The background image shows a Dutch town with a prominent church tower, likely the Deventer Church, reflected in a body of water. The scene is captured during sunset or sunrise, with warm lighting and a cloudy sky.

BIM Legal: defining a standard for 3D cadastral registration of apartment complexes

Jantien Stoter^{1,2}, Martin Peersmann¹, Marcel Reuvers¹, Doris Smudde¹, Ruben Roes¹
and Abdoulaye Diakité³

¹Kadaster NL; ²3D Geoinformation, TU Delft; ³BIM-Expert. Australia

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Gold sponsor:



Silver sponsor:



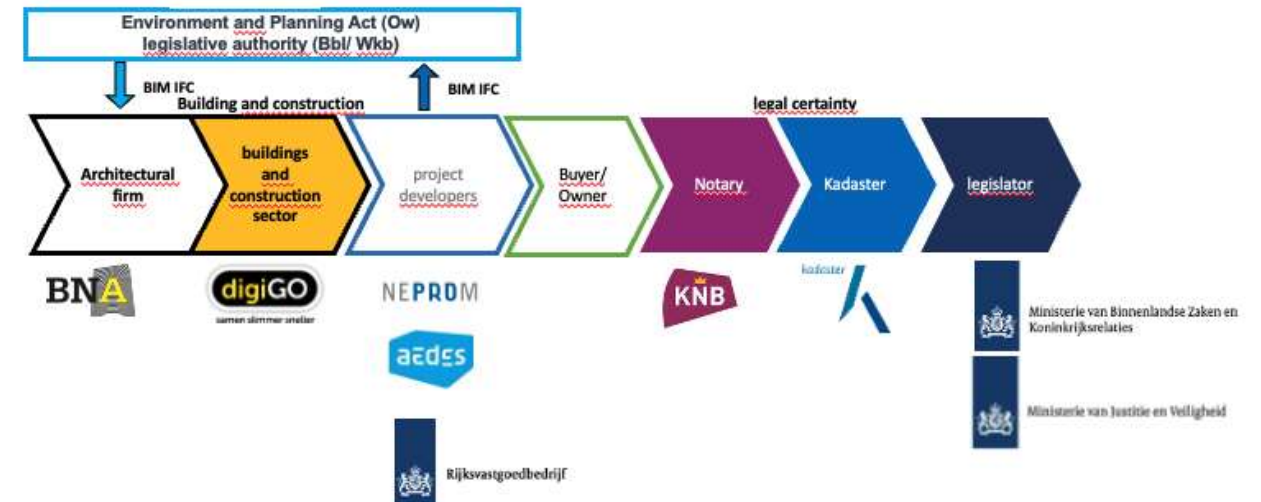
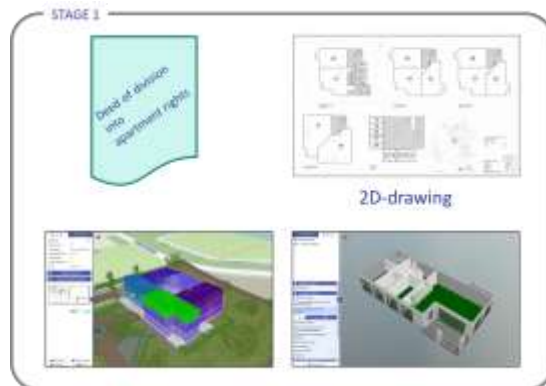
Bronze sponsors:



BIM Legal standard – aim of the project

- Define content BIM Legal model to establish RRR of apartment complexes
- Many similar previous researches: What is new?
- How to make this reality
 - Aligning to processes in practice: planning -> design/construction -> legal security
 - How can BML be produced, validated, registered, published, maintained for different purposes in chain

• First phase 1



Align to int standards

LADM Definitions:

4.1.18 responsibility

formal or informal obligation to do something

- EXAMPLE The responsibility to clean a ditch, to keep a snow-free pavement or to remove icicles from the roof during winter, or to maintain a monument.

4.1.1 restriction

formal or informal obligation to refrain from doing something

- EXAMPLE 1 It is not allowed to build within 200 metres of a fuel station; or, a servitude or mortgage as a restriction to the ownership right (4.1.20).
- EXAMPLE 2 Sequestration can be registered for baunit as a restriction

4.1.20 right

action, activity or class of actions that a system participant may perform on or using an associated resource

- NOTE 1 A right may provide a formal or informal entitlement to own or do something.
- NOTE 2 This International Standard deals with real rights and personal rights. Real rights are rights over or in respect of spatial units (4.1.23) (e.g. ownership, or usufruct). Personal rights are rights that parties (4.1.13) have (e.g. fishing rights, grazing rights, or use rights).
- NOTE 3 Rights may be overlapping, or may be in disagreement.
- EXAMPLE Ownership right, apartment right, tenancy right, possessions, customary right, Islamic right (e.g. miri or milk), indigenous right, or informal right.

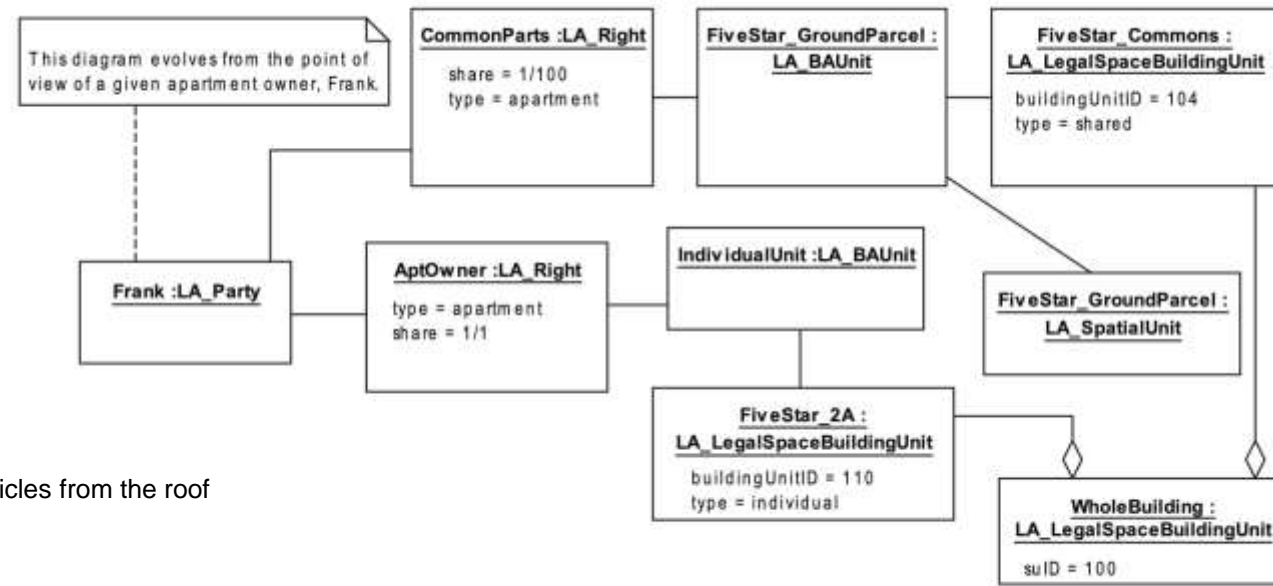
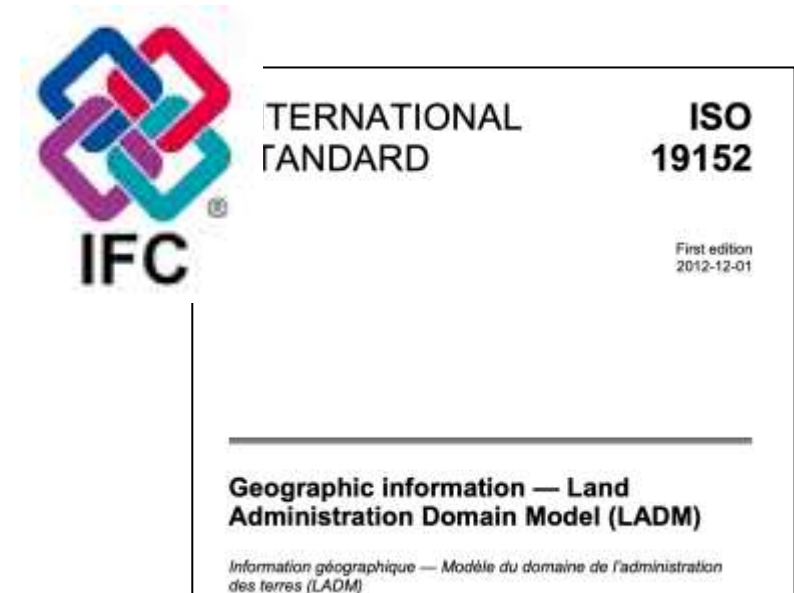
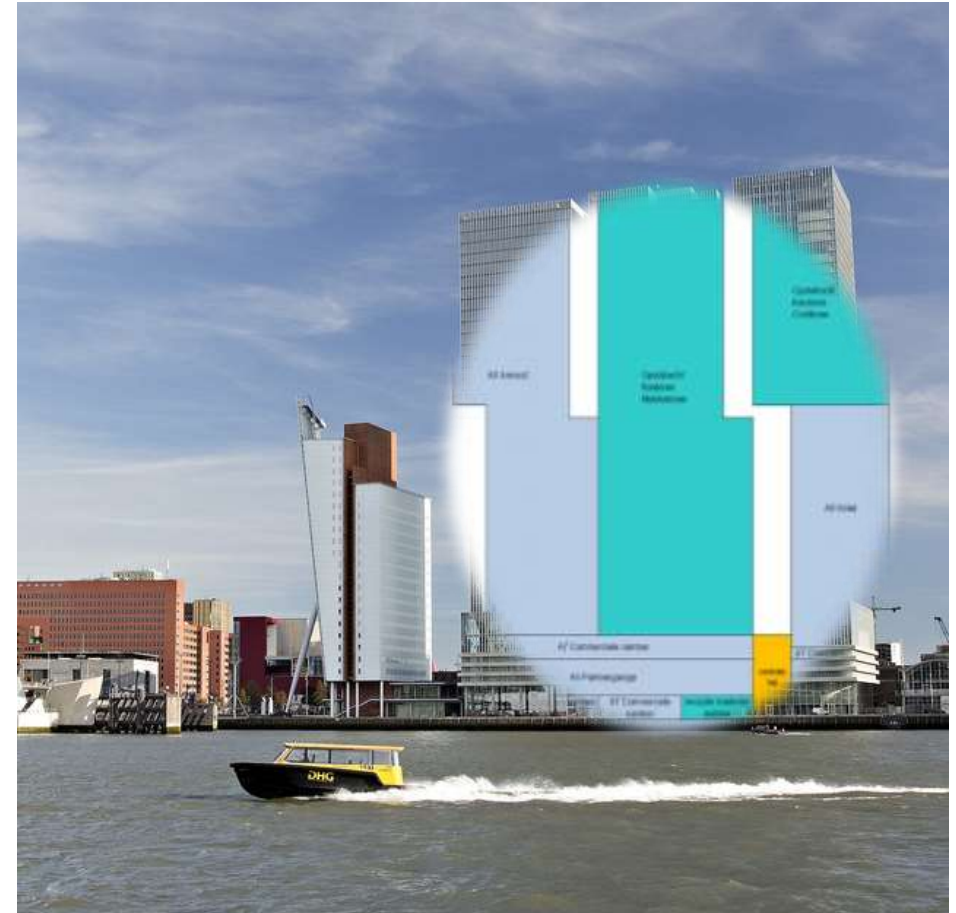


Figure C.6 — Apartment building



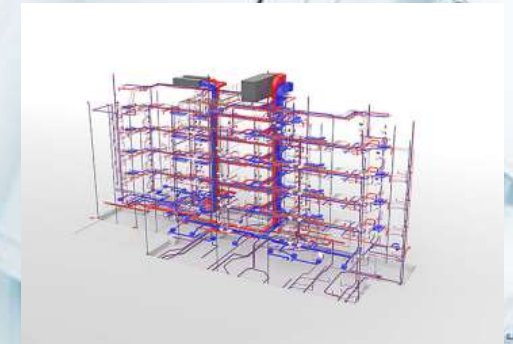
Content

- **Business rules**
- UML models
- Technical considerations
- Validation
- Observations & conclusions



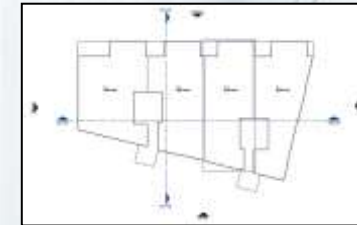
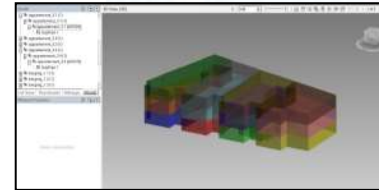
Business rules: General

- Each subdivision submission can **optionally** be accompanied by a **single** BIM Legal model (BLM)
- BLM should contain all (no more) elements mentioned in the Deed of Division (DoD):
 - Apartment complex
 - Apartment units + Shared spaces
 - Land parcels
 - Internal elements (installations) to which RRR are assigned
 - External elements to which RRR are assigned
- BLM exists and can be updated independent from the construction model


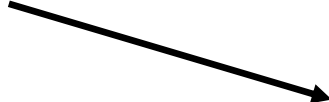


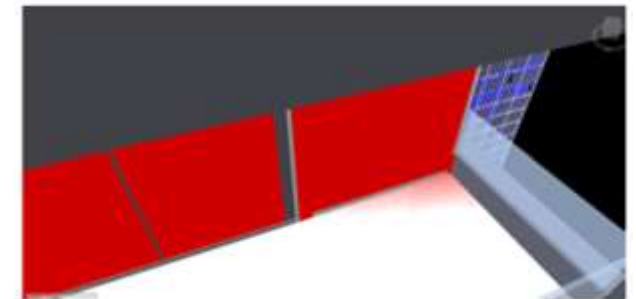
Business rules: Apartment complex

- An apartment complex consists:
 - of (private) apartment units (private ownership); spaces with shared ownership
 - Building elements with RRR
- The BML should also contain the traditional 2D division drawings (until the BIM Legal model will replace the deed)
- The 3D BIM Legal model covers the entire apartment complex
- An apartment complex is located on one or more parent land parcels
 - BIM Legal model should contain the parcel numbers
- Shared and privately owned spaces can also contain (groups of) building elements to which a RRR is assigned to
 - see business rules for these legal physical elements elements



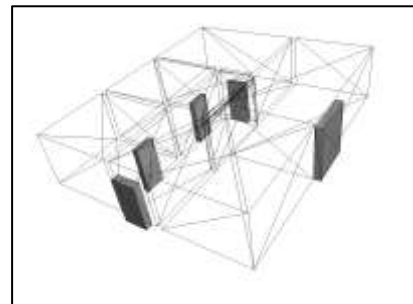
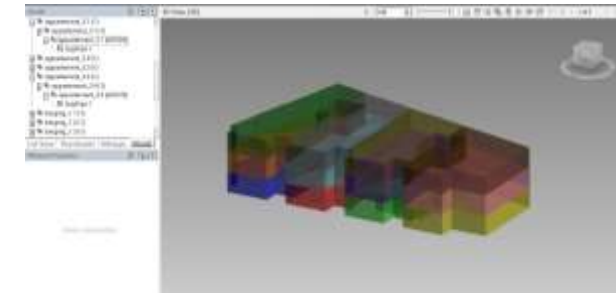
Business rules: Apartment units

- Each unit should have an unique apartment index number, a unique BAG-address and the BAG-ID of the building in which it is situated
- All spaces belonging to an apartment unit, even if they are not connected, must identifiable as such in the BML (geometry) 
- If a privat unit is made up of unconnected spaces, it must be known for each individual space which other parts are part of the same unit
- Parking spaces, storerooms and the like should also be added as spaces to each unit
- The spaces should cover the whole spatial extent of a unit, including balconies
 - legal boundaries may not always coincide with physical elements 



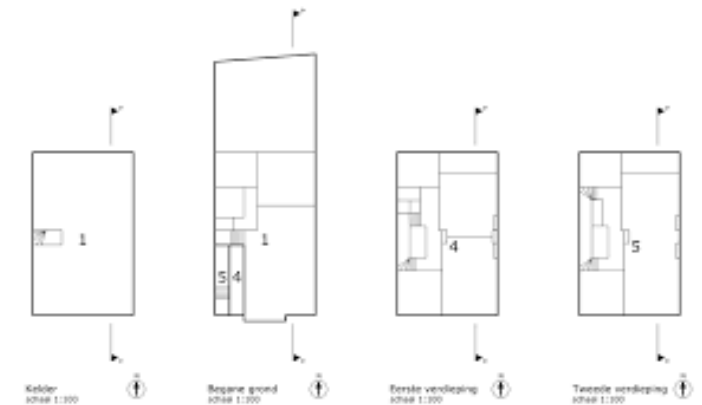
Business rules: Legal spaces

- At least two spaces are mandatory in the BLM
- All spaces must:
 - be either private or shared, as described in the deed
 - watertight
- Collection of all legal spaces in the BLM:
 - must have no gaps (= fully fill the complex) and no overlaps
- In what way spaces are connected should clear



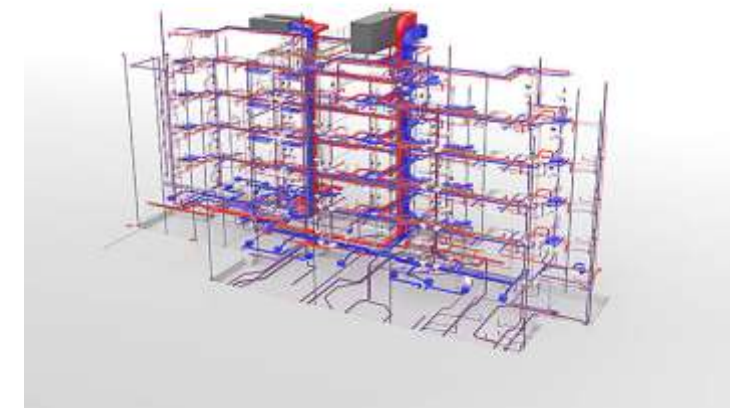
General remark: Legal spaces

- For orientation purposes an abstracted version of the BIM model should be included
 - This object should be mentioned in DoD
- Specific attention should be paid to define exact location of 3D boundaries of spaces
 - e.g. side of wall (which side?) or centre of wall?
 - compare to 2D division drawings: boundary lines often coincide with the extent of a wall



Business rules: Legal building elements 1/2

- Legal building elements can be internal and/or external
- Only building elements with legal obligations (RRR) should be included in the BIM Legal model:
 - building elements without legal obligations should not be included in the BIM Legal model
- Building elements that are private or shared because they fall within a particular space and are not subject to other legal obligations as contained in the division deed should not be included in the model
- Legal building elements can intersect multiple legal spaces. The link between building elements and spaces should become clear from visualisation



Business rules: Legal building elements 2/2

- Building elements to which one RRR applies should be grouped to avoid redundancy of legal text:
 - eg. 'installation', 'window', 'solar panel',
- Building elements (or group of BE) to which a RRR is attached should be given a unique ID
- The proposed mapping to IFC should be followed

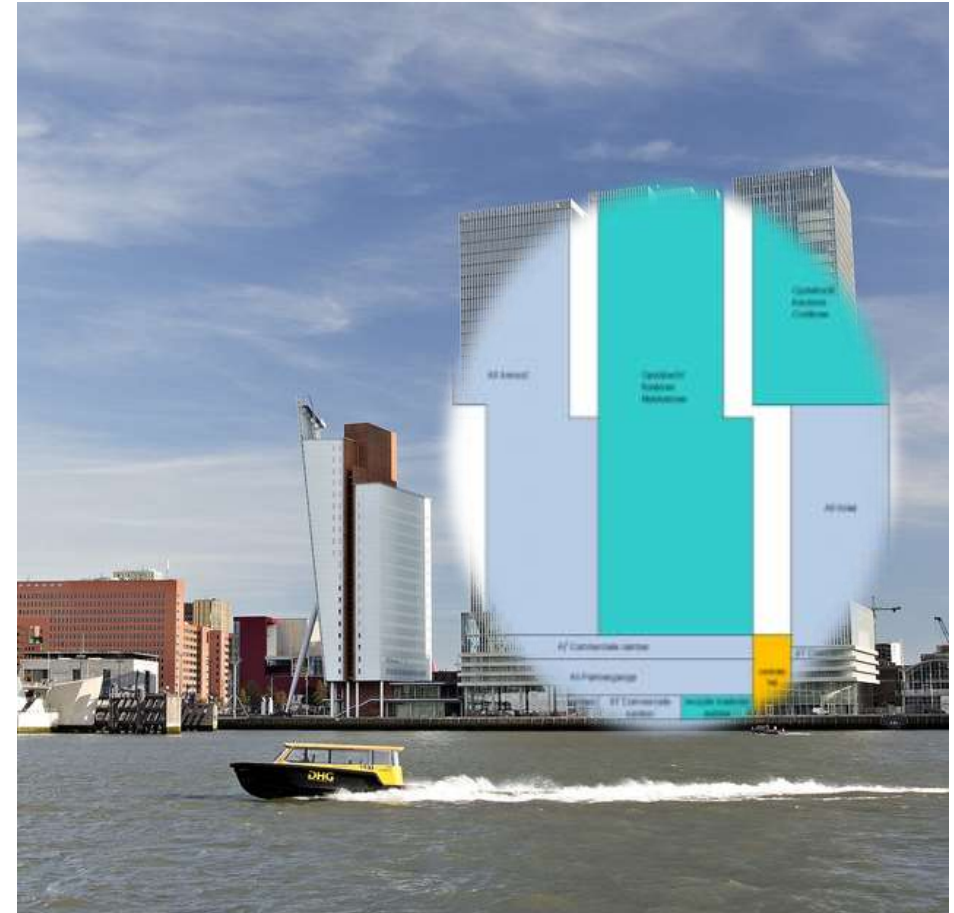
Element	IFC class	
Skelet van het pand - (Skeleton)	IfcBeam IfcColumn IfcSlab IfcFooting	IfcWall IfcPlate IfcBrace IfcTruss
Gevels - (Facade)	IfcWall, IfcSlab, IfcWindow, IfcDoor	
Balkonconstructie - (Balcony)	IfcSlab IfcRailing	
Terrasbedekking - (Terrace covering)	IfcSlab IfcRoof IfcCovering	
Dak(en) – (Roofs)	IfcRoof	
Dakterrassen – (Roof terraces)	IfcRoof IfcCovering	
Muren – (Walls)	IfcWall IfcWallStandardCase IfcCurtainWall	
Vloeren en plafonds – (Floors & Ceilings)	IfcSlab	
Ramen en deuren – (Windows & Doors)	IfcWindow IfcDoor IfcOpeningElement	



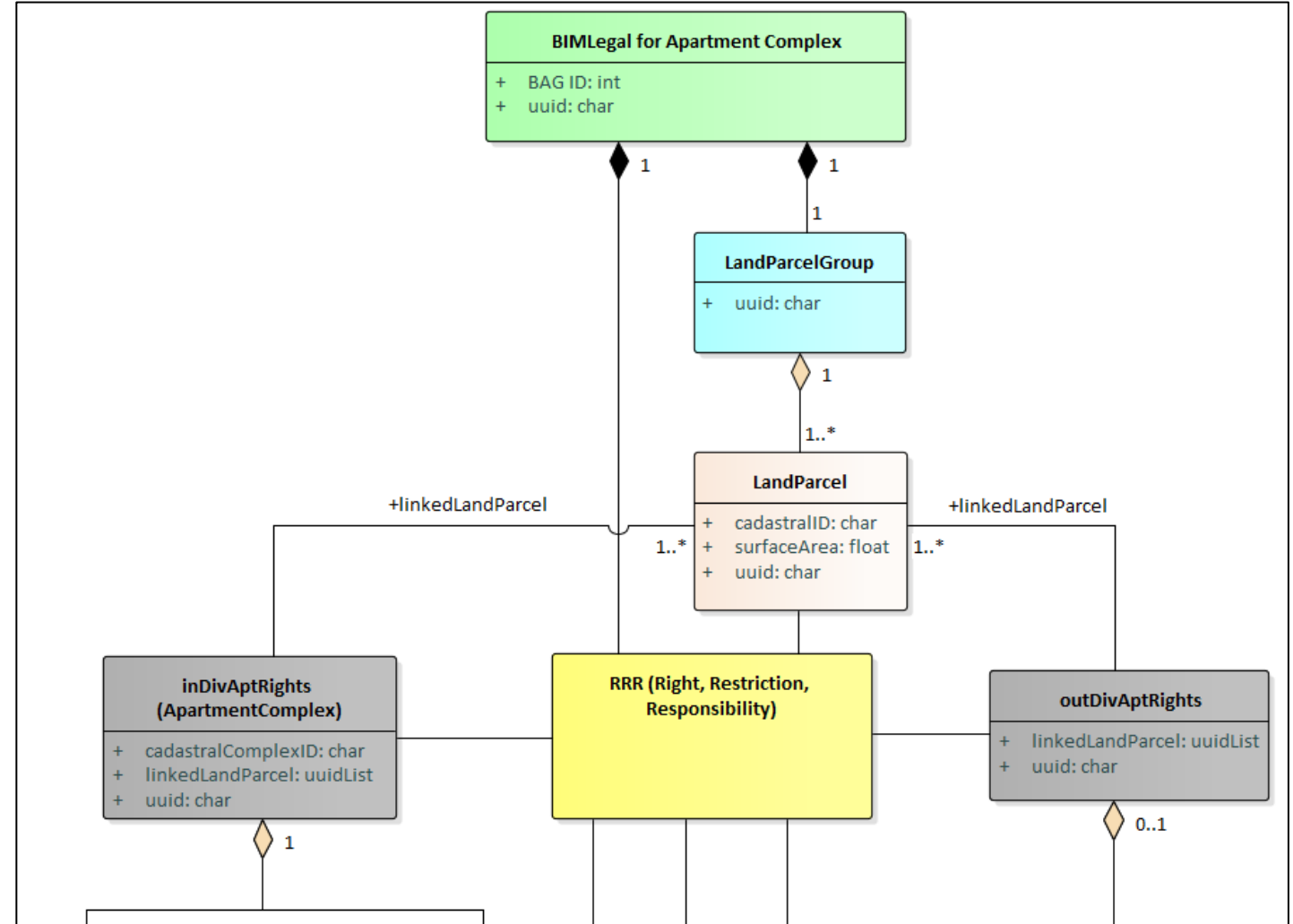
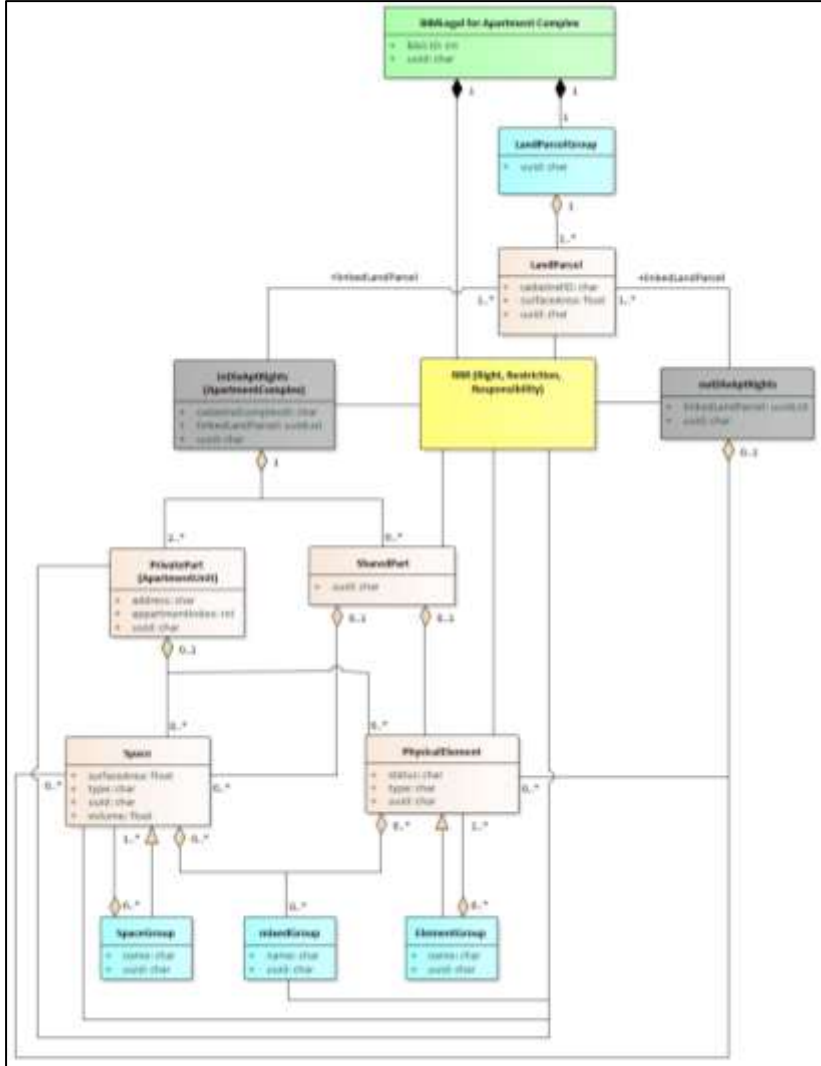
Element	IFC class	
Gemeenschappelijke ruimten – (Common areas)	IfcSpace	
Liftinstallatie - (Elevator installation)	IfcTransportElement (IfcTransportElementType)	
Schachten – (Shafts)	IfcSpace	
Energievoorziening – (Energy supply)	IfcEnergyConversionDevice IfcDistributionFlowElement IfcFlowController	IfcThermalZone IfcSpaceHeaterType <i>IfcEnergyProperties</i>
Installaties – (Installations)	IfcDistributionElement IfcDistributionFlowElement IfcDistributionControlElement IfcDistributionPort IfcFlowTerminal	IfcFlowController IfcFlowFitting IfcFlowSegment IfcSystem IfcElementAssembly
Voorzieningen – (Services)	IfcDistributionSystem IfcDistributionElement IfcDistributionFlowElement IfcDistributionControlElement IfcSystem	IfcFlowTerminal IfcFlowController IfcFlowFitting IfcFlowSegment IfcPort
Parkeergarage – (Parking garage)	IfcSpace IfcWall	
Parkeerplaatsen (afzonderlijk van parkeergarage) - Parking spaces (separate from parking garage)	similar	
Groen – (Green)	IfcBuildingElementProxy	

Content

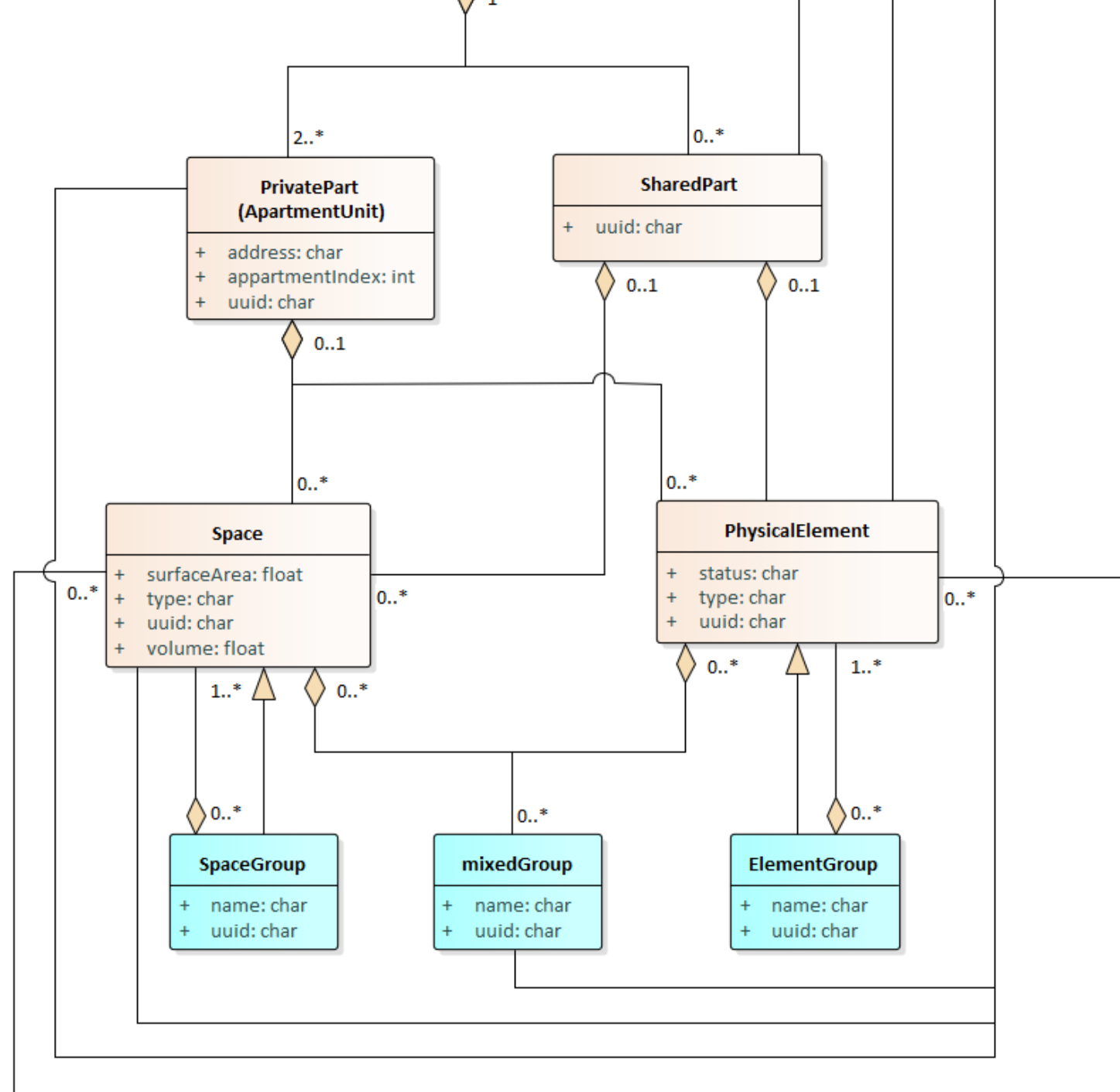
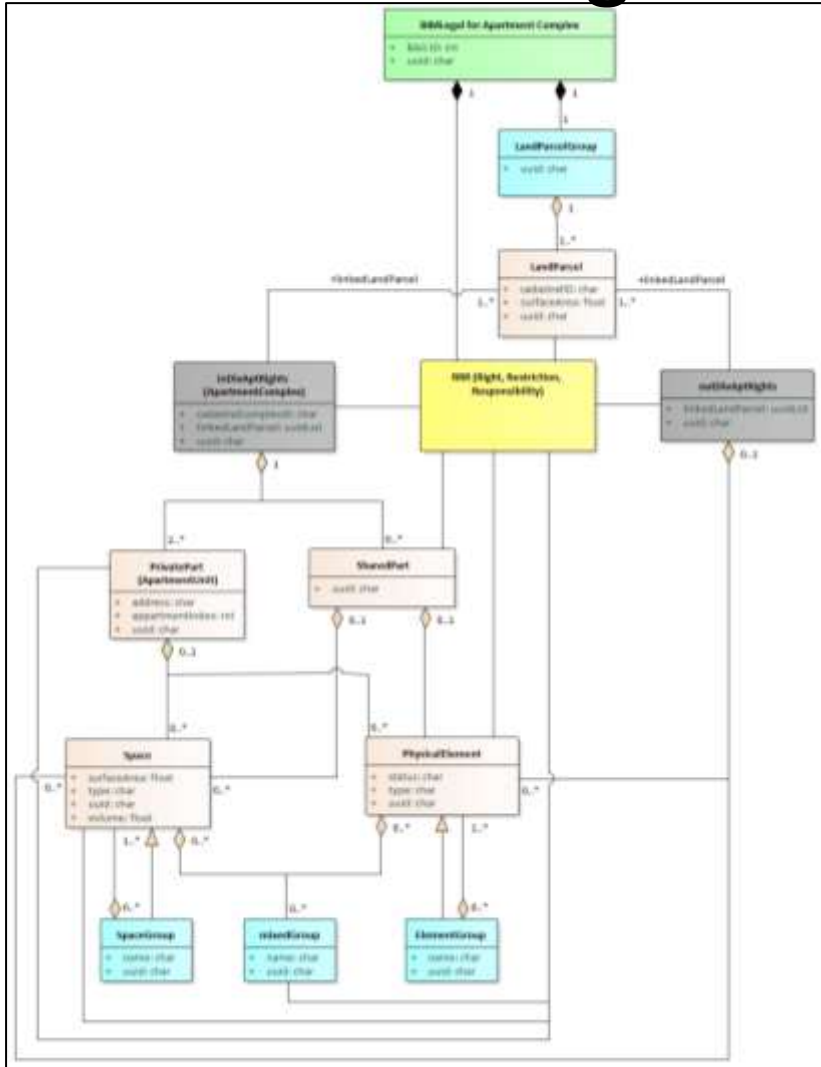
- Business rules
- **UML models**
- Technical considerations
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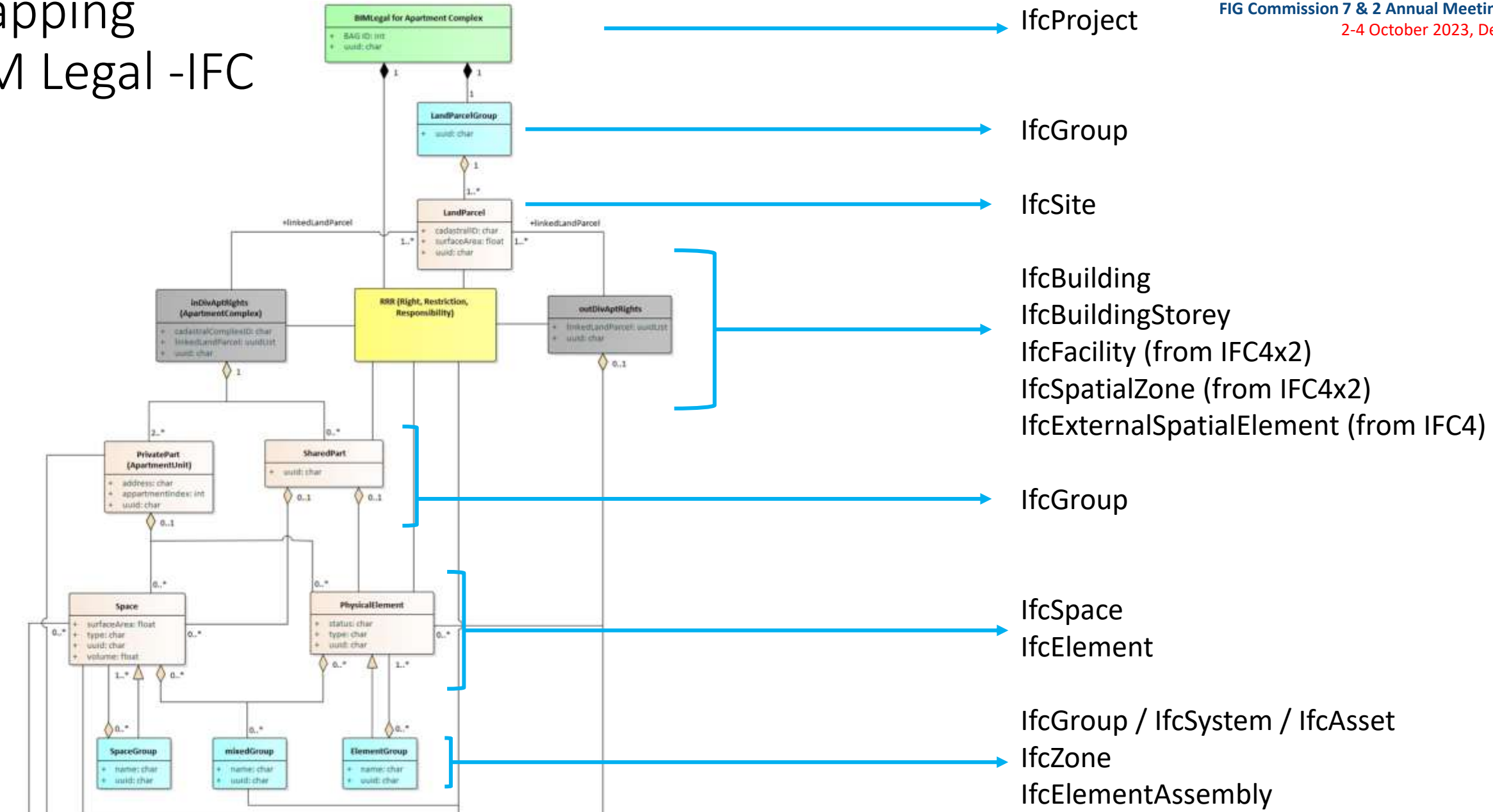
Latest BIM Legal model



Latest BIM Legal model



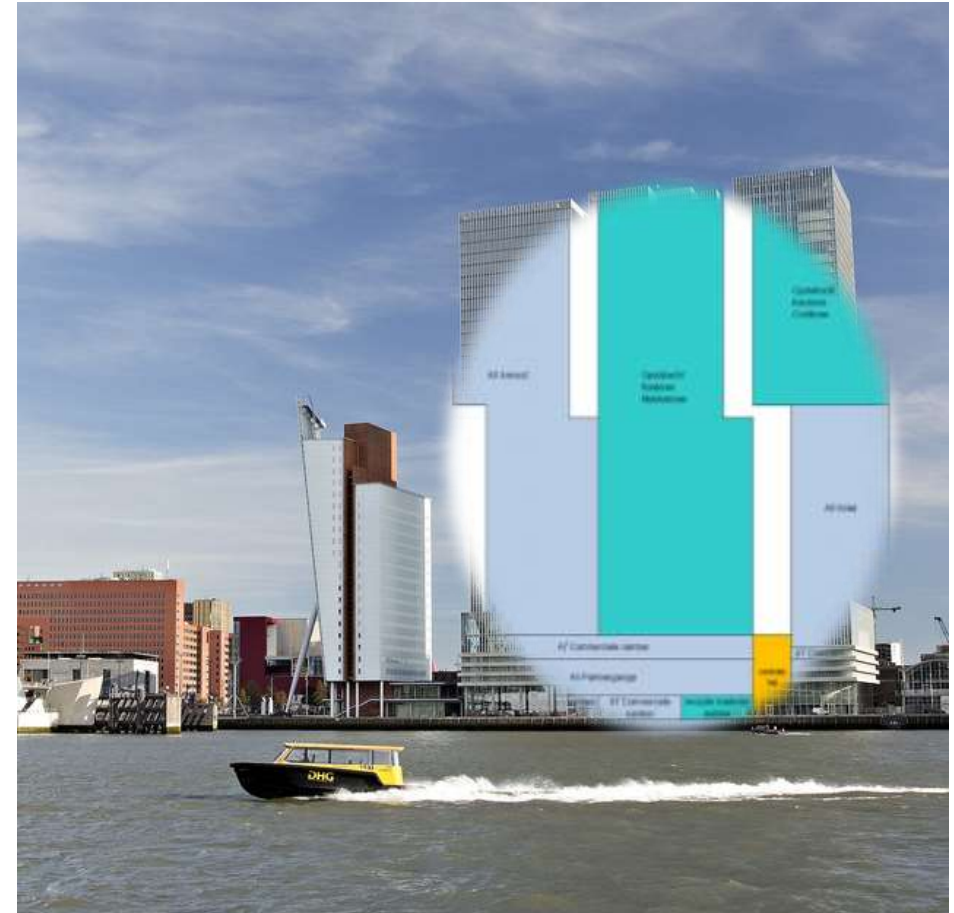
Mapping BIM Legal -IFC



C

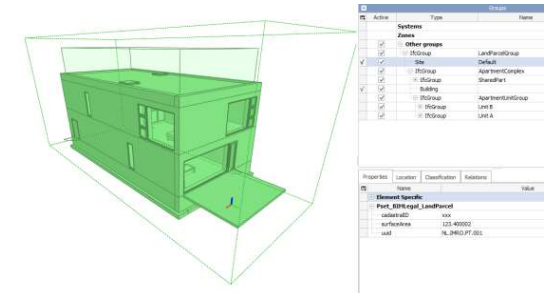
Content

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- **Technical considerations**
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Technical considerations 1/2

- Submission format: IFC +PDF (legal text)
 - As zipped file to be signed by notary
 - For each legal rule create a corresponding IfcGroup with unique ID
 - UID to link IFC elements to paragraphs in the pdf (native IFC IDs)
- Why IFC+PDF?
 - Closest to working method of notaries
 - IFC can be kept simple
 - Easier to implement
- Alternative: BIM Collaboration Format
 - Meant for interaction/communication/collaboration
 - Relying on it for legal information could present a risk in the long run



```
<p id="NL.IMRO.PT.001" class="Right">
This is a legal paragraph concerning the rights that apply to
the BIM Legal element with the uuid NL.IMRO.PT.001.
</p>
```

Technical considerations 2/2

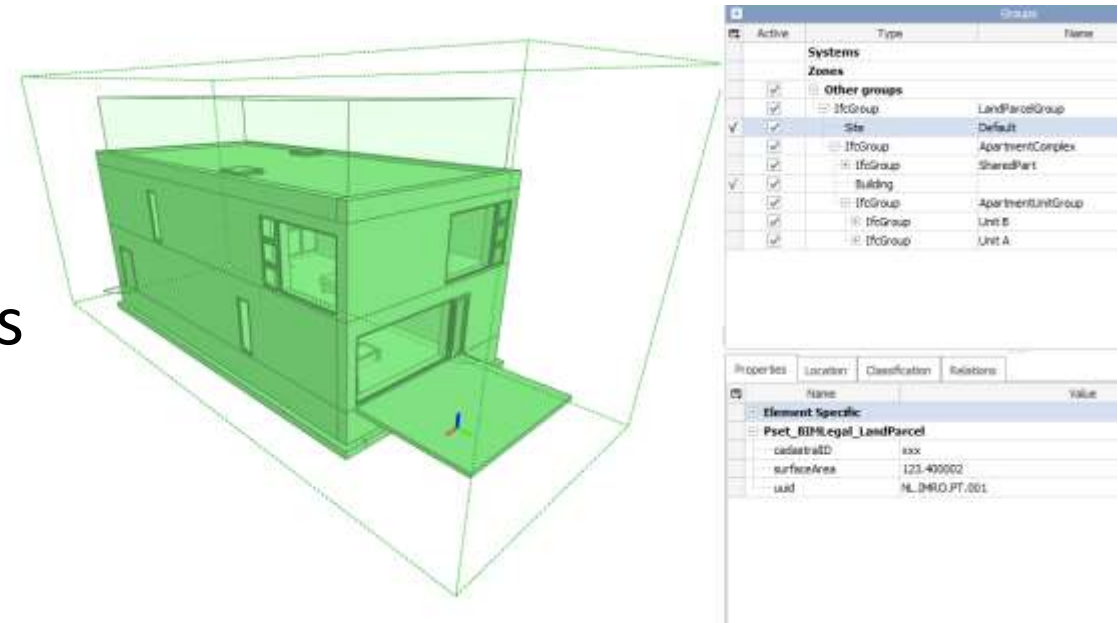
- We aim for IFC version 4:
 - has the richest mapping options

- BLM do not need to be georeferenced
 - Adding 3 points with georeferencing info is considered
 - Kadaster will investigate to further process the models into a 3D map (including georeferencing)



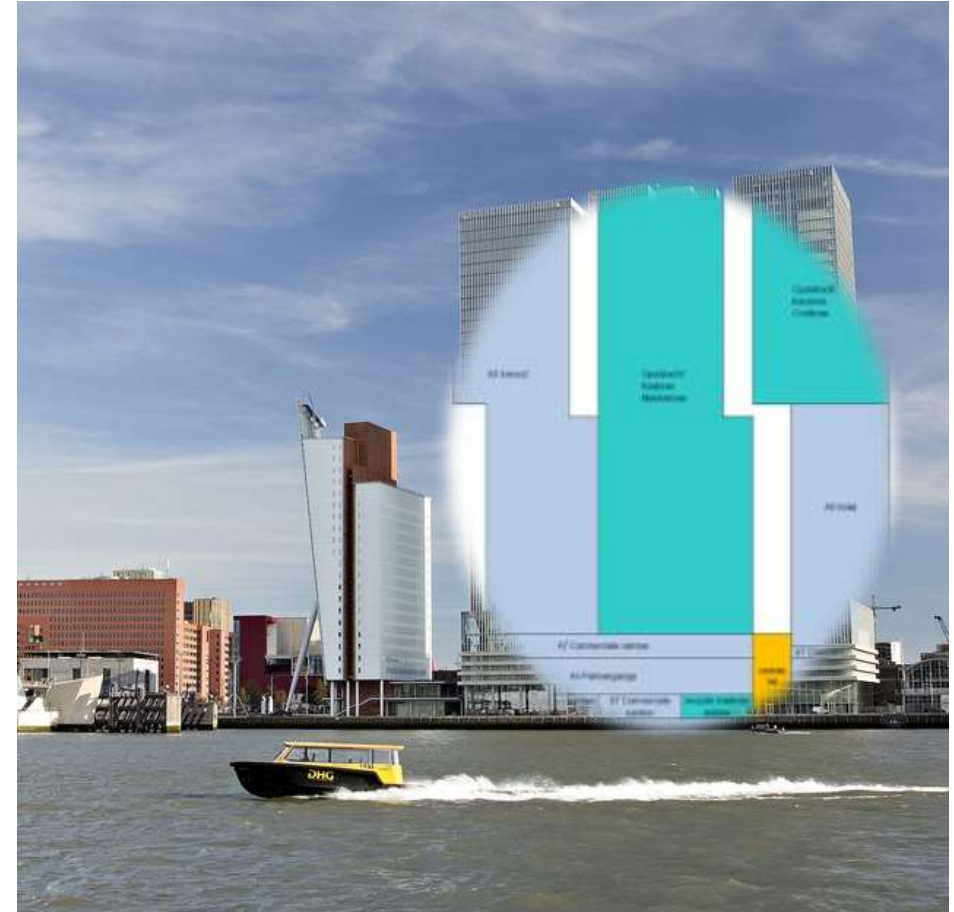
BIM Legal Example model

- Possible to create a valid instance directly from existing IFC model
- Assuming that it contains all entities with legal liabilities



Content

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Validation: IDS for BIM Legal specs

Example IDS for permits:



Ruimten volumes NVO - 10

[NL] NVO ruimte als IfcSpace conform NEN2580[ENG] NFA space as IfcSpace in accordance with NEN2580

IFC versions: **IFC4 IFC4X3**

The model MUST contain entities that have

- IFC class **IFCSPACE** with predefined type **USERDEFINED**

that MEET the following requirements

- HAVING relationship type **IfcRelContainedInSpatialStructure** with elements of IFC class **IFCBUILDINGSTOREY**
- HAVING attribute **Name** with value **of min. length equal to 1** (Instructions: Hier een vrij te kiezen ruimte nummer vb: 1.12 of B_S_123.21)
- HAVING attribute **ObjectType** with value **equal to functieruimte (or: equal to verblijfsruimte; equal to verblijfsruimte_cel; equal to verblijfsruimte_logiesverblijf; equal to verblijfsruimte_bedruimte; equal to verkeersruimte; equal to verkeersruimte_trappenhuis; equal to verkeersruimte_rooksluis; equal to technische ruimte; equal to technische ruimte_meterruimte; equal to technische ruimte_liftmachineruimte; equal to technische ruimte_stookruimte; equal to badruimte; equal to toiletruimte; equal to buitenruimte; equal to buitenberging; equal to onbenoemde ruimte)** (Instructions: Picklist van eerste tabblad "Ruimtefunctie" van dit document <https://www.rijksvastgoedbedrijf.nl/documenten/richtlijn/2019/04/01/rvb-bim-specificatie-v1.0-bijlage-nomenclatuur-bb2012>)
- HAVING attribute **LongName** with value **of min. length equal to 1** (Instructions: vrij te kiezen tekst, bijvoorbeeld: kantoorruimte)

Instructions

[NL] Unieke ruimte zijn voorzien van bouwbesluitfunctie toetsing



Information Delivery Specification (IDS):

an XML-based BuildingSmart standard *in development* (first Github commit 3 years ago)



Helps better definition of information requirements for data exchange



Meant to facilitate automation

the use of properties (including quantities and attributes)



Can be used to require:

materials, classifications, entity types and object dependency

IDS for BIM Legal specs

- Example (provided by BSi):

All Space data in a model shall be classified as [AT]Zimmer and have NetFloorArea and GrossFloorArea (both in set called 'BaseQuantities') and a property called AT_Zimmernummer in the property set Austria_example.

- Suitability for BIM Legal needs further research:
 - Scope of use
 - Full suitability for the geometrical and legal constraints
 - Software support

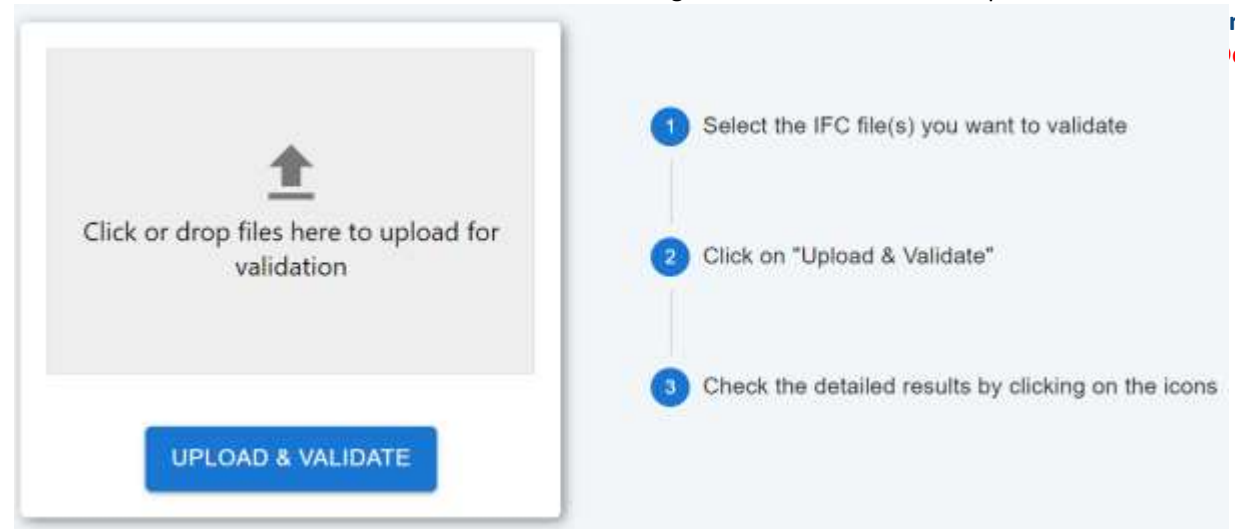
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- <ids:info>
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  <ids:copyright>buildingSMART</ids:copyright>
  <ids:version>0.0.3</ids:version>
  <ids:description>A few example checks</ids:description>
  <ids:author>contact@buildingSMART.org</ids:author>
  <ids:date>2023-01-16+01:00</ids:date>
</ids:info>
- <ids:specifications>
  - <ids:specification minOccurs="1" ifcVersion="IFC2X3 IFC4" name="Spaces">
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      - <ids:propertySet>

```

IFC Validator service

- <https://validate.buildingsmart.org/> (beta)
- Validates syntax, schema, rules and bSDD integrity



> Syntax

▼ Schema

▼ Schema - IfcGroup.IsGroupedBy

Id	Entity	Message
#770820	IfcGroup	With inverse: IsGroupedBy : IfcRelAssignsToGroup FOR RelatingGroup Value: 0 Not valid

<input type="checkbox"/>	File Name	IFC Syntax and Schema [Ⓢ]	Rules [Ⓢ]	bSDD	
<input type="checkbox"/>	20230320_high5_bimlegal_hoevesteijn.ifc				

▼ Rules

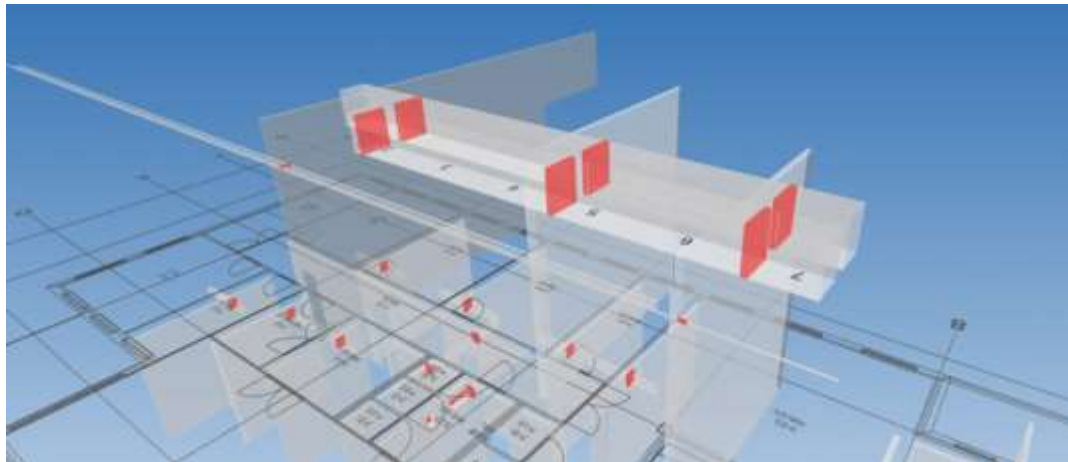
[GEM111 - No duplicated points within a polyloop or polyline/Agreement on no duplicated p](#)

It must have no duplicate points including first and last point

On instance #481090=IfcPolyLoop((#475...75803)) there are duplicate points: point (201.221937540139, 8.17886638733794, -373.514629277457) and point (201.221937540139, 8.17886638795042,

Develop additional validation for BIM Legal NL

- Specific to BIM Legal
 - E.g. to check the existence of non-BIM Legal elements
- Geometry:
 - First implementation of BIM Legal geometry validation



GitHub

GitHub - jaspervdv/cityCHEKer: Experimental implementation of BimLegal in a CityJSON format
 Experimental implementation of BimLegal in a CityJSON format - GitHub - jaspervdv/cityCHEKer: Experimental implementation of BimLegal in a CityJSON format

jaspervdv/
cityCHEKer



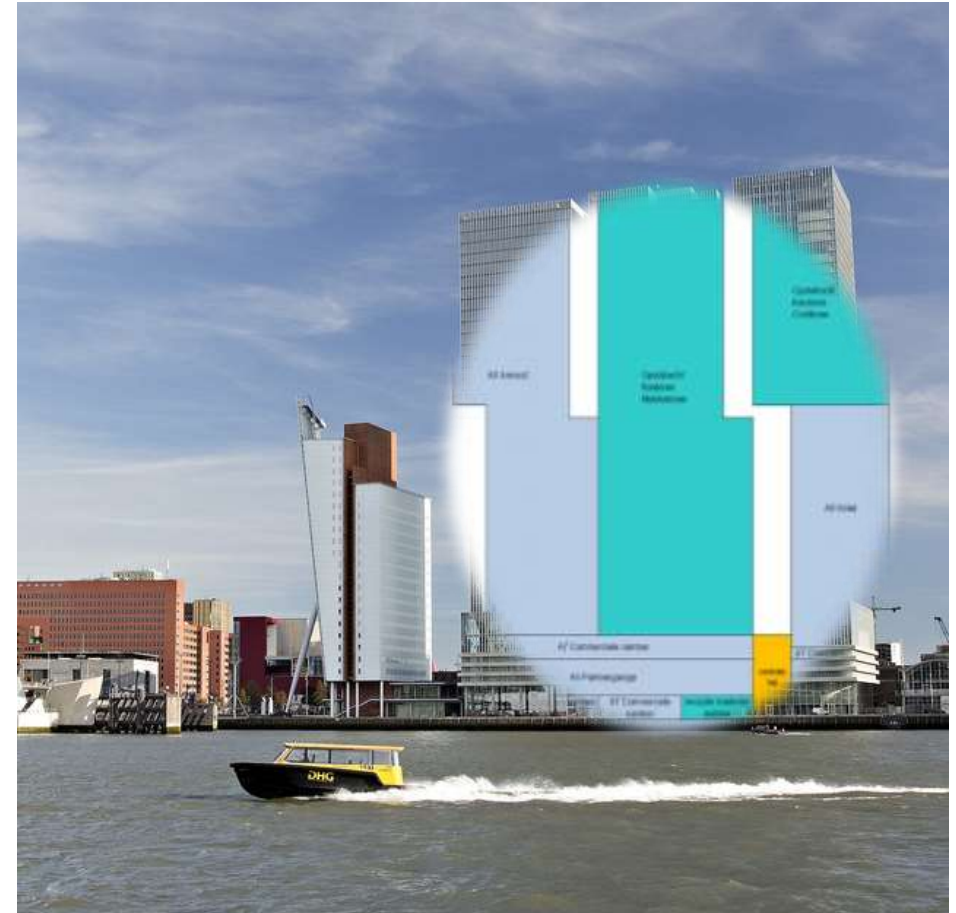
Experimental implementation of BimLegal in a CityJSON format

👤 1 Contributor 🕒 0 Issues ⭐ 0 Stars 🍴 0 Forks

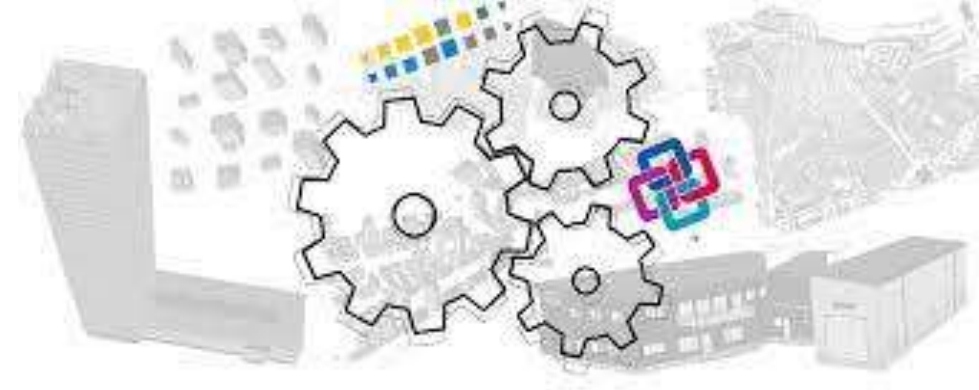


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Observations and conclusions

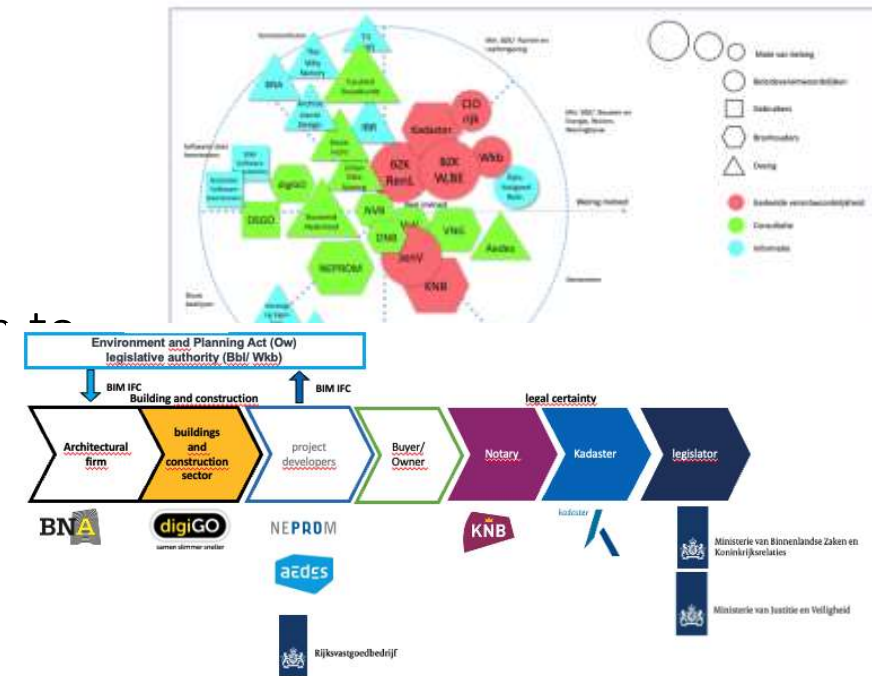


- Our BLM can be derived from existing IFCs
- But how IFC is handled & supported across BIM sftw varies
 - BLMs may depend on the tools
 - can be a barrier to good practices
- Existing/renovated buildings may struggle to produce compliant files without being redrawn
- Deriving legal security from a BIM is not straightforward:
 - Every technical decision/step requires careful reflection of legal experts
 - Also to establish understanding between legal and technical experts

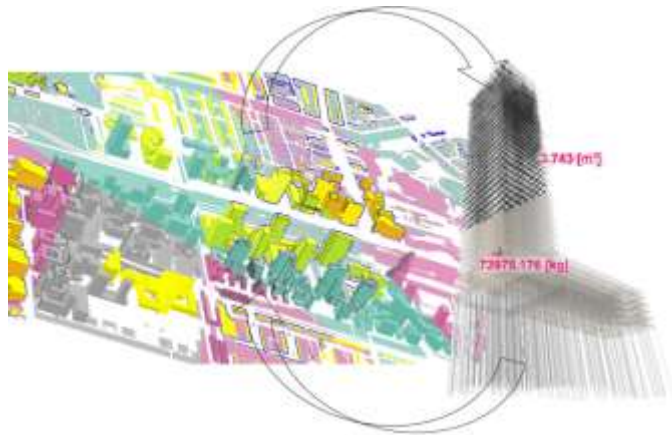


What's next

- Stakeholder support:
 - Also to check how BLMs fit in the whole chain from design to construction
- Further investigation of open issues:
 - Data model refinement based on instantiating BLM
 - Suitability of IDS + its validation
 - Consistency across BIM software
 - Processing of IFC model in Kadaster registration workflows
 - BIM Legal for existing buildings
 - Signing of documents
 -



Thank you for your attention!



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