GEODESIGN SUMMIT EUROPE 2016 // November 1–2, 2016 Delft, Netherlands

3D Cadastre

31-10-2016

Peter van Oosterom

Seminar Geodesign Summit Europe,
31 October 2016, Delft, Netherlands

Content overview

1. *Introduction*
2. FIG working group, international overview
3. 2D and 3D in ISO 19152
4. 3D examples in various countries
5. Conclusion

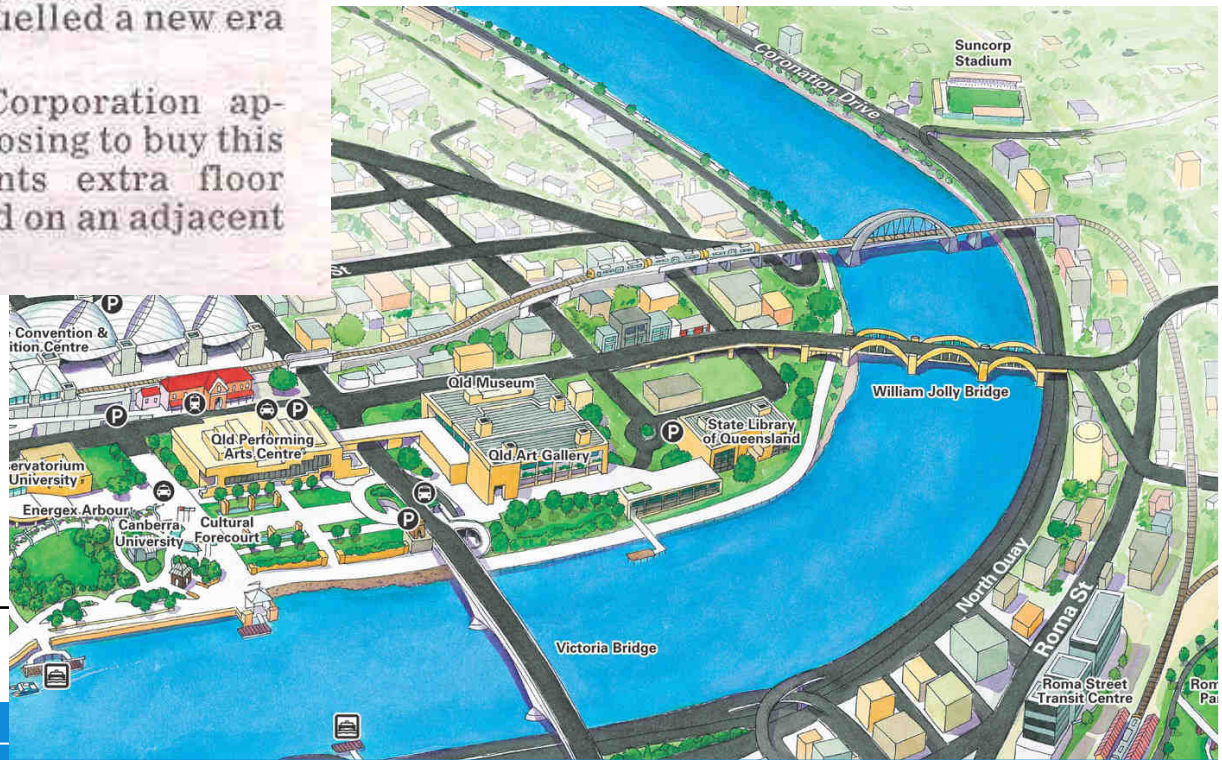
Today's practice:
Queensland Australia

Airspace sold

STATE cabinet has approved the sale of airspace over the South Bank rail corridor, which will allow planned offices to extend over the rail lines.

Premier Peter Beattie and Transport Minister Steve Bredhauer said the sale fuelled a new era in Brisbane city development.

"Mirvac and South Bank Corporation approached the Government proposing to buy this airspace because Mirvac wants extra floor space for offices it plans to build on an adjacent lot," Mr Beattie said.



Happening in Singapore...

Upward looking Singapore looks below for room to grow

NOVEL SOLUTION: It may build interconnected cities with shopping malls and transport hubs, writes *Calvin Yang*

Singapore ***has been building upward, with apartment structures reaching as high as 70 stories****, but the demand for land is* ***pushing it to build underground****.*

SINGAPORE, with a little less land mass than New York City, is running out of room for its 5.4 million people.

The city-state has built upward — with apartment buildings reaching as high as 70 stories — reclaimed underused properties for housing and pushed out coastlines for more usable land.

But as one of the world's most crowded cities, and with projections for 1.5 million more people in the next 15 years, Singapore's options are as limited as its space.

So Singapore is considering a novel solution: building underground to create an extensive, interconnected city, with shopping malls, transport hubs, public spaces, pedestrian links and even cycling lanes.

"Singapore is small, and whether we have 6.9 million or not, there is always a need to find new land space," said Zhao Zhiye, the interim director of the Nanyang Center for Underground Space at Nanyang Technological University. "The utilisation of underground space is one option for Singapore."

Height restrictions imposed on areas around air bases and airports have prevented developers from building taller projects. And there is a limit to how much land can be reclaimed from the ocean — so far it accounts for a fifth of Singapore's space, but it is vulnerable to rising sea levels caused by climate change.

The squeeze has led to the closing of several old estates and military camps to make way for residential and industrial development.

Building underground is not new in Singapore. About 12km of expressways and about 80km of transit lines are below ground. Underground drainage systems and utility tunnels are common features beneath the urban landscape.

Now Singapore is going further, beginning work on a huge underground oil bunker called Jurong Rock Caverns. When this is completed, it will free up about 60ha of land, an area equivalent to six petrochemical plants.

Another project on the drawing board is the Underground Science City, with 40 interconnected caverns for data centres and research and development labs that would support the biomedical and life sciences industries. The science centre, with an estimated 20ha to be situated 30 stories below a science park in western Singapore, would house as many as 4,200 scientists and researchers.

"A lot of facilities can go underground if you fully utilise the underground space," Zhao said.

"In the beginning there might be a psychological issue, but as long as we have proper lighting and proper ventilation, gradually people can overcome the idea of working and living underground."

Subterranean projects can be three to four times as costly as surface projects because of higher construction costs and the need for extensive soil investigations.

In a recent blog post, Khaw Boon Wan, Singapore's national development minister, pointed to extensive pedestrian passageways and shopping malls in Japan and Canada.

He cited the possibilities in Singapore "of creating underground transport hubs, pedestrian links, cycling lanes, utility plants, storage and research facilities, industrial uses, shopping areas and other public spaces here".

"The earlier we begin this process, the faster we will learn and the easier it would be for us to realise these plans." NYT

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International Federation of Surveyors

- FIG working group 3D Cadastres since 2002
  (International Federation of Surveyors, founded 1878 NGO)
- 3D Cadastres sessions at every FIG WW or congress since

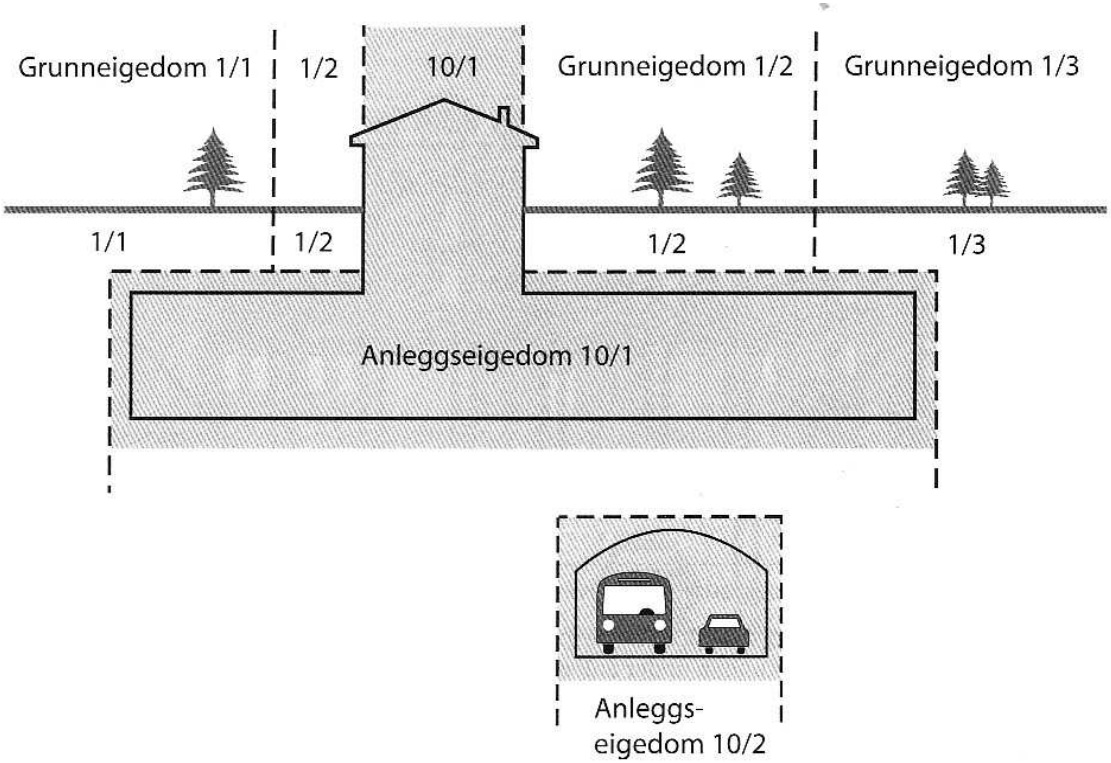
- Working group 3D Cadastres, scoping questions:
  1. What are the types of 3D cadastral objects?
     Related to (future) constructions (buildings, pipelines, tunnels, etc.)
     any part of the 3D space, both airspace or subsurface?
  2. 3D Parcels for infrastructure objects, such as long tunnels, pipelines, cables: divided by surface parcels or one object?
  3. For representation of 3D parcel, has legal space own geometry or specified by referencing to existing topographic objects

FIG Working group objectives

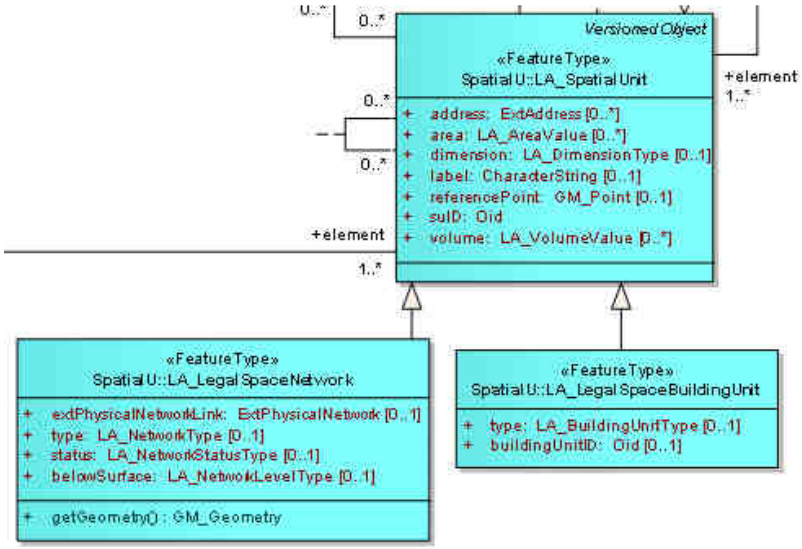
- Common understanding of terms and issues involved;
  ISO 19152 Land Administration Domain Model: LADM with 3D

- Guidelines/checklist for implementation of 3D-Cadastres:
  'best practices' legal, institutional and technical aspects

Note: 3D Parcels in broadest sense: land & water spaces, both above & below surface.

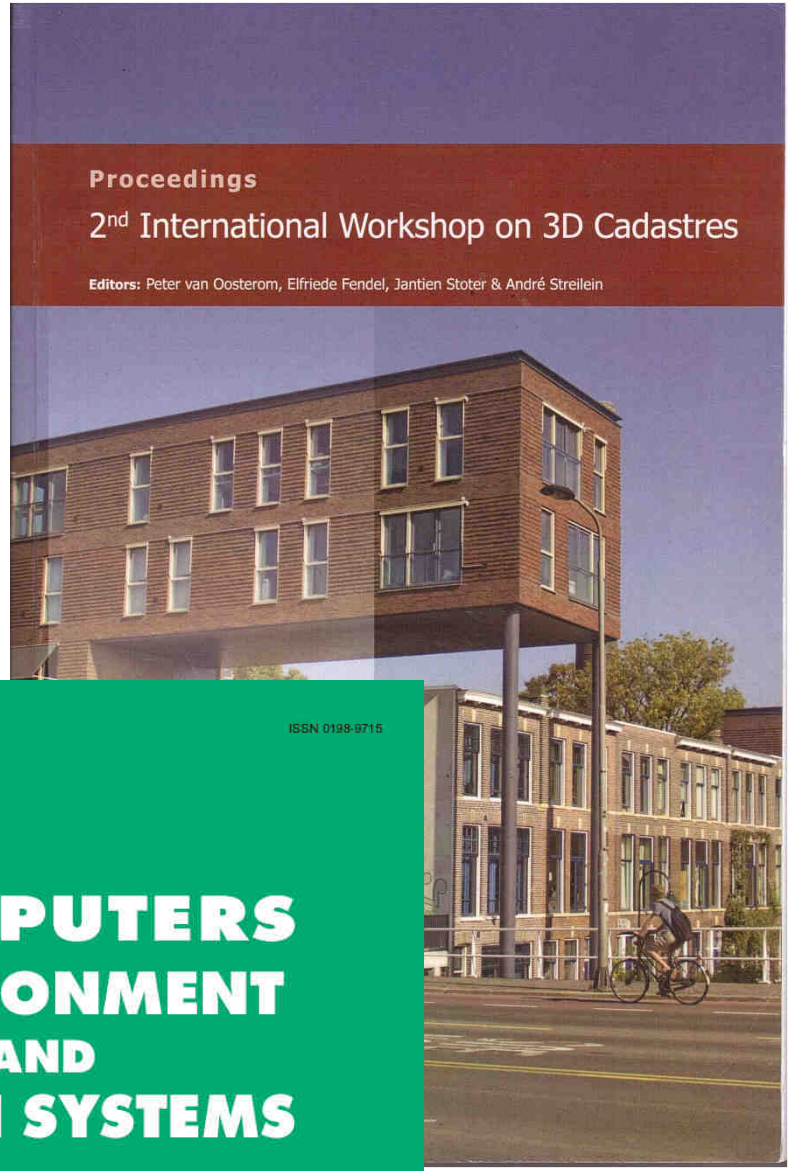


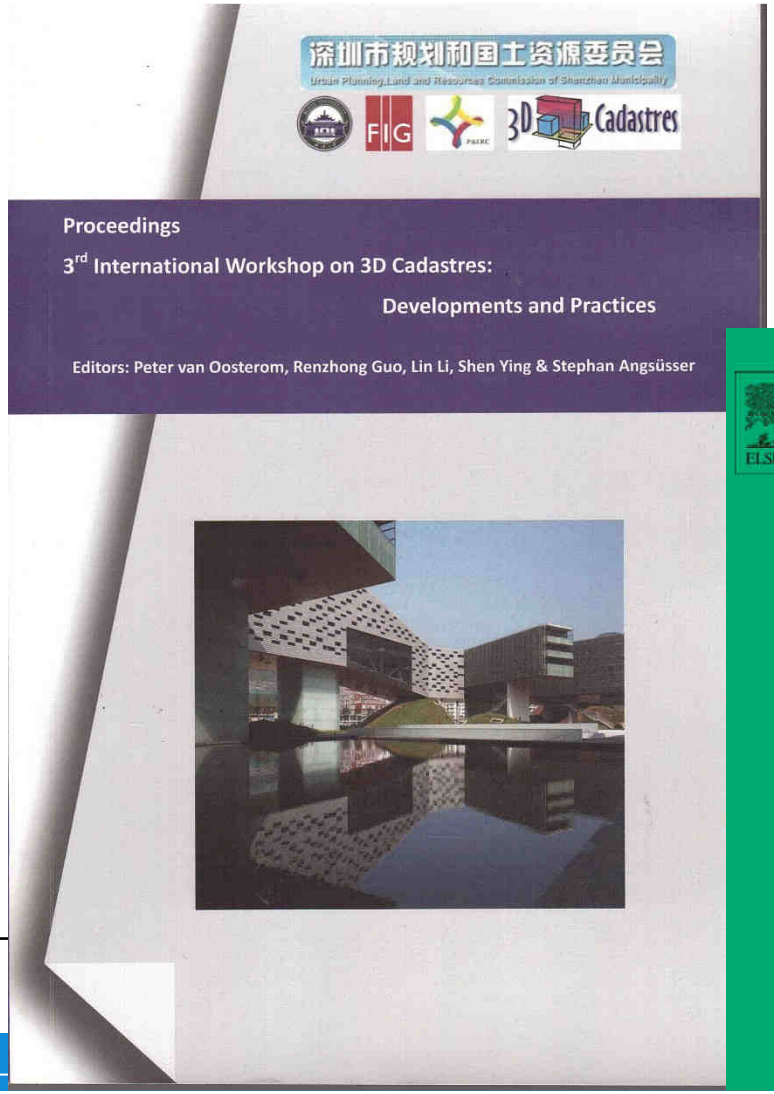
Topics

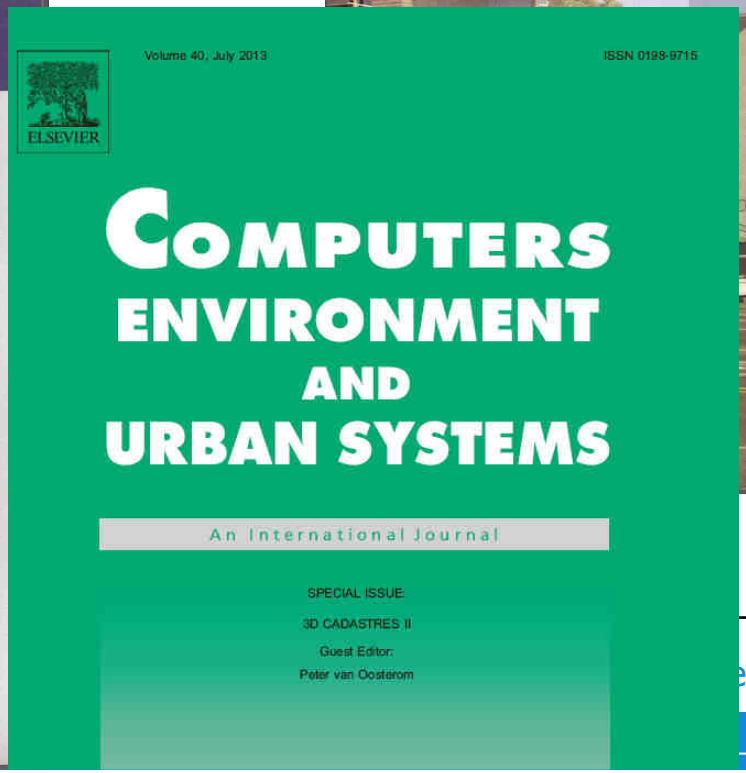


- 3D-Cadastres and models: role of earth surface, 3D parcels open at top and bottom, topology structure, relative height,...
- 3D-Cadastres and SDI: legal objects (cadastral parcels and associated rights) and their physical counterparts (buildings or tunnels) result into two different, but related registrations
- 3D-Cadastres and time: partition of legal space into 4D parcels: no overlaps or gaps in space of time
- 3D-Cadastres and usability: graphic user interface (GUI) for interacting with 3D cadastral data; e.g. Google Earth

Journal special issues & Proceedings





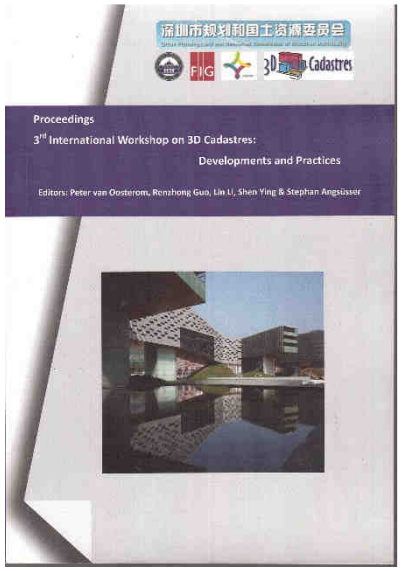


Current term 2014-2018
FIG 3D Cadastres Working Group

- 3D Cadastre is here to stay and #implementations increase
- LADM conformance
- In 3D even more need to connect to other registrations via SDI: buildings, tunnels, cables/pipelines, terrain elevation, etc. (physical and legal 3D objects should be aligned)

- New focus topics:
  1. Experiences of operation 3D Cadastral systems (law, organization, technology)
  2. 3D Cadastre in mega-cities, often in Latin-America (Brazil, Mexico), Asia (China, Malaysia, Korea, Singapore) and Africa (Nigeria)
  3. 3D Cadastre usability studies, web-dissemination and 3D cartography
  4. 3D Cadastre as part full life cycle in 3D

Plans 2014-2018



- 2014-18: Web-site and interest-group www.gdmc.nl/3DCadastres (inc. literature)
- 2014: second questionnaire status 3D Cadastres
- 2014: 4th workshop on 3D-Cadastres (9-11 nov, Dubai) in cooperation with the 3D GeoInfo
- 2015-17: 3D Cadastres session at FIG working weeks
- *2016: 5th workshop on 3D-Cadastres*
- 2017-18: FIG-publication on 3D-Cadastres
- 2018 : third questionnaire status 3D Cadastres
- 2018: presentation of the results FIG-congress

Peter van Oosterom - OTB -... | GDMC Home | 4th International FIG 3D Ca... | GIS 2014 :: 9th International 3D...

engr.aud.edu/conferences/GIS2014/index.asp

AUD | AMERICAN UNIVERSITY IN DUBAI

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GIS 2014

DUBAI | NOVEMBER 9-13, 2014

3D GeoInfo CONFERENCE

3D Cadastres

We invite you to join us for the 9th International 3D GeoInfo Conference and the 4th International FIG 3D Cadastres Workshop hosted by the American University in Dubai (AUD). The Cadastres Workshop will be held from the 9 to 11 November 2014, followed by the 3D GeoInfo from 11 to 13 November 2014.

Participating Organizations

AUD | AMERICAN UNIVERSITY IN DUBAI
School of Engineering

KIT

5th International FIG Workshop on 3D Cadastres

The **5th International FIG Workshop on 3D Cadastres** will be organized in **Athens Greece, 18 (afternoon) -20 (morning) October 2016**. Together with the 11th 3D GeoInfo Conference (20-21 October 2016), this is part of the Joint 3D Athens Conference 2016, Greece (http://www.3dathens2016.gr/).

The increasing complexity of infrastructures and densely built-up areas requires a proper registration of the legal status (private and public), which can only be provided to a limited extent by the existing 2D cadastral registrations. The registration of the legal status in complex 3D situations will be investigated under the header of 3D Cadastres. The 5th International Workshop on 3D Cadastres addresses the developments in the following areas:

- 3D Cadastre operational experiences (analysis, LADM based, learn from each other, discover gaps)
- 3D Cadastre cost effective work flow for new/updated 3D parcels = 4D (part of whole chain: from planning/design/permit in 3D, to registration/use in 3D)
- 3D Cadastre web-based dissemination (usability, man-machine interfaces, including mobile/AR)
- Legal aspects for 3D Cadastre, best legal practises in various legislation systems
- Focus on large cities, including developing countries

Second FIG 3D-Cadastres questionnaire: Status 2014 + expectations 2018

- Review and update of current 3D Cadastre developments
- All relevant issues incorporated
- Keep track of development worldwide
- Assist researchers etc. with snapshot of past and current

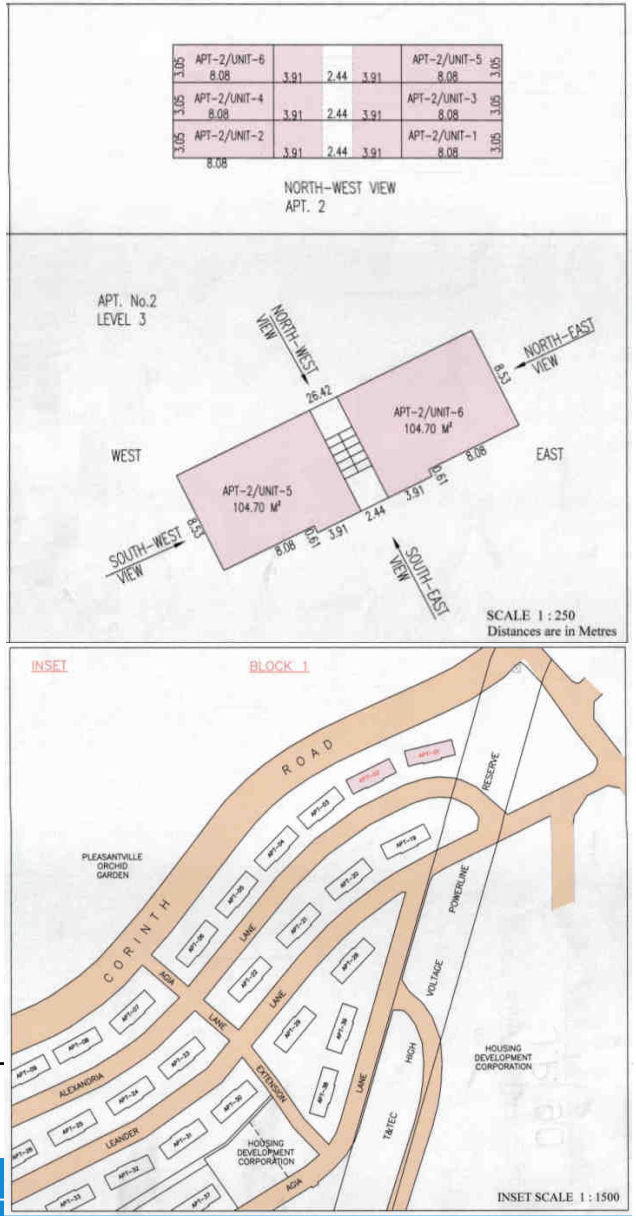

FIG joint commission 3 and 7 Working Group on 3D Cadastres

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Workshop 2014
Workshop 2012
Workshop 2011
Workshop 2001

Working Group participants

New questionnaire

The 2014 version of the 3D Cadastres questionnaire is available MS Word version of questionnaire
PDF version of questionnaire

If you are interested in participating, please complete the questionnaire and send it a.s.a.p. to Peter van Oosterom (e-mail: P.J.M.vanOosterom@tudelft.nl).

Participants

The years in the list below, 2010 and/or 2014, indicate whether a questionnaire on the status of 3D Cadastres is available for a country (or state). The year is the link to the relevant document. 2010 refers to the period 2010-2014, 2014 refers to the period 2014-2018.

Country (- State)			Participants
Argentina	2010	2014	Diego Alfonso Erba
Australia			Ali Aien, Don Grant, Mohsen Kalantari, Sudarshan Karki, Davood Shojaei, Rod Thompson
AUS - Queensland	2010	2014	
AUS - Victoria	2010	2014	
Austria	2010		Gerhard Muggenhuber, Gerhard Navratil
Bahrain	2010		Neeraj Dixit, Ammar Rashid Kashram
Brazil	2010	2014	Andréa Flávia Tenório Carneiro
Canada			Francois Brochu, Louis-André Desbiens, Paul Egesborg, Marc Gervais, Jacynthe Pouliot, Francis Roy
CAN - Québec	2010	2014	

Received responses → www.3dcadastres.nl

- Completed questionnaires received for 2010-2014 and 2014-2018: Argentina, Australia, Brazil, Canada, China, Croatia, Cyprus, Denmark, Finland, Germany, Greece, Hungary, India, Israel, Kenya, Macedonia, *Malaysia,* The Netherlands, Nigeria, Norway, Poland, South Korea, Spain, Sweden, Switzerland, Trinidad and Tobago, Turkey

- Only 2014-2018 (new ones, ongoing/expected developments?) Costa Rica, Czech Republic, Portugal, Serbia, Singapore

- Only 2010-2014 (old ones, not much changed?): Austria, Bahrain, France, Indonesia, Italy, Kazakhstan, Nepal, Russia, United Kingdom

Questionnaire Participants

- Agnieszka Bieda, Amalia Velasco, Andrea F.T. Carneir, Andrés Hernández Bolaños, Anita Kwartnik-Pruc, Cemal Biyik, Charisse Griffith-Charles, Dabiri O. Thomas, Dave Raphael, David Siriba, Davood Shojaei, Dimitrios Kitsakis, Efi Dimopoulou, Esben Munk Sørensen, Fatih Doner, Gjorgji Gjorgjiev, Gyula Ivan, Hamed Olfat, Helena Åström Boss, Jacynthe Pouliot, Jani Hokkanen, Jarosław Bydłosz, Jason Matthews, Jesper M. Paasch, José Miguel Olivares, José-Paulo Elvas Duarte de Almeida, Joseph Forrai, Karel Janecka, Louis-André Desbiens, Magni Busterud, Markus Seifert, Miodrag Roić, Neil Coupar, Osman Demir, Paul McClelland, Per Sörbom, Peter Wiström, Pradeep Khandelwal, Rajica Mihajlovic, Renzhong Guo, Shen Ying, Tarun Ghawana, Teng Chee Hua, Vanco Gjorgjiev, Youngho Lee.

Many, many thanks for completing the questionnaires!

Design/modification of Questionnaire

- As similar as possible to the first one (2010-2014) → enable to track changes over time

- Understanding data distribution
- Numerical analysis - benchmark
- Expected vs. realised development

Existing

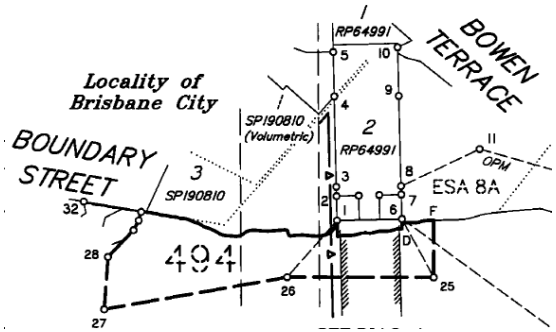
1. General/applicable 3D real-world situations
2. Infrastructure/utility networks
3. Construction/building units
4. X/Y Coordinates
5. Z Coordinates/height representation
6. Temporal Issues
7. Rights, Restrictions and Responsibilities
8. DCDB (The Cadastral Database)
9. Plans of Survey (including field sketches)

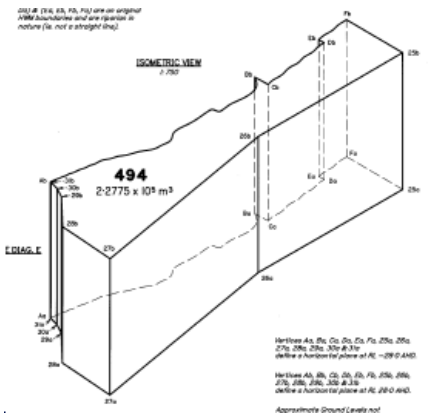
New

10. Dissemination of 3D Cadastral information
11. Statistical information
12. Reflection

General applicable 3D real-world situations

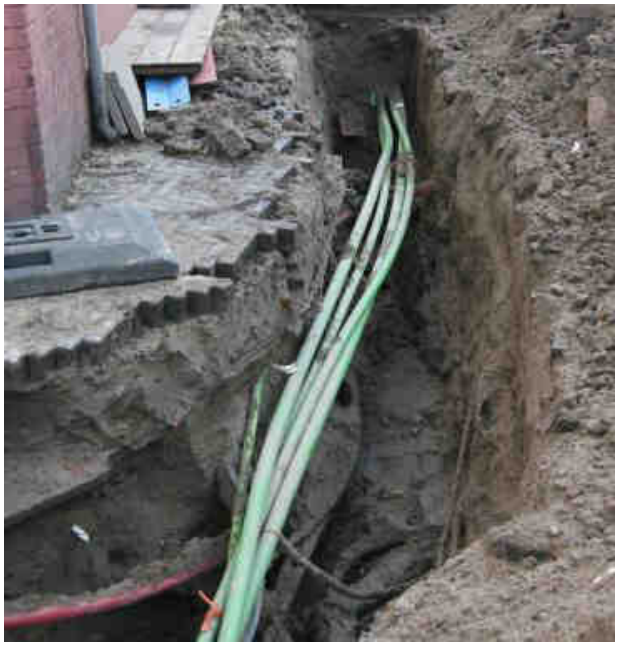
- Most cases related to construction – some exceptions
- No consensus on whether a multi-part is allowed
- Natural resources part of land-administration - not shown as 3D





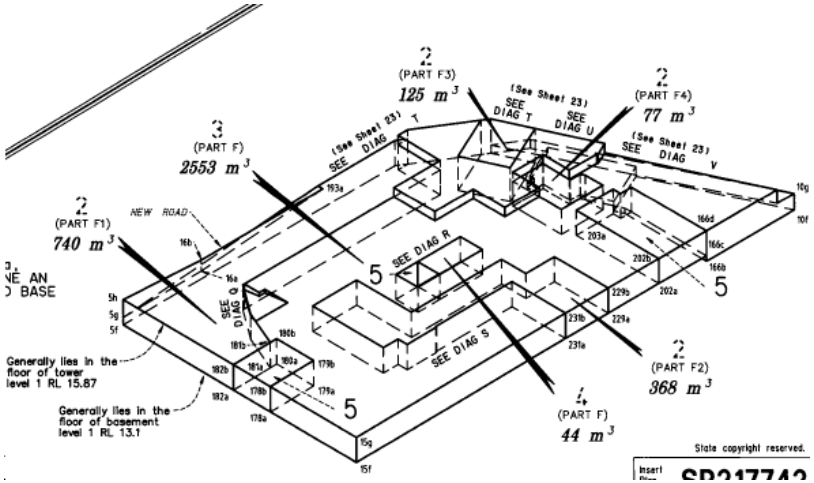
Infrastructure/utility network

- Most cases network not part of cadastre
- Many show utility network lines on the cadastral map



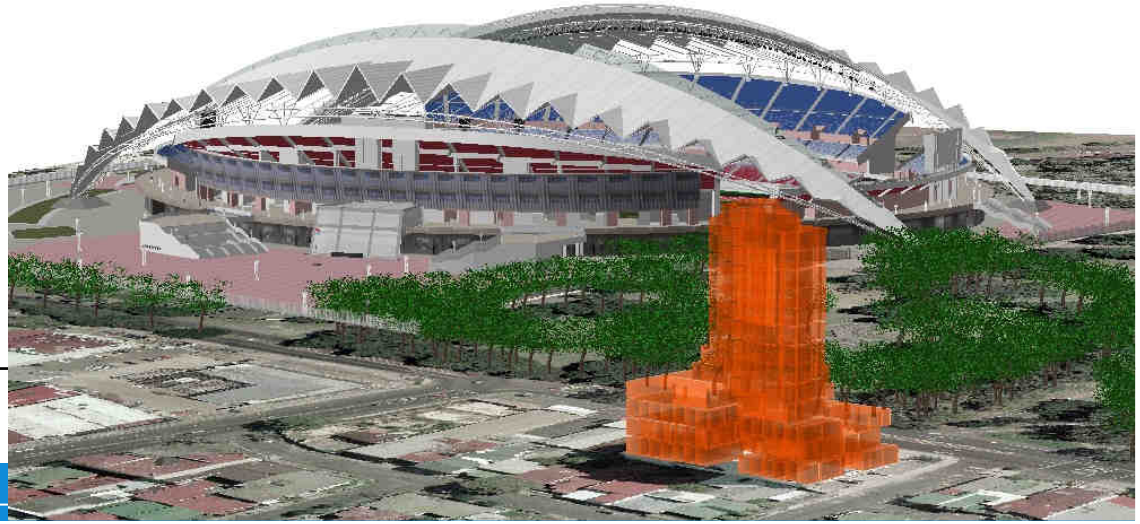
Construction/ building units

- Most constructions registered - apartments/condominium
- Units often defined by actual walls and structure of building



Conclusion Questionnaire 2014-2018

- Significant progress in the last 4 years
- More countries have legal provisions for registration of 3D data
- Many have 3D information on cadastral plans – isometric views, vertical profiles, textual
- Most register apartments
- Some examples of 3D DCDB
- Use of building construction plan for cadastre



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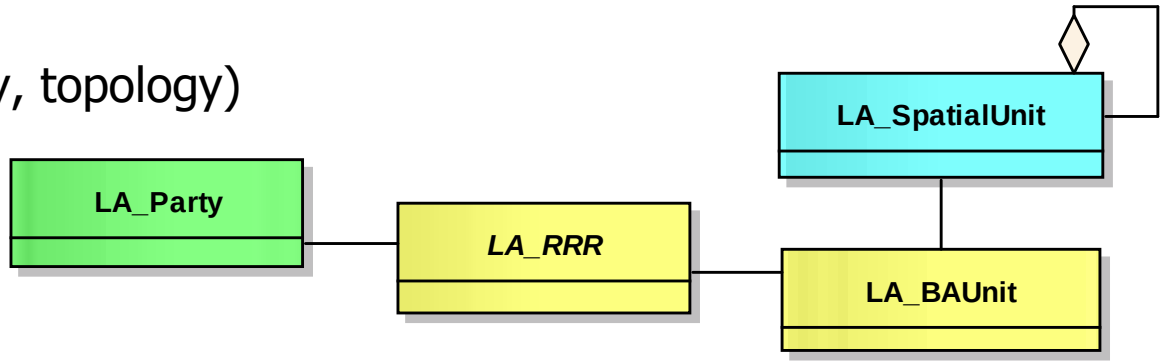
Land Administration Domain Model ISO 19152 (LADM)

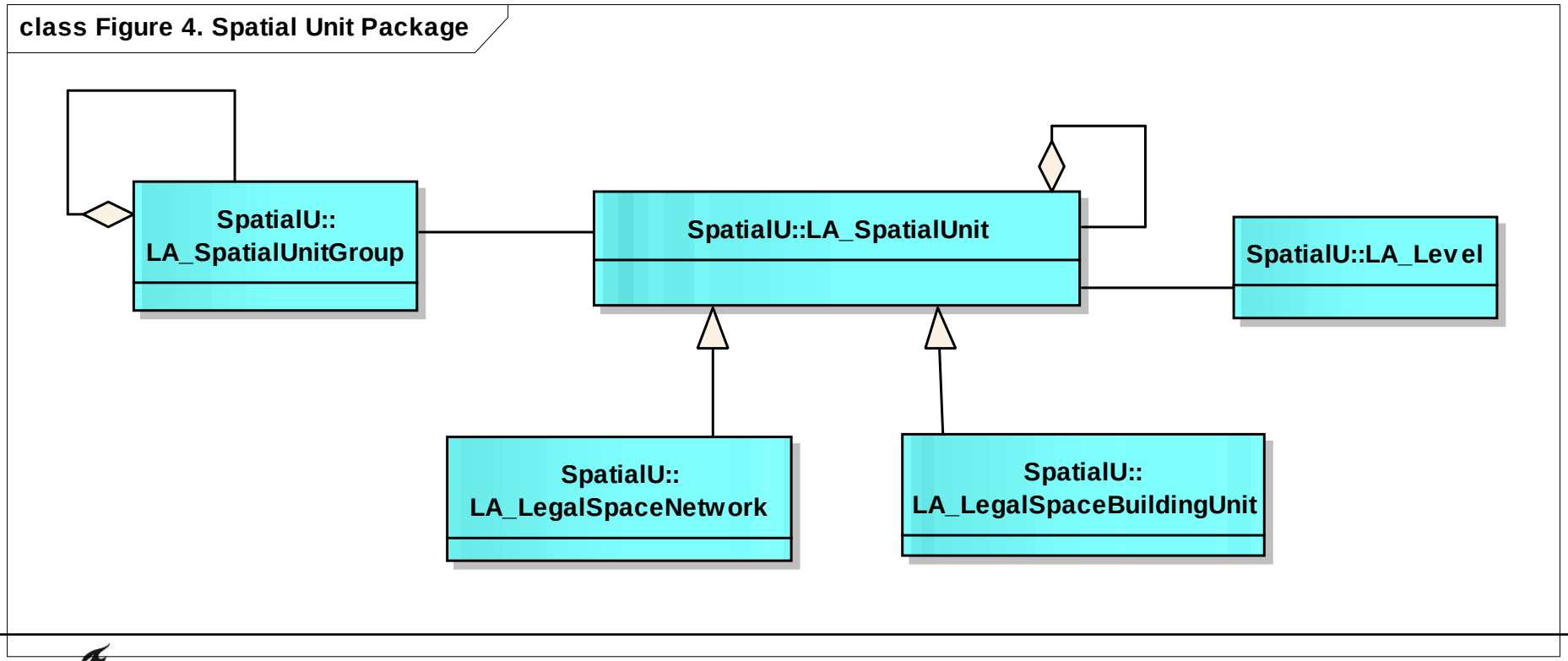
- Model includes:
  - Spatial part (geometry, topology)
  - Extensible frame for legal/admin parts

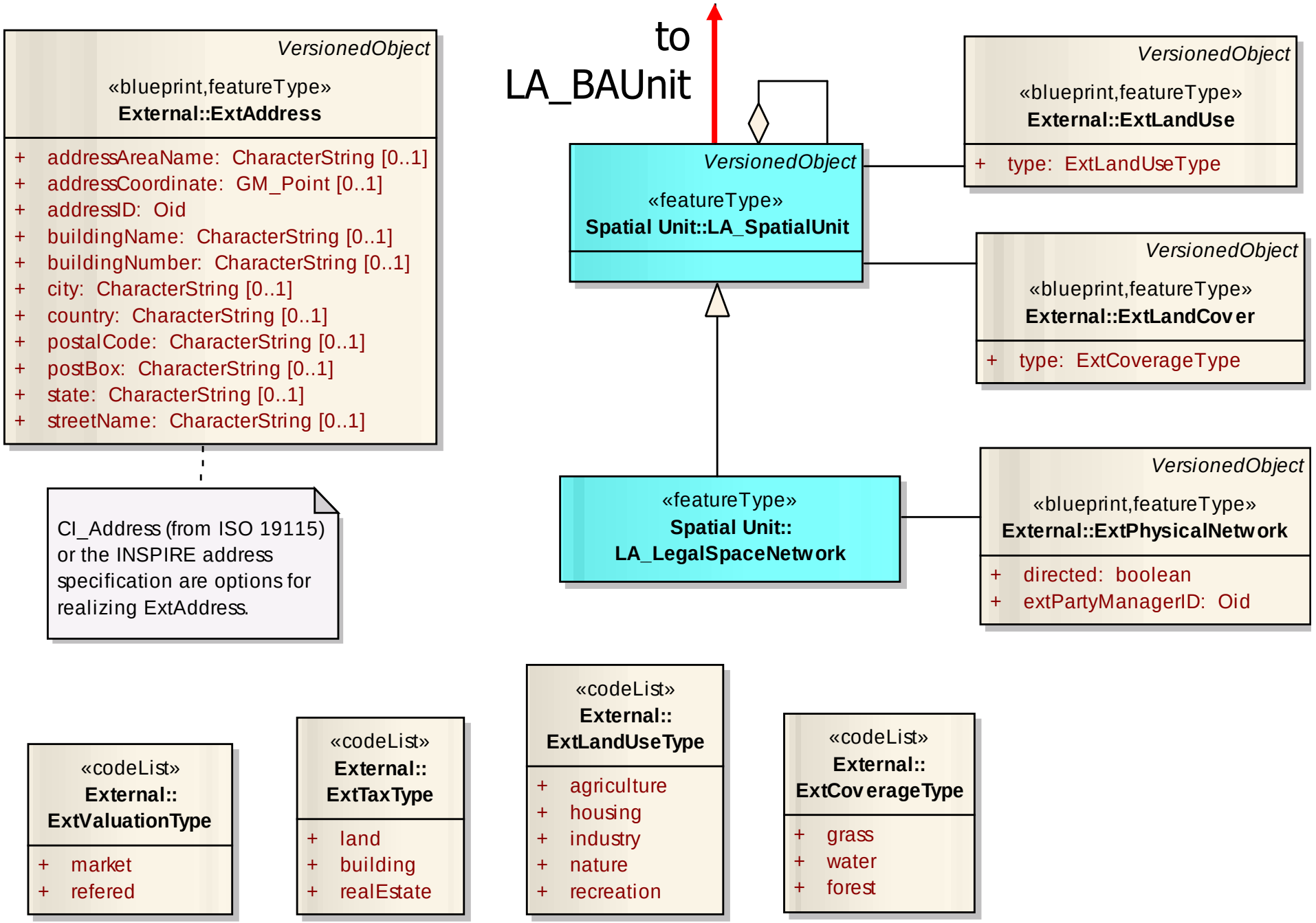


- Stared within the FIG in 2002
- FIG proposed LADM to ISO/TC211, January 2008 (parallel voting in ISO TC211 and CEN TC287) → 'IS' status, December 2012
- Includes integrated 2D and 3D support

LA_SpatialUnit (alias LA_Parcel)

- LA_SpatialUnit specializations: network, building unit
- organized in LA_Level based on structure or content
- 5 types: point, text (unstructured) line, polygon, and topology
- 2D and 3D integrated without complicating 2D



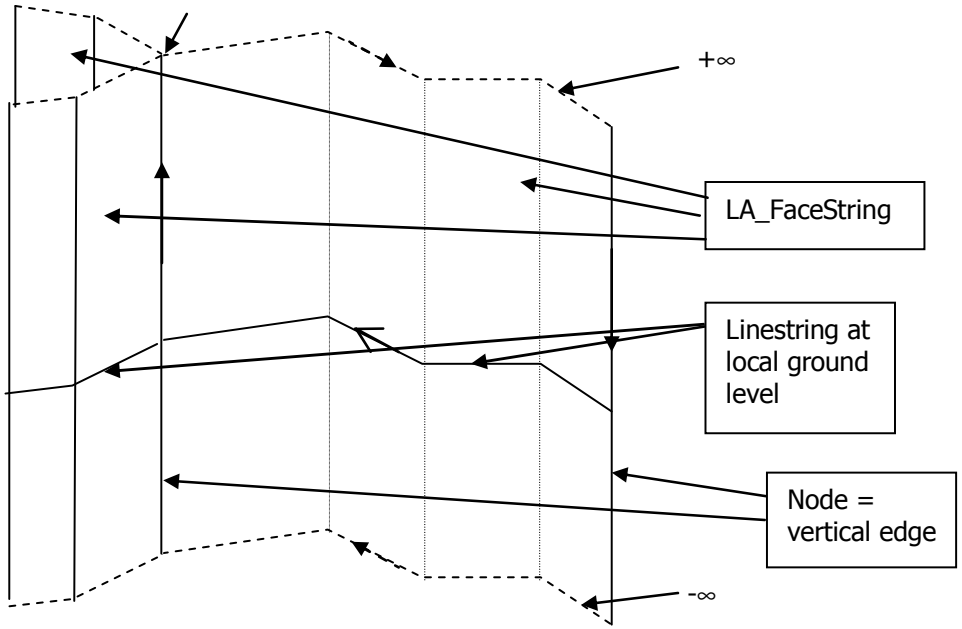

VersionedObject
«blueprint,featureType»
External::ExtAddress
+ addressAreaName: CharacterString [0..1]
+ addressCoordinate: GM_Point [0..1]
+ addressID: Oid
+ buildingName: CharacterString [0..1]
+ buildingNumber: CharacterString [0..1]
+ city: CharacterString [0..1]
+ country: CharacterString [0..1]
+ postalCode: CharacterString [0..1]
+ postBox: CharacterString [0..1]
+ state: CharacterString [0..1]
+ streetName: CharacterString [0..1]
CI_Address (from ISO 19115) or the INSPIRE address specification are options for realizing ExtAddress.
to LA_BAUnit
VersionedObject
«featureType»
Spatial Unit::LA_SpatialUnit
VersionedObject
«blueprint,featureType»
External::ExtLandUse
+ type: ExtLandUseType
VersionedObject
«blueprint,featureType»
External::ExtLandCover
+ type: ExtCoverageType
«featureType»
Spatial Unit::
LA_LegalSpaceNetwork
VersionedObject
«blueprint,featureType»
External::ExtPhysicalNetwork
+ directed: boolean
+ extPartyManagerID: Oid
«codeList»
External::
ExtValuationType
+ market
+ refered
«codeList»
External::
ExtTaxType
+ land
+ building
+ realEstate
«codeList»
External::
ExtLandUseType
+ agriculture
+ housing
+ industry
+ nature
+ recreation
«codeList»
External::
ExtCoverageType
+ grass
+ water
+ forest

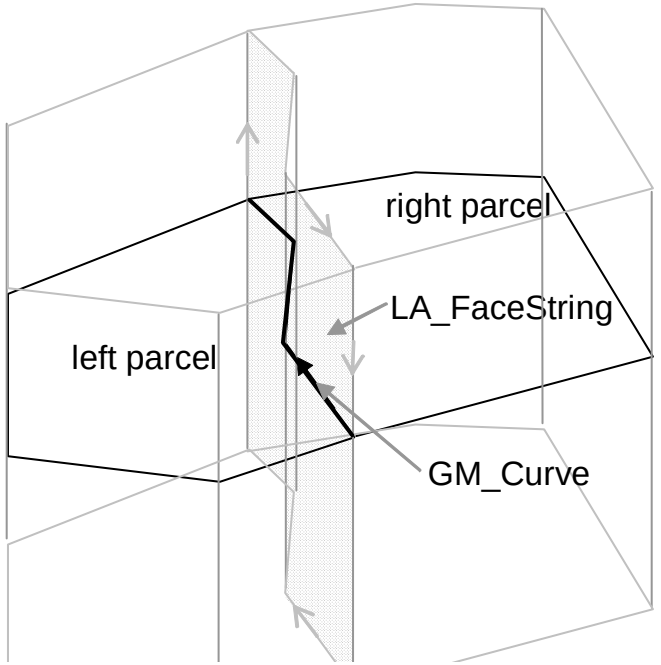
Spatial Units in 3D

- Extend the equivalent concept from 2D to 3D
  → 3D parcels are in areas of highest land values
- Sharing of surfaces between 3D parcels
  where lines would be shared in 2D
- point-line-area becomes point-line-area-volume
- Challenges:
  1. Majority of parcels is in 2D and should not be lost
     → integrate 2D/3D
  2. 3D parcels can be unbounded (up/down) according to National law
     → does not fit in ISO 19107 (spatial schema), so alternative needed

2D parcels and their 3D interpretation

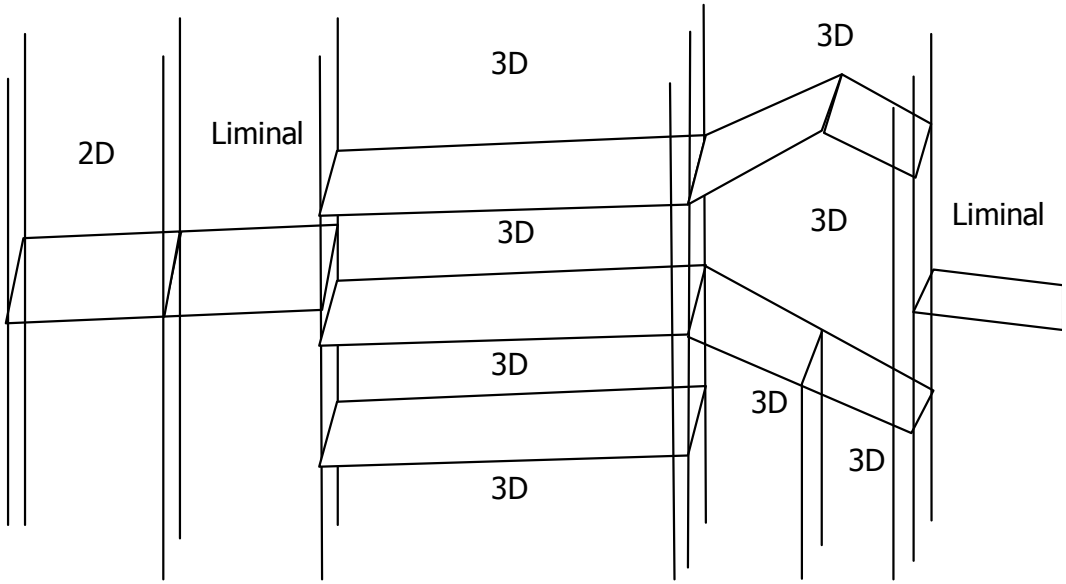
- Observation: 2D description implies 3D prismatic volume
- 2D polyline (GM_curve) implies string of vertical faces





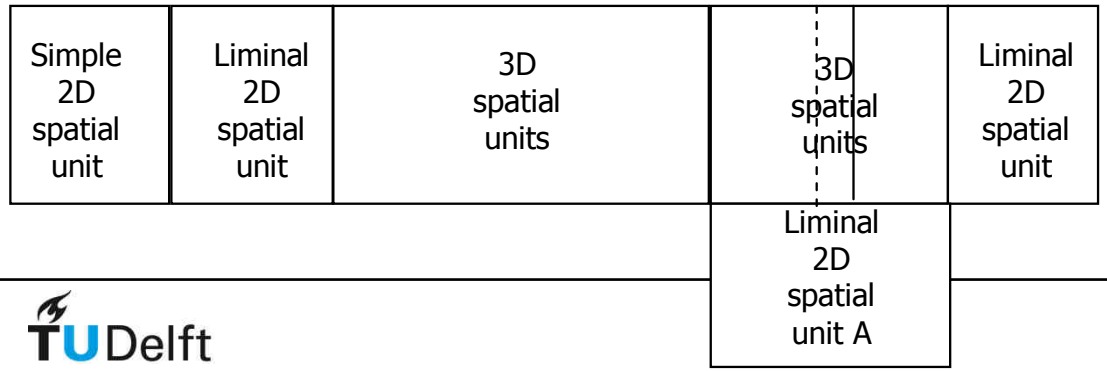
2D and 3D Integration

- between 2D and 3D spatial unit transition via liminal spatial units



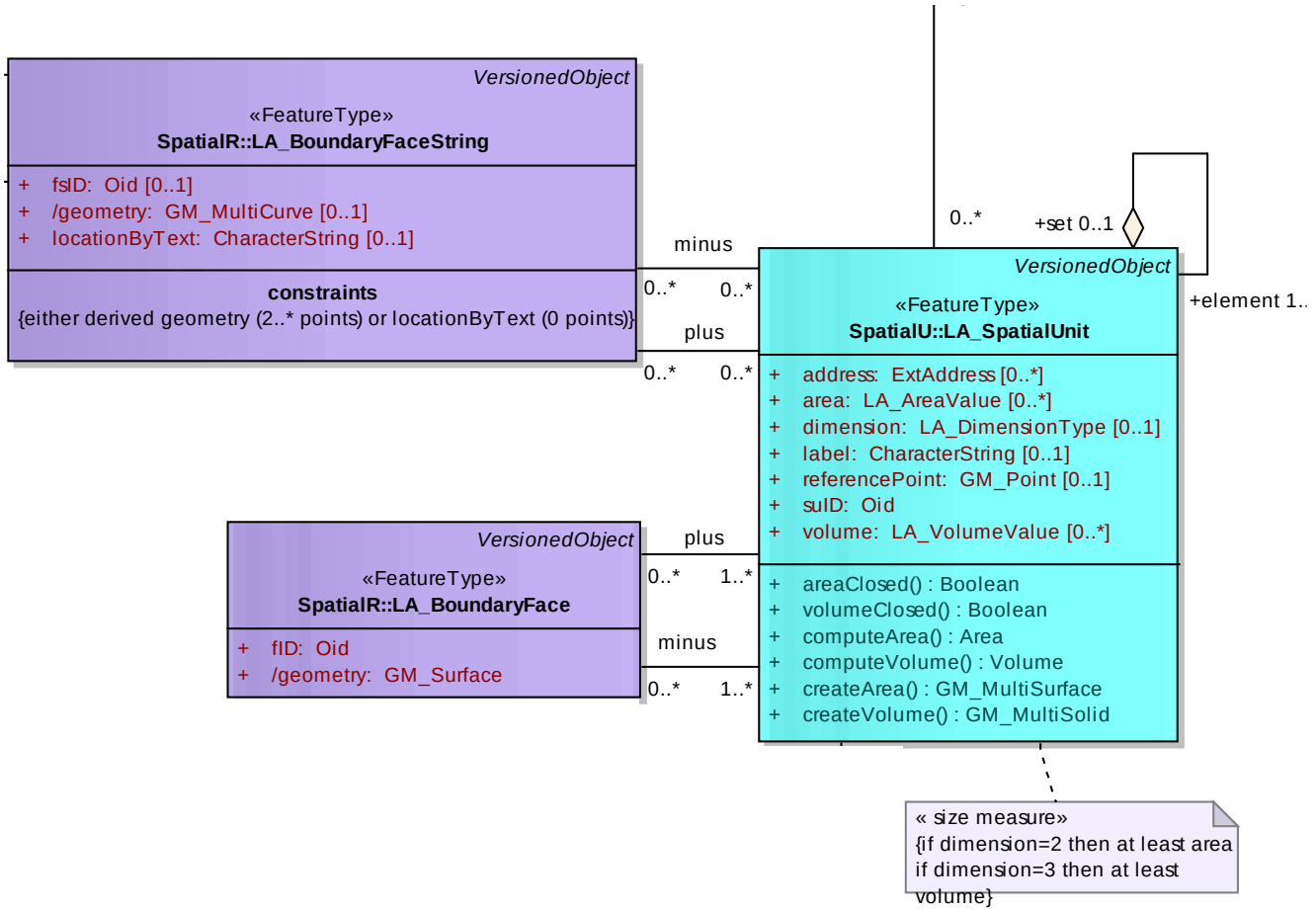
- Liminal spatial units are 2D parcels, but are stored as 3D parcels

- Liminal spatial units are delimited by a combination of LA_BoundaryFace and LA_BoundaryFaceString objects



2D and 3D integration

- 2D polyline (GM_curve) implies string of vertical faces: LA_BoundaryFaceString
- true 3D described with arbitrary oriented faces: LA_BoundaryFace



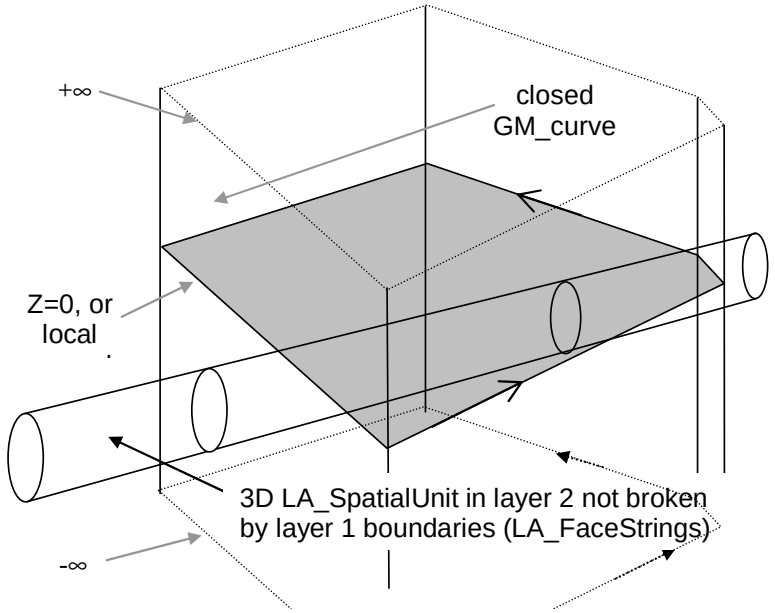
The 3D use of LA_Level

- organization based on content or structure:
  - example 1, content-based: one layer with 'primary' (strongest) rights, another layer with rights that can be added/subtracted (e.g. restrictions)
  - example 2, structure-based: one layer with topologically structured parcels (one part of the country), another layer with (unstructured) line based parcels (other part of country)

- can also be used in 3D context: one layer 'normal' parcels, another layer with subtracted 3D parcels

- based on independence principle

- each country design own levels



Content overview

1. Introduction
2. FIG working group, international overview
3. 2D and 3D in ISO 19152
4. *3D examples in various countries*
5. Conclusion

Some countries

- The Netherlands
- China
- Russian Federation
- Malaysia
- Israel

- Greece
- Australia (operational; most examples in this presentation)
- Spain
- New Zealand
- Singapore
- Norway
- Sweden
- ...

3D Cadastre in the Netherlands

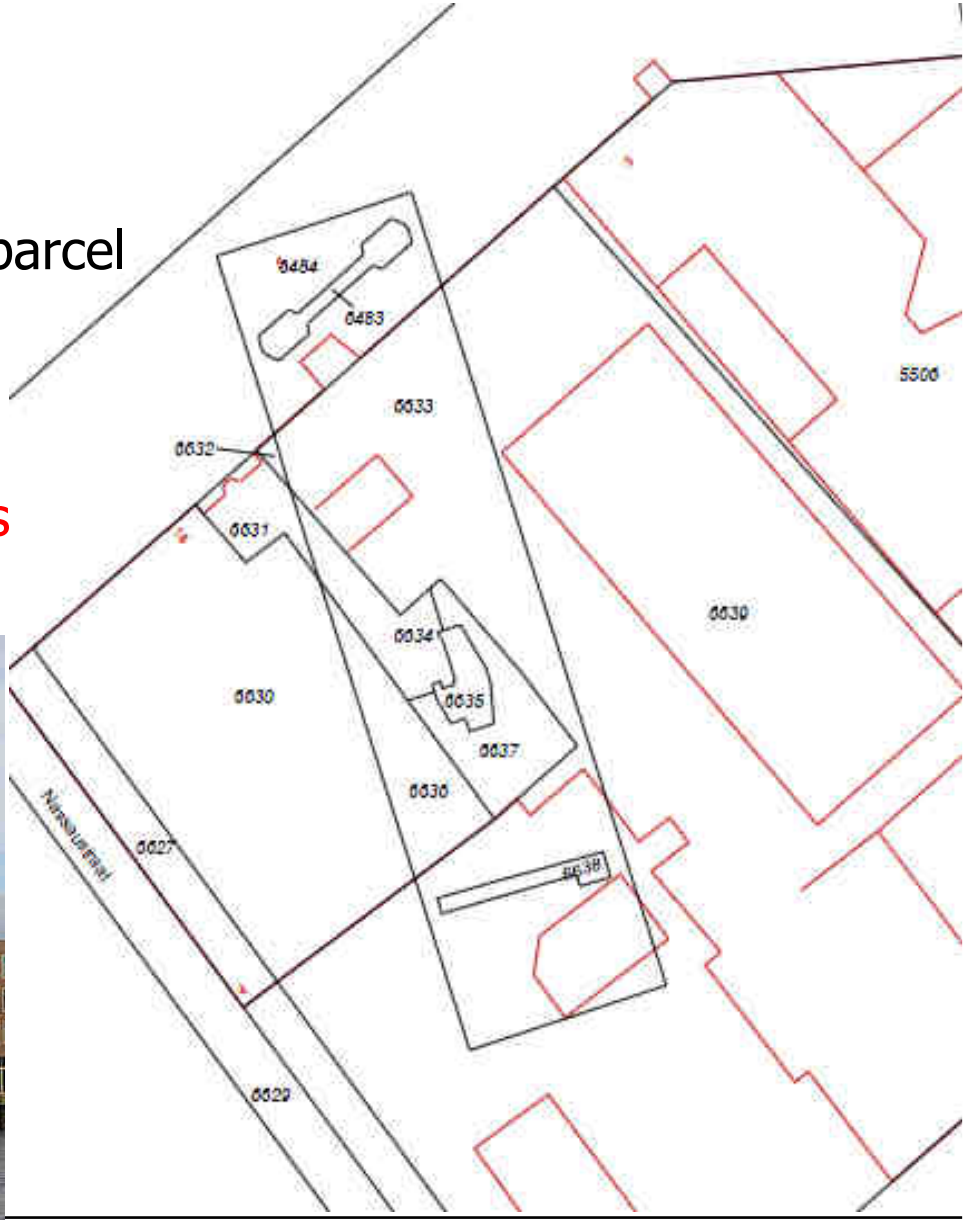
- Several studies have been carried out in the past decade
- Now actual implementation
  within legal, institutional, organisational context

Why now?

- Technically it has become possible to accept 3D drawings
- Practice has asked for support

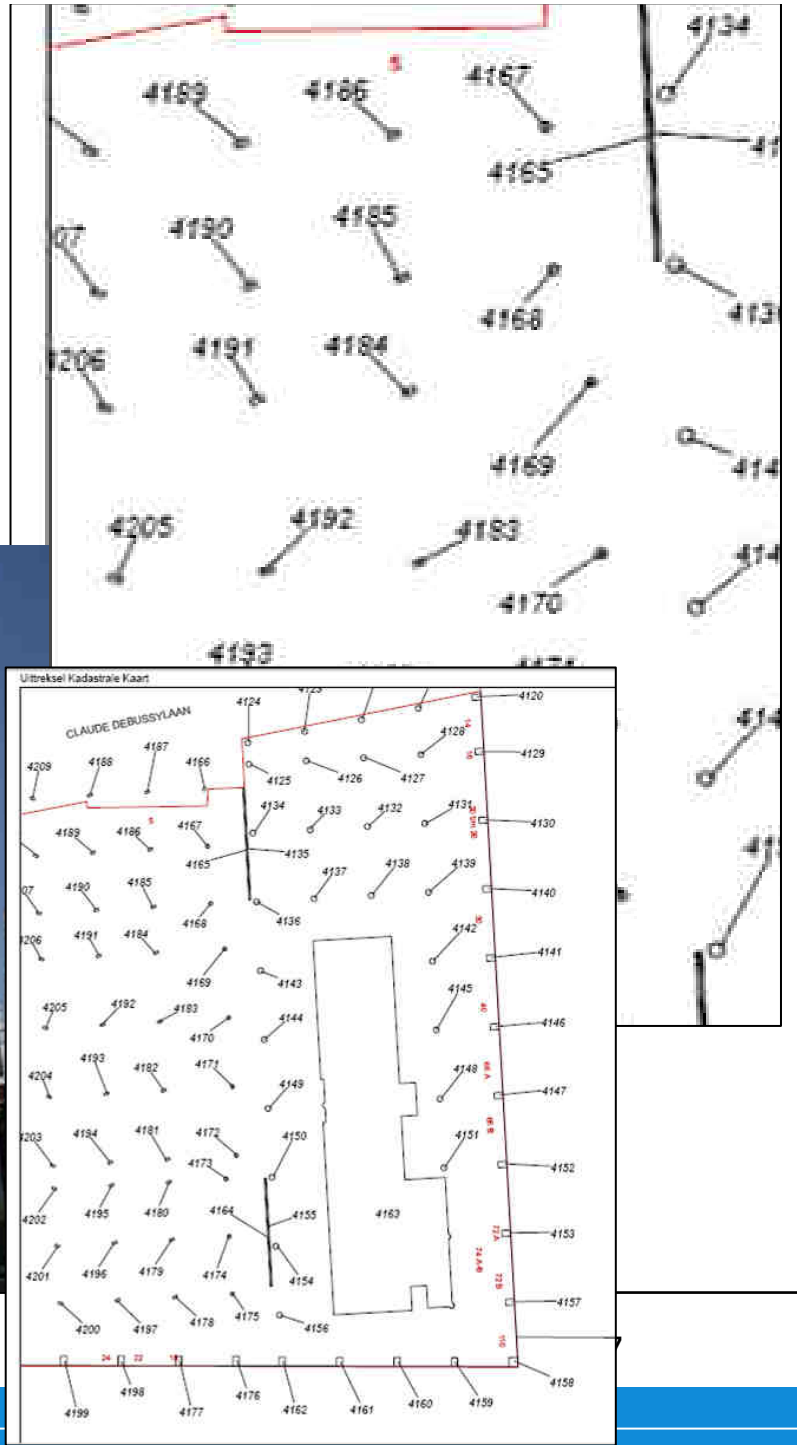
Background

- Main registration entity is 2D parcel
- Although it is possible to establish property rights with 3D boundaries
- Case 1: one object, superficies
- Note parcel fragmentation



Case 2

- Land by municipality
- Two 3D objects, long lease:
  1. Parking garage
  2. Office tower on 80 pillars
- Note again parcel fragmentation



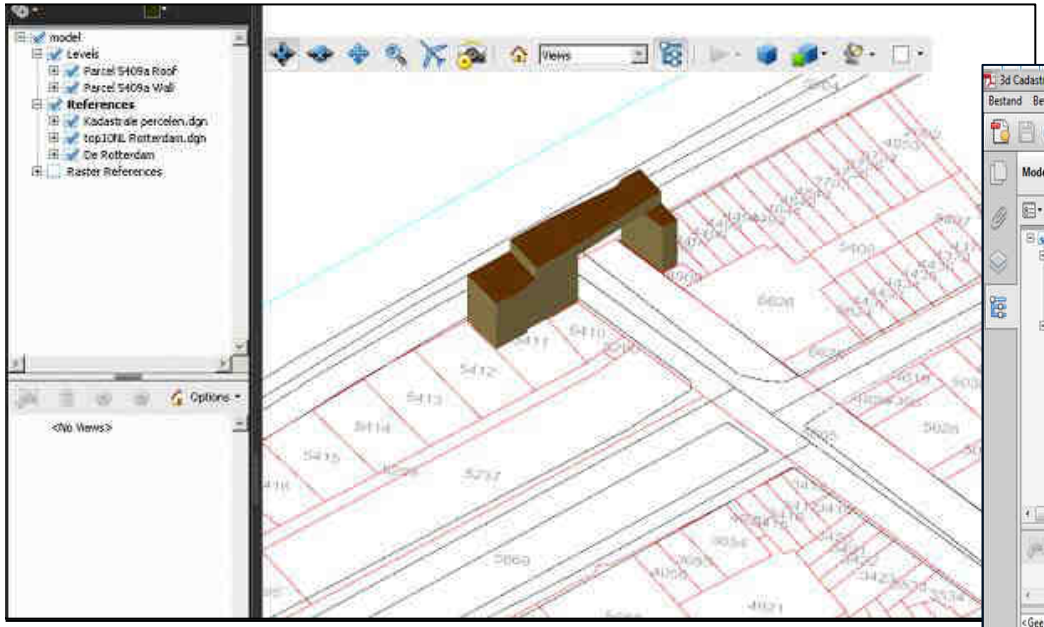
Findings from the case studies (many more than now presented)

- Registration and publication of rights on 3D property is possible with the traditional 2D approach

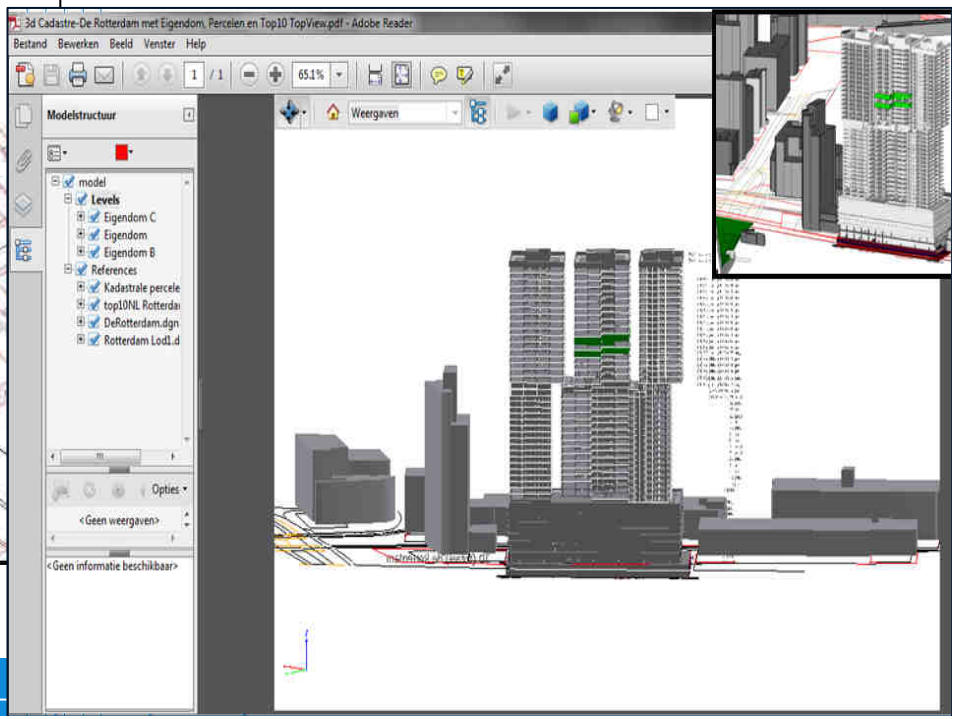
- But:
  1. Registration is not clear:
     Hard to understand if more than one object/part is involved
  2. Objects are divided over several parcels:
     Hard to maintain

Phase I

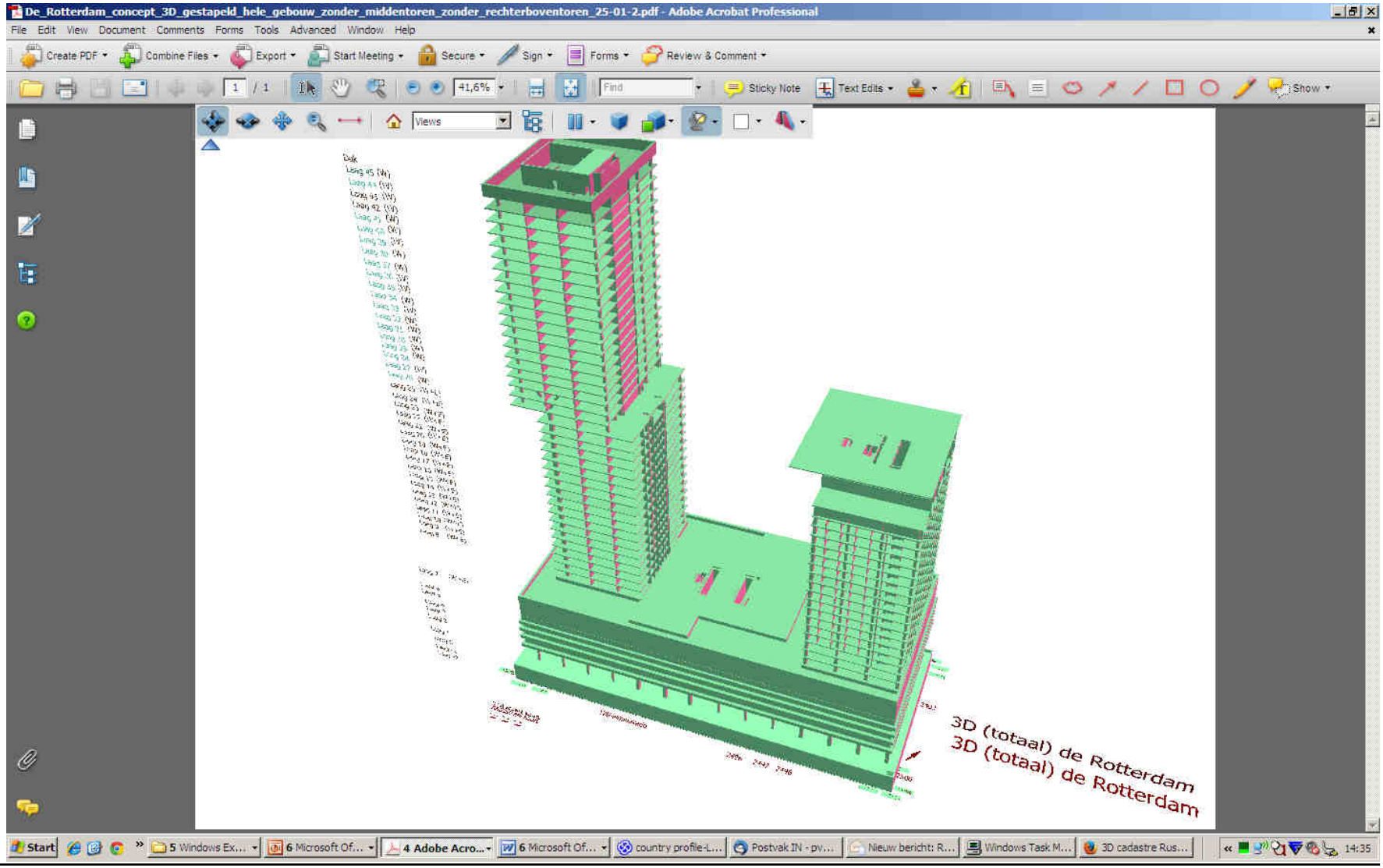
- No dramatic change
- Principle: refuse "fragmented parcel creation"
- Require a registration of 3D representation that reflects the space to which right applies
- 3D PDF (is already possible!)



Courtesy of Kees van Prooijen, Bentley



3D PDF, NL example



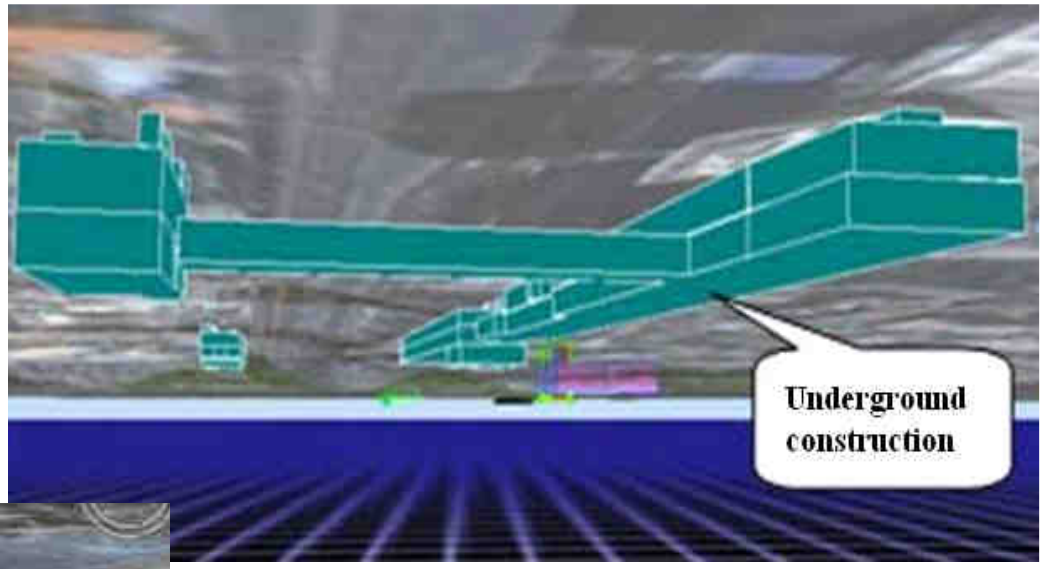
Next, Phase II

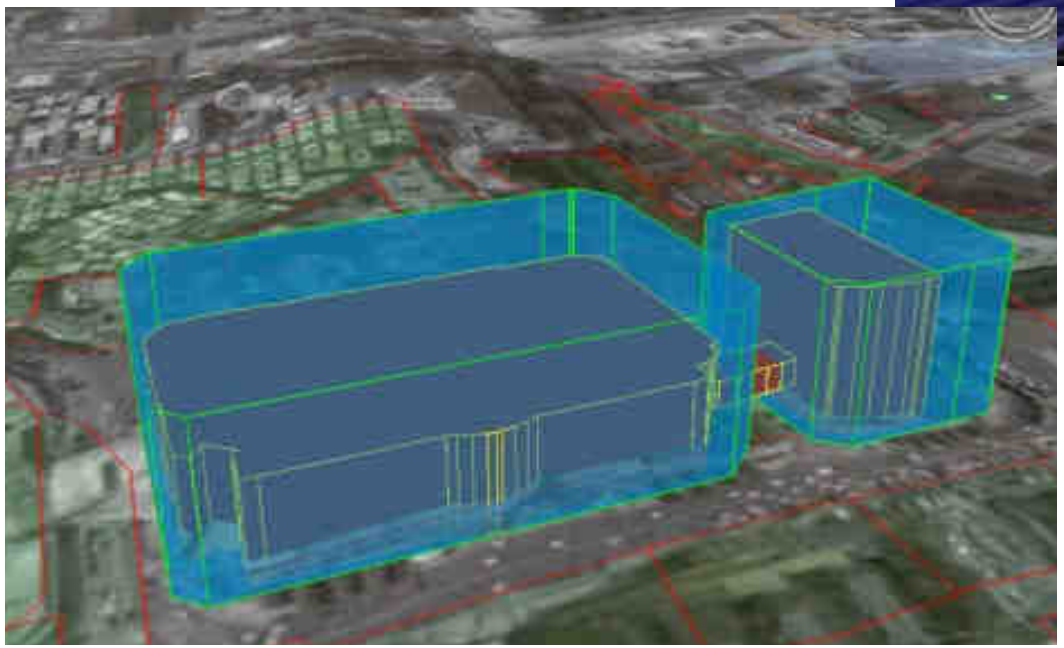
- Obligatory in specific situations
- Still related to one or more ground parcels
- A 3D graphical representation is always required
- based on ISO standard LADM and full integration 2D/3D (LA_BoundaryFace and LA_BoundaryFaceString)

- 3D data itself: XML-encoding (CityGML, LandXML, IFC?)
- Kadaster checks on geometry, topology, overlap:
  - Requirements for allowed geometries

- Possible to establish legal space that overlaps several ground parcels with own identification

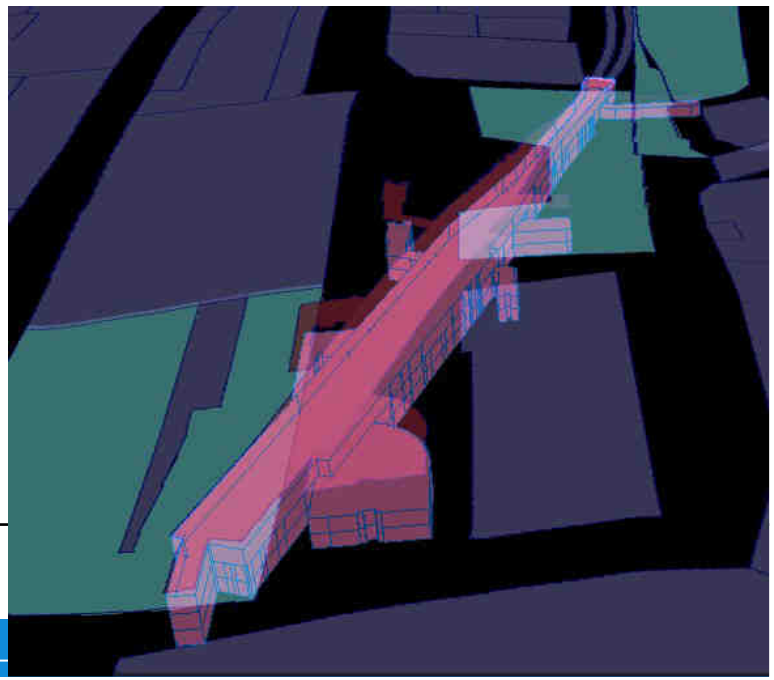
Shenzhen China



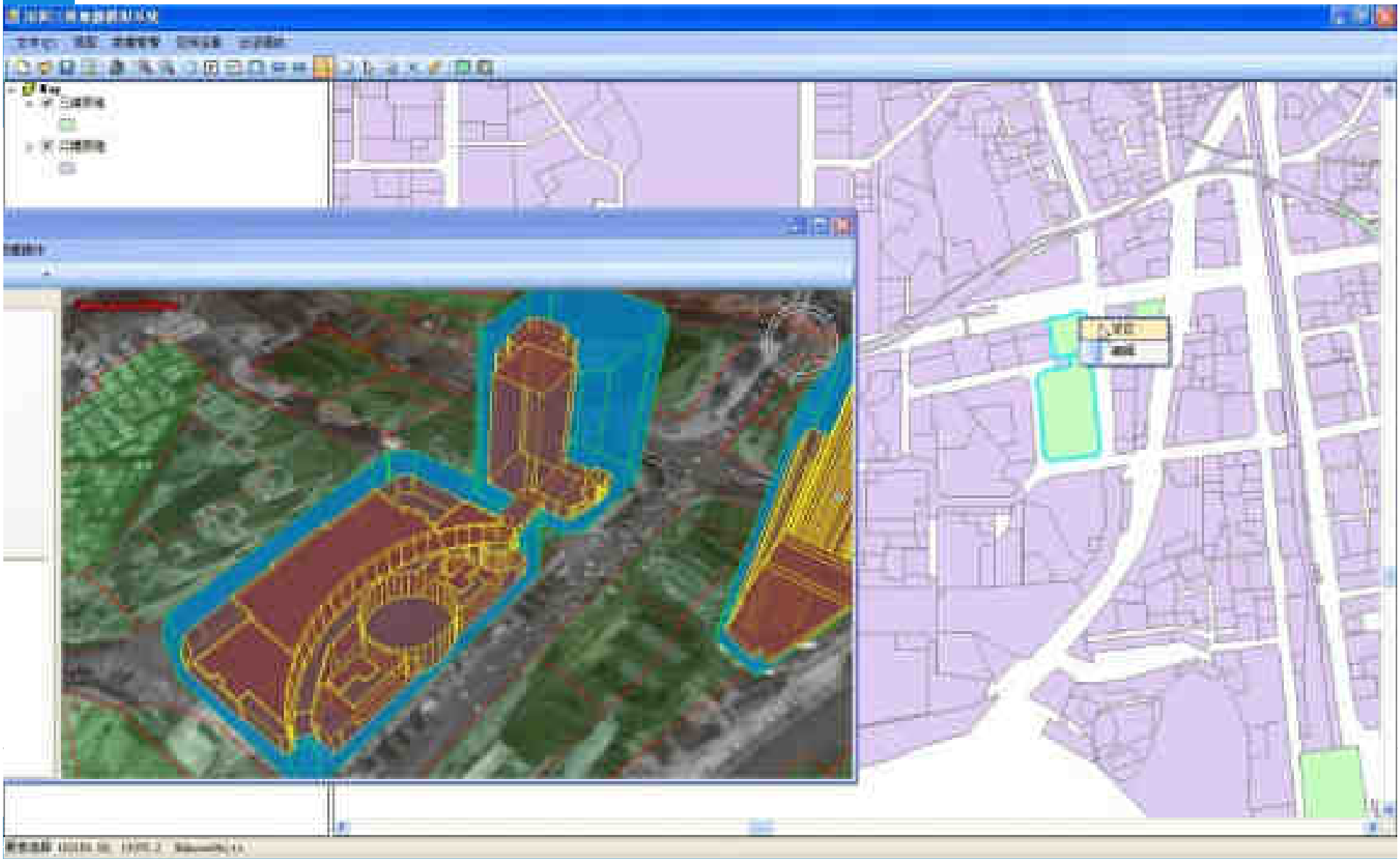


Legal space (blue), buildings (brown)

Subsurface metro, 3 levels



2D and 3D Cadastral data (Shenzhen)



Demo's of 3D Cadastre, 2012 workshop Changchun and Shenzhen

Relevant publications

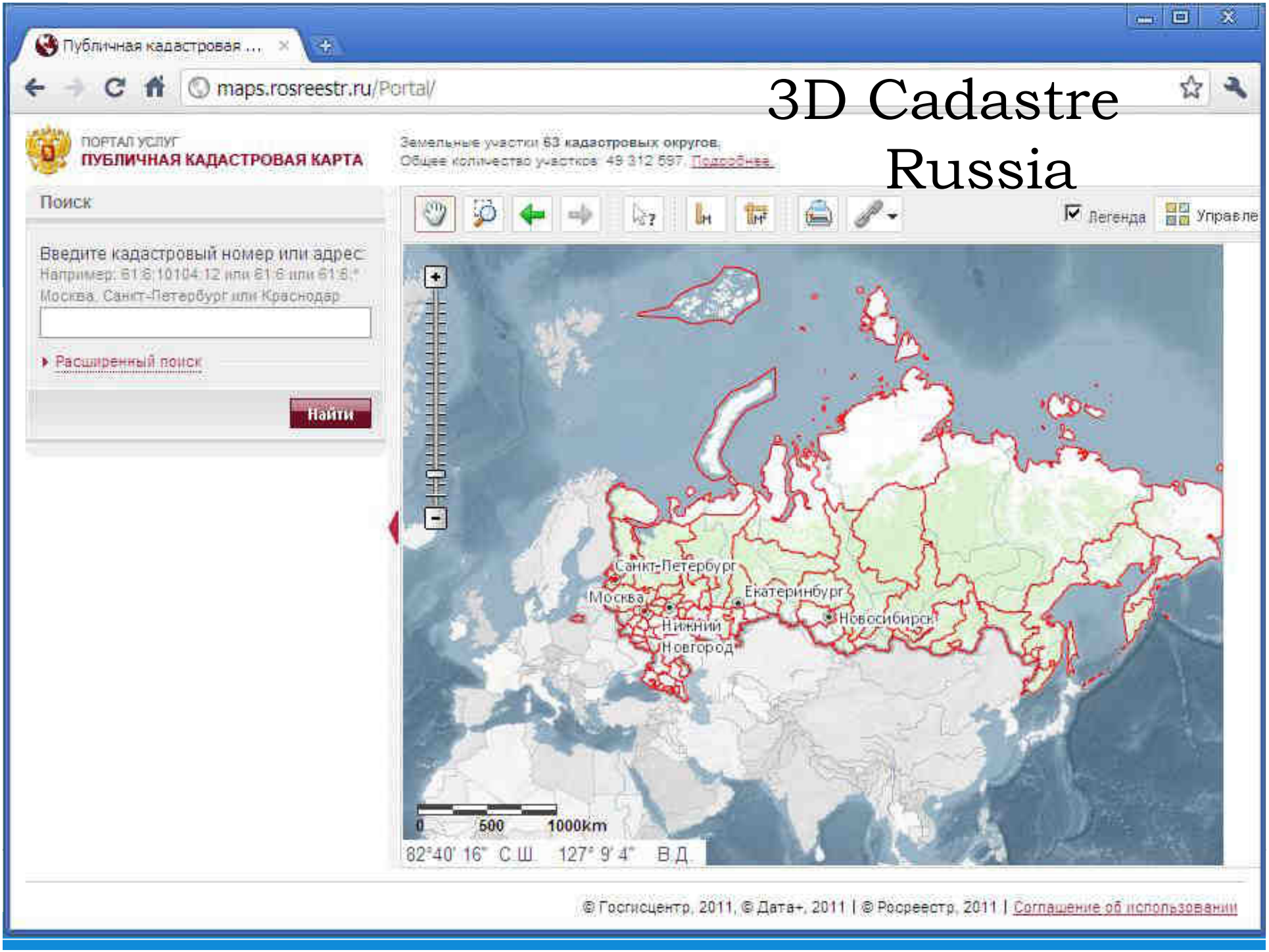
3D Cadastre, Shenzhen (in FIG 3D Cadastres 2011 workshop):

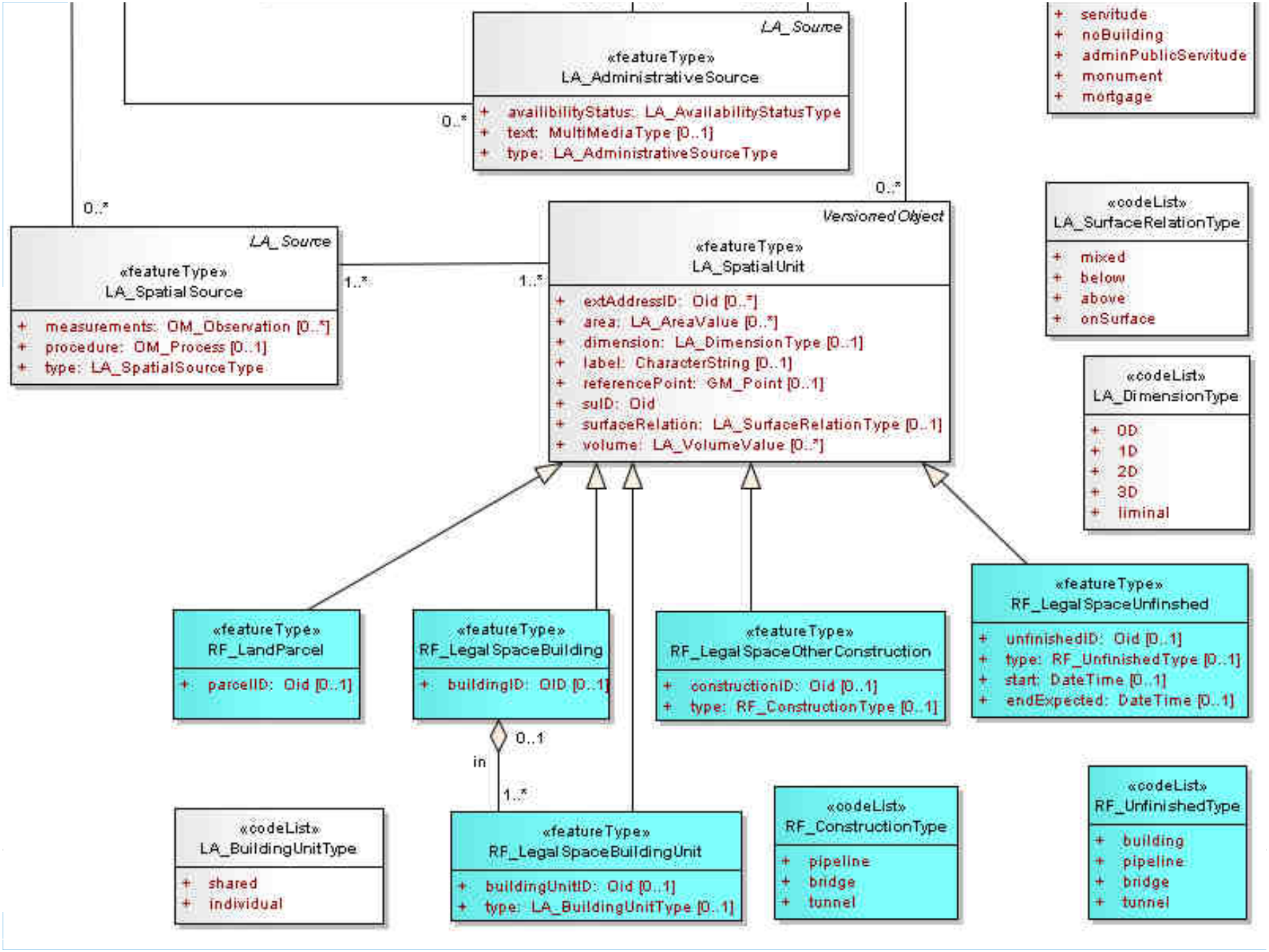
- A Multi-jurisdiction Case Study of 3D Cadastre in Shenzhen, China as Experiment using the LADM (by Renzhong Guo, Shen Ying, Lin Li, Ping Luo and Peter van Oosterom)
- Design and Development of a 3D Cadastral System Prototype based on the LADM and 3D Topology (by Shen Ying, Renzhong Guo, Lin Li, Peter van Oosterom, Hugo Ledoux and Jantien Stoter)

LADM:

- Integration of Land and Housing in China: First Analysis of Legal Requirements for LADM Compliance (by Yuefei Zhuo, Zhimin Ma, Christiaan Lemmen and Rohan Bennett)

3D Cadastre Russia

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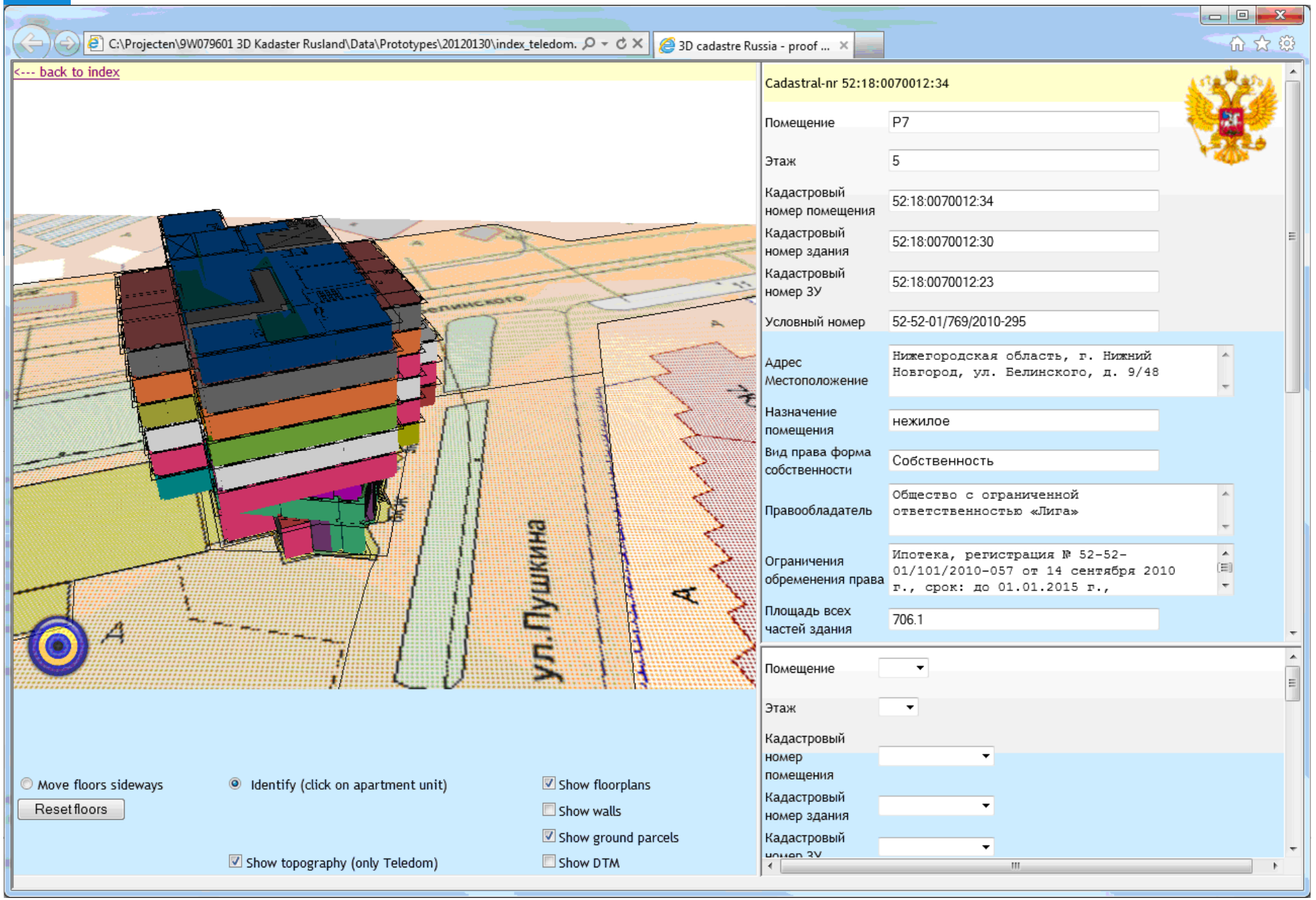
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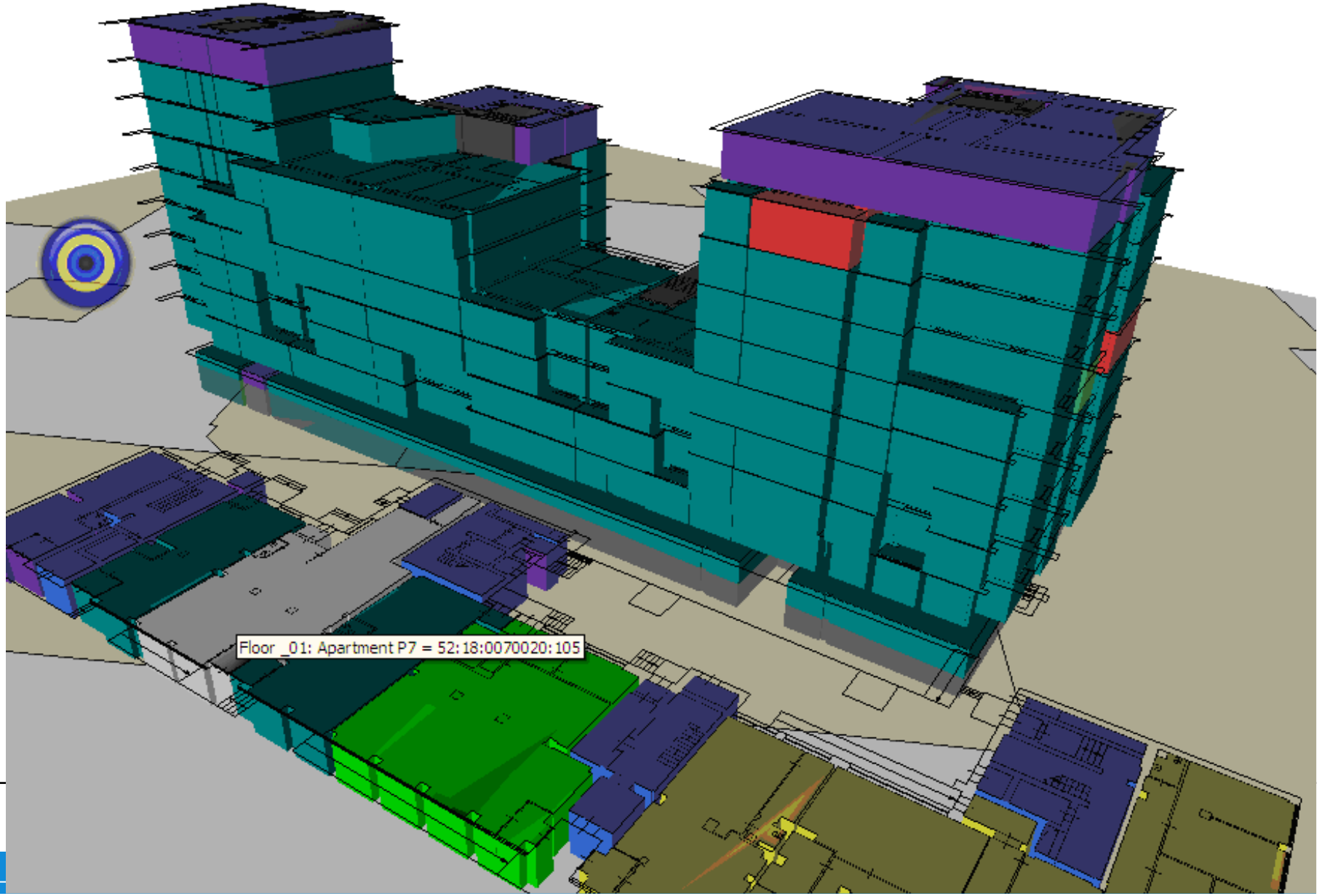
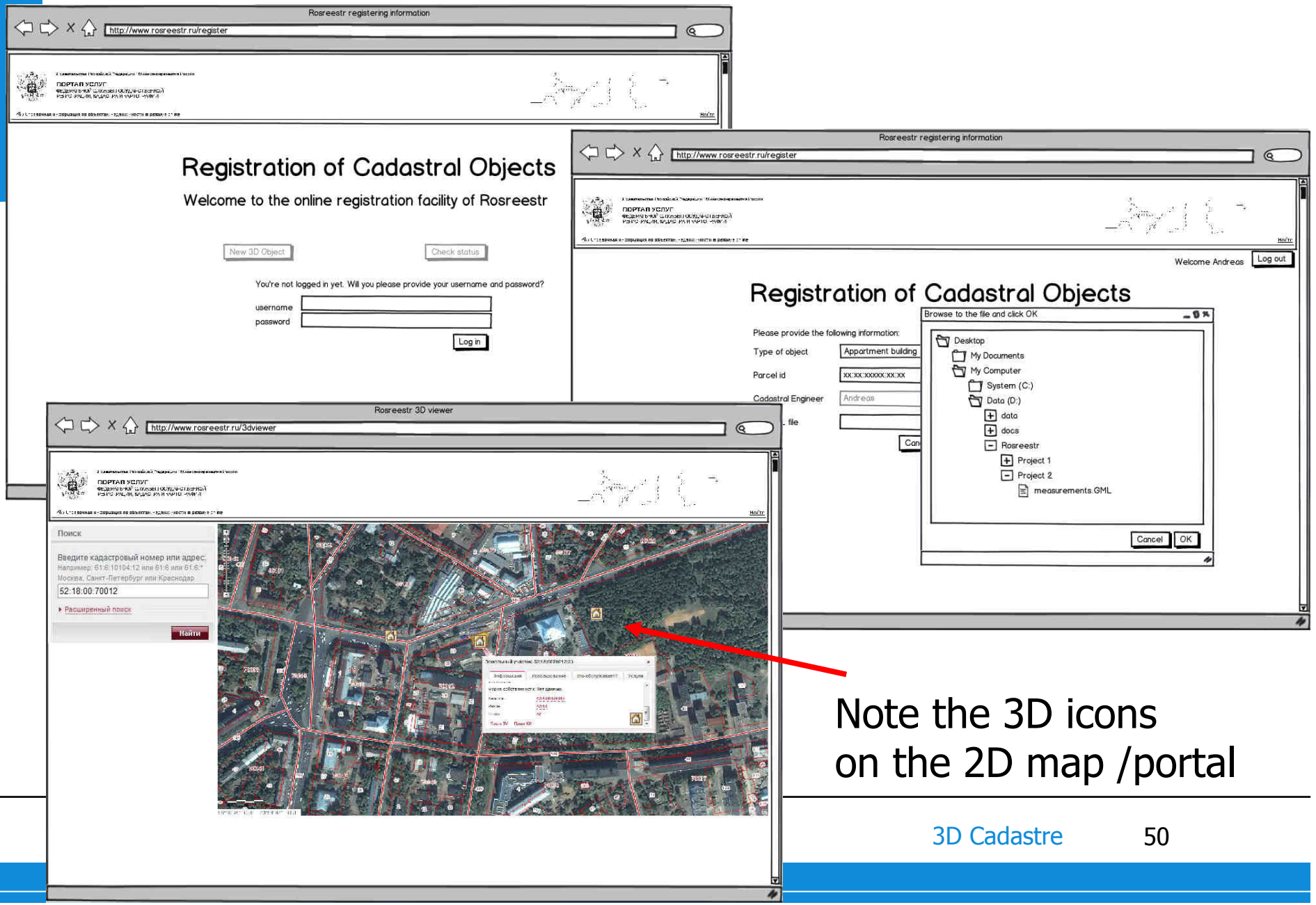
3D cadastre Russia - proof ...
<--- back to index
Cadastral-nr 52:18:0070012:34
Помещение
P7
Этаж
5
Кадастровый номер помещения
52:18:0070012:34
Кадастровый номер здания
52:18:0070012:30
Кадастровый номер ЗУ
52:18:0070012:23
Условный номер
52-52-01/769/2010-295
Адрес Местоположение
Нижегородская область, г. Нижний Новгород, ул. Белинского, д. 9/48
Назначение помещения
нежилое
Вид права форма собственности
Собственность
Правообладатель
Общество с ограниченной ответственностью «Лига»
Ограничения обременения права
Ипотека, регистрация № 52-52-01/101/2010-057 от 14 сентября 2010 г., срок: до 01.01.2015 г.,
Площадь всех частей здания
706.1
ул.Пушкина
Move floors sideways
Identify (click on apartment unit)
Reset floors
Show topography (only Teledom)
Show floorplans
Show walls
Show ground parcels
Show DTM
Помещение
Этаж
Кадастровый номер помещения
Кадастровый номер здания
Кадастровый

Slide-out interface (look inside)



Registration mock-up



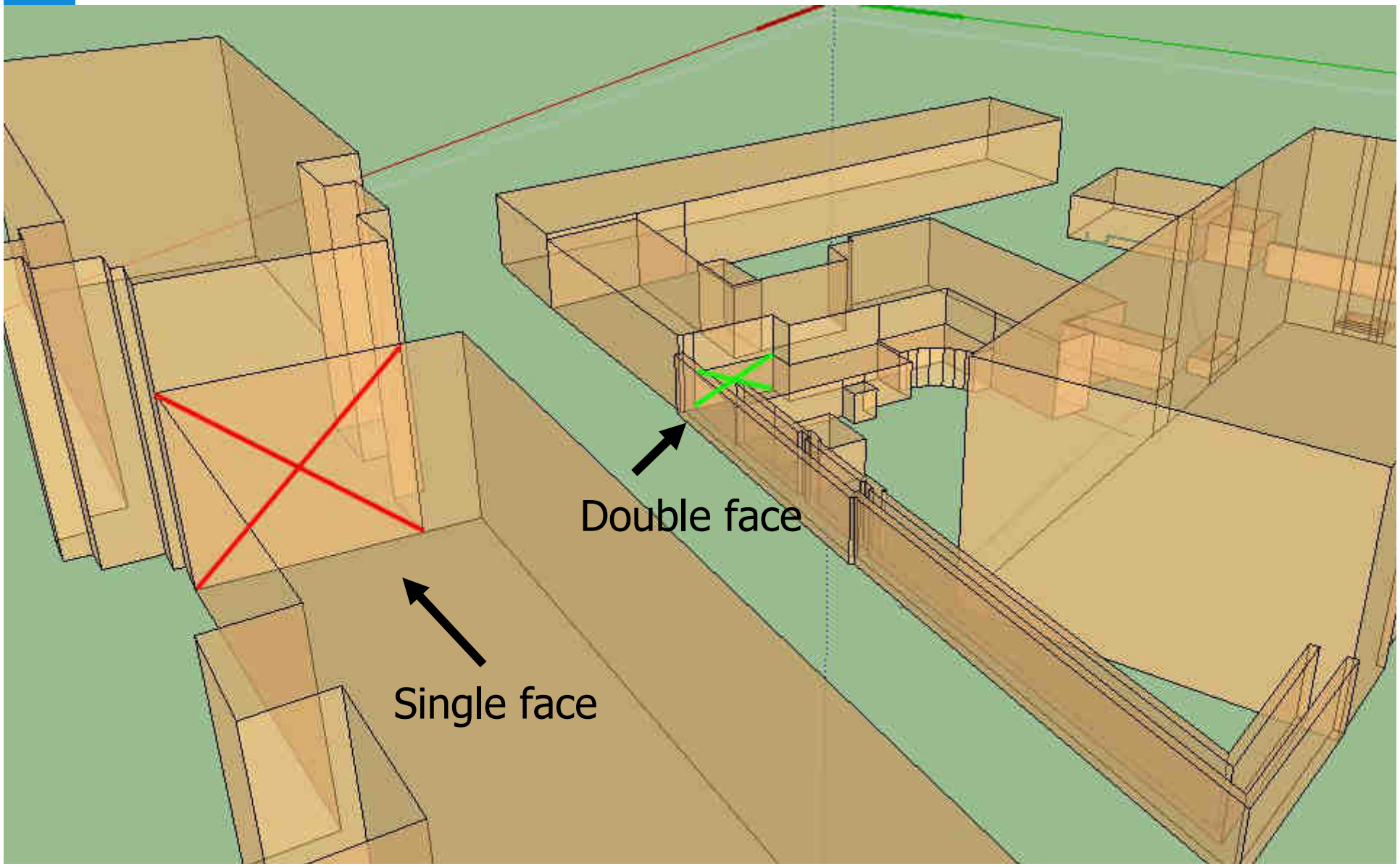
Note the 3D icons
on the 2D map /portal

Russian 3D cadastre prototype

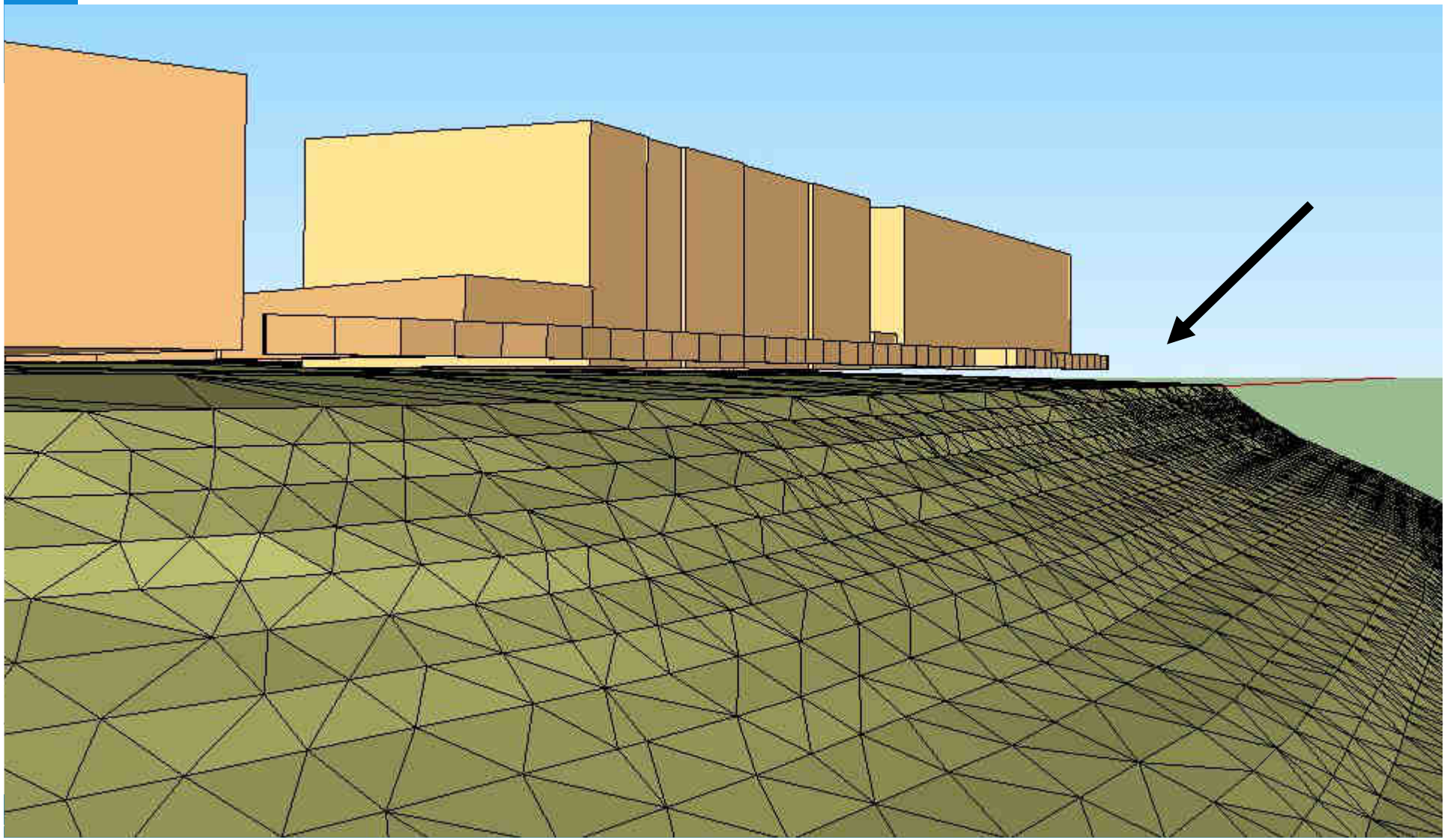
- Prototype focused on
  - Visualization of the three selected cases
  - Web dissemination of 3D cadastral objects and related admin
  - Added reference objects DTM, walls of buildings, scanned map,…
  - Spatial interaction with data in 2D/3D environment
  - Selection based on admin conditions

- Excluded from prototype/pilot, but needed:
  1. Initial registration (use of required format)
  2. Data validation (check input data quality)
  3. Data storage and management (in DBMS)

3D cadastral objects not in solid group
→ non-trivial to correct



Buildings partially floating in air (case gas pipeline)

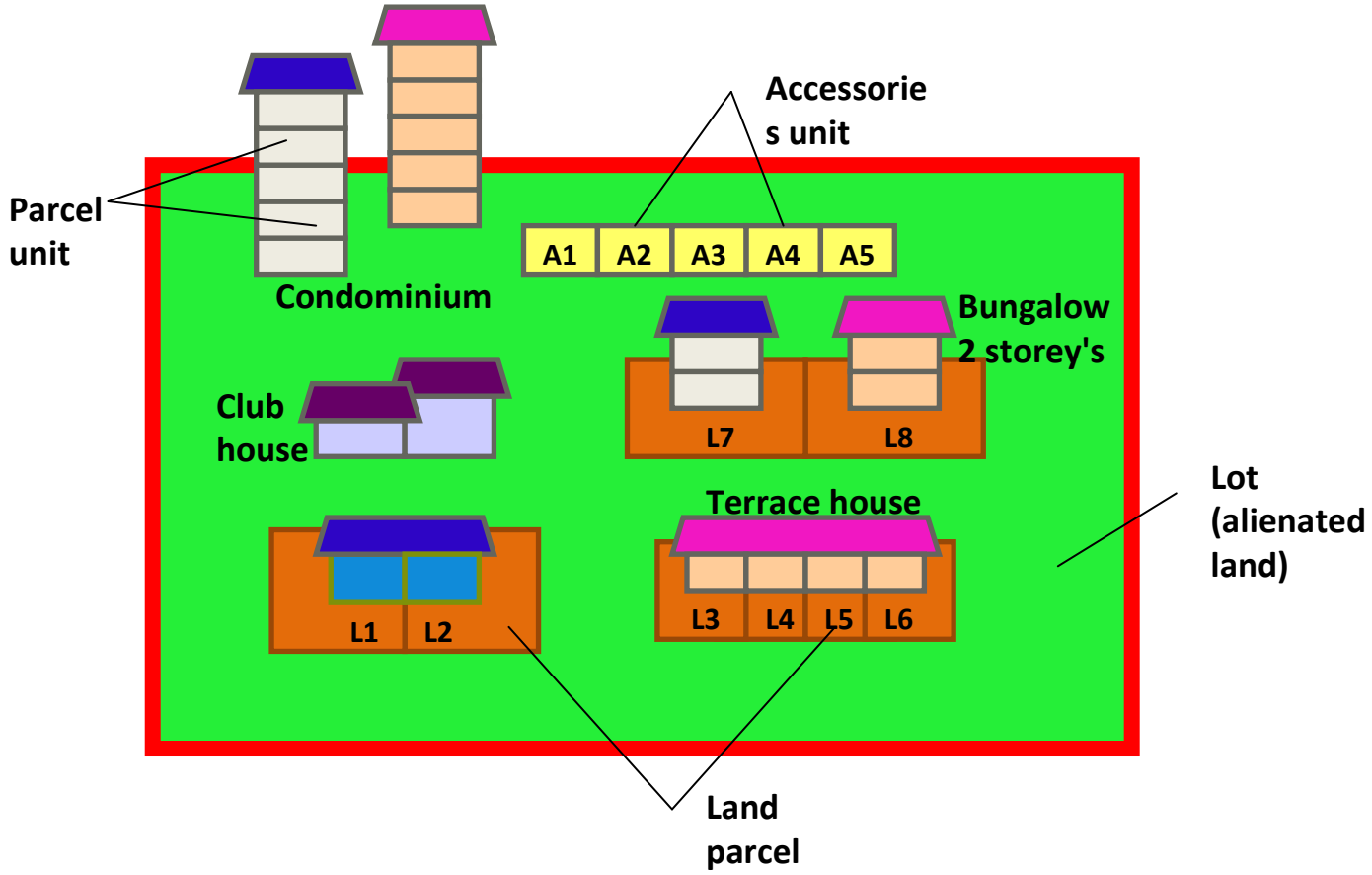


Validator (more in annex of presentation)

- (Automatic) check 3D cadastral object before input
- Use proper data management (right data type in DBMS) during storage
- Check for potential conflicts with other 3D objects (or columns implied by 2D surface parcel)
- Should 3D cadastral objects be connected (indirectly) to earth surface, i.e. must be reachable

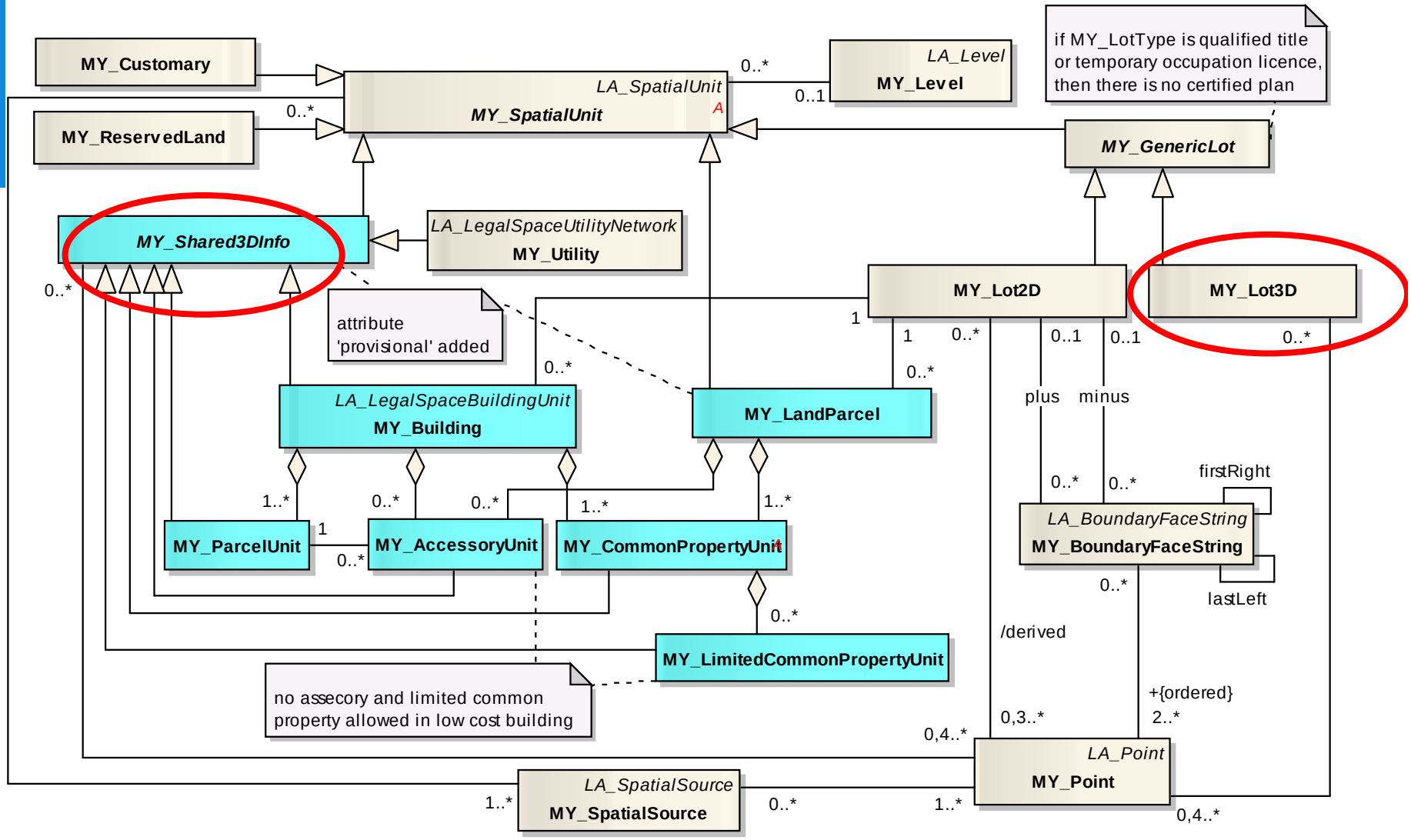
- Check spatial aspects (flat faces, partition of space)
- Check consistency between spatial – legal/admin data
- Check legal/admin attributes, proper transfer of rights between involved parties

Malaysia: integrated 2D and 3D



Various cadastral objects related to strata titles in context of one lot

Spatial data modelling based on LADM

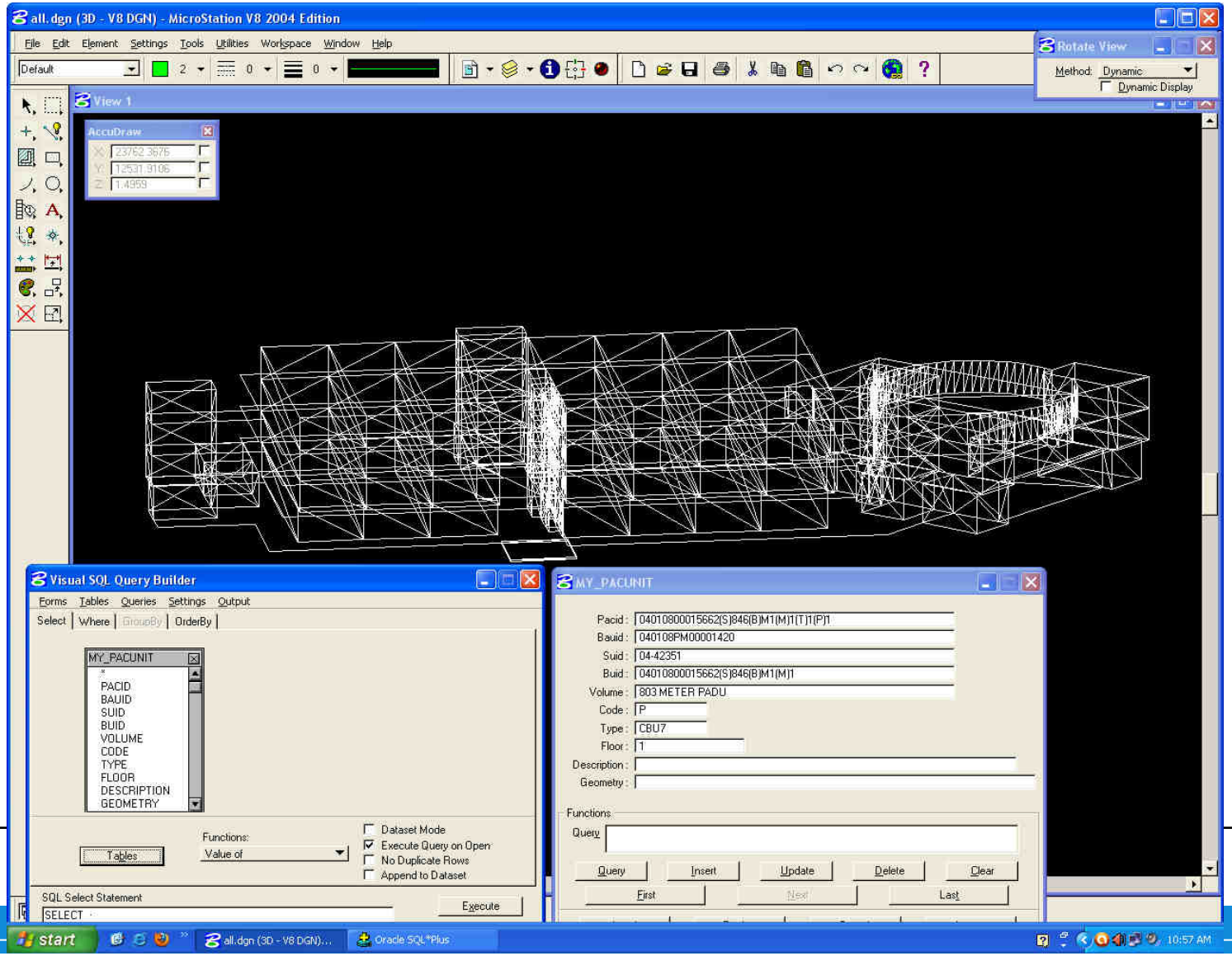


Implementation

- Convert conceptual model (UML class diagram) into technical model, decide on indexing, exact data types, references/id's, topology, history/versions,…

- Database Oracle spatial: MDSYS.SDO_GEOMETRY type
- Malaysian country profile: 2D topology structure for land parcel
- Managing 2D and 3D spatial object, Oracle Spatial supports storage for 3D points, lines and polygons
- MY_BoundaryFaceString represent 2D cadastral object
  → polyline, GTYPE=2002
- MY_Shared3DInfo represent 3D cadastral objects
  → multipolygon method, GTYPE=3007

3D Cadastral object



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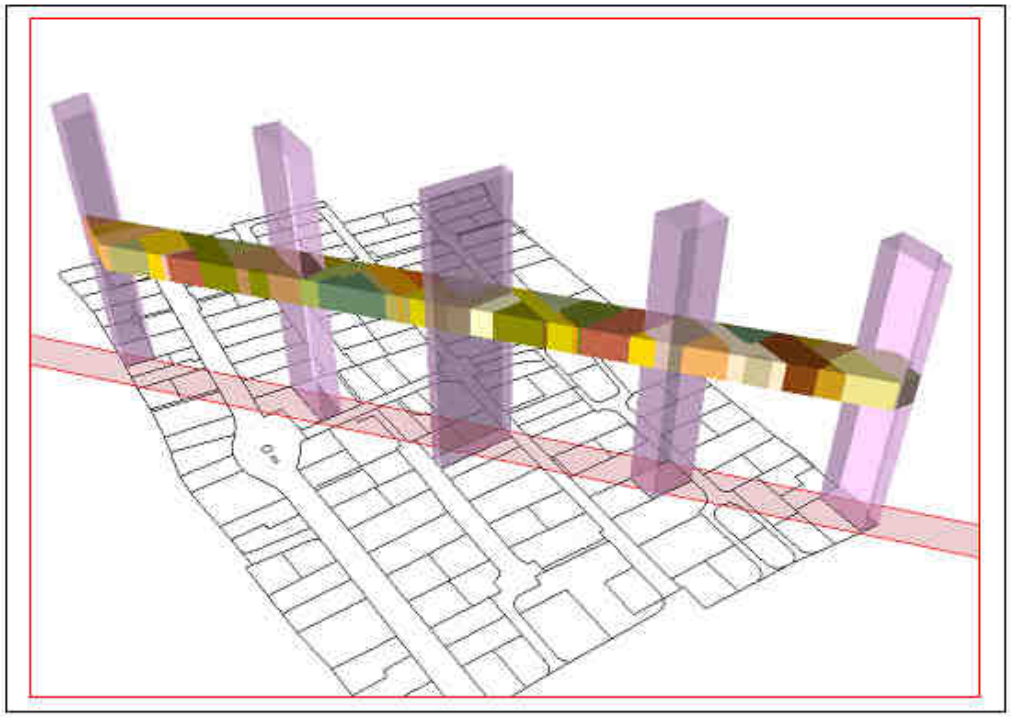
Israel 3D subparcel concept, previous investigations

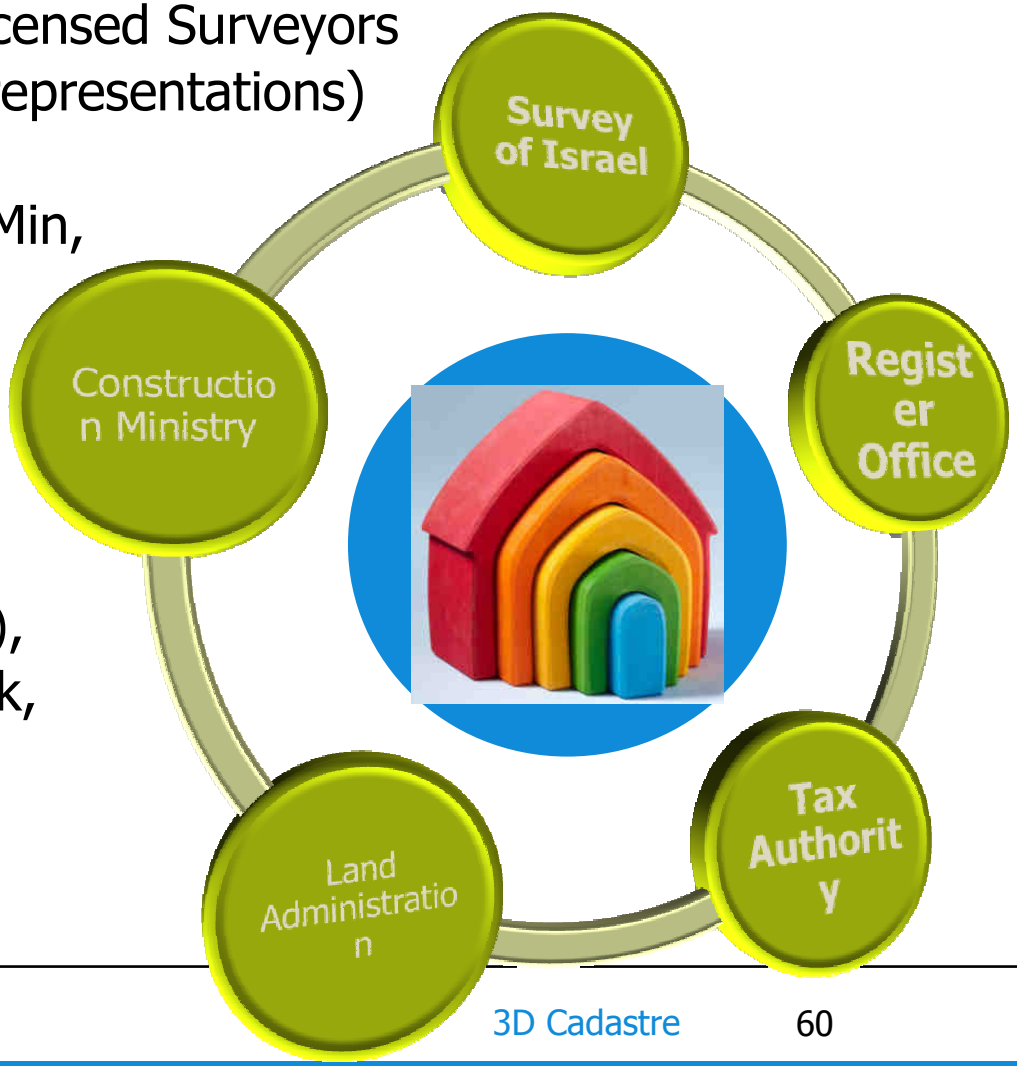
- 3D subparcel is temporarily created by subtraction form 3D column implied by 2D base parcel
- In single transaction for a infrastructure object many temporary 3D subparcels are created (involving multiple owners)
- Within transaction these join in single 3D parcel with own ID within block (same RRR/Party)

Illustration:
Shoshani et al. 2005



Towards an Israel SDI approach meaningful exchange

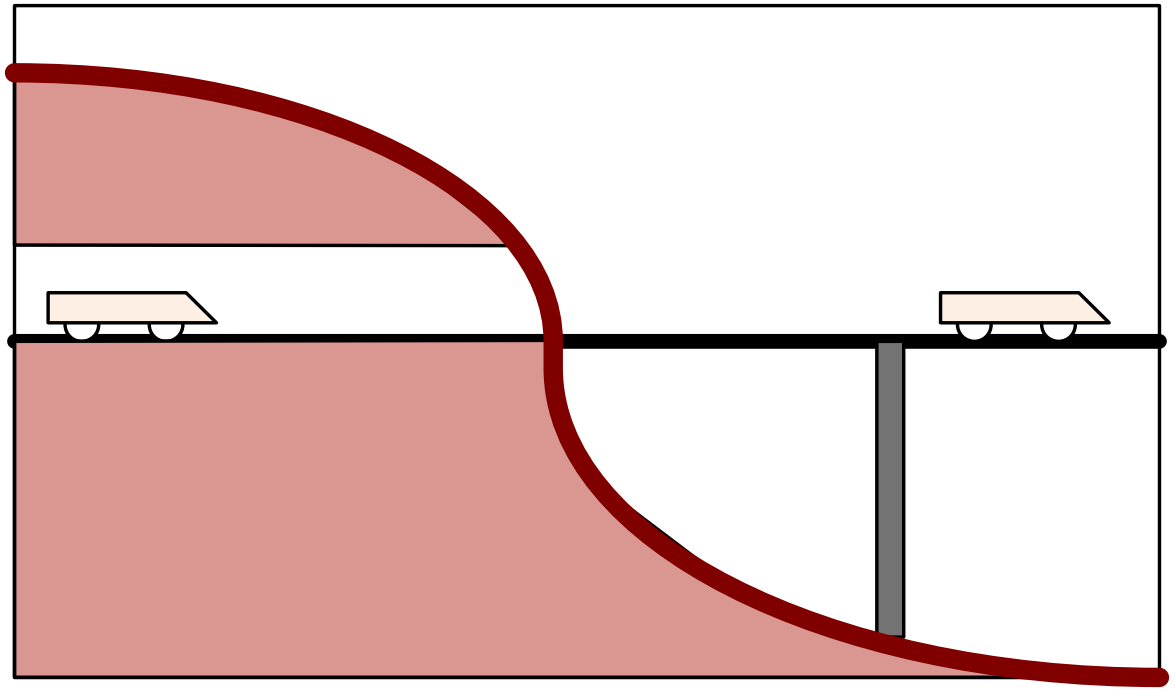
1. Survey of Israel (SOI) + Licensed Surveyors (LSs, creating new 2D/3D representations)
2. Land Registry (LR, Justice Min, register apartments in 3D)
3. Israel Land Authority (ILA, 93% Israel government)
4. Others: Interior Min (plans), Construction Min, Tax, Bank, Municipalities,..



SDI for other reference data

- Terrain elevation (earth surface) not part of land administration
- Via SDI this data may be obtained in order to be able if a 3D parcel is above, below the surface (or both)

- In 3D Cadastre: absolute coords (additional option relative coords)
- 3D Parcel does not change when Earth surface changes!



Scope of Israel 3D Cadastre, checklist of FIG 3D Cadastre WG

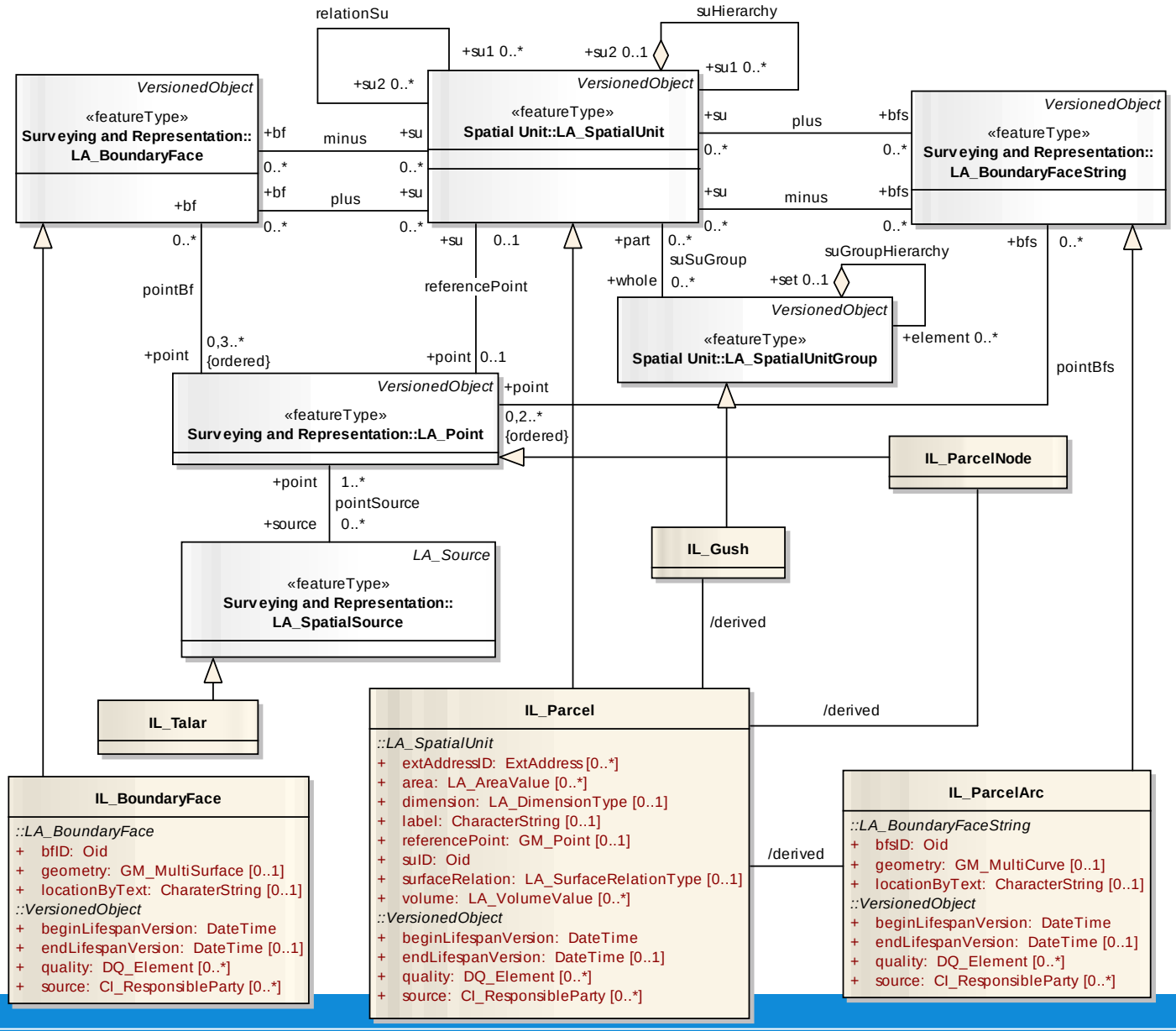
- What are the types of 3D cadastral objects?
  → Both a. related to (future) constructions (buildings, pipelines, tunnels, etc.), and b. any part of 3D space (airspace, subsurface)

- 3D Parcels also for simple apartments/ condominium buildings?
  → Not in short term (use 2D floor plans), May be in longer term

- 3D Parcels for infrastructure objects, such as long tunnels, pipelines, cables: divided by surface parcels or single object?
  → Only divided by blocks (so join subparcels in block)

- For representation of 3D parcel, has legal space own geometry or specified by referencing to existing topographic objects
  → Own geometry

IL_LADM Country Profile (spatial part, very first draft…)



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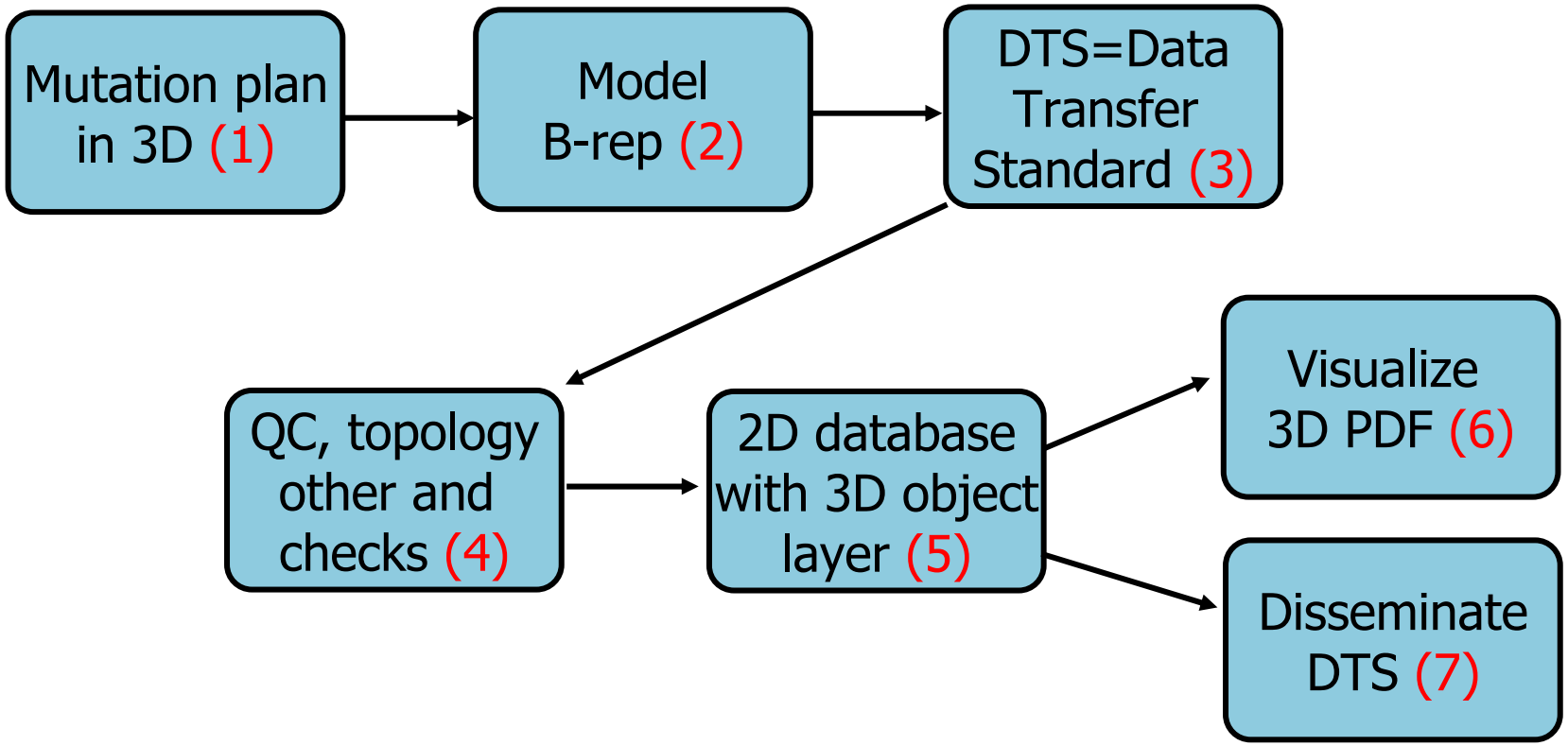
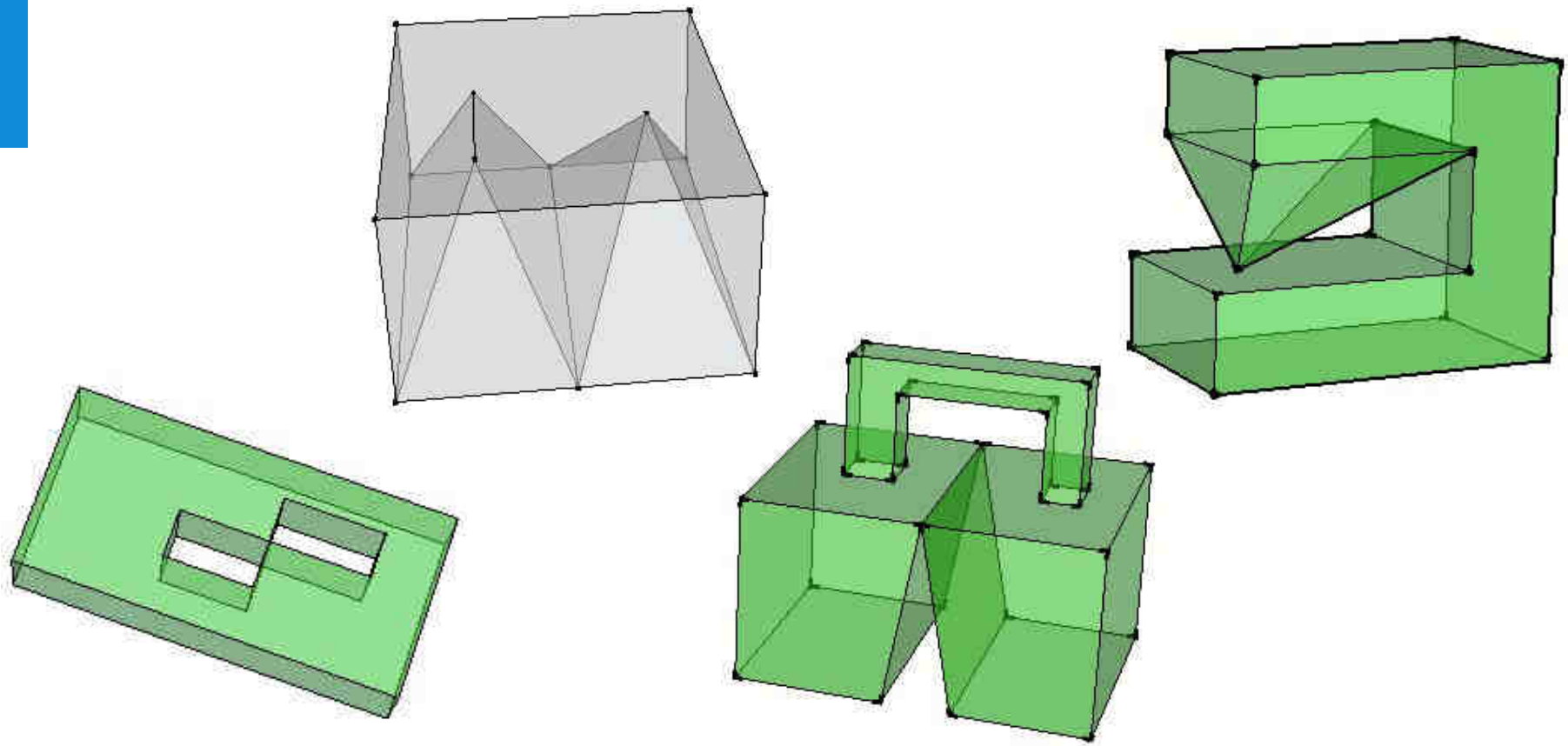
Technical model: basis for implementation

Consider the whole 3D Cadastre processing chain:



Non trivial 3D quality check: Valid, but non 2-manifold 3D Parcels



Single object correctness rule: *interior connected*

Illustrations by Shen Ying (Wuhan University, visiting TU Delft)

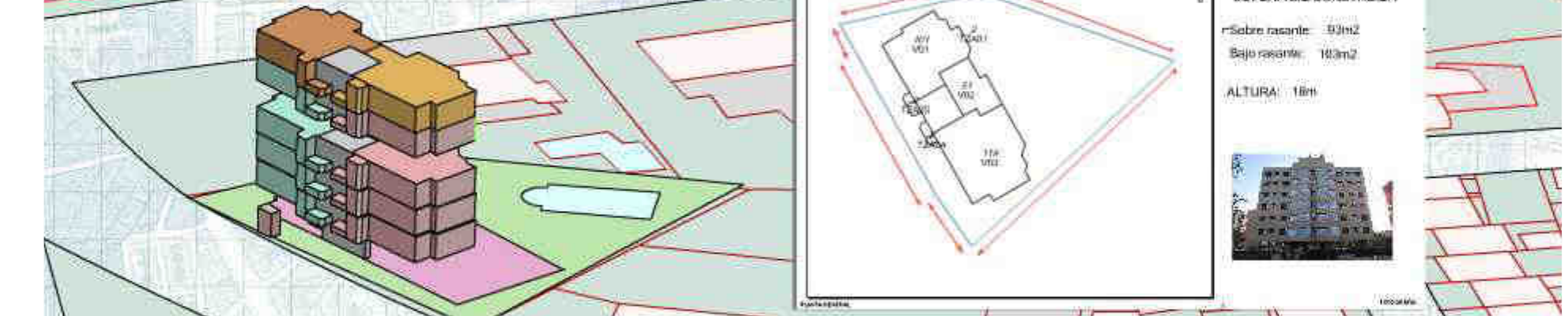
MINISTERIO DE ECONOMÍA Y HACIENDA

SECRETARÍA DE ESTADO DE HACIENDA Y PRESUPUESTOS

DIRECCIÓN GENERAL DEL CATASTRO

El e-catastro 4D
actualizado diariamente

Localización, Altura de edificios, croquis por planta, Datos catastrales, fotografías de fachada.
Real state location, buildings height, floor sketches (CU1), Cadastral data, front photographs.



Toda esta información permite el estudio de la realidad territorial incorporando el volumen de las edificaciones, obtenida directamente de la cartografía

All this information allows territorial studies. Buildings are also incorporated, directly taken out directly from the cartography.

Content overview

1. Introduction
2. FIG working group, international overview
3. 2D and 3D in ISO 19152
4. 3D examples in various countries
5. *Conclusion*

Conclusion

- Besides legal and technological aspects, 3D Cadastre implementation in specific country requires communication with stake holders (surveyors, notary, banks, government agencies, public), and taking (scoping) decisions

- Educate future data providers, help them with practical rules/ guidelines and tools for proper description of 3D cadastral objects:
  - What to do with wall or ceilings?
  - What horizontal and vertical reference system to use?
  - What to do with pipelines crossing multiple parcels?
  - What to do with curved surfaces (non-horizontal/vertical)?
  - What to do with partial (un)bounded objects
  - When can 3D Cadastral Unit exist (specific rules or not; e.g. relation to construction or connection to Earth surface)?

Cost of realizing 3D Cadastral system

- Some cadastral organizations estimate limited cost for realization as often: 3D data will originate from outside
- But registration guidelines are crucial

- Possible sources:
  1. Survey in 3D
  2. Old floor plan upgraded to 3D volumes
  3. New architecture design (CAD) directly in 3D

- In all cases:
  1. Agree on submission format (LADM, encoding CityCML/LandXML/..)
  2. Rules for valid 3D objects
  3. Automated checking as much as possible

Questions?

Peter van Oosterom