cities of the same urban scale are necessary to simplify complex situations.

This document defines statistical grid for time-series comparison and regional comparison, and specifies the encoding format of statistical grid.

In addition, global city model of national or world is necessary for comparing cities and understanding the relationships between cities through quantitative assessment. This is necessary in order to clarify the current situation and problems in urban areas.

The Levels of Detail (LOD) defined in CityGML do not cover such a rough description, therefore this document defines the mechanism to describe the global city model and specifies the encoding format of the information.

2. Normative references

Followings are normative references of this document.

- OpenGIS® OGC City Geography Markup Language (CityGML) Encoding Standard, Version 2.0, OGC document 12-019

3. Conventions

3.1 Terms and definitions

No terms and definitions are listed in this document.

3.2 Abbreviated terms

ADE Application Domain Extensions

CityGML City Geography Markup Language

GML Geography Markup Language

LOD Levels Of Detail

OGC Open Geospatial Consortium

UML Unified Modeling Language

4. Statistical Grid Data Encoding

4.1 Overview

In city planning, characteristics of features are abstracted and mapped into statistical units for global representation and analysis. An Administrative boundary is often used as a statistical unit. However, changes of administrative boundries such as municipal mergers and dissolutions make it difficult to conduct time-series comparison and regional comparison. In addition, different sizes of administrative districts hinder finding regional issues. A Statistical grid which divides cities into grid cells with almost

equal area are useful for such global analysis. Therefore this module extends LODs to describe suc rough city models which do not have to be detailed but should be described with a unified unit among cities. This enables users to analyse and visualise cities under the same conditions. Figure 3-1 shows an example of grid cells describing a global city model.

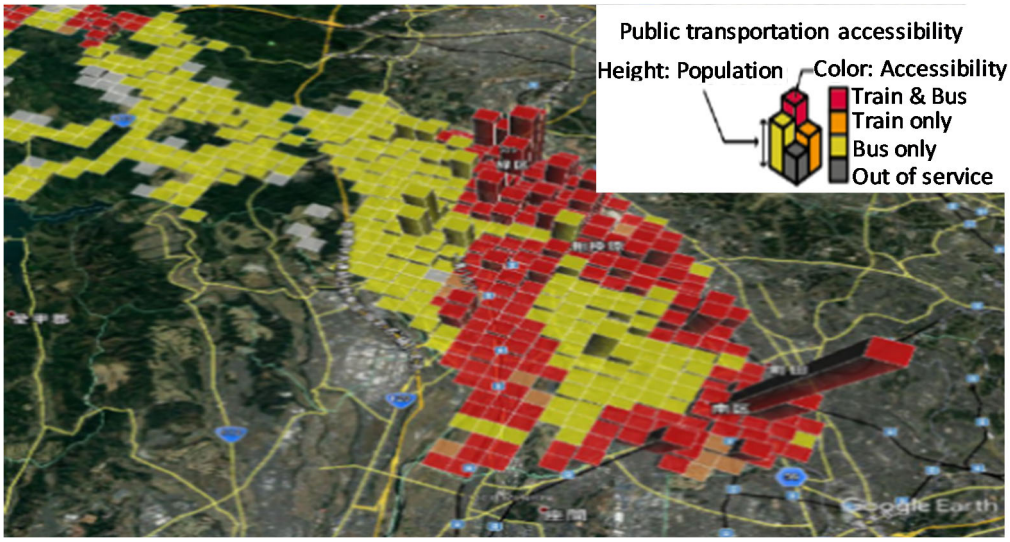


Figure 3-1 Example of grids describing a global city model

This module defines two additional LODs for statistical grids, LOD-1 (minus one) for nationwide city models and LOD-2 (minus two) for worldwide city models. This extension allows users to compare different times of a city and among different cities with statistical grids without inconsistency between LOD 0 to 4 (Figure 3-2).

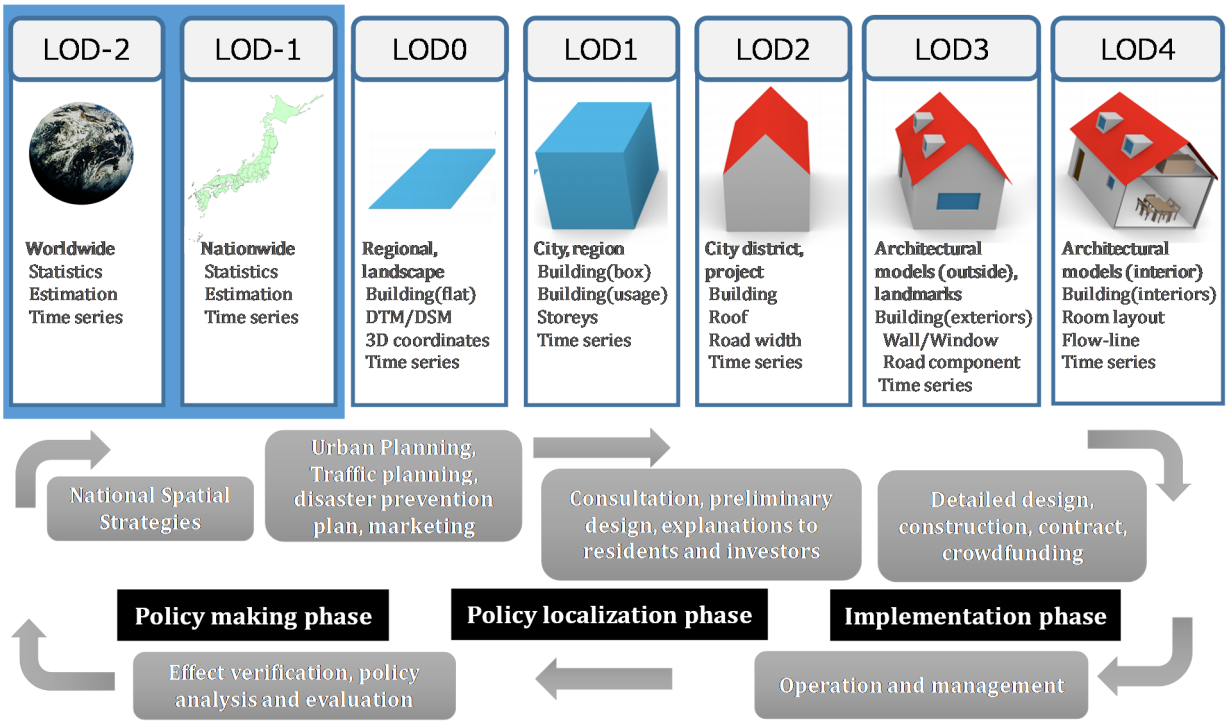


Figure 3-2 Extended LOD for global city models

Based on the above, this document defines the elements and types according to the rules of Application Domain Extensions (ADE) which describe statistical grid for global city models but not defined in CityGML. Those already defined in CityGML are imported without any inconsistency.

Figure 3-3 shows the structure of Statistical Grid Data.

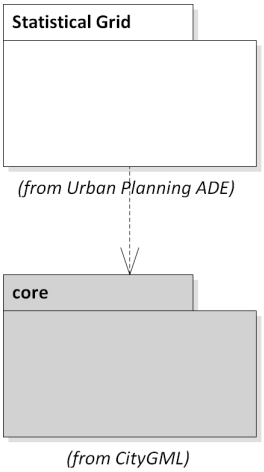


Figure 3-3 Package diagram of Statistical Grid Data

Module name	Statistical Grid
XML namespace identifier	http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/urg/1.3
XMLSchema location	http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/schemas/urg/1.3/statisticalGrid.xsd
Recommended namespace prefix	urg
Description	This module defines statistical grid which divides specific area to grids. Each grid has its own thematic value, e.g. population, land price.

4.2 Object definition

4.2.1 StatisticalGridType, _StatisticalGrid

The Statistical grid module enables users with time-series analysis and regional comparison. A grid is a network composed of two or more sets of curves, in which the members of each set intersect the members of the other sets in an algorithmic way, and the curves separate space into grid cells. Statistical grid module gives statistical values to each grid cell.

Figure 3-4 shows the UML diagram of the Statistical grid module, and the XMLSchema Definition is attached in Annex A. A root class of this module is *urg::_StatisticalGrid*. A grid cell defined in Coverage schema is not distinguishable and is regarded as a part of a feature, however a statistical grid cell has its identifier. This means a statistical grid cell is a feature rather than a part of a feature, and therefore *urg::_StatisticalGrid* inherits from *gml::_Feature* via *core::_CityObject*.

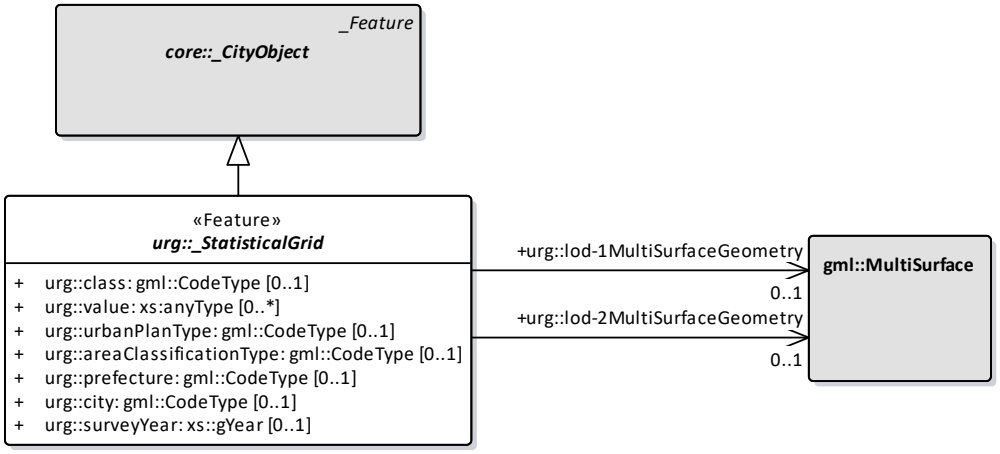


Figure 3-4 UML diagram of Statistical Grid Data

Object	Definition
urg::_StatisticalGrid	grid cell for statistical data
Property	**Definition**
urg::class	type of the mesh
urg::value	value of the mesh
urg::urbanPlanType	Type of the grid location designated by the Urban Plan
urg::areaClassificationType	Type of the grid location designated by the Area classification
urg::prefecture	Prefecture name of the grid location
urg::city	City name of the grid location
urg::surveyYear	year of the survey
urg::lod-1MultiSurfaceGeometry	geometry of the mesh at LOD-1 level
urg::lod-2MultiSurfaceGeometry	geometry of the mesh at LOD-2 level

```
<xs:complexType name="StatisticalGridType" abstract="true">
 <xs:complexContent>
  <xs:extension base="core:AbstractCityObjectType">
     <xs:sequence>
     <xs:element name="class" type="gml:CodeType" minOccurs="0"/>
     <xs:element name="value" type="xs:anyType" minOccurs="0" maxOccurs="unbounded"/>
     <xs:element name="urbanPlanType" type="gml:CodeType" minOccurs="0"/>
     <xs:element name="areaClassificationType" type="gml:CodeType" minOccurs="0"/>
     <xs:element name="prefecture" type="gml:CodeType" minOccurs="0"/>
     <xs:element name="city" type="gml:CodeType" minOccurs="0"/>
     <xs:element name="surveyYear" type="xs:gYear" minOccurs="0"/>
     <xs:element name="lod-1MultiSurfaceGeometry" type="gml:MultiSurfacePropertyType" minOccurs="0"/>
     <xs:element name="lod-2MultiSurfaceGeometry" type="gml:MultiSurfacePropertyType" minOccurs="0"/>
     <xs:element ref="_GenericApplicationPropertyOfStatisticalGrid" minOccurs="0" maxOccurs="unbounded"/>
     </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<xs:element name="_StatisticalGrid" type="StatisticalGridType" abstract="true" substitutionGroup="core:_CityObject"/>
<xs:element name="_GenericApplicationPropertyOfStatisticalGrid" type="xs:anyType" abstract="true">
 <xs:annotation>
  <xs:documentation>This element is reserved for future use.</xs:documentation>
 </xs:annotation>
</xs:element>
```

The elements "_GenericApplicationPropertyOf…". "_GenericApplicationPropertyOf…" are reserved for future use and not used in this document.

A *urg::_StatisticalGrid* is the root class of this module and is extended for defining specific statistical grid objects. Figure 3-5 shows subclasses of *urg::_StatisticalGrid*.

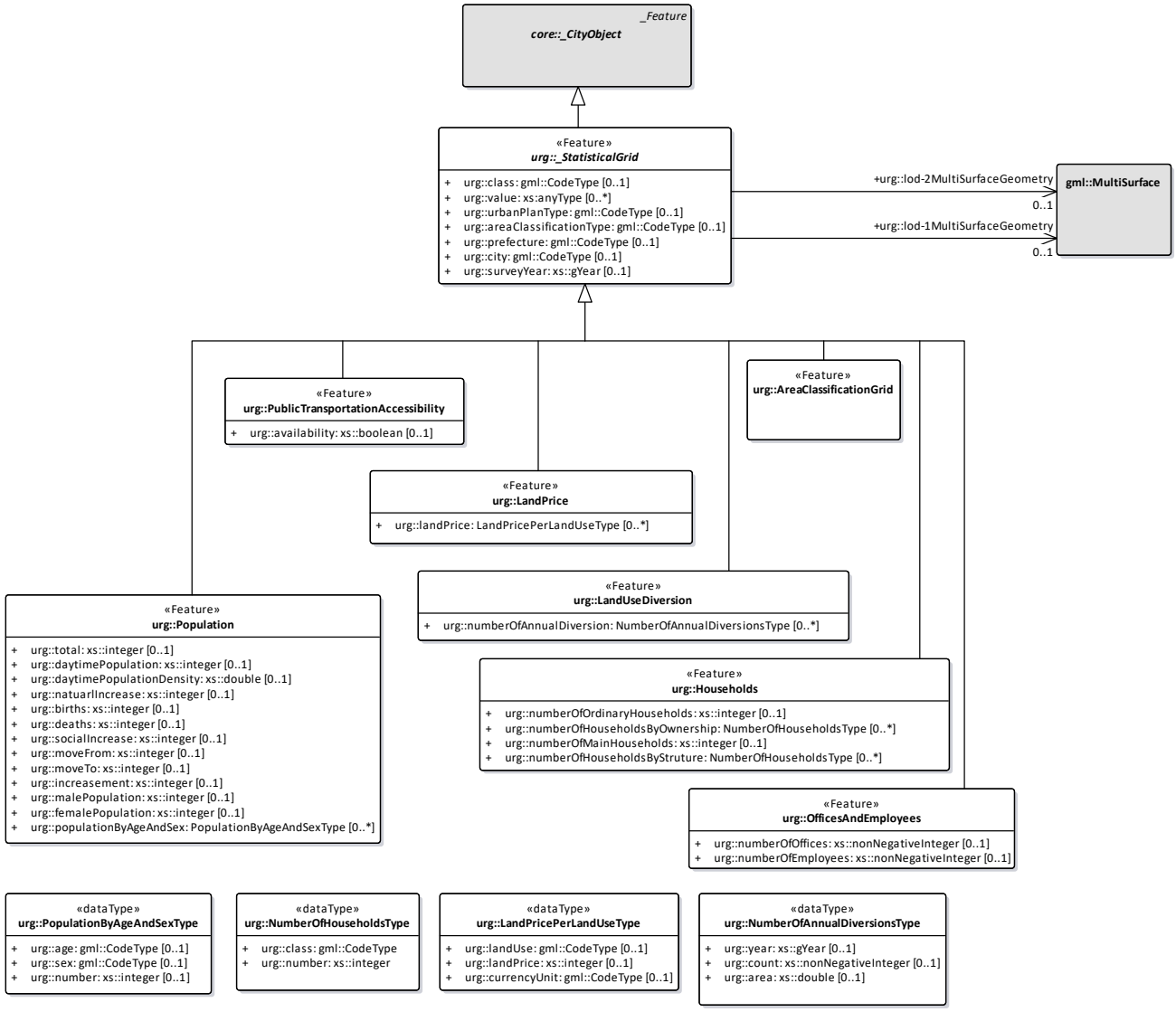


Figure 3-5 Subclasses of *urg::_StatisticalGrid*

4.2.2 PopulationType, Population

Object	Definition
urg::Population	Population information in a grid cell
Property	**Definition**
urg::total	Total population
urg::daytimePopulation	Daytime population
urg:daytimePopulationDensity	Daytime population density
urg::naturalIncrease	Natural increase per year
urg::births	Number of births
urg::deaths	Number of deaths

urg::socialIncrease	Increase of social community
urg::moveFrom	Number of people who move from
urg::moveTo	Number of people who move to
urg::increasement	Population increase
urg::malePopulation	Total male population
urg::femalePopulation	Total female population
urg:: populationByAgeAndSex	Population by age and sex

```
 <xs:complexType name="PopulationType">
 <xs:annotation>
  <xs:documentation>grid cell with population values</xs:documentation>
 </xs:annotation>
 <xs:complexContent>
  <xs:extension base="StatisticalGridType">
     <xs:sequence>
     <xs:element name="total" type="xs:integer" minOccurs="0"/>
     <xs:element name="daytimePopulation" type="xs:integer" minOccurs="0"/>
     <xs:element name="daytimePopulationDensity" type="xs:double" minOccurs="0"/>
     <xs:element name="naturalIncrease" type="xs:integer" minOccurs="0"/>
     <xs:element name="births" type="xs:integer" minOccurs="0"/>
     <xs:element name="deaths" type="xs:integer" minOccurs="0"/>
     <xs:element name="socialIncrease" type="xs:integer" minOccurs="0"/>
     <xs:element name="moveFrom" type="xs:integer" minOccurs="0"/>
     <xs:element name="moveTo" type="xs:integer" minOccurs="0"/>
     <xs:element name="increasement" type="xs:integer" minOccurs="0"/>
     <xs:element name="malePopulation" type="xs:integer" minOccurs="0"/>
     <xs:element name="femalePopulation" type="xs:integer" minOccurs="0"/>
     <xs:element name="populationByAgeAndSex" type="PopulationByAgeAndSexPropertyType" minOccurs="0"
maxOccurs="unbounded"/>
     <xs:element ref="_GenericApplicationPropertyOfPopulation" minOccurs="0" maxOccurs="unbounded"/>
     </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="Population" type="PopulationType" substitutionGroup="_StatisticalGrid"/>
<xs:complexType name="PopulationPropertyType">
 <xs:sequence minOccurs="0">
  <xs:element ref="Population"/>
 </xs:sequence>
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfPopulation" type="xs:anyType" abstract="true"/>
```

PopulationByAgeAndSexType

Type	Definition
urg::PopulationByAgeAndSexType	Population by age and sex
Property	**Definition**
urg::age	Age
urg::sex	Sex
urg::number	population

```
<xs:element name="PopulationByAgeAndSex" type="PopulationByAgeAndSexType"/>
<xs:complexType name="PopulationByAgeAndSexType">
 <xs:sequence>
```

```
   <xs:element name="age" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="sex" type="gml:CodeType" minOccurs="0"/>
   <xs:element name="number" type="xs:integer" minOccurs="0"/>
  </xs:sequence>
 </xs:complexType>
 <xs:complexType name="PopulationByAgeAndSexPropertyType">
  <xs:sequence>
   <xs:element ref="PopulationByAgeAndSex"/>
  </xs:sequence>
 </xs:complexType>
```

4.2.3 PublicTransportationAccessibilityType, PublicTransportationAccessibility

Object	Definition
urg:: PublicTransportationAccessibility	Accessibility of public transportation service such as busses and railways
Property	**Definition**
urg::availability	Whether the grid cell location is within the specified distance from the bus stop/ train station or not

```
 <xs:complexType name="PublicTransportationAccessibilityType">
  <xs:complexContent>
   <xs:extension base="StatisticalGridType">
      <xs:sequence>
      <xs:element name="availability" type="xs:boolean" minOccurs="0"/>
      <xs:element ref="_GenericApplicationPropertyOfPublicTransportationAccessibility" minOccurs="0"
maxOccurs="unbounded"/>
      </xs:sequence>
   </xs:extension>
  </xs:complexContent>
 </xs:complexType>
 <!-- ========================================================================== -->
 <xs:element name="PublicTransportationAccessibility" type="PublicTransportationAccessibilityType"
substitutionGroup="_StatisticalGrid"/>
 <xs:complexType name="PublicTransportationAccessibilityPropertyType">
  <xs:sequence minOccurs="0">
   <xs:element ref="PublicTransportationAccessibility"/>
  </xs:sequence>
  <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
 </xs:complexType>
 <!-- ========================================================================== -->
 <xs:element name="_GenericApplicationPropertyOfPublicTransportationAccessibility" type="xs:anyType"
abstract="true"/>
```

4.2.4 LandPriceType, LandPrice

Object	Definition
urg::LandPrice	Average land price in a grid cell
Property	**Definition**
urg::landPrice	land price per unit area by land use types

```
 <xs:complexType name="LandPriceType">
  <xs:annotation>
   <xs:documentation>grid cell with land prices</xs:documentation>
  </xs:annotation>
  <xs:complexContent>
   <xs:extension base="StatisticalGridType">
```

```
    <xs:sequence>
    <xs:element name="landPrice" type="LandPricePerLandUsePropertyType" minOccurs="0" maxOccurs="unbounded"/>
    <xs:element ref="_GenericApplicationPropertyOfLandPrice" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="LandPrice" type="LandPriceType" substitutionGroup="_StatisticalGrid"/>
<xs:complexType name="LandPricePropertyType">
 <xs:sequence minOccurs="0">
  <xs:element ref="LandPrice"/>
 </xs:sequence>
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfLandPrice" type="xs:anyType" abstract="true"/>
```

LandPricePerLandUseType

Type	Definition
urg:: LandPricePerLandUseType	Land price per unit area of the specified land use
Property	**Definition**
urg::landUse	Land use type
urg::landPrice	Land price per unit area
urg::currencyUnit	Currency unit for the price

```
<xs:element name="LandPricePerLandUse" type="LandPricePerLandUseType"/>
<xs:complexType name="LandPricePerLandUseType">
 <xs:sequence>
  <xs:element name="landUse" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="landPrice" type="xs:integer" minOccurs="0"/>
  <xs:element name="currencyUnit" type="gml:CodeType" minOccurs="0"/>
 </xs:sequence>
</xs:complexType>
<xs:complexType name="LandPricePerLandUsePropertyType">
 <xs:sequence>
  <xs:element ref="LandPricePerLandUse"/>
 </xs:sequence>
</xs:complexType>
```

4.2.5 LandUseDiversionType, LandUseDiversion

Object	Definition
urg:: LandUseDiversion	Land use diversion per year
Property	**Definition**
urg::numberOfAnnualDiversion	Annual number and area of land diversion

```
<xs:complexType name="LandUseDiversionType">
 <xs:complexContent>
  <xs:extension base="StatisticalGridType">
    <xs:sequence>
    <xs:element name="numberOfAnnualDiversion" type="NumberOfAnnualDiversionsPropertyType" minOccurs="0"
maxOccurs="unbounded"/>
    <xs:element ref="_GenericApplicationPropertyOfLandUseDiversion" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:extension>
```

```
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="LandUseDiversion" type="LandUseDiversionType" substitutionGroup="_StatisticalGrid"/>
<xs:complexType name="LandUseDiversionPropertyType">
 <xs:sequence minOccurs="0">
  <xs:element ref="LandUseDiversion"/>
 </xs:sequence>
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfLandUseDiversion" type="xs:anyType" abstract="true"/>
```

NumberOfAnnualDiversionsType

Type	Definition
urg:: NumberOfAnnualDiversionsType	Number of diversion and total area per year
Property	**Definition**
urg::year	Survey year
urg:count	number of land diversion
urg:area	total area

```
<xs:element name="NumberOfAnnualDiversions" type="NumberOfAnnualDiversionsType"/>
<xs:complexType name="NumberOfAnnualDiversionsType">
 <xs:sequence>
  <xs:element name="year" type="xs:gYear" minOccurs="0"/>
  <xs:element name="count" type="xs:nonNegativeInteger" minOccurs="0"/>
  <xs:element name="area" type="gml:MeasureType" minOccurs="0"/>
 </xs:sequence>
</xs:complexType>
<xs:complexType name="NumberOfAnnualDiversionsPropertyType">
 <xs:sequence>
  <xs:element ref="NumberOfAnnualDiversions"/>
 </xs:sequence>
</xs:complexType>
```

4.2.6 HouseholdsType, Households

Object	Definition
urg:: Households	Number of households by ownership and building structure
Property	**Definition**
urg::numberOfOrdinaryHouseholds	Number of ordinary households
urg::numberOfMainHouseholds	Number of main households
urg::numberOfHouseholdsByOwnership	Number of households by ownership
urg::numberOfHouseholdsByStructure	Number of households by building structure

```
<xs:complexType name="HouseholdsType">
 <xs:annotation>
  <xs:documentation>grid cell with the number of households</xs:documentation>
 </xs:annotation>
 <xs:complexContent>
  <xs:extension base="StatisticalGridType">
     <xs:sequence>
     <xs:element name="numberOfOrdinaryHousehold" type="xs:integer"/>
     <xs:element name="numberOfHouseholdsByOwnership" type="NumberOfHouseholdsPropertyType" minOccurs="0"
maxOccurs="unbounded"/>
```

```
      <xs:element name="numberOfHouseholdsByStructure" type="NumberOfHouseholdsPropertyType" minOccurs="0"
maxOccurs="unbounded"/>
      <xs:element name="numberOfMainHousehold" type="xs:integer"/>
      <xs:element ref="_GenericApplicationPropertyOfHouseholds" minOccurs="0" maxOccurs="unbounded"/>
      </xs:sequence>
    </xs:extension>
  </xs:complexContent>
 </xs:complexType>
 <!-- ========================================================================== -->
 <xs:element name="Households" type="HouseholdsType" substitutionGroup="_StatisticalGrid"/>
 <xs:complexType name="HouseholdsPropertyType">
  <xs:sequence minOccurs="0">
   <xs:element ref="Households"/>
  </xs:sequence>
  <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
 </xs:complexType>
 <!-- ========================================================================== -->
 <xs:element name="_GenericApplicationPropertyOfHouseholds" type="xs:anyType" abstract="true"/>
```

NumberOfHouseholdsType

Type	Definition
urg:: NumberOfHouseholdsType	Number of households by type
Property	**Definition**
urg::class	Type of household
urg::number	Number of households

```
<xs:element name="NumberOfHouseholds" type="NumberOfHouseholdsType"/>
<xs:complexType name="NumberOfHouseholdsType">
 <xs:sequence>
  <xs:element name="class" type="gml:CodeType"/>
  <xs:element name="number" type="xs:integer"/>
 </xs:sequence>
</xs:complexType>
<xs:complexType name="NumberOfHouseholdsPropertyType">
 <xs:sequence>
  <xs:element ref="NumberOfHouseholds"/>
 </xs:sequence>
</xs:complexType>
```

4.2.7 OfficesAndEmployeesType, OfficesAndEmployees

Object	Definition
urg:: OfficesAndEmployees	Number of offices and employees in a mesh
Property	**Definition**
urg::numberOfOffices	Number of offices
urg::numberOfEmployees	Number of employees

```
<xs:complexType name="OfficesAndEmployeesType">
 <xs:complexContent>
  <xs:extension base="StatisticalGridType">
   <xs:sequence>
    <xs:element name="numberOfOffices" type="xs:nonNegativeInteger" minOccurs="0"/>
    <xs:element name="numberOfEmployees" type="xs:nonNegativeInteger" minOccurs="0"/>
    <xs:element ref="_GenericApplicationPropertyOfOfficesAndEmployees" minOccurs="0"
maxOccurs="unbounded"/>
   </xs:sequence>
```

```
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="OfficesAndEmployees" type="OfficesAndEmployeesType" substitutionGroup="_StatisticalGrid"/>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfOfficesAndEmployees" type="xs:anyType" abstract="true"/>
```

Annex A
(normative)

XMLSchema Definition

A.1 XMLSchema

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:urg="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/urg/1.3"
xmlns:core="http://www.opengis.net/citygml/2.0" xmlns:grp="http://www.opengis.net/citygml/cityobjectgroup/2.0"
xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:gml="http://www.opengis.net/gml"
targetNamespace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/urg/1.3"
elementFormDefault="qualified" attributeFormDefault="unqualified" version="1.3.0">
 <xs:annotation>
  <xs:documentation>XML Schema for Statistical Grid module</xs:documentation>
 </xs:annotation>
 <xs:import namespace="http://www.opengis.net/gml"
schemaLocation="http://schemas.opengis.net/gml/3.1.1/base/gml.xsd"/>
 <xs:import namespace="http://www.opengis.net/citygml/2.0"
schemaLocation="http://schemas.opengis.net/citygml/2.0/cityGMLBase.xsd"/>
 <xs:import namespace="http://www.opengis.net/citygml/cityobjectgroup/2.0"
schemaLocation="http://schemas.opengis.net/citygml/cityobjectgroup/2.0/cityObjectGroup.xsd"/>
 <!-- ================================================================== -->
 <!-- ====================   CityGML StatisticalGrid module ============== -->
 <!-- ================================================================== -->
 <xs:complexType name="StatisticalGridType" abstract="true">
  <xs:annotation>
   <xs:documentation>The root type for statistical grid. As subclass of _CityObject, an
      _StatisticalGrid inherits all attributes and relations, in particular a description,
      an id and names. </xs:documentation>
  </xs:annotation>
  <xs:complexContent>
   <xs:extension base="core:AbstractCityObjectType">
      <xs:sequence>
      <xs:element name="class" type="gml:CodeType" minOccurs="0"/>
      <xs:element name="value" type="xs:anyType" minOccurs="0" maxOccurs="unbounded"/>
      <xs:element name="urbanPlanType" type="gml:CodeType" minOccurs="0"/>
      <xs:element name="areaClassificationType" type="gml:CodeType" minOccurs="0"/>
      <xs:element name="prefecture" type="gml:CodeType" minOccurs="0"/>
      <xs:element name="city" type="gml:CodeType" minOccurs="0"/>
      <xs:element name="surveyYear" type="xs:gYear" minOccurs="0"/>
      <xs:element name="lod-1MultiSurfaceGeometry" type="gml:MultiSurfacePropertyType" minOccurs="0"/>
      <xs:element name="lod-2MultiSurfaceGeometry" type="gml:MultiSurfacePropertyType" minOccurs="0"/>
      <xs:element ref="urg:_GenericApplicationPropertyOfStatisticalGrid" minOccurs="0" maxOccurs="unbounded"/>
      </xs:sequence>
   </xs:extension>
  </xs:complexContent>
 </xs:complexType>
 <!-- ================================================================== -->
 <xs:element name="_StatisticalGrid" type="urg:StatisticalGridType" abstract="true"
substitutionGroup="core:_CityObject"/>
 <!-- ================================================================== -->
 <xs:element name="_GenericApplicationPropertyOfStatisticalGrid" type="xs:anyType" abstract="true">
  <xs:annotation>
   <xs:documentation>This element is reserved for future use.</xs:documentation>
  </xs:annotation>
 </xs:element>
```

```
<!-- ========================================================================== -->
<xs:complexType name="PopulationType">
 <xs:annotation>
  <xs:documentation>grid cell with population values</xs:documentation>
 </xs:annotation>
 <xs:complexContent>
  <xs:extension base="urg:StatisticalGridType">
   <xs:sequence>
    <xs:element name="total" type="xs:integer" minOccurs="0"/>
    <xs:element name="daytimePopulation" type="xs:integer" minOccurs="0"/>
    <xs:element name="daytimePopulationDensity" type="xs:double" minOccurs="0"/>
    <xs:element name="naturalIncrease" type="xs:integer" minOccurs="0"/>
    <xs:element name="births" type="xs:integer" minOccurs="0"/>
    <xs:element name="deaths" type="xs:integer" minOccurs="0"/>
    <xs:element name="socialIncrease" type="xs:integer" minOccurs="0"/>
    <xs:element name="moveFrom" type="xs:integer" minOccurs="0"/>
    <xs:element name="moveTo" type="xs:integer" minOccurs="0"/>
    <xs:element name="increasement" type="xs:integer" minOccurs="0"/>
    <xs:element name="malePopulation" type="xs:integer" minOccurs="0"/>
    <xs:element name="femalePopulation" type="xs:integer" minOccurs="0"/>
    <xs:element name="populationByAgeAndSex" type="urg:PopulationByAgeAndSexPropertyType" minOccurs="0"
maxOccurs="unbounded"/>
    <xs:element ref="urg:_GenericApplicationPropertyOfPopulation" minOccurs="0" maxOccurs="unbounded"/>
   </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="Population" type="urg:PopulationType" substitutionGroup="urg:_StatisticalGrid"/>
<xs:complexType name="PopulationPropertyType">
 <xs:sequence minOccurs="0">
  <xs:element ref="urg:Population"/>
 </xs:sequence>
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfPopulation" type="xs:anyType" abstract="true">
 <xs:annotation>
  <xs:documentation>This element is reserved for future use.</xs:documentation>
 </xs:annotation>
</xs:element>
<!-- ========================================================================== -->
<xs:element name="PopulationByAgeAndSex" type="urg:PopulationByAgeAndSexType"/>
<xs:complexType name="PopulationByAgeAndSexType">
 <xs:sequence>
  <xs:element name="age" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="sex" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="number" type="xs:integer" minOccurs="0"/>
 </xs:sequence>
</xs:complexType>
<xs:complexType name="PopulationByAgeAndSexPropertyType">
 <xs:sequence>
  <xs:element ref="urg:PopulationByAgeAndSex"/>
 </xs:sequence>
</xs:complexType>
<!-- ========================================================================== -->
<xs:complexType name="PublicTransportationAccessibilityType">
 <xs:annotation>
  <xs:documentation>grid cell to describe areas where the public transportation service is
   available</xs:documentation>
```

```
 </xs:annotation>
 <xs:complexContent>
  <xs:extension base="urg:StatisticalGridType">
   <xs:sequence>
   <xs:element name="availability" type="xs:boolean" minOccurs="0"/>
   <xs:element ref="urg:_GenericApplicationPropertyOfPublicTransportationAccessibility" minOccurs="0"
maxOccurs="unbounded"/>
   </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="PublicTransportationAccessibility" type="urg:PublicTransportationAccessibilityType"
substitutionGroup="urg:_StatisticalGrid"/>
<xs:complexType name="PublicTransportationAccessibilityPropertyType">
 <xs:sequence minOccurs="0">
  <xs:element ref="urg:PublicTransportationAccessibility"/>
 </xs:sequence>
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfPublicTransportationAccessibility" type="xs:anyType"
abstract="true">
 <xs:annotation>
  <xs:documentation>This element is reserved for future use.</xs:documentation>
 </xs:annotation>
</xs:element>
<!-- ========================================================================== -->
<xs:complexType name="LandPriceType">
 <xs:annotation>
  <xs:documentation>grid cell with land prices</xs:documentation>
 </xs:annotation>
 <xs:complexContent>
  <xs:extension base="urg:StatisticalGridType">
   <xs:sequence>
   <xs:element name="landPrice" type="urg:LandPricePerLandUsePropertyType" minOccurs="0"
maxOccurs="unbounded"/>
   <xs:element ref="urg:_GenericApplicationPropertyOfLandPrice" minOccurs="0" maxOccurs="unbounded"/>
   </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="LandPrice" type="urg:LandPriceType" substitutionGroup="urg:_StatisticalGrid"/>
<xs:complexType name="LandPricePropertyType">
 <xs:sequence minOccurs="0">
  <xs:element ref="urg:LandPrice"/>
 </xs:sequence>
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfLandPrice" type="xs:anyType" abstract="true">
 <xs:annotation>
  <xs:documentation>This element is reserved for future use.</xs:documentation>
 </xs:annotation>
</xs:element>
<!-- ========================================================================== -->
<xs:element name="LandPricePerLandUse" type="urg:LandPricePerLandUseType"/>
<xs:complexType name="LandPricePerLandUseType">
```

```
 <xs:sequence>
  <xs:element name="landUse" type="gml:CodeType" minOccurs="0"/>
  <xs:element name="landPrice" type="xs:integer" minOccurs="0"/>
  <xs:element name="currencyUnit" type="gml:CodeType" minOccurs="0"/>
 </xs:sequence>
</xs:complexType>
<xs:complexType name="LandPricePerLandUsePropertyType">
 <xs:sequence>
  <xs:element ref="urg:LandPricePerLandUse"/>
 </xs:sequence>
</xs:complexType>
<!-- ========================================================================== -->
<xs:complexType name="LandUseDiversionType">
 <xs:annotation>
  <xs:documentation>grid cell with the number and area of land use
    diversion</xs:documentation>
 </xs:annotation>
 <xs:complexContent>
  <xs:extension base="urg:StatisticalGridType">
    <xs:sequence>
    <xs:element name="numberOfAnnualDiversion" type="urg:NumberOfAnnualDiversionsPropertyType" minOccurs="0"
maxOccurs="unbounded"/>
    <xs:element ref="urg:_GenericApplicationPropertyOfLandUseDiversion" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="LandUseDiversion" type="urg:LandUseDiversionType" substitutionGroup="urg:_StatisticalGrid"/>
<xs:complexType name="LandUseDiversionPropertyType">
 <xs:sequence minOccurs="0">
  <xs:element ref="urg:LandUseDiversion"/>
 </xs:sequence>
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfLandUseDiversion" type="xs:anyType" abstract="true">
 <xs:annotation>
  <xs:documentation>This element is reserved for future use.</xs:documentation>
 </xs:annotation>
</xs:element>
<!-- ========================================================================== -->
<xs:element name="NumberOfAnnualDiversions" type="urg:NumberOfAnnualDiversionsType"/>
<xs:complexType name="NumberOfAnnualDiversionsType">
 <xs:sequence>
  <xs:element name="year" type="xs:gYear" minOccurs="0"/>
  <xs:element name="count" type="xs:nonNegativeInteger" minOccurs="0"/>
  <xs:element name="area" type="gml:MeasureType" minOccurs="0"/>
 </xs:sequence>
</xs:complexType>
<xs:complexType name="NumberOfAnnualDiversionsPropertyType">
 <xs:sequence>
  <xs:element ref="urg:NumberOfAnnualDiversions"/>
 </xs:sequence>
</xs:complexType>
<!-- ========================================================================== -->
<xs:complexType name="HouseholdsType">
 <xs:annotation>
  <xs:documentation>grid cell with the number of households</xs:documentation>
 </xs:annotation>
```

```
 <xs:complexContent>
  <xs:extension base="urg:StatisticalGridType">
   <xs:sequence>
    <xs:element name="numberOfOrdinaryHousehold" type="xs:integer"/>
    <xs:element name="numberOfHouseholdsByOwnership" type="urg:NumberOfHouseholdsPropertyType"
minOccurs="0" maxOccurs="unbounded"/>
    <xs:element name="numberOfHouseholdsByStructure" type="urg:NumberOfHouseholdsPropertyType" minOccurs="0"
maxOccurs="unbounded"/>
    <xs:element name="numberOfMainHousehold" type="xs:integer"/>
    <xs:element ref="urg:_GenericApplicationPropertyOfHouseholds" minOccurs="0" maxOccurs="unbounded"/>
   </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="Households" type="urg:HouseholdsType" substitutionGroup="urg:_StatisticalGrid"/>
<xs:complexType name="HouseholdsPropertyType">
 <xs:sequence minOccurs="0">
  <xs:element ref="urg:Households"/>
 </xs:sequence>
 <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="_GenericApplicationPropertyOfHouseholds" type="xs:anyType" abstract="true">
 <xs:annotation>
  <xs:documentation>This element is reserved for future use.</xs:documentation>
 </xs:annotation>
</xs:element>
<!-- ========================================================================== -->
<xs:element name="NumberOfHouseholds" type="urg:NumberOfHouseholdsType"/>
<xs:complexType name="NumberOfHouseholdsType">
 <xs:sequence>
  <xs:element name="class" type="gml:CodeType"/>
  <xs:element name="number" type="xs:integer"/>
 </xs:sequence>
</xs:complexType>
<xs:complexType name="NumberOfHouseholdsPropertyType">
 <xs:sequence>
  <xs:element ref="urg:NumberOfHouseholds"/>
 </xs:sequence>
</xs:complexType>
<!-- ========================================================================== -->
<xs:complexType name="OfficesAndEmployeesType">
 <xs:complexContent>
  <xs:extension base="urg:StatisticalGridType">
   <xs:sequence>
    <xs:element name="numberOfOffices" type="xs:nonNegativeInteger" minOccurs="0"/>
    <xs:element name="numberOfEmployees" type="xs:nonNegativeInteger" minOccurs="0"/>
    <xs:element ref="urg:_GenericApplicationPropertyOfOfficesAndEmployees" minOccurs="0"
maxOccurs="unbounded"/>
   </xs:sequence>
  </xs:extension>
 </xs:complexContent>
</xs:complexType>
<!-- ========================================================================== -->
<xs:element name="OfficesAndEmployees" type="urg:OfficesAndEmployeesType"
substitutionGroup="urg:_StatisticalGrid"/>
<xs:complexType name="OfficesAndEmployeesPropertyType">
 <xs:sequence minOccurs="0">
```

```
   <xs:element ref="urg:OfficesAndEmployees"/>
  </xs:sequence>
  <xs:attributeGroup ref="gml:AssociationAttributeGroup"/>
 </xs:complexType>
 <!-- ========================================================================== -->
 <xs:element name="_GenericApplicationPropertyOfOfficesAndEmployees" type="xs:anyType" abstract="true">
  <xs:annotation>
   <xs:documentation>This element is reserved for future use.</xs:documentation>
  </xs:annotation>
 </xs:element>
</xs:schema>
```

A.2 Sample data (informative)

```
<?xml version="1.0" encoding="UTF-8"?>
<core:CityModel xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xmlns:grp="http://www.opengis.net/citygml/cityobjectgroup/2.0"
 xmlns:xlink="http://www.w3.org/1999/xlink"
 xmlns:gml="http://www.opengis.net/gml"
 xmlns:core="http://www.opengis.net/citygml/2.0"
 xmlns:urg="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/urg/1.3"
 xmlns:uro="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/uro/1.3"
 xsi:schemaLocation="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/urg/1.3 http://www.kantei.g
o.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/schemas/urg/1.3/statisticalGrid.xsd
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/uro/1.3 http://www.kantei.go.jp/jp/singi/tiiki/tos
hisaisei/itoshisaisei/iur/schemas/uro/1.3/urbanObject.xsd
http://www.opengis.net/citygml/cityobjectgroup/2.0 http://schemas.opengis.net/citygml/cityobjectgroup/2.0/cityO
bjectGroup.xsd
http://www.opengis.net/citygml/2.0 http://schemas.opengis.net/citygml/2.0/cityGMLBase.xsd
http://www.opengis.net/gml http://schemas.opengis.net/gml/3.1.1/base/gml.xsd">
 <gml:boundedBy>
  <gml:Envelope srsName="http://www.opengis.net/def/crs/EPSG/0/3857" srsDimension="3">
   <gml:lowerCorner>14532000 4006000 0</gml:lowerCorner>
   <gml:upperCorner>14533500 4007500 0</gml:upperCorner>
  </gml:Envelope>
 </gml:boundedBy> <core:cityObjectMember>
  <grp:CityObjectGroup>
   <gml:name>grid sample data</gml:name>
   <grp:usage codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/CityObjectG
roup_usage.xml">2000</grp:usage>
   <grp:groupMember>
    <urg:Population gml:id="population418">
     <gml:description>サンプル地区 1</gml:description>
     <gml:name>503064032</gml:name>
     <urg:urbanPlanType codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/C
ommon_urbanPlanType.xml">1010</urg:urbanPlanType>
     <urg:areaClassificationType codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelist
s/1.3/Common_areaClassification.xml">1030</urg:areaClassificationType>
     <urg:prefecture codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Com
mon_prefecture.xml">40</urg:prefecture>
     <urg:city codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Common_loc
alPublicAuthorities.xml">40220</urg:city>
     <urg:surveyYear>2017</urg:surveyYear>
     <urg:lod-1MultiSurfaceGeometry>
      <gml:MultiSurface gml:id="grid1">
       <gml:surfaceMember>
        <gml:Polygon>
         <gml:exterior>
          <gml:LinearRing>
```

```
          <gml:pos>14532759.523100004 4006444.6594000012 0</gml:pos>
          <gml:pos>14532759.523100004 4007003.0613999963 0</gml:pos>
          <gml:pos>14532063.776199996 4007003.0613999963 0</gml:pos>
          <gml:pos>14532063.776199996 4006444.6594000012 0</gml:pos>
          <gml:pos>14532759.523100004 4006444.6594000012 0</gml:pos>
         </gml:LinearRing>
        </gml:exterior>
       </gml:Polygon>
     </gml:surfaceMember>
    </gml:MultiSurface>
   </urg:lod-1MultiSurfaceGeometry>
   <urg:total>400</urg:total>
   <urg:daytimePopulation>50</urg:daytimePopulation>
   <urg:naturalIncrease>-1</urg:naturalIncrease>
   <urg:births>3</urg:births>
   <urg:deaths>4</urg:deaths>
   <urg:socialIncrease>5</urg:socialIncrease>
   <urg:moveFrom>10</urg:moveFrom>
   <urg:moveTo>5</urg:moveTo>
   <urg:increasement>4</urg:increasement>
   <urg:malePopulation>200</urg:malePopulation>
   <urg:femalePopulation>200</urg:femalePopulation>
   <urg:populationByAgeAndSex>
    <urg:PopulationByAgeAndSex>
     <urg:age codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/PopulationB
yAgeAndSexType_age.xml">1010</urg:age>
     <urg:sex codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/PopulationB
yAgeAndSexType_sex.xml">1010</urg:sex>
     <urg:number>5</urg:number>
    </urg:PopulationByAgeAndSex>
   </urg:populationByAgeAndSex>
   <urg:populationByAgeAndSex>
    <urg:PopulationByAgeAndSex>
     <urg:age codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/PopulationB
yAgeAndSexType_age.xml">1020</urg:age>
     <urg:sex codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/PopulationB
yAgeAndSexType_sex.xml">1010</urg:sex>
     <urg:number>5</urg:number>
    </urg:PopulationByAgeAndSex>
   </urg:populationByAgeAndSex>
                                                    <!-- omitted -->
  </urg:Population>
 </grp:groupMember>
 <grp:groupMember>
  <urg:Population gml:id="population417">
   <gml:description>サンプル地区 1</gml:description>
   <gml:name>503064032</gml:name>
   <urg:urbanPlanType codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/C
ommon_urbanPlanType.xml">1010</urg:urbanPlanType>
   <urg:areaClassificationType codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelist
s/1.3/Common_areaClassification.xml">1030</urg:areaClassificationType>
   <urg:prefecture codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Com
mon_prefecture.xml">40</urg:prefecture>
   <urg:city codeSpace="http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Common_loc
alPublicAuthorities.xml">40220</urg:city>
   <urg:surveyYear>2016</urg:surveyYear>
   <urg:lod-1MultiSurfaceGeometry xlink:href="#grid1">
   </urg:lod-1MultiSurfaceGeometry>
                                                    <!-- omitted -->
```

```
   </urg:Population>
  </grp:groupMember>
  <uro:fiscalYearOfPublication>2016</uro:fiscalYearOfPublication>
 </grp:CityObjectGroup>
</core:cityObjectMember>
</core:CityModel>
```

Annex B
(informative)

Code lists for Statistical Grid Data

This annex exemplifies the specification of code lists for enumerative attributes of type *gml:CodeType* in Urban Planning ADE and provides proposals for selected attributes. Please note that this annex is non-normative and the presented code lists are neither mandatory nor complete.

Code lists for StatisticalGrid

Code list of the subclasses of *StatisticalGrid* attribute *urbanPlanType*
See Code list for the *UrbanPlan* attribute *class* in part 2

Code list of the subclasses of *StatisticalGrid* attribute *areaClassificationType*
See Code list for the *AreaClassification* attribute *class* in part 2

Code list of the subclasses of *StatisticalGrid* attribute *prefecture*
See Code list for the *Administration* attribute *prefecture* in part 2

Code list of the subclasses of *StatisticalGrid* attribute *city*
See Code list for the *Administration* attribute *city* in part 2

Code lists for Population

Code list for *Population* attribute *populationByAgeAndSex* (attribute *age* of the datatype *PopulationByAgeAndSexType*)			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/PopulationByAgeAndSexType_age.xml			
1010	0-4	1120	55-59
1020	5-9	1130	60-64
1030	10-14	1140	65-69
1040	15-19	1150	70-74
1050	20-24	1160	75-79
1060	25-29	1170	80-84
1070	30-34	1180	85-89
1080	35-39	1190	90-94
1090	40-44	1200	95-99
1100	45-49	1210	100-
1110	50-54		

Code list for *Population* attribute *populationByAgeAndSex* (attribute *sex* of the datatype *PopulationByAgeAndSexType*)			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/PopulationByAgeAndSexType_sex.xml			
1010	male	1020	female

Code lists for LandPrice

Code list for *LandPrice* attribute *landPrice* (attribute *landuse* of the datatype *LandPricePerLandUseType*)			
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/LandPricePerLandUseType_landuse.xml			
1010	Residential ara	3030	Forestry

1011	Housing prospective area	6010	Residential in urbanization control area
5010	Industry area	6020	Forestry in urbanization control area
5011	Semi-industrial area		
5021	Commertial area		

Code list for *LandPrice* attribute *landPrice* (attribute *currencyUnit* of the datatype *LandPricePerLandUseType*)
http://www.kantei.go.jp/jp/singi/tiiki/toshisaisei/itoshisaisei/iur/codelists/1.3/Common_currencyUnit.xml
Currency codes defined by ISO 4217 that composed of a country's two-character Internet country code plus a third character denoting the currency unit.

Bibliography

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[2] CityGML UtilityNetworkADE, http://www.citygmlwiki.org/index.php?title=CityGML_UtilityNetworkADE (Accessed 7 March 2019)

[3] City Bureau, Ministry of Land, Infrastructure, Transport and Tourism of Japan: Implementation Guidelines of Basic Survey of City Planning (in Japanese), March 2019, http://www.mlit.go.jp/common/001282174.pdf (Accessed 18 April 2019)

[4] Fukuoka Prefecture, Data Specification for Basic Survey of City Planning Database (survey by city), 2018 (in Japanese)

[5] Fukuoka Prefecture, Data Specification for Basic Survey of City Planning Database (survey by prefecture), 2018 (in Japanese)

Revision History

Date	Release	Author	Paragraph modified	Description
2019/3/20	0.9		All	Document created
2019/5/7	1.0		All	Add elements and properties to ensure consistency with Basic Surveys Concerning City Planning (Part 1, Part 2, and Part 3) Add temporal attribute to accumulate and utilize time series datasets (Part1, part2, Part 3 and Part4) Import and extend grp::CityObjectGroup for object collection to mention the purpose or usage of the collection (Part1) Rename or add properties for clarification (Part 1) Add associations to describe global city model as LOD extension (Part 4) Modify UML diagrams and XML Schemata based on the modifications above (Part1, part2, Part 3 and Part4) Modify text description for clarification and Correct editorial errors (Through the document)
2019/11/01	1.1		Part 1	Add an attribute “uro::widthType” to “tran::Road” and the code list for the attribute.
			Part 2	Change the associated classes of “urf::area”, “urf::boundary” and “urf::location” to the multiple geometric objects.
			Part 1, Part 2 and Part 4	Correct inconsistency between UML diagrams and XMLSchema.
			Part 2 and Part 3	Add remarks to that of featureType classes. Change global element of feature attributes to local elements not to use the mechanism of “hook”. Delete “_GenericApplicationPropertyOf…” elements of dataType classes.
			All	Correct editorial errors (Through the document)
2020/02/24	1.2		Part 3 and Part 4	Delete Part 4 to integrate the concept of extended LOD into statistical grid.
			All	Clarify the XMLSchema location

			All	Update UML diagrams based on the OGC best practice (Modeling an application domain extension of CityGML in UML, 12-066. Open Geospatial Consortium. 2014.)
			All	Correct inconsistency with “Element - Property” structure in XMLSchema
			All	The type “xs:double” used to describe area is changed to “gml:MeasureType” for its strictness with “uom”.
			Part 2	The type “xs:double” used to describe length is changed to “gml:LengthType” for its strictness with “uom”.
			All Annex A	XML Schemas are updated based on the modification above.
			All Annex B	The URL of each codelist is added.
			All Annex A	Sample datasets are updated based on the modification above. Describe CRS identifier in the sample datasets.
2020/03/11	1.3		Figures	Fix printing mistakes in figures.
			Part 1	Add property lod0NetworkNode to represent point instance as a part of linear network.
			Part 2 and 3	Correct typos.