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Towards 3D and 4D Cadastral in Croatia

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INTRODUCTION

- In the last couple of decades, there has been an increasing demand for property development in urban areas, resulting in the division of property ownership so that different owners can own delimited space on, above or below ground surface.
- Establishing a 4D cadastre, which registers and provides access to all required 4D information of real estate, is not simple, since it comprises legal, organizational as well as technical issues.
- First investigation of a 4D cadastre has been studied based on the ISO 19152 - Land Administration Domain Model

Croatian Land Administration System

- Based on 2D representation of objects including cadastral parcels, buildings and other structures
- Two registers: Cadastre and Land Book
- Significant changes in past 10 years:
 - i. introduction of new geodetic datum and map projection
 - ii. transition from land cadastre to real estate cadastre
 - iii. increasing use of national network of reference GNSS stations

3D CADASTRE IN CROATIAN LAND ADMINISTRATION

- Land administration institutions in Croatia decided not to get merged into one institution but opted for Croatian solution of linking the institutions at the level of data and business processes to be maintained according to respective jurisdictions.
- Joint Information System of the Land Book and Cadastre (JIS)
- The JIS technical solution enables IT communication with the basic State registers:
 - I. databases comprising the data on Personal Identification Number,
 - II. spatial data register,
 - III. State Geodetic Administration (SGA) digital archives
 - IV. One Stop Shop system

3D CADASTRE IN CROATIAN LAND ADMINISTRATION

- **Implementation of the Joint Information System will have following benefits:**
- integrated cadastre and land book data - a unique land database
- integrated spatial and alphanumeric data
- single centralized application for all cadastral and land book offices
- inimitable data maintenance
- avoiding the generation of copies of data due to different applications at cadastral and land book offices
- integration with the Geoportal and the ability to view digital orthophoto data
- integration with the Register of Administrative Units
- JIS is process-oriented application, accelerating business processes and increasing internal transparency
- the ability to review and edit spatial data
- digital signing of electronically generated documents as the basis for the electronic exchange and centralized printing
- VAT (value added tax) system integration.

3D products in current Croatian Land Administration System

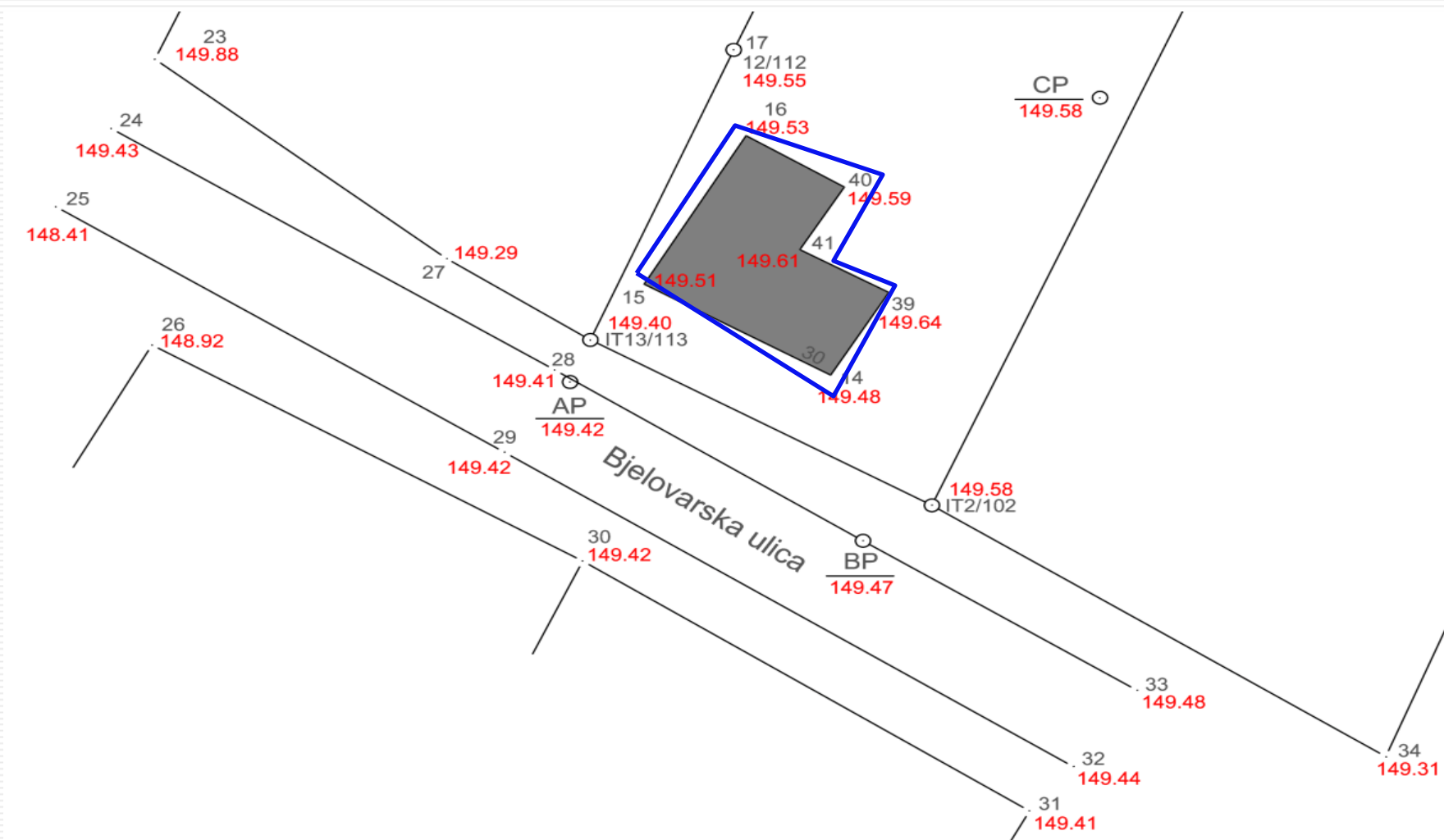
➤ Special Geodetic Basis

- implies digital orthophoto map with altitude display – contours and elevations with embedded cadastral maps or topographical map with embedded cadastral map, all made in the appropriate scale and certified by the competent authority of state surveying and real property cadastre.

3D products in current Croatian Land Administration System

- **Surveying Design**
- Ordinance on Surveying Design was based and passed on Physical Planing Act.
- According to Ordinance on Surveying Design integral part of surveying design is document called Geodetic Situational Draft.
- Geodetic Situational Draft is made to display position and elevation data on all visible natural and built features of the land surface in the construction area (e.g., buildings and other structures, utility lines with associated facilities, traffic infrastructure, vegetation, water and related objects, relief etc.)

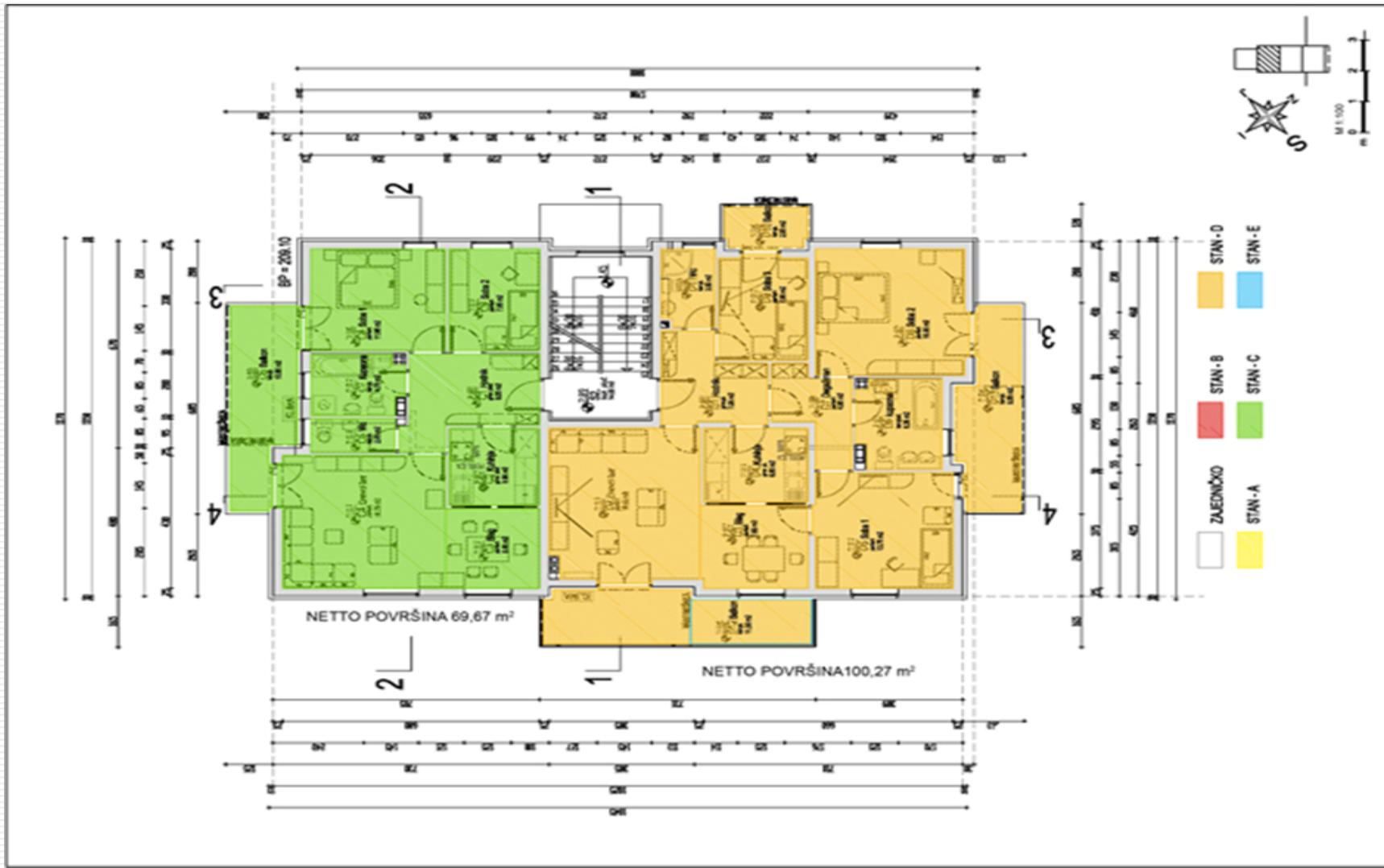
Geodetic Situational Draft (part of Surveying Design)



Report on Partition of Real Property

- Partition of the real property establishes ownership of a separate part of real property (apartment, office space, garage, etc.) that becomes associated with proportionally shared part on the property
- Data about separate parts must be technically processed providing drawings of separate and common parts with required labels and areas of separate parts. These drawings are currently provided in analogue format. Shared ownership contract must also be provided

Report on Partition of Real Property



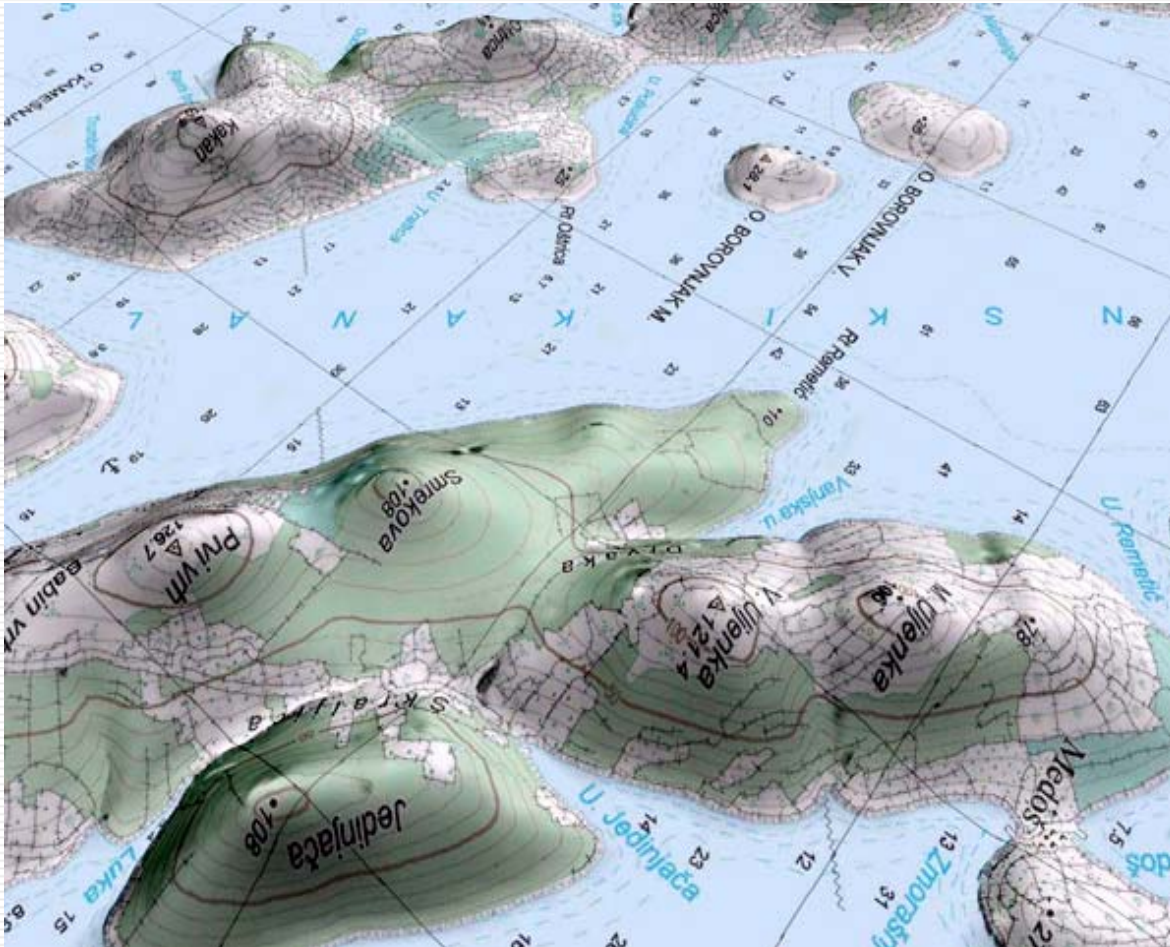
Other 3D products

- The basic topographic data represents a core set of data that is the basis for making all official maps (digital or analogue) in various scales.
- Topographic Map (TM25) is the official state map and is produced at a scale of 1: 25000. The official state map is coded images of natural and human-made objects on the surface to be made for the entire Croatian territory. The entire Croatian territory is covered with 594 sheets. The surface of one sheet covers an area of 13745 hectares.
- Croatian Base Map (CBM) is the official state map and is produced at a scale of 1: 5000. The official state map is coded images of natural and human-made objects on the surface to be made for the entire Croatian territory. The entire Croatian territory is covered by the 9802 sheet of the CBM. The surface of one sheet covers an area of 675 hectares.

Other 3D products – Digital Terrain Model

source:

<http://www.zzf.hr>



Data acquisition for development of the Digital Terrain Model (DTM) is made by 3D photogrammetric data acquisition from aerial images (stereopairs) according to the principles of the CROTIS (Croatian Topographic Information System).

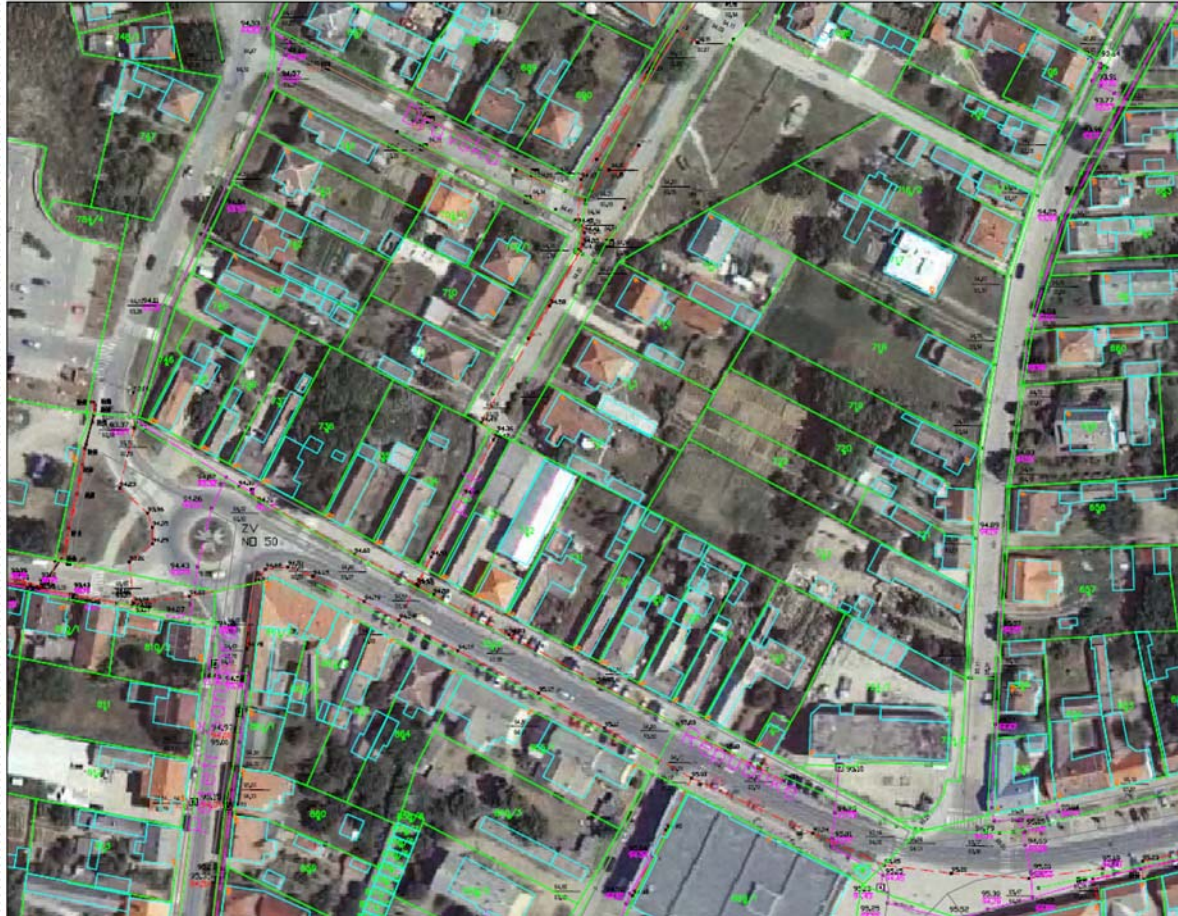
PUBLIC UTILITY INFRASTRUCTURE

- Cadastral registration of utility networks includes temporal aspects such as creation, changes during life time, deletion, splitting and merging etc.
- Physical registration of the utilities is not organized at national level in the Republic of Croatia.
- Long history of Utility Cadastre
- Legislation regulating that bodies of local government must establish and manage the utility cadastre was passed already in 1999, but only few of these bodies assumed this responsibility since.

Utility Cadastre in 3D cadastre context

- State Geodetic Administration is considering that physical registration of the utilities must be organized at national level in the Republic of Croatia. Based on the current status of the Utility Cadastre in the Republic of Croatia, the new implemented Utility Cadastre should achieve the following goals:
 - i. obtaining information about the “occupancy of space” with regard to the underground utility and other infrastructure,
 - ii. prevention of infrastructure related negative publicity, preventing and reducing the cost of direct and indirect damages,
 - iii. management of the infrastructure, implementation of conditions for keeping records of the utility infrastructure,
 - iv. developed in such a way that infrastructure data will be merged together with land cadastre data and available in the same projected coordinate reference system - Croatian Terrestrial Reference System 96 (HTRS96) to all interested parties.

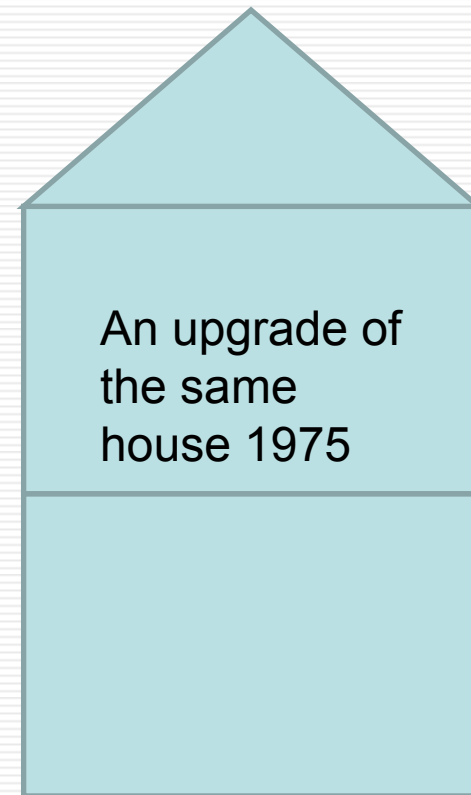
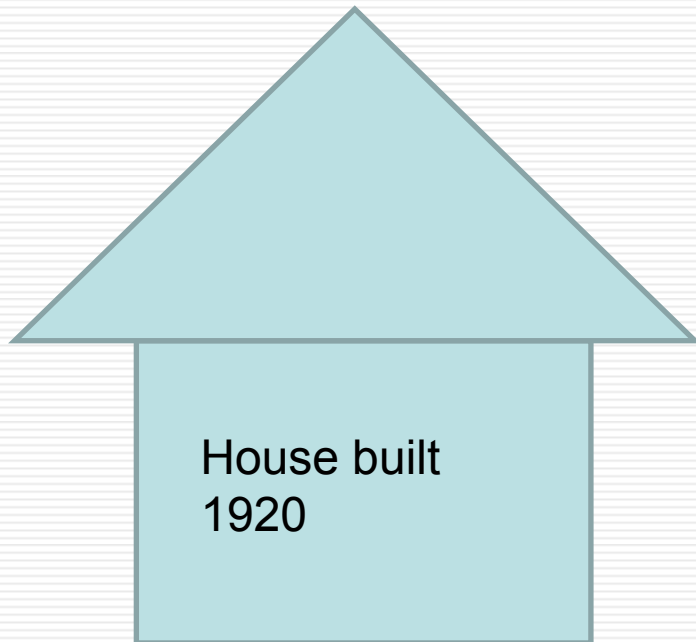
3D Cadastre in Croatian Land Administration



Utility lines on the digital cadastral map – overlapped with digital orthophoto image (town of Beli Manastir)

Towards Croatian 4D Cadastre

➤ Why 3D is not enough??



3D Cadastral Registration

- Today's computer technologies enable advanced methods of real property registration in official registers
- possibility of connecting to services which visualize 3D space such as Google Earth, Google Street View, CityGML, 3D Warehouse ...



3D model of
Shopping mall –
Case study 1
(Avenue Mall,
Zagreb)

3D Cadastral Registration

- Along with publicly available services such as Google Earth and Google Street View and others which for some time now deal with spatial modelling and free providing of these data to users, there is also the need for an official register.
- Available underlying regulations are Law on state survey and real property cadastre and Law on ownership and other real rights. These laws should be changed for full 3D cadastre implementation. State Geodetic Administration currently works on preparing a new Law on state survey and real property cadastre.
- According to the Technical specifications for determining coordinates in coordinate system of the Republic of Croatia we have possibilities to capture, process, and store 3D coordinates in SGA database (FME Server). SGA FME Server is a platform that provides the procedures for conversion, transformation, preparation for migration and quality control of spatial data.

4D cadastral registration

- The need for 3D representation of cadastral data is identified. The next dimension is time: there is a need to include time to reconstruct history, to manage events in maintenance processes and to reflect reality in case of temporal rights. Spatial units with different accuracies, dimensions and representation should be possible to include. This implies a range of spatial units should be possible. One more reason to include the temporal dimension (3D + time) is the need for information assurance within the NSDI: both current and historic versions are always accessible
- In Croatia history of changes on the cadastral parcels is subject of interest for key users, mostly parties. For this purpose, Croatian land administration system was adapted to become a four-dimensional. In the land books and cadastre all changes since their inception are recorded with the time component and date of the change.

4D cadastral registration

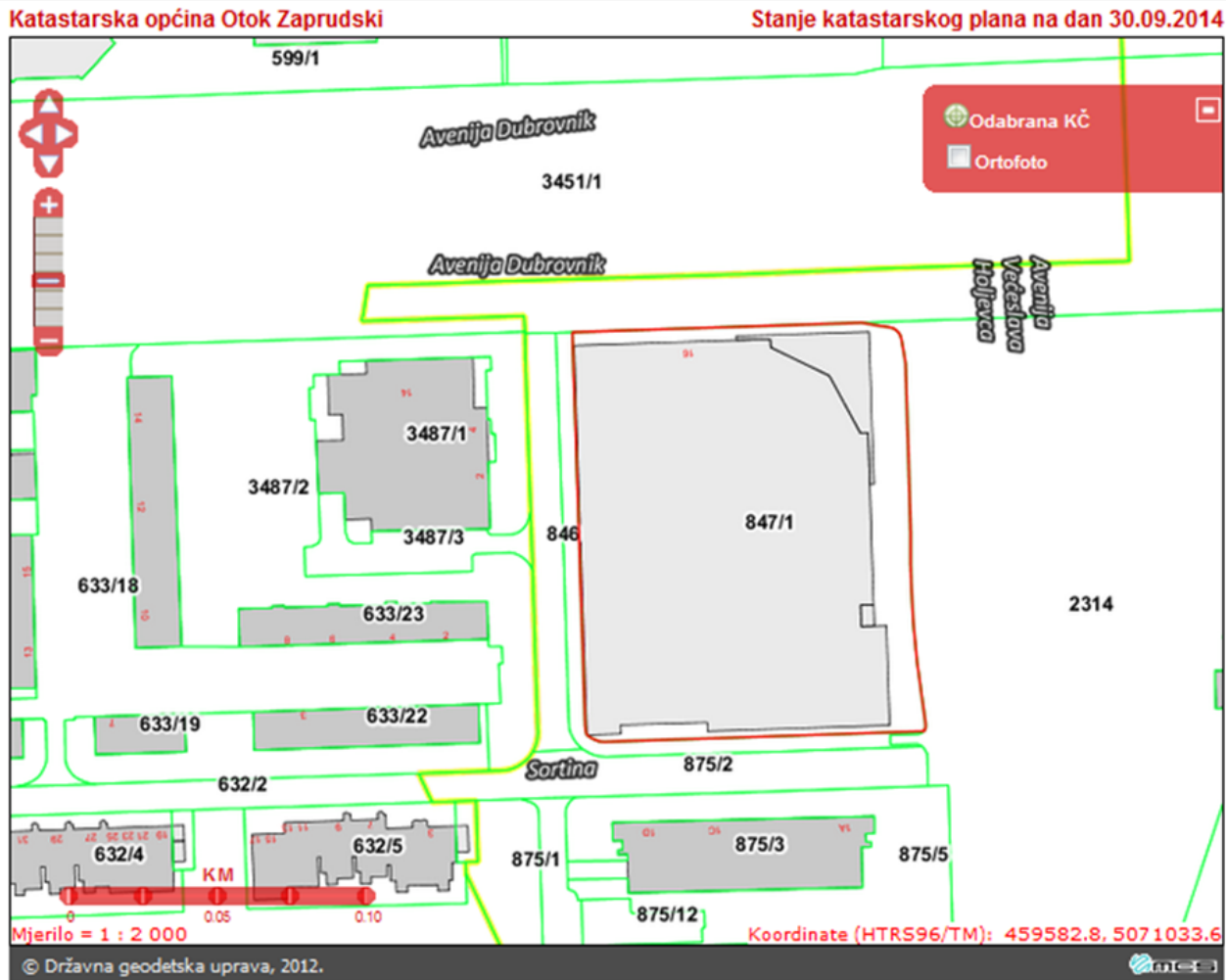


Case study 1 (Avenue Mall, Zagreb) - seven years old office building (shopping center with three underground floors and several levels above ground). The figure acquired from Google Earth shows the land before and after construction

4D cadastral registration

- If we searched for cadastral data in 4D terms, we could get a cadastral map and Digital Orthophoto Map at scale 1:5000, both from period before and after construction. Cadastre and Land book have every spatial information about changes on the land, from undeveloped construction land to registered building with Report on Partition of Real Property. Utility lines attached to the building are also surveyed and recorded in three-dimensional way (X, Y, Z) and time component can be assigned too.

4D Cadastral Registration



Case study 1
(Avenue Mall,
Zagreb) -current
state on digital
cadastral map

4D Cadastral Registration

- Cadastral offices can issue the history of changes in cadastral parcels for variety of purposes, usually in a descriptive form as an official certificate. However, many cadastral offices substantiate standard form with official documentation such as archive cadastral maps, parts of geodetic reports etc. Today almost all Croatian cadastral offices maintain digital cadastral maps overlapped with orthophoto images from different time period, so it is easier and faster to obtain history of changes in spatial terms than it was when cadastral maps were analogue.

4D Cadastral Registration

Case study 2 (building over highway)



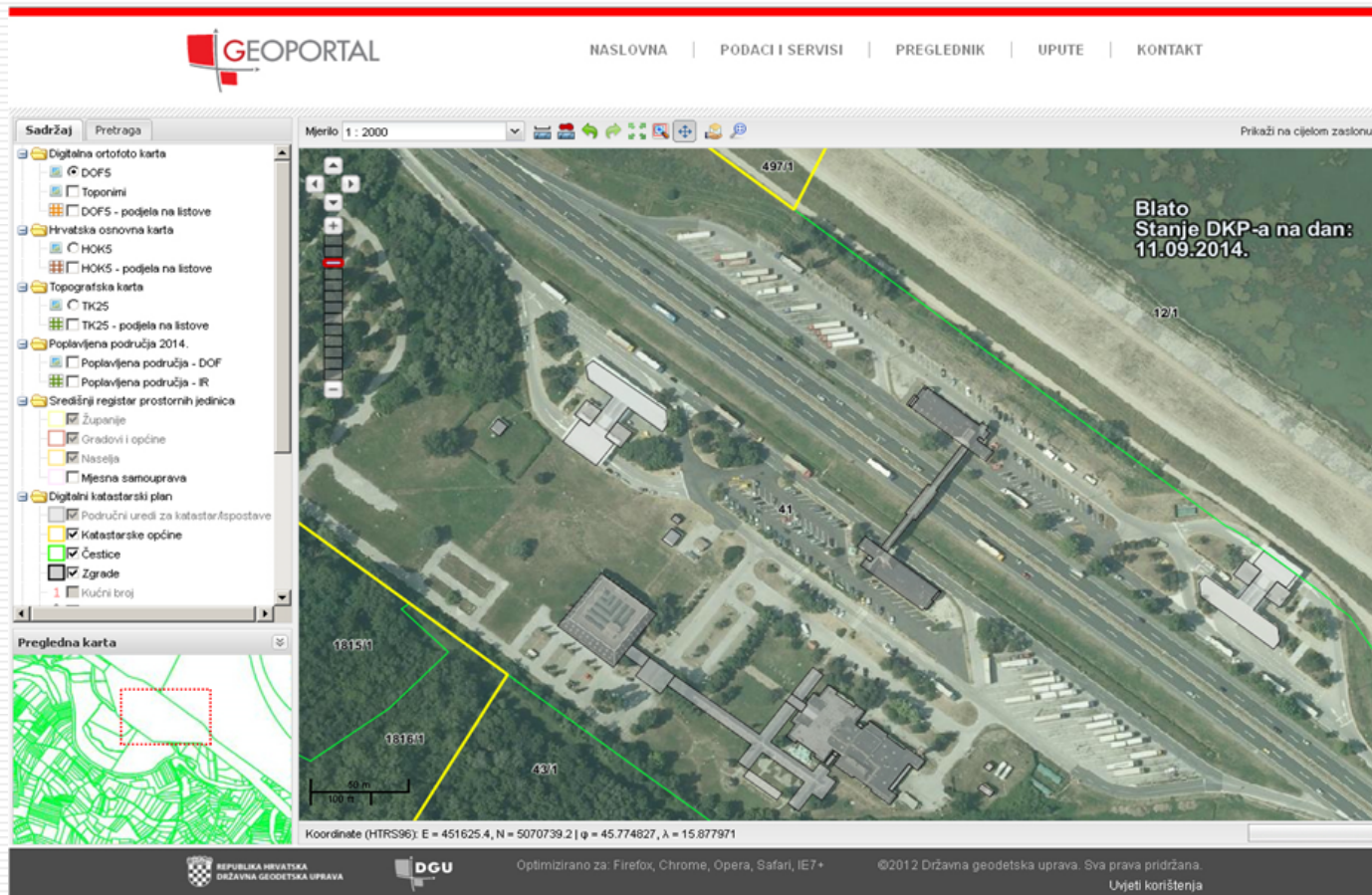
4D Cadastral Registration



Case study (building over highway)

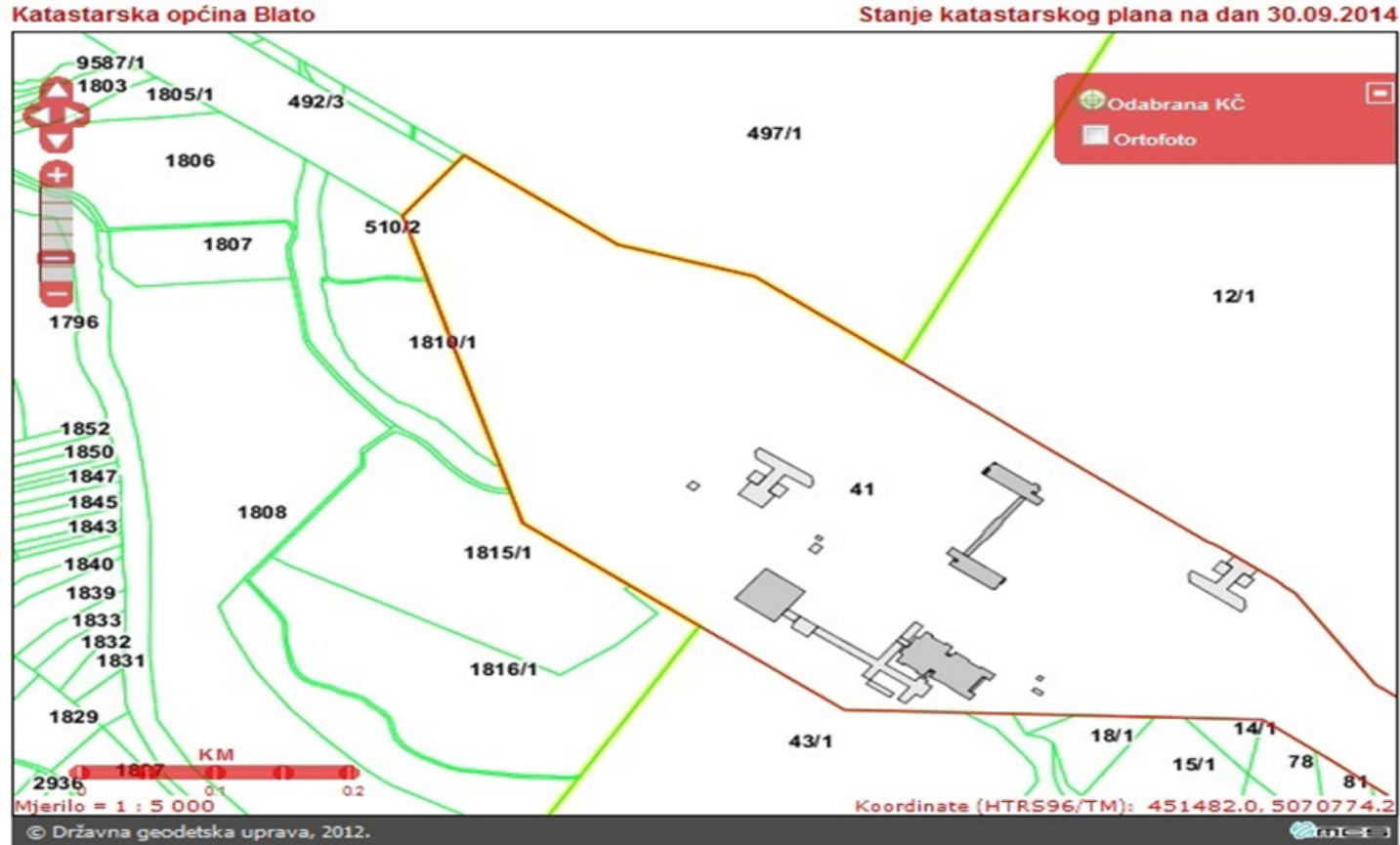
Aero-photogrammetry image from 1968 overlapped with Digital cadastral map

Towards Croatian 4D Cadastre



Case study 2 -
Building over
highway on
SGA Geoportal

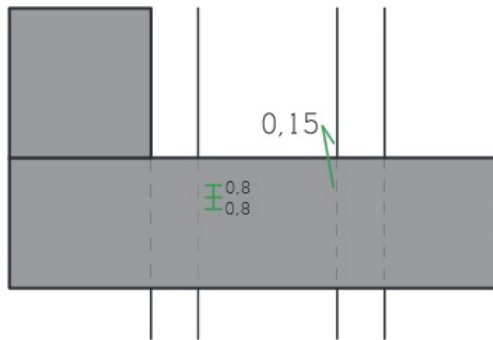
4D Cadastral Registration



Case study 2 -
Digital cadastral
map with building
over highway

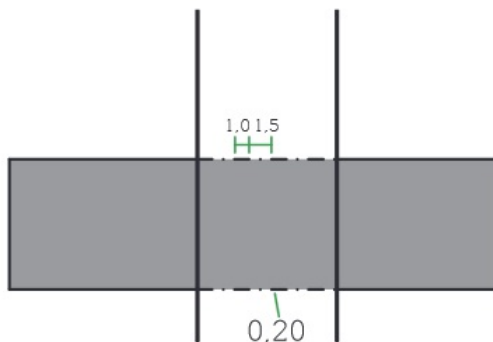
4D Cadastral Registration

2.1.8. Prolaz ispod zgrade **Pass under the building**



**Ordinance on
Cartographic
Signs**

2.1.9. Zgrada nad prometnicom **Building above road**

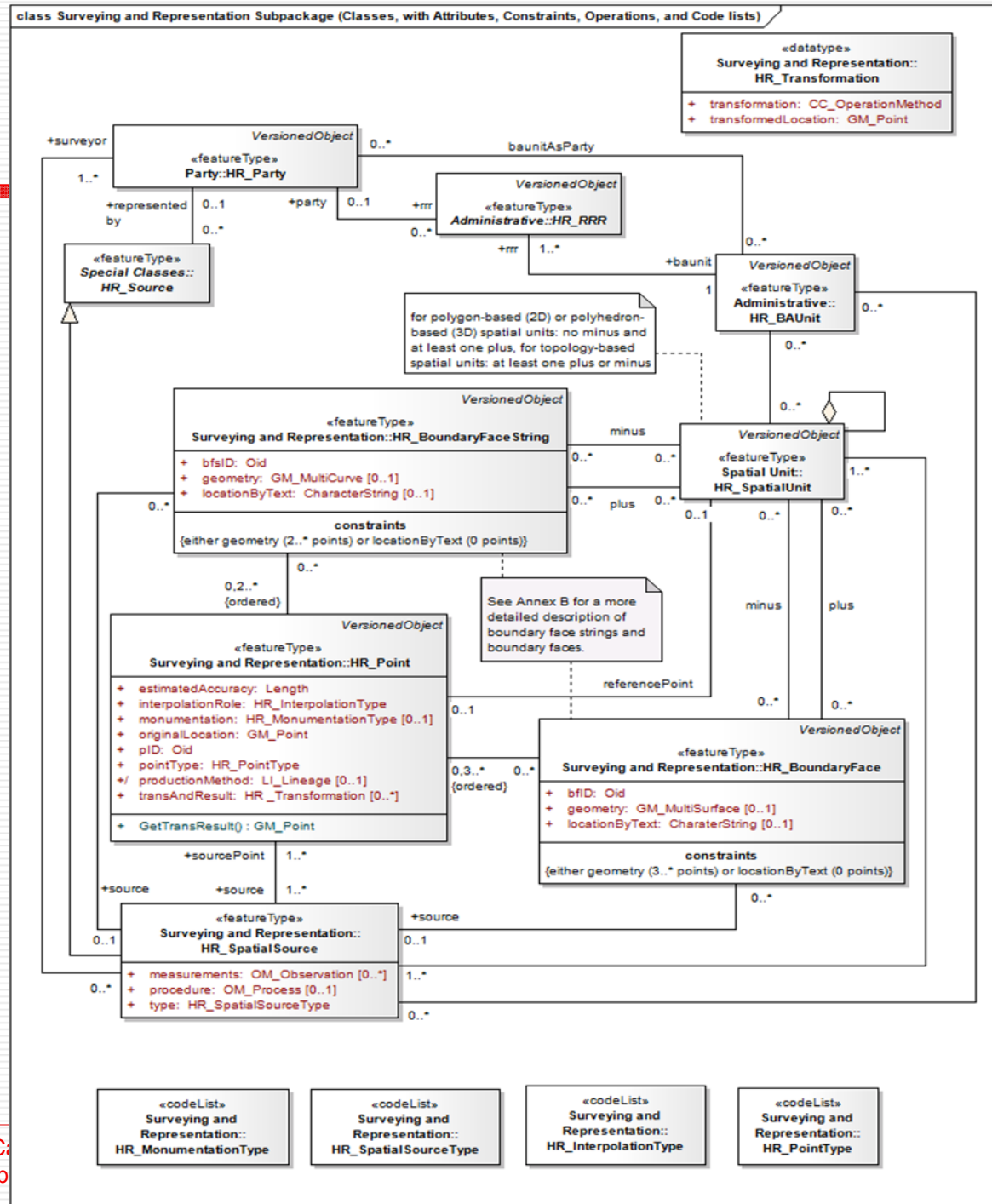


Cartographic sign
for the building
over highway

LADM IN CROATIA

- LADM describes the data contents of land administration in general. Implementation of the LADM can be performed in a flexible way; the standard can be extended and adapted to local situations
- First version of Croatian country LADM profile was developed 2012. It is based on LADM and adds some new classes, attributes and types to the code list
- Most of LADM classes can apply directly to Croatian Land Administration System (LAS). The types in some code lists have been changed and added to suit to the Croatian LAS. Previous researches have been explored in detail; Party Package, Administrative package and Spatial unit package

Surveying and Representation Subpackage in Croatia



CONCLUSION

- The focus must be how to design a spatial data model for 3D and 4D
- Goals of the new Law on Cadastre and State Survey, which is being prepared, are legal regulation of 3D cadastre in the Republic of Croatia (building cadastre), as well as the central repository establishment of Utility cadastre under the authority of the State Geodetic Administration, because Utility cadastre in local government despite statutory obligation from 1999, was not developed in the past 40 years.
- Establishing 3D/4D cadastre is not an easy task as seen in Croatian example and we shall see if it will be accomplished with another new law.

THANK YOU FOR YOUR ATTENTION!

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Cadastres

