



**AGH UNIVERSITY OF SCIENCE
AND TECHNOLOGY**

The 3D and 4D aspects in INSPIRE and ISO 19152

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INSPIRE Directive

- DIRECTIVE 2007/2/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)
- ANNEX I -9 SPATIAL DATA THEMES
- ANNEX II -4 SPATIAL DATA THEMES
- ANNEX III -21 SPATIAL DATA THEMES

ISO 19152:2012 „Geographic information – Land Administration Domain Model (LADM)“

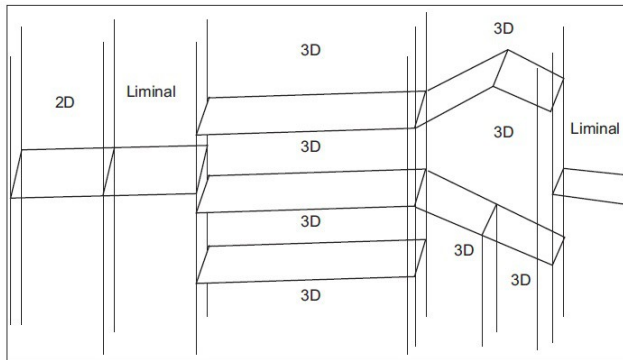
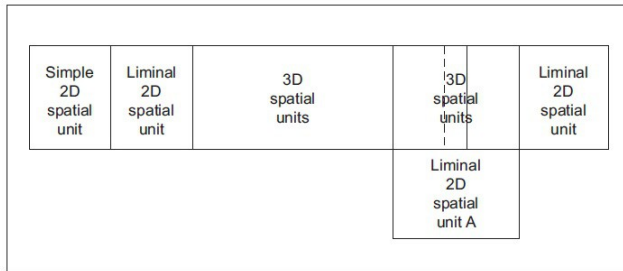
- The Geographic Information - Land Administration Domain Model (LADM) was developed by the Technical Committee 211 of the International Organization for Standardization. It was finally approved on the 1st of November and was formally published on the 1st of December 2012 as ISO 19152 standard.
- The Land Administration Domain Model was also accepted in European Committee for Standardization (CEN) and became a European standard as well.

ISO 19152 and INSPIRE Directive

From article 7 of INSPIRE Directive:

- Relevant user requirements, existing initiatives and international standards for the harmonisation of spatial data sets, as well as feasibility and cost-benefit considerations shall be taken into account in the development of the implementing rules.
- Where organisations established under international law have adopted relevant standards to ensure interoperability or harmonisation of spatial data sets and services, these standards shall be integrated, and the existing technical means shall be referred to, if appropriate, in the implementing rules mentioned in this paragraph.

3D aspects in ISO 19152



Top and side views of mixed 2D and 3D representations (source: (ISO 19152)).

- The most significant class concerning 3D situations is LA_SpatialUnit with spatial units as instances.
- The spatial unit is the single area (or multiple areas) of land and/or water, or a single volume (or multiple volumes) of space.
- The spatial unit can be 2-dimensional (2D), 3-dimensional (3D), or mixed (2D and 3D) one, which may be described in text (“from this tree to that river”), or based on a single point, or represented as a set of unstructured lines, or as a surface, or as a 3D volume.

3D aspects in ISO 19152

The Land Administration Domain model also includes mixed spatial profile configurations. The 3D topological based profile is among them. This profile include pure 3D topology structure. The instance of 3D spatial unit is also given in annex E (informative) of LADM.

3D aspects in chosen INSPIRE data specifications

The following data specification, with the same area of interest as ISO 19152, were searched for references to „3D situations“:

- D2.8.I.6 Data Specification on Cadastral Parcels – Technical Guidelines (2014-04-17)
- D2.8.III.2 Data Specification on Buildings – Technical Guidelines (2013-12-10)
- D2.8.I.4 Data Specification on Administrative Units – Technical Guidelines (2014-04-17)
- D2.8.III.6 Data Specification on Utility and Government Services – Technical Guidelines (2013-12-10)

The references to 3D (except coordinate reference systems) were found in data specifications on cadastral parcels and buildings.

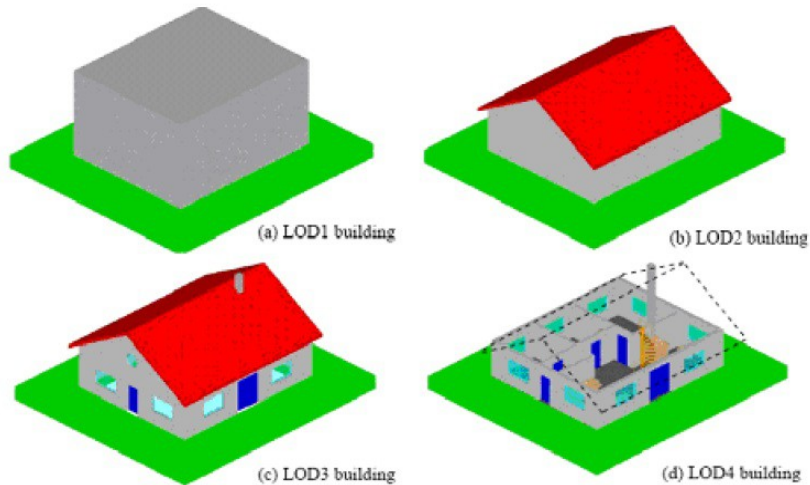
Data Specification on Cadastral Parcels – Technical Guidelines

- The INSPIRE Data Specification on Cadastral Parcels has not got the harmonized solutions for 3D cadastral objects. Some use cases concerning 2.5D or 3D cadastral parcels are listed in so called recapitulative check list of the cadastral parcels data specification.
- According to this list, there is an interest in 2.5D cadastral parcels and possible requirements for 3D parcels in future.
- Few countries have 3D parcels, for example Norway has some 2.5D parcels for representing 3D parcels. There is stated in harmonization approach, that Thematic Working Group Cadastral Parcels has restricted parcels to 2D or 2.5D as the INSPIRE directive define parcels as areas, so volumes are excluded.
- It is also stated that 3D parcels may be useful for non-environmental or environmental use cases in future.
- Some users have expressed the requirement (in future) to combine cadastral parcels with 3D data like DTM or buildings.

Data Specification on Buildings – Technical Guidelines

As building as a physical object has got three dimensions, many references, i.a. to 3D data, 3D geometry, 3D building profiles, 3D building models are included in the specification.

Data Specification on Buildings – Technical Guidelines



Source: INSPIRE Data Specification on Buildings

The 3D representations of buildings are generally described using the well defined levels of detail of the CityGML OGC standard. CityGML offers different levels of detail (LoD) for the modeling of *Buildings*:

- LoD 0 that offers a 2D model for buildings has been included in the latest version of City GML (v2.0).
- LoD 1 with block models (flat roofs)
- LoD 2 with the shape of roofs
- LoD 3 with accurate description of exterior (including openings: doors and windows)
- LoD 4: interior model

Cadastral parcels in ISO 19152 and INSPIRE

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<ul style="list-style-type: none"> + areaClosed(): Boolean + volumeClosed(): Boolean + computeArea(): Area + computeVolume(): Volume + createArea(): GM_MultiSurface + createVolume(): GM_MultiSolid

«featureType» CadastralParcels::CadastralParcel
<ul style="list-style-type: none"> + geometry: GM_Object + inspireId: Identifier + label: CharacterString + nationalCadastralReference: CharacterString
«voidable»
<ul style="list-style-type: none"> + areaValue: Area [0..1] + referencePoint: GM_Point [0..1] + validFrom: DateTime [0..1] + validTo: DateTime [0..1]
«lifeCycleInfo, voidable»
<ul style="list-style-type: none"> + beginLifespanVersion: DateTime + endLifespanVersion: DateTime [0..1]

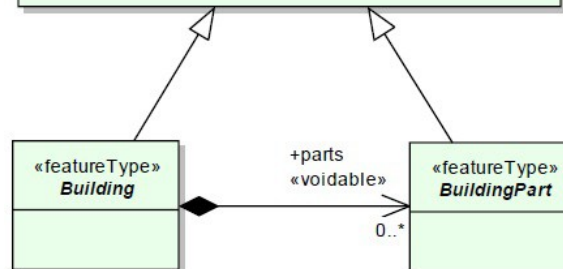
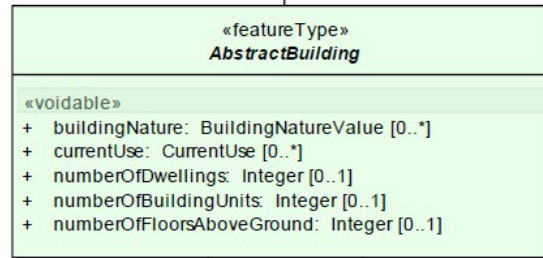
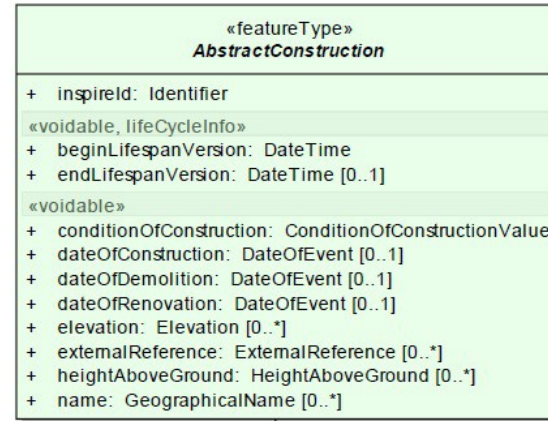
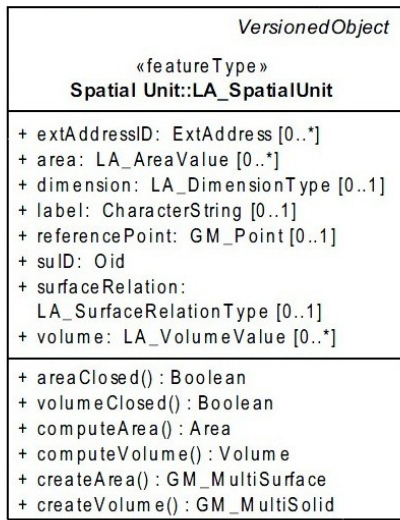
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<i>::LA_SpatialUnit</i>
<ul style="list-style-type: none"> + area: LA_AreaValue [0..*] + dimension: LA_DimensionType [0..1] + extAddressID: Oid [0..*] + label: CharacterString [0..1] + referencePoint: GM_Point [0..1] + suID: Oid + surfaceRelation: LA_SurfaceRelationType [0..1] + volume: LA_VolumeValue [0..*]
<i>::VersionedObject</i>
<ul style="list-style-type: none"> + beginLifespanVersion: DateTime + endLifespanVersion: DateTime [0..1] + quality: DQ_Element [0..*] + source: CI_ResponsibleParty [0..*]

Sources : ISO 19152 (left and right figures, 3), INSPIRE Data Specification on Cadastral Parcels (middle figure)

The cadastral parcel definition (INSPIRE) based on LA_SpatialUnit class (figure on the right) is a result of cooperation between LADM project Team and TWG CP.

This definition enables expanding INSPIRE cadastral parcel definition into 3D if there is such a need.

Buildings in ISO 19152 and INSPIRE



- The LADM definition of buildings indicates generally legal space, whereas INSPIRE definitions concerns physical object.
- The generalisation relationships are generally applied in both definitions. It means that the some attributes are inherited from more general classes.

Sources : ISO 19152 (figure on the left),
Data Specification on Buildings
(figure on the right)

4D (temporal) aspects in ISO 19152

Two different views are used to model the result of dynamic systems (discrete changes in the state of the system):

- Event based modelling - transactions are modelled as separate entities within the system (with their own identity and set of attributes).
 - The event is represented by an instance of LA_Source. When the start state is known, and all events are known, it is possible to reconstruct every state in the past by reversing the whole chain of events.
- State based modelling - the states (that is to say, the results) are modelled explicitly: every object is assigned (at least) two dates/times which indicate the time interval during which the object is recorded in the system as actual version.
 - The temporal aspect is inherited from class VersionedObject with its attributes beginLifespanVersion and endLifespanVersion.

4D (temporal) aspects in INSPIRE

The INSPIRE directive (Article 8-2 (d)):

- The implementing rules shall address the following aspects of spatial data: information on the temporal dimension of the data
- Article 8-2 (d) is addressed by specifying temporal properties for each of the spatial object types in the INSPIRE application schemas following the rules of ISO 19109 (Rules for application schemas) and ISO 19108 (Temporal schema) – 4.1.1.8 of "INSPIRE Generic Conceptual Model"
- More details in "INSPIRE Generic Conceptual Model" D.2.5 (2014-04-08), chapter 10 "Spatial and temporal aspects"
- Temporal aspects still under development in INSPIRE



Recapitulation and conclusions

- The LADM Project Team cooperated with Thematic Working Groups when working on Cadastral Parcels and Buildings specifications. ISO 19152 is referred in these two specifications as a „draft“, so this cooperation seems not to have taken place recently – it may need restoring for further developments.
- Further research should be performed not only on models but on real data, as well.



Thank you very much

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