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i. Abstract

The CityGML 3.0 GML Encoding Standard presents the implementation-dependent, GML encoding of the concepts defined by the CityGML 3.0 Conceptual Model(CM) standard. Those concepts include the most relevant topographic objects in cities and regional models with respect to their geometrical, topological, semantical, and appearance properties. “City” is broadly defined to comprise not just built structures, but also elevation, vegetation, water bodies, city furniture, and more. Included are generalization hierarchies between thematic classes, aggregations, relations between objects, and spatial properties.

CityGML-XML is published as a multi-part standard. This Part 0 addresses the following requirements classes from the CityGML conceptual model.

- Core: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-core
- ADE: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-ade

Table 1. Conceptual Model Mapping

Conceptual Model	Section	GML Schema
ADE	Base Conformance Class	cityGMLBase.xsd
Appearance	Appearance Conformance Class	appearance.xsd
Bridge	Bridge Conformance Class	bridge.xsd
Building	Building Conformance Class	building.xsd
City Furniture	City Furniture Conformance Class	cityFurniture.xsd
City Object Group	City Object Group Conformance Class	cityObjectGroup.xsd
Construction	Construction Conformance Class	construction.xsd
Core	Base Conformance Class	cityGMLBase.xsd
Dynamizer	Dynamizer Conformance Class	dynamizer.xsd
Generics	Generics Conformance Class	generics.xsd
Land Use	Land Use Conformance Class	landUse.xsd
Point Cloud	Point Cloud Conformance Class	pointCloud.xsd
Relief	Relief Conformance Class	relief.xsd
Transportation	Transportation Conformance Class	transportation.xsd
Tunnel	Tunnel Conformance Class	tunnel.xsd
Vegetation	Vegetation Conformance Class	vegetation.xsd
Versioning	Versioning Conformance Class	versioning.xsd
Water Body	Water Body Conformance Class	waterBody.xsd

ii. Keywords

The following are keywords to be used by search engines and document catalogues.

ogcdoc, OGC document, CityGML, 3D city models, GML, XML

iii. Preface

In order to achieve consensus on the basic entities, attributes, and relations of a 3D city model, a UML Conceptual Model, CityGML 3.0, was approved as an OGC standard in March, 2021. This model provides a unifying conceptual basis for city model encoding standards. This cityGML 3.0 XML Encoding Standard defines how those concepts should be realized using XML and GML technologies.

As an OGC standard, CityGML follows the OGC modular specification standard, OGC 08-131r3. Because of the breadth of CityGML, its conceptual model was divided into separate Requirements Classes, one for each subject area. This CityGML encoding similarly is divided into Requirements Classes which are then grouped into Parts. A Part may address multiple CityGML Requirements Classes but each Requirements Class is addressed in a single part. Because Requirements Classes may depend on other Requirements Classes the reader of this CityGML Part may need to conform to Requirements Classes in other Parts as well.

Note that this CityGML encoding standard is a standardization target of the CityGML 3.0 Conceptual Model Standard. Therefore this standard conforms to the Conformance Classes in that standard. Evidence of that conformance is provided in Conceptual Model Conformance (Normative). On the other hand, an application claiming conformance to this CityGML encoding standard must conform to the Requirements Classes contained in this standard.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. The Open Geospatial Consortium shall not be held responsible for identifying any or all such patent rights.

Recipients of this document are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might be infringed by any implementation of the standard set forth in this document, and to provide supporting documentation.

iv. Submitting organizations

The following organizations submitted this Document to the Open Geospatial Consortium (OGC):

Table 2. Submitting Organizations

Organization	Points of Contact
Heazeltech LLC	Charles Heazel

v. Submitters

All questions regarding this submission should be directed to the editor or the submitters:

Table 3. Submission Contact Points

Name	Institution
Charles Heazel	Heazeltech LLC

Chapter 1. Scope

This Standard documents the OGC GML Implementation Specification (IS) for the CityGML 3.0 Conceptual Model. The CityGML 3.0 conceptual model is a Platform Independent Model (PIM). It defines concepts in a manner which is independent of any implementing technology. As such, the CityGML CM cannot be implemented directly. Rather, it serves as the base for Platform Specific Models (PSM). A PSM adds to the PIM the technology-specific details needed to fully define the CityGML model for use with a specific technology. The PSM can then be used to generate the schema and other artifacts needed to build CityGML 3.0 implementations.

This standard defines the PSMs and schemas for the CityGML 3.0 Implementation Specification (IS) for Geography Markup Language (GML) implemenations.

The target of the conformance classes specified in this document are:

- GML Implementataions of CityGML 3.0.

Chapter 2. Conformance

This standard defines an Implementation Specification which specifies how the CityGML 3.0 Conceptual Model should be implemented using Geography Markup Language (GML). The Standardization Target for this standard is:

1. Implementations of the CityGML 3.0 Conceptual Model using GML encodings.

2.1. Implementation Specifications

Implementation Specifications define how a Conceptual Model should be implemented using a specific technology. Conformant Implementation Specifications provide evidence that they are an accurate representation of the Conceptual Model. This evidence includes data demonstrating that the applicable criteria documented in the CityGML 3.0 CM Abstract Test Suite have been satisfied. That evidence is provided in Conceptual Model Conformance (Normative).

2.2. Conformance Classes

This standard identifies seventeen (17) conformance classes. One conformance class is defined for each GML schema. Each conformance class is defined by one requirements class. The tests in Annex A are organized by Requirements Class. So an implementation of the *Base* conformance class must pass all tests specified in Annex A for the *Base* requirements class.

Of these seventeen conformance classes, only the *Base* conformance class is mandatory. All other conformance classes are optional. In the case where a conformance class has a dependency on another conformance class, that conformance class should also be implemented.

Chapter 3. References

The following normative documents contain provisions that, through reference in this text, constitute provisions of OGC TBD. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of OGC TBD are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

- IETF: RFC 2045 & 2046, Multipurpose Internet Mail Extensions (MIME). (November 1996),
- IETF: RFC 3986, Uniform Resource Identifier (URI): Generic Syntax. (January 2005)
- INSPIRE: D2.8.III.2 Data Specification on Buildings – Technical Guidelines. European Commission Joint Research Centre.
- ISO: ISO 19101-1:2014, Geographic information - Reference model - Part 1: Fundamentals
- ISO: ISO 19103:2015, Geographic Information – Conceptual Schema Language
- ISO: ISO 19105:2000, Geographic information – Conformance and testing
- ISO: ISO 19107:2003, Geographic Information – Spatial Schema
- ISO: ISO 19108:2002/Cor 1:2006, Geographic information – Temporal schema — Technical Corrigendum 1
- ISO: ISO 19109:2015, Geographic Information – Rules for Application Schemas
- ISO: ISO 19111:2019, Geographic information – Referencing by coordinates
- ISO: ISO 19123:2005, Geographic information — Schema for coverage geometry and functions
- ISO: ISO 19156:2011, Geographic information – Observations and measurements
- ISO: ISO/IEC 19505-2:2012, Information technology — Object Management Group Unified Modeling Language (OMG UML) — Part 2: Superstructure
- ISO/IEC 19507:2012, Information technology — Object Management Group Object Constraint Language (OCL)
- ISO: ISO/IEC 19775-1:2013 Information technology — Computer graphics, image processing and environmental data representation — Extensible 3D (X3D) — Part 1: Architecture and base components
- Khronos Group Inc.: COLLADA – Digital Asset Schema Release 1.5.0
- OASIS: Customer Information Quality Specifications - extensible Address Language (xAL), Version v3.0
- OGC: The OpenGIS® Abstract Specification Topic 5: Features, OGC document 08-126
- OGC: The OpenGIS™ Abstract Specification Topic 8: Relationships Between Features, OGC document 99-108r2
- OGC: The OpenGIS™ Abstract Specification Topic 10: Feature Collections, OGC document 99-110

Chapter 4. Terms and Definitions

This document uses the terms defined in Sub-clause 5.3 of [OGC 06-121r8], which is based on the ISO/IEC Directives, Part 2, Rules for the structure and drafting of International Standards. In particular, the word “shall” (not “must”) is the verb form used to indicate a requirement to be strictly followed to conform to this Standard.

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

2D data
geometry of features is represented in a two-dimensional space
NOTE In other words, the geometry of 2D data is given using (X,Y) coordinates.
[INSPIRE D2.8.III.2, definition 1]

2.5D data
geometry of features is represented in a three-dimensional space with the constraint that, for each (X,Y) position, there is only one Z
[INSPIRE D2.8.III.2, definition 2]

3D data
Geometry of features is represented in a three-dimensional space.
NOTE In other words, the geometry of 2D data is given using (X,Y,Z) coordinates without any constraints.
[INSPIRE D2.8.III.2, definition 3]

application schema
A set of conceptual schema for data required by one or more applications. An application schema contains selected parts of the base schemas presented in the ORM Information Viewpoint. Designers of application schemas may extend or restrict the types defined in the base schemas to define appropriate types for an application domain. Application schemas are information models for a specific information community.
OGC Definitions Register at http://www.opengis.net/def/glossary/term/ApplicationSchema

codelist
A value domain including a code for each permissible value.

conceptual model
model that defines concepts of a universe of discourse
[ISO 19101-1:2014, 4.1.5]

conceptual schema

1. formal description of a conceptual model
   [ISO 19101-1:2014, 4.1.6]
2. base schema. Formal description of the model of any geospatial information. Application schemas are built from conceptual schemas.
   OGC Definitions Register at http://www.opengis.net/def/glossary/term/ConceptualSchema

Implementation Specification

Specified on the OGC Document Types Register at http://www.opengis.net/def/doc-type/is

levels of detail
quantity of information that portrays the real world
NOTE The concept comprises data capturing rules of spatial object types, the accuracy and the types of geometries, and other aspects of a data specification. In particular, it is related to the notions of scale and resolution.
[INSPIRE Glossary]

life-cycle information
set of properties of a spatial object that describe the temporal characteristics of a version of a spatial object or the changes between versions
[INSPIRE Glossary]

Platform (Model Driven Architecture)
the set of resources on which a system is realized.
[Object Management Group, Model Driven Architecture Guide rev. 2.0]

Platform Independent Model
a model that is independent of a spacific platform
[Object Management Group, Model Driven Architecture Guide rev. 2.0]

Platform Specific Model
a model of a system that is defined in terms of a specific platform
[Object Management Group, Model Driven Architecture Guide rev. 2.0]

Chapter 5. Conventions

This section provides details and examples for any conventions used in the document. Examples of conventions are symbols, abbreviations, use of XML schema, or special notes regarding how to read the document.

5.1. Identifiers

The normative provisions in this Standard are denoted by the URI

http://www.opengis.net/spec/{standard}/{m.n}

All requirements and conformance tests that appear in this document are denoted by partial URIs which are relative to this base.

Chapter 6. Requirements

6.1. Base Conformance Class

The Base Conformance Class implements the following Requirements Classes from the CityGML 3.0 Conceptual Model Standard:

- Core: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-core
- ADE: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-ade

The applicable GML schema is cityGMLBase.xsd

Requirements Class	
http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-base	
Target type	Implementation
Dependency	cityGMLBase.xsd
Dependency	http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-core
Dependency	http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-ade
Requirement 1	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-1 requirement description
Requirement 2	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-2 requirement description
Requirement 3	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-3 requirement description

6.2. Appearance Conformance Class

The Appearance Conformance Class implements the following Requirements Classes from the CityGML 3.0 Conceptual Model Standard:

- Appearance: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-appearance

The applicable GML schema is appearance.xsd

Requirements Class	
http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-appearance	
Target type	Implementation
Dependency	appearance.xsd
Dependency	http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-appearance
Dependency	http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-base

Requirement 1	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-1 requirement description
Requirement 2	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-2 requirement description
Requirement 3	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-3 requirement description

6.3. Bridge Conformance Class

The Bridge Conformance Class implements the following Requirements Classes from the CityGML 3.0 Conceptual Model Standard:

- Bridge: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-bridge

The applicable GML schema is bridge.xsd

Requirements Class	
http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-bridgee	
Target type	Implementation
Dependency	bridge.xsd
Dependency	http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-bridge
Dependency	http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-base
Requirement 1	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-1 requirement description
Requirement 2	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-2 requirement description
Requirement 3	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-3 requirement description

6.4. Building Conformance Class

The Building Conformance Class implements the following Requirements Classes from the CityGML 3.0 Conceptual Model Standard:

- Building: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-building

The applicable GML schema is building.xsd

Requirements Class	
http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-building	
Target type	Implementation
Dependency	building.xsd

Dependency	http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-building
Dependency	http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-base
Requirement 1	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-1 requirement description
Requirement 2	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-2 requirement description
Requirement 3	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-3 requirement description

6.5. City Furniture Conformance Class

The City Furniture Conformance Class implements the following Requirements Classes from the CityGML 3.0 Conceptual Model Standard:

- CityFurniture: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-cityfurniture

The applicable GML schema is cityFurniture.xsd

Requirements Class	
http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-cityfurniture	
Target type	Implementation
Dependency	cityFurniture.xsd
Dependency	http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-cityfurniture
Dependency	http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-base
Requirement 1	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-1 requirement description
Requirement 2	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-2 requirement description
Requirement 3	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-3 requirement description

6.6. City Object Group Conformance Class

The City Object Group Conformance Class implements the following Requirement Classe from the CityGML 3.0 Conceptual Model Standard:

- CityObjectGroup: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-cityobjectgroup

The applicable GML schema is cityObjectGroup.xsd

Requirements Class
http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-cityobjectgroup

Target type	Implementation
Dependency	cityObjectGroup.xsd
Dependency	http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-cityobjectgroup
Dependency	http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-base
Requirement 1	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-1 requirement description
Requirement 2	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-2 requirement description
Requirement 3	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-3 requirement description

6.7. Construction Conformance Class

The Construction Conformance Class implements the following Requirements Classes from the CityGML 3.0 Conceptual Model Standard:

- Construction: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-construction

The applicable GML schema is construction.xsd

Requirements Class	
http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-construction	
Target type	Implementation
Dependency	construction.xsd
Dependency	http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-construction
Dependency	http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-base
Requirement 1	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-1 requirement description
Requirement 2	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-2 requirement description
Requirement 3	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-3 requirement description

6.8. Dynamizer Conformance Class

The Dynamizer Conformance Class implements the following Requirements Classes from the CityGML 3.0 Conceptual Model Standard:

- Dynamizer: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-dynamizer

The applicable GML schema is dynamizer.xsd

Requirements Class	
http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-dynamizer	
Target type	Implementation
Dependency	dynamizer.xsd
Dependency	http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-dynamizer
Dependency	http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-base
Requirement 1	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-1 requirement description
Requirement 2	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-2 requirement description
Requirement 3	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-3 requirement description

6.9. Generics Conformance Class

The Generics Conformance Class implements the following Requirements Classes from the CityGML 3.0 Conceptual Model Standard:

- Generics: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-generics

The applicable GML schema is generics.xsd

Requirements Class	
http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-generics	
Target type	Implementation
Dependency	generics.xsd
Dependency	http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-generics
Dependency	http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-base
Requirement 1	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-1 requirement description
Requirement 2	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-2 requirement description
Requirement 3	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-3 requirement description

6.10. Land Use Conformance Class

The Land Use Conformance Class implements the following Requirements Classes from the CityGML 3.0 Conceptual Model Standard:

- LandUse: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-landuse

The applicable GML schema is landUse.xsd

Requirements Class	
http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-landuse	
Target type	Implementation
Dependency	landUse.xsd
Dependency	http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-landuse
Dependency	http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-base
Requirement 1	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-1 requirement description
Requirement 2	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-2 requirement description
Requirement 3	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-3 requirement description

6.11. Point Cloud Conformance Class

The Point Cloud Conformance Class implements the following Requirements Classes from the CityGML 3.0 Conceptual Model Standard:

- Point Cloud: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-pointcloud

The applicable GML schema is pointCloud.xsd

Requirements Class	
http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-pointcloud	
Target type	Implementation
Dependency	pointCloud.xsd
Dependency	http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-pointcloud
Dependency	http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-base
Requirement 1	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-1 requirement description
Requirement 2	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-2 requirement description
Requirement 3	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-3 requirement description

6.12. Relief Conformance Class

The Relief Conformance Class implements the following Requirements Classes from the CityGML 3.0 Conceptual Model Standard:

- Relief: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-relief

The applicable GML schema is relief.xsd

Requirements Class	
http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-relief	
Target type	Implementation
Dependency	relief.xsd
Dependency	http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-relief
Dependency	http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-base
Requirement 1	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-1 requirement description
Requirement 2	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-2 requirement description
Requirement 3	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-3 requirement description

6.13. Transportation Conformance Class

The Transportation Conformance Class implements the following Requirements Classes from the CityGML 3.0 Conceptual Model Standard:

- Transportation: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-transportation

The applicable GML schema is transportation.xsd

Requirements Class	
http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-transportation	
Target type	Implementation
Dependency	transportation.xsd
Dependency	http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-transportation
Dependency	http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-base
Requirement 1	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-1 requirement description
Requirement 2	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-2 requirement description
Requirement 3	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-3 requirement description

6.14. Tunnel Conformance Class

The Tunnel Conformance Class implements the following Requirements Classes from the CityGML 3.0 Conceptual Model Standard:

- Tunnel: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-tunnel

The applicable GML schema is tunnel.xsd

Requirements Class	
http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-tunnel	
Target type	Implementation
Dependency	tunnel.xsd
Dependency	http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-tunnel
Dependency	http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-base
Requirement 1	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-1 requirement description
Requirement 2	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-2 requirement description
Requirement 3	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-3 requirement description

6.15. Vegetation Conformance Class

The Vegetation Conformance Class implements the following Requirements Classes from the CityGML 3.0 Conceptual Model Standard:

- Vegetation: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-vegetation

The applicable GML schema is vegetation.xsd

Requirements Class	
http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-vegetation	
Target type	Implementation
Dependency	vegetation.xsd
Dependency	http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-appearance
Dependency	http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-vegetation
Requirement 1	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-1 requirement description
Requirement 2	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-2 requirement description

Requirement 3	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-3 requirement description

6.16. Versioning Conformance Class

The Versioning Conformance Class implements the following Requirements Classes from the CityGML 3.0 Conceptual Model Standard:

- Versioning: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-versioning

The applicable GML schema is versioning.xsd

Requirements Class	
http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-versioning	
Target type	Implementation
Dependency	versioning.xsd
Dependency	http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-versioning
Dependency	http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-base
Requirement 1	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-1 requirement description
Requirement 2	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-2 requirement description
Requirement 3	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-3 requirement description

6.17. Water Body Conformance Class

The Water Body Conformance Class implements the following Requirements Classes from the CityGML 3.0 Conceptual Model Standard:

- WaterBody: http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-waterbody

The applicable GML schema is waterBody.xsd

Requirements Class	
http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-waterbody	
Target type	Implementation
Dependency	waterBody.xsd
Dependency	http://www.opengis.net/spec/CityGML-1/3.0/req/req-class-waterbody
Dependency	http://www.opengis.net/spec/CityGML-2/3.0/req/req-class-base
Requirement 1	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-1 requirement description

Requirement 2	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-2 requirement description
Requirement 3	http://www.opengis.net/spec/ABCD/m.n/req/req-class-a/req-name-3 requirement description

Chapter 7. Media Types for any data encoding(s)

A section describing the MIME-types to be used is mandatory for any Standard involving data encodings. If no suitable MIME type exists in http://www.iana.org/assignments/media-types/index.html then this section may be used to define a new MIME type for registration with IANA.

Annex A: Conformance Class Abstract Test Suite (Normative)

NOTE	Ensure that there is a conformance class for each requirements class and a test for each requirement (identified by requirement name and number)

A.1. Conformance Class A

A.1.1. Requirement 1

Test id:	/conf/conf-class-a/req-name-1
Requirement:	/req/req-class-a/req-name-1
Test purpose:	Verify that…
Test method:	Inspect…

A.1.2. Requirement 2

Annex B: Examples (Informative)

NOTE	This is where any examples will live. For ease of maintenance, each example should be created in its' own asccidoc file and then imported using an "include" statement.

Annex C: Schema (Normative)

NOTE	This is where any XML or JSON schema reside. Conformance is defined, in part, by conformance to these schema.

Annex D: Conceptual Model Conformance (Normative)

NOTE	This is where conformance with CityGML 3.0 Conceptual Model is documented.

Annex E: CityGML Data Dictionary (Normative)

NOTE	The data dictionary from CityGML 3.0 Conceptual Model is imported here. This releives the user of this document from having to refer back to the CM standard.

Annex F: Revision History

Date	Release	Editor	Primary clauses modified	Description
2016-04-28	0.1	G. Editor	all	initial version

Annex G: Glossary

conformance test class
set of conformance test modules that must be applied to receive a single certificate of conformance
[OGC 08-131r3, definition 4.4]

feature
abstraction of real world phenomena
[ISO 19101-1:2014, definition 4.1.11]

feature attribute
characteristic of a feature
[ISO 19101-1:2014, definition 4.1.12]

feature type
class of features having common characteristics
[ISO 19156:2011, definition 4.7]

measurement
set of operations having the object of determining the value of a quantity
[ISO 19101-2:2018, definition 3.21] / [VIM:1993, 2.1]

model
abstraction of some aspects of reality
[ISO 19109:2015, definition 4.15]

observation
act of measuring or otherwise determining the value of a property
[ISO 19156:2011, definition 4.11]

observation procedure
method, algorithm or instrument, or system of these, which may be used in making an observation
[ISO 19156:2011, 4.12]

observation result
estimate of the value of a property determined through a known observation procedure
[ISO 19156:2011, 4.14]

property
facet or attribute of an object referenced by a name.
[ISO 19143:2010, definition 4.21]

requirements class
aggregate of all requirement modules that must all be satisfied to satisfy a conformance test class
[OGC 08-131r3, definition 4.19]

schema
formal description of a model
[ISO 19101-1:2014, definition 4.1.34]

sensor
type of observation procedure that provides the estimated value of an observed property at its output
[OGC 08-094r1, definition 4.5]

Standardization Target
TBD

timeseries
sequence of data values which are ordered in time
[OGC 15-043r3]

universe of discourse
view of the real or hypothetical world that includes everything of interest
[ISO 19101-1:2014, definition 4.1.38]

version
Particular variation of a spatial object
[INSPIRE Glossary]

G.1. ISO Concepts

The following concepts from the ISO TC211 Harmonized UML model are referenced by the CityGML Conceptual UML model but do not play a major role in its' definition. They are provided here to support a more complete understanding of the model.

Area
The measure of the physical extent of any topologically 2-D geometric object. Usually measured in "square" units of length.
[ISO 19103:2015]

Boolean
boolean is the mathematical datatype associated with two-valued logic
[ISO 19103:2015]

CC_CoordinateOperation
mathematical operation on coordinates that transforms or converts coordinates to another coordinate reference system.
[ISO 19111:2019]

Character
symbol from a standard character-set.
[ISO 19103:2015]

CharacterString
Characterstring is a family of datatypes which represent strings of symbols from standard character-sets.
[ISO 19103:2015]

CRS

Coordinate reference system which is usually single but may be compound.
[ISO 19111:2019]

CV_DiscreteCoverage
A subclass of CV_Coverage that returns a single record of values for any direct position within a single geometric object in its spatiotemporal domain.
[ISO 19123:2005]

CV_DomainObject
[ISO 19123:2005]

CV_GridPointValuePair
[ISO 19123:2005]

CV_GridValuesMatrix
The geometry represented by the various offset vectors is in the image plane of the grid.
[ISO 19123:2005]

CV_ReferenceableGrid
[ISO 19123:2005]

Date
Date gives values for year, month and day. Representation of Date is specified in ISO 8601. Principles for date and time are further discussed in ISO 19108.
[ISO 19103:2015]

DateTime
A DateTime is a combination of a date and a time types. Representation of DateTime is specified in ISO 8601. Principles for date and time are further discussed in ISO 19108.
[ISO 19103:2015]

Distance
Used as a type for returning distances and possibly lengths.
[ISO 19103:2015]

Engineering CRS
A contextually local coordinate reference system which can be divided into two broad categories:

1. earth-fixed systems applied to engineering activities on or near the surface of the earth;
2. CRSs on moving platforms such as road vehicles, vessels, aircraft or spacecraft.
   [ISO 19111:2019]

Generic Name
Generic Name is the abstract class for all names in a NameSpace. Each instance of a GenericName is either a LocalName or a ScopedName.
[ISO 19103:2015]

Geometry
[ISO 19107:2003]

GM_CompositePoint
[ISO 19107:2003]

GM_CompositeSolid
set of geometric solids adjoining one another along common boundary geometric surfaces
[ISO 19107:2003]

GM_GenericSurface
GM_Surface and GM_SurfacePatch both represent sections of surface geometry, and therefore share a number of operation signatures. These are defined in the interface class GM_GenericSurface.
[ISO 19107:2003]

GM_LineString
consists of sequence of line segments, each having a parameterization like the one for GM_LineSegment
[ISO 19107:2003]

GM_MultiPrimitive
[ISO 19107:2003]

GM_OrientableSurface
a surface and an orientation inherited from GM_OrientablePrimitive. If the orientation is "+", then the GM_OrientableSurface is a GM_Surface. If the orientation is "-", then the GM_OrientableSurface is a reference to a GM_Surface with an upNormal that reverses the direction for this GM_OrientableSurface, the sense of "the top of the surface".
[ISO 19107:2003]

GM_PolyhedralSurface
a GM_Surface composed of polygon surfaces (GM_Polygon) connected along their common boundary curves.
[ISO 19107:2003]

GM_Position
a union type consisting of either a DirectPosition or of a reference to a GM_Point from which a DirectPosition shall be obtained.
[ISO 19107:2003]

GM_Primitive
The abstract root class of the geometric primitives. Its main purpose is to define the basic "boundary" operation that ties the primitives in each dimension together.
[ISO 19107:2003]

Integer
An exact integer value, with no fractional part.
[ISO 19103:2015]

Internet of Things
The network of physical objects--“things”--that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the Internet.

Wikipedia

IO_IdentifiedObjectBase
[ISO 19103:2015]

Length
The measure of distance as an integral, i.e. the limit of an infinite sum of distances between points on a curve.
[ISO 19103:2015]

Measure
The result from performing the act or process of ascertaining the extent, dimensions, or quantity of some entity.
[ISO 19103:2015]

Number
The base type for all number data, giving the basic algebraic operations.
[ISO 19103:2015]

Point
GM_Point is the basic data type for a geometric object consisting of one and only one point.
[ISO 19107:2003]

Real
The common binary Real finite implementation using base 2.
[ISO 19103:2015]

RS_ReferenceSystem
Description of a spatial and temporal reference system used by a dataset.
[ISO 19111:2019]

Scoped Name
ScopedName is a composite of a LocalName for locating another NameSpace and a GenericName valid in that NameSpace. ScopedName contains a LocalName as head and a GenericName, which might be a LocalName or a ScopedName, as tail.
[ISO 19103:2015]

Solid
GM_Solid, a subclass of GM_Primitive, is the basis for 3-dimensional geometry. The extent of a solid is defined by the boundary surfaces.
[ISO 19107:2003]

Time
Time is the designation of an instant on a selected time scale, astronomical or atomic. It is used in the sense of time of day.
[ISO 19103:2015]

TM_Duration
[ISO 19108:2006]

TM_TemporalPosition
The position of a TM_Instant relative to a TM_ReferenceSystem.
[ISO 19108:2006]

Unit of Measure
Any of the systems devised to measure some physical quantity such distance or area or a system devised to measure such things as the passage of time.
[ISO 19103:2015]

URI
Uniform Resource Identifier (URI), is a compact string of characters used to identify or name a resource
[ISO 19103:2015]

Volume
Volume is the measure of the physical space of any 3-D geometric object.
[ISO 19103:2015]

G.2. Abbreviated Terms

- 2D Two Dimensional
- 3D Three Dimensional
- AEC Architecture, Engineering, Construction
- ALKIS German National Standard for Cadastral Information
- ATKIS German National Standard for Topographic and Cartographic Information
- BIM Building Information Modeling
- B-Rep Boundary Representation
- bSI buildingSMART International
- CAD Computer Aided Design
- COLLADA Collaborative Design Activity
- CSG Constructive Solid Geometry
- DTM Digital Terrain Model
- DXF Drawing Exchange Format
- EuroSDR European Spatial Data Research Organisation
- ESRI Environmental Systems Research Institute
- FM Facility Management
- GDF Geographic Data Files
- GDI-DE Spatial Data Infrastructure Germany (Geodateninfrastruktur Deutschland)
- GDI NRW Geodata Infrastructure North-Rhine Westphalia
- GML Geography Markup Language

- IAI International Alliance for Interoperability (now buildingSMART International (bSI))
- IETF Internet Engineering Task Force
- IFC Industry Foundation Classes
- IoT Internet of Things
- ISO International Organization for Standardisation
- ISO/TC211 ISO Technical Committee 211
- LOD Levels of Detail
- MQTT
- NBIMS National Building Information Model Standard
- OASIS Organisation for the Advancement of Structured Information Standards
- OGC Open Geospatial Consortium
- OSCRE Open Standards Consortium for Real Estate
- SIG 3D Special Interest Group 3D of the GDI-DE
- TIC Terrain Intersection Curve
- TIN Triangulated Irregular Network
- UML Unified Modeling Language
- URI Uniform Resource Identifier
- VRML Virtual Reality Modeling Language
- W3C World Wide Web Consortium
- W3DS OGC Web 3D Service
- WFS OGC Web Feature Service
- X3D Open Standards XML-enabled 3D file format of the Web 3D Consortium
- XML Extensible Markup Language
- xAL OASIS extensible Address Language

Annex H: Bibliography

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