

Reorganization of Conformance Requirements

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PROJECT CITYDOCTOR

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Consortium

HFT Stuttgart, Prof. Dr. Coors

CPA Geoinformation

Fraunhofer Institut für Graphische
Datenverarbeitung (IGD)

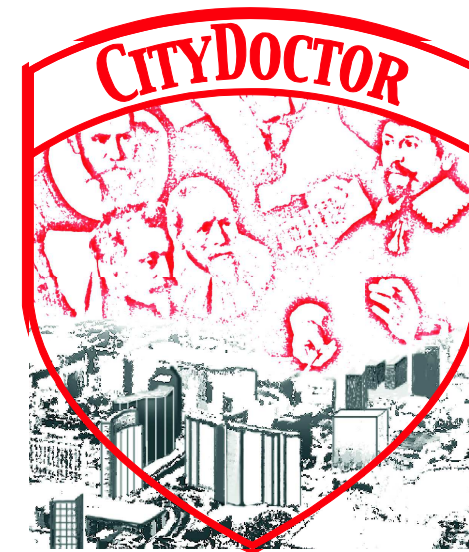
Conterra GmbH

Stadtmessungsamt Stuttgart

Stadt Düsseldorf

TU München, Prof. Dr. Kolbe

InGeoForum

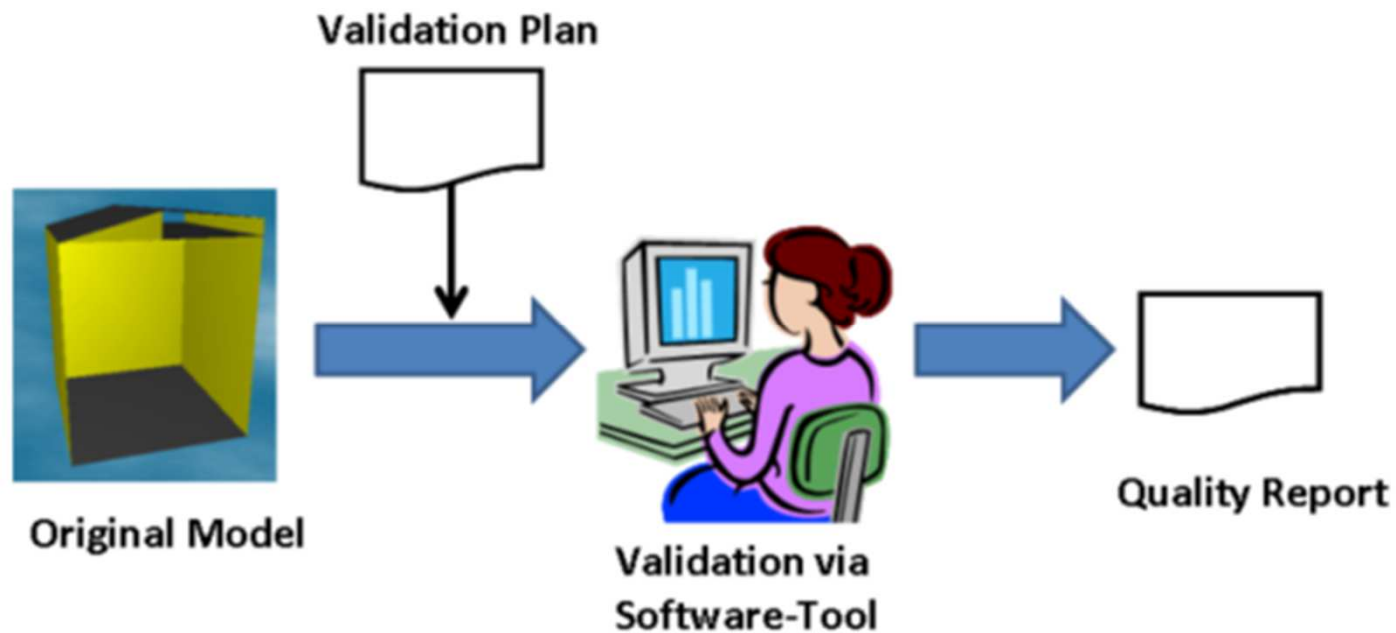


Beuth Hochschule Berlin,
Prof. Dr. Pries

MVI Solve-IT GmbH

Fraunhofer Institut für
Produktionsanlagen und
Konstruktionstechnik (IPK)

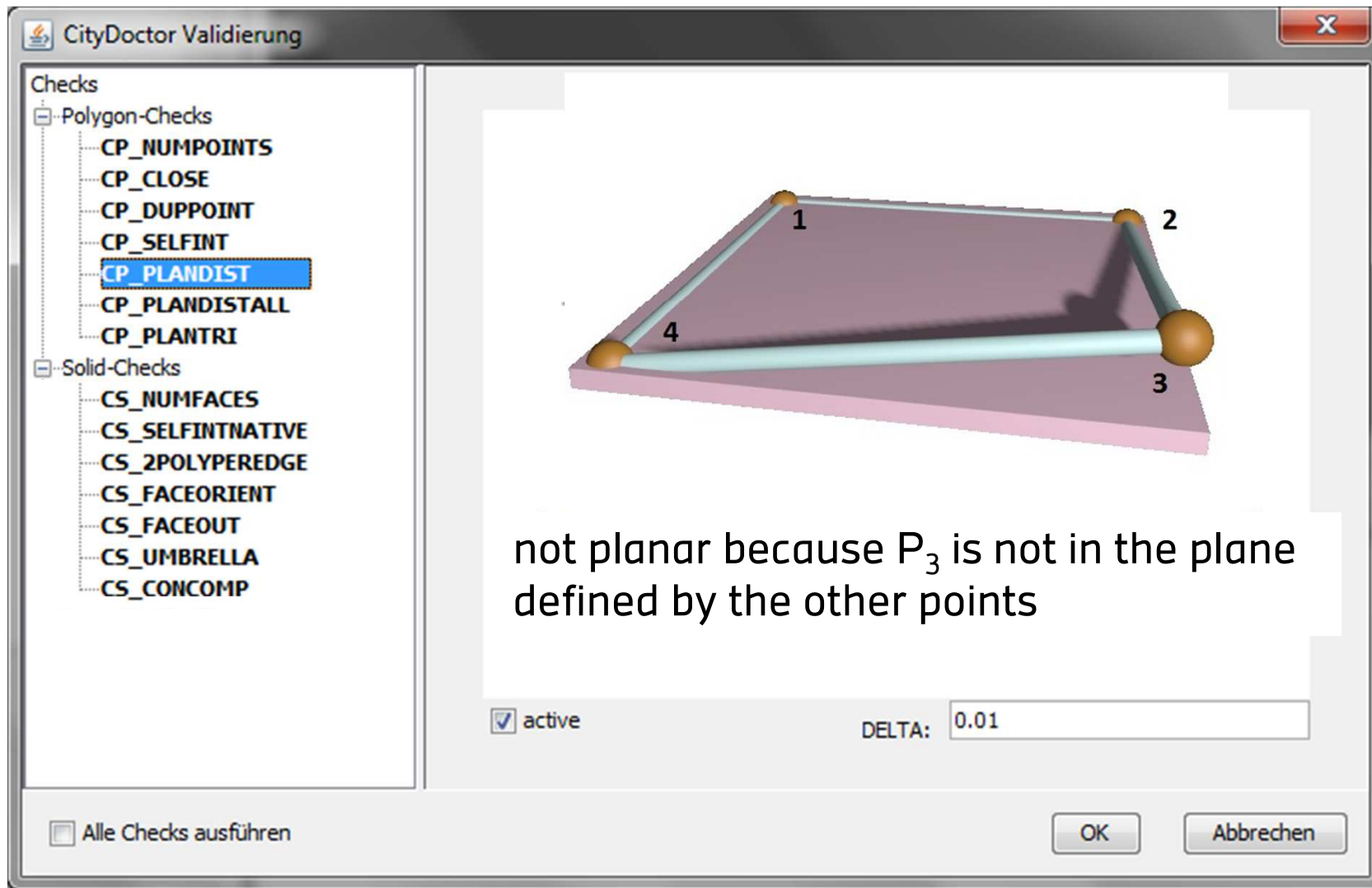
Overview



Quality of CityGML data

- XMLSchema-compliant
- correct geometry / topology
- correct semantics
- spatio-semantical conherency
- ...

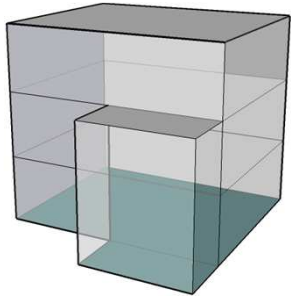
List of Geometry Checks



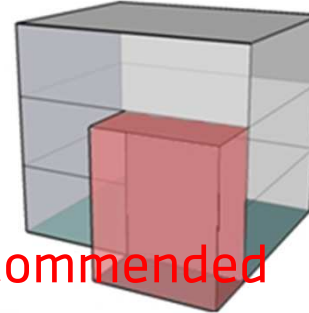
Structure

- Specification of modeling alternatives
Verbal description of constraints
Formal description with UML and OCL (Object Constraint Language), e.g. Building / BuildingPart
- Plausibility check
e.g. measuredHeight, storeysAboveGround, ...
- Validation plan defines, which model structure is accepted

Building / BuildingPart in LoD1

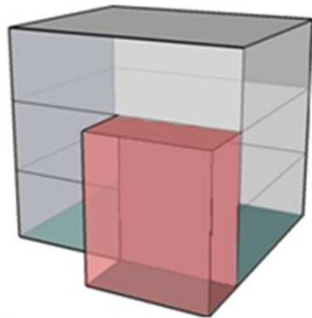


Alternative 1:
1 Building (Solid)

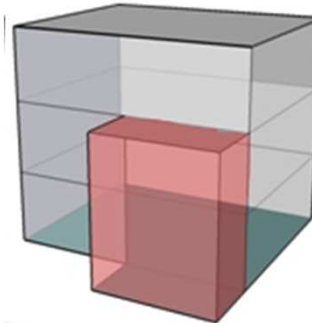


recommended

Alternative 2:
1 Building (Solid)
1 BuildingPart (Solid)
Complete geometry: Composite Solid



Alternative 3:
1 Building (--)
2 BuildingParts (Solid)
Complete geometry: Composite Solid



Alternative 4:
1 Building (Multisurface)
1 BuildingPart (Multisurface)
Complete geometry: Solid

Building / BuildingPart in LoD1

Rule 2: If a building consists of several parts the main element is modeled as a Solid, as well as all other building parts. The combined geometry of all parts forms a CompositeSolid:

```
context Building
inv: self.oclIsTypeOf(t:Building)
inv: self.lod1Solid->notEmpty() and
self.lod1MultiSurface->isEmpty()
inv: self.consistsOfBuildingPart->notEmpty()->
forAll(b:BuildingPart | b.lod1Solid->notEmpty()
and b.lod1multisurface->isEmpty())
inv: self.lod1Solid->union(union
(self.consistsOfBuildingPart.lod1Solid))
= compositeSolid
```


Conformance Requirements

Describe the properties of a data set in order to be conform with a specified standard.

Conformance Requirements in CityGML

Base requirements

Usage restrictions (certain modules)

Referential integrity

Verbal description

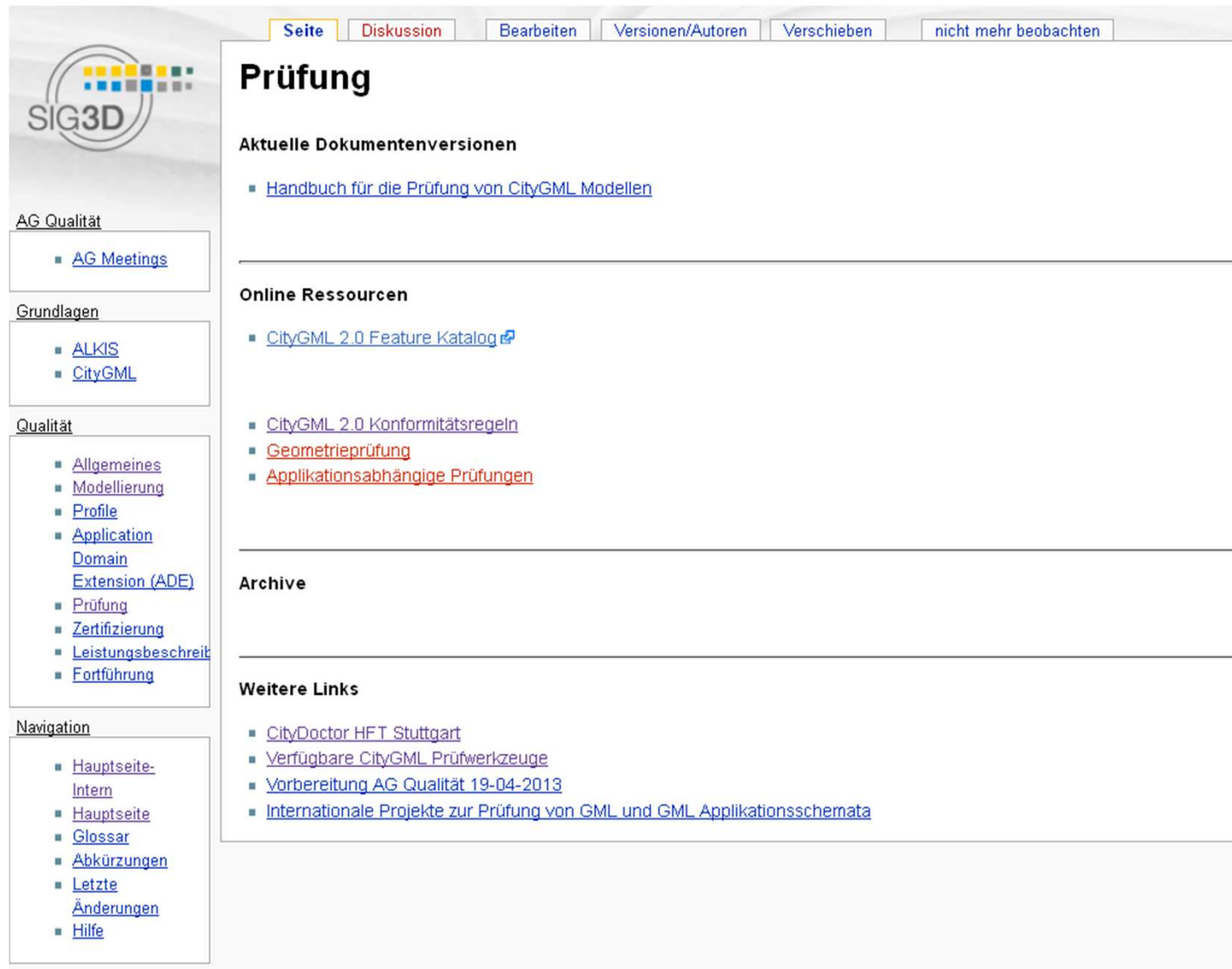
Quality of CityGML data

Test for conformance

Goal:

Derive a rule for each conformance requirement

SIG3D – Quality Working Group



The screenshot displays the SIG3D website interface. At the top, there is a navigation bar with buttons: **Seite**, **Diskussion**, **Bearbeiten**, **Versionen/Autoren**, **Verschieben**, and **nicht mehr beobachten**. The main heading is **Prüfung**.

AG Qualität

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- [CityGML](#)

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Navigation

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- [Hauptseite](#)
- [Glossar](#)
- [Abkürzungen](#)
- [Letzte Änderungen](#)
- [Hilfe](#)

Aktuelle Dokumentenversionen

- [Handbuch für die Prüfung von CityGML Modellen](#)

Online Ressourcen

- [CityGML 2.0 Feature Katalog](#)
- [CityGML 2.0 Konformitätsregeln](#)
- [Geometrieprüfung](#)
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Archive

Weitere Links

- [CityDoctor HFT Stuttgart](#)
- [Verfügbare CityGML Prüfwerkzeuge](#)
- [Vorbereitung AG Qualität 19-04-2013](#)
- [Internationale Projekte zur Prüfung von GML und GML Applikationsschemata](#)

Collection of requirements

Bridge module

Base requirements

- [CR-Bridge-001](#) (Bridge --- BridgePart)

Usage restriction of building model components according to different LODs

- [CR-Bridge-002](#) (lodXSolid and lodXMultiSurface)
- [CR-Bridge-003](#) (boundedBy)
- [CR-Bridge-004](#) (lodXMultiCurve)
- [CR-Bridge-005](#) (outerBridgeConstruction)
- [CR-Bridge-006](#) (outerBridgeConstruction - boundedBy)
- [CR-Bridge-007](#) (outerBridgeInstallation)
- [CR-Bridge-008](#) (outerBridgeInstallation - boundedBy)
- [CR-Bridge-009](#) (opening) - Verschiedene Anmerkungen KIT
- [CR-Bridge-010](#) (interiorBridgeRoom)
- [CR-Bridge-011](#) (interiorBridgeInstallation - bridgeRoomInstallation)
- [CR-Bridge-012](#) (IntBridgeInstallation - boundedBy)

Referential integrity

- [CR-Bridge-013](#) (_AbstractBridge - boundedBy)
- [CR-Bridge-014](#) (_AbstractBridge - outerBridgeConstruction)
- [CR-Bridge-015](#) (_AbstractBridge - outerBridgeInstallation)
- [CR-Bridge-016](#) (_AbstractBridge - interiorBridgeInstallation)
- [CR-Bridge-017](#) (_AbstractBridge - interiorBridgeRoom)
- [CR-Bridge-018](#) (_AbstractBridge - consistsOfBridgePart)
- [CR-Bridge-019](#) (_AbstractBridge - address)
- [CR-Bridge-020](#) (_BoundarySurface - opening)

Collection of requirements

CR-Bridge-001

Specification: If a bridge only consists of one (homogeneous) part, it shall be represented by the element Bridge. However, if a bridge is composed of individual structural segments, it shall be modelled as a Bridge element having one or more additional BridgePart elements. Only the geometry and non-spatial properties of the main part of the bridge should be represented within the aggregating Bridge element.

Rule:

For all (BridgePart) **exist** (Bridge) **with** (Bridge\consistsOfBridgePart == BridgePart)

Code: CR-Bridge-001

Classification:

Error

Message:

Example:

Comments:

KIT (2013-05-14): Dies ist zum Teil eine Modellierungs-Vorschrift und zum Teil eine Konformitätsregel: Ein BridgePart darf nicht ohne ein zugehöriges Objekt Bridge vorkommen. Nur das letztere kann man prüfen.

AG-Qualität: Die Regel sollte über das Schema formalisiert werden.

CR-Bridge-001

If a bridge only consists of one (homogeneous) part, it shall be represented by the element *Bridge*. However, if a bridge is composed of individual structural segments, it shall be modelled as a *Bridge* element having one or more additional *BridgePart* elements. Only the geometry and non-spatial properties of the main part of the bridge should be represented within the aggregating *Bridge* element.

For all (*BridgePart*) exist (*Bridge*) with (
 Bridge/consistsOf*BridgePart* == *BridgePart*)

CR-Bridge-001

Combination of modeling advice and conformance requirement.

CR-Bridge-009

Starting from LOD3, openings of *_BoundarySurface* elements may be modelled using the opening property (type: *OpeningPropertyType*) of *_BoundarySurface*. This property shall not be used for *_BoundarySurface* elements only represented in LOD2. Accordingly, the surface geometry representing a *_BoundarySurface* in LOD2 must be simply connected.

The opening property of *_BoundarySurface* may contain or reference *_Opening* elements. If the geometric location of an *_Opening* element topologically lies within a surface component of the *_BoundarySurface*, the opening must also be represented as inner hole of that surface. The embrasure surface of an *_Opening* element shall belong to the relevant adjacent *_BoundarySurface*.

CR-Bridge-009

First part unnecessary (part of schema).

Only one rule per conformance requirement.

CR-Bridge-009

"Accordingly, the surface geometry representing a `_BoundarySurface` in LOD2 must be simply connected."

This should be a requirement on its own.

No restrictions/rules concerning the topology of `MultiSurface` representations exist.

CR-Bridge-013

The *boundedBy* property (type: *BoundarySurfacePropertyType*) of the element *_AbstractBridge* may contain a *_BoundarySurface* element inline or an XLink reference to a remote *_BoundarySurface* element using the XLink concept of GML 3.1.1. In the latter case, the *xlink:href* attribute of the *boundedBy* property may only point to a remote *_BoundarySurface* element (where remote *_BoundarySurface* elements are located in another document or elsewhere in the same document). Either the contained element or the reference must be given, but neither both nor none.

Only *RoofSurface*, *WallSurface*, *GroundSurface*, *OuterCeilingSurface*, *OuterFloorSurface* and *ClosureSurface* elements are allowed to be encapsulated or referenced by the *boundedBy* property of *_AbstractBridge*.

CR-Bridge-013

The requirements for referential integrity contain a lot of repeating text in many variations.

Essentially, a sub-element can be contained inline or via Xlink reference, but neither both nor none. Which elements are allowed can be derived from the schema.

CR-Building-002

The *gml:MultiSurface* geometries that are associated using the *lod0FootPrint* and *lod0RoofEdge* properties must have 3D coordinates. For each surface, the height values of the coordinate tuples belonging to the same surface shall be identical.

if (*_AbstractBuilding/lod0FootPrint* != NULL) then (
 _AbstractBuilding/lod0FootPrint/MultiSurface/surfaceMember/Polygon/exterior/LinearRing/posList[$\forall z$] } == h)
z=3v-1 mit $v \in [1..p/3]$, p=Anzahl der Koordinaten mit
Indizierung ab 0, h = const

Discussion

- Reorganization
- Removal of pure modeling requirements
- Separation from requirements which are part of the XML schema
- Definition of formal rules here possible
- Add missing requirements
- Combine similar requirements