

STATE GEODETIC ADMINISTRATION

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# Topographic Signs – Important Context of 3D Cadastre

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# INTRODUCTION

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- Utilities, buildings and infrastructure digital representations are very important set of spatial data for quality and sustainable spatial management and development of community in general. Many countries are on the way of the establishment of the 3D cadastre.
- Existing 2D cadastral systems are able to make gradual transition to 3D cadastre, but for the implementation of real 3D cadastre in many countries it is necessary to change the regulations.
- Modern cadastral systems need to be designed and supported from three dimensional spatial perspectives. For the development of 3D cadastral system of any country a good foundation is ISO 19152, LADM (Land Administration Domain Model)

# INTRODUCTION

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- Determining the height or third coordinate (Z) has never been easier thanks to the use of GNSS technology in geodetic practice.
- Many countries have developed networks of permanent GNSS stations that surveyors use to easily obtain very precise 3D coordinates in real time. This paper describes the complex real world situations (overlapping on same x,y location of natural objects with those built by man) in terms of context that topographical signs can provide in establishment of 3D cadastre.

# INTRODUCTION



# TOPOGRAPHICAL SIGNS

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- A *topographic sign* or *topographic symbol* is cartographic / symbolic representation of a topographic object on map. In combination with other geodetic and cartographic products we can get to very useful information, often quite relevant reference for a **3D cadastre**.



# State Geodetic Administration

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- ***public administration organisation performing administrative and expert tasks in the fields of:***
- geodesy, cartography, cadastre and photogrammetry,
- concerned with the establishment of a national spatial data infrastructure, digitisation of cadastre and geodetic-spatial system, official state mapping (1:5000, 1:25000, 1:100000, 1:200000), geodetic documentation,
- statistical data about real property cadastre,
- spatial units and utilities,
- geodetic-cadastral activities related to the state border,
- National Spatial Data Infrastructure

# SGA Geoportal

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- Croatian State Geodetic Administration (SGA) Geoportal is the central place to access spatial data and one of the basic elements of National Spatial Data Infrastructure.
- In the period 2013-2015 Croatian State Geodetic Administration has implemented EU financed project “Support to the establishment of the components of the Integrated Land Administration System (ILAS) in the State Geodetic Administration - Instrument for Pre-Accession Assistance for Croatia - IPA 2010”.
- Data dissemination was implemented through the use of standard OGC services (WMS, WMTS, WFS and WCS) thus allowing their use in other systems as well.
- Also in this project the migration of alphanumeric database into the new GIS system was done. Around 1.600.000 house numbers and buildings spatially recorded were migrated from previous to the new system.



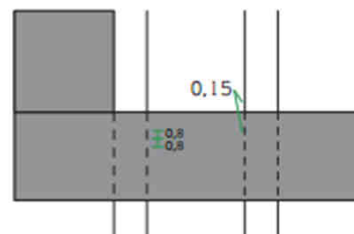
# Buildings (3D situations from real life)

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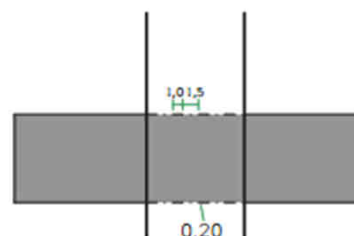
- In Croatian land administration there are special topographic signs for 3D situations such as overlapping buildings with other structures (such as underpasses, overpasses, roads or other parcels with projections (ancones) of building parts).
- **It is important that buildings have been registered in the official registers (cadastre and land registry) in a way that they accurately depict the actual state of real property.**

## Different 3D cadastre situations in Croatian Land Administration System and their official representation on the cadastral maps for scales 1:500 to 1:2000

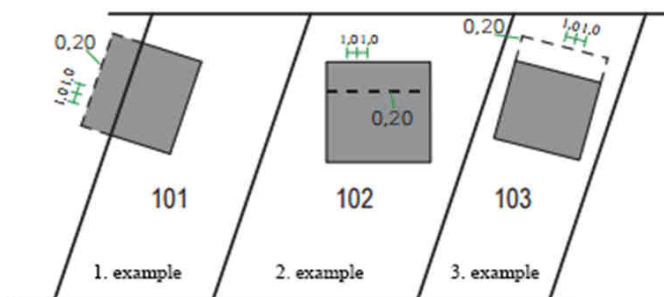
Passage under the building



Building over the road

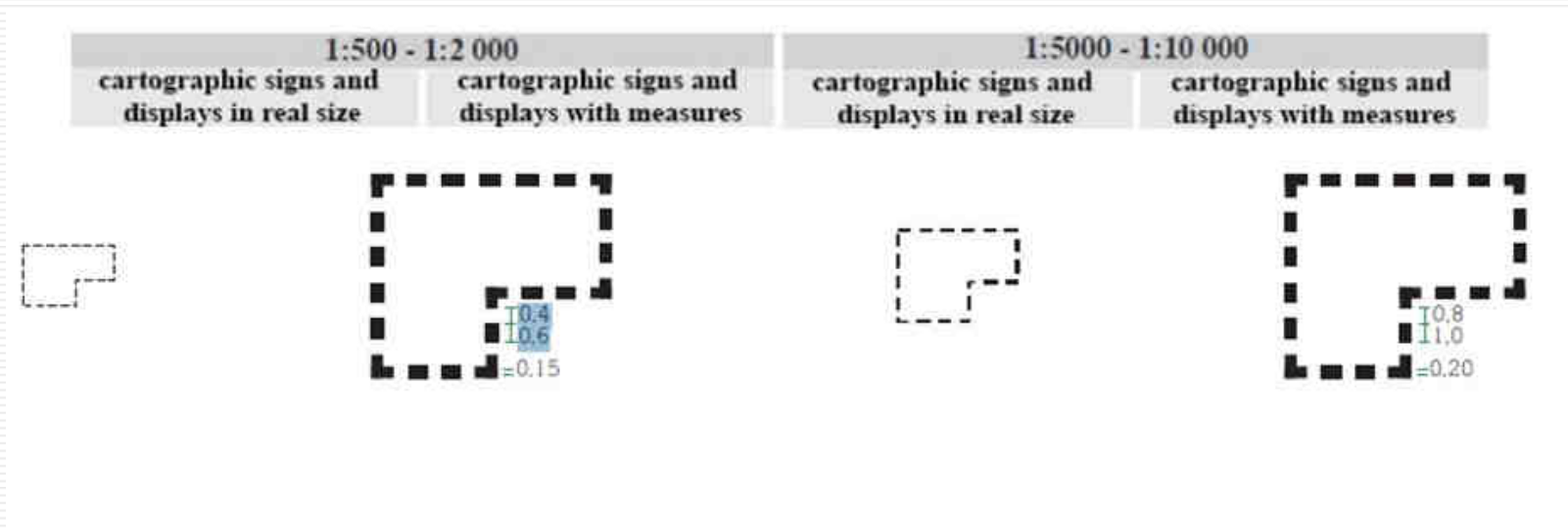


Building with ancon



# Underground building

- There are special signs that represent underground buildings on cadastral and topographic maps. Cadastre can register underground buildings only on the cadastral maps and in the land database, **but without area information, while in the land registry area can be registered.**
- State Geodetic Administration of the Republic of Croatia is considering a new regulations which will be able to register underground buildings with area and other attributes into the cadastre.



# STUDY OF BUILDING CADASTRE

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- STUDY FINISHED 14<sup>th</sup> October 2016
- One of the strategic objectives of the State Geodetic Administration is establishment of multipurpose registration of buildings to provide such data and information. Implementation study of the registration of buildings should answer:
  - I. *how to establish institutional, legislative and financial framework*
  - II. *propose the structure of the data model and technical standard for the information system of such cadastre.*
  - III. *Provide short-term and long-term strategic guidelines regarding system architecture, data model, specific needs of stakeholders, required legislation,*
  - IV. *Provide the benefits delivered by such system and financial resources needed for its establishment and maintenance*
- Plan is: move fast and forward and make and implement building cadastre as soon as possible

# Bridges

1:500 - 1:2 000		1:5000 - 1:10 000	
cartographic signs and displays in real size	cartographic signs and displays with measures	cartographic signs and displays in real size	cartographic signs and displays with measures
<b>Stone and concrete bridge</b>			
<b>Iron bridge</b>			
<b>Pontoon bridge</b>			
<b>Drawbridge</b>			
<b>Footbridge</b>			

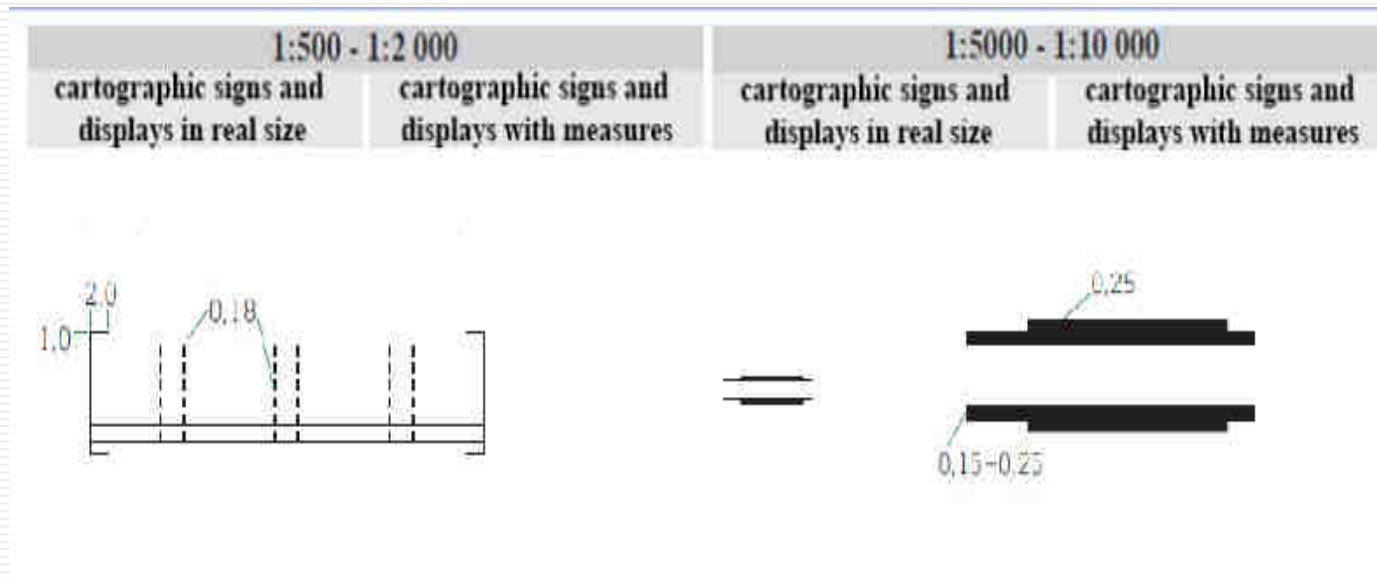
# Other real life 3D situations

1:500 - 1:2 000		1:5000 - 1:10 000	
cartographic signs and displays in real size	cartographic signs and displays with measures	cartographic signs and displays in real size	cartographic signs and displays with measures
Pedestrian passage over roads			
- over the road			
- under the road			

## Pedestrian passages in 3D cadastre

# Other real life 3D situations

Road viaducts (overpasses) are often found on highways and junctions near highways. There are also often found in cities.



## Road viaducts (overpasses) in 3D cadastre

# LINK BETWEEN TOPOGRAPHICAL DATA AND CADASTRAL DATA

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- The base register for large scale topography forms an excellent context for 3D cadastral solutions as the 3D cadastral parcels (3D legal spaces) are often related to (planned) physical objects; such as buildings, tunnels, pipelines and other constructions. For reference purposes the 3D legal objects and their 3D physical counterparts should be associated. This implies two aspects:
  - I. the 3D physical object descriptions (topographic objects) should exist, which is not obvious as in most countries the large scale topographic base map is still 2D, and
  - II. the topographic objects should be usable and reference-able even when the data is maintained by other organizations.



# Case study 1 - tunnel

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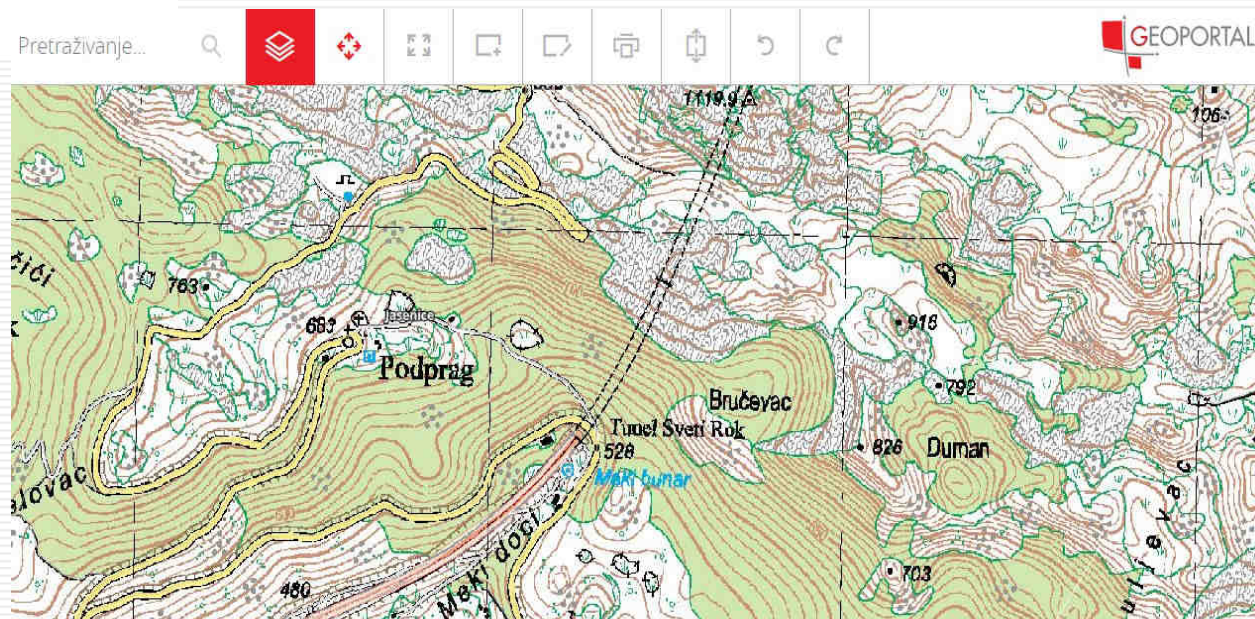
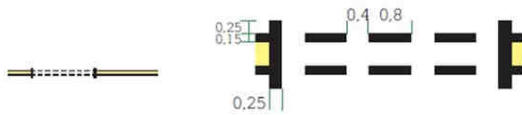
Sveti (eng. Saint) Rok tunnel is a double-tube tunnel located on the Sveti Rok - Maslenica Section on the Zagreb - Split - Dubrovnik Motorway. The length of the left tunnel tube is 5,679 m and the length of the right one is 5,670 m. The traffic flow runs through both tubes, separately for each traffic direction. The north tunnel portal is placed at 561 m above sea level and the south portal at 510 m above sea. The tunnel passes through Velebit mountain.

# Case study 1 - tunnel



# Case study 1 - tunnel

Topographic sign for the road tunnel (for scales 1:20000 to 1:25000)



Tunnel on the Croatian State Geodetic Administration Geoport (layer: Topographic Map 1:25000)

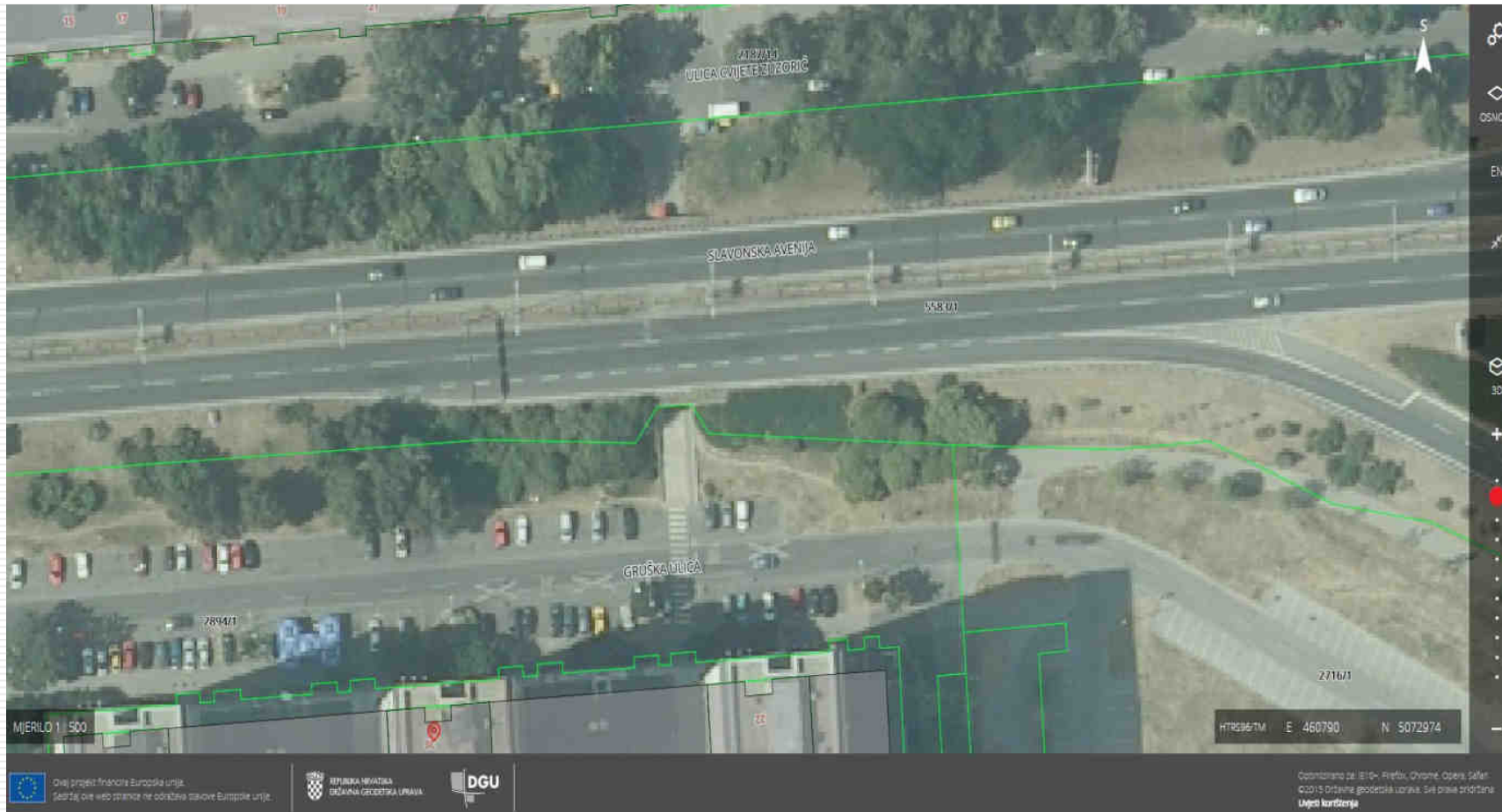
# Case study 2 – pedestrian passage under the road

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Pedestrian passage under the street, Zagreb, Savica (source: [www.d-a-z.hr](http://www.d-a-z.hr))

# Case study 2 – pedestrian passage under the road



**Pedestrian passage under the road, Zagreb, Savica – on the SGA Geoprtal - digital orthophoto image overlapped with digital cadastral map**

# GNSS

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- Determining the height of GNSS-leveling with positional surveying (coordinate: X, Y) can significantly contribute to future registration of tunnels in the official registers (cadastre and land registry) because the registration in the cadastre usually requires less accuracy than is provided for the engineering geodesy. Certainly GNSS-leveling is suitable for surveying entry and exit of tunnel portal, while for surveying the interior of the tunnel is still necessary to use the terrestrial surveying methods.
- Also the registration of bridges in the cadastre usually requires less accuracy than is provided for the engineering geodesy and we can conclude that network-based real-time kinematic GNSS method is optimal for the spatial registration of bridges in the official registers (cadastre and land registry).

# CONCLUSION

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- The real world, physical, objects as included with specific signs (cartographic symbols) on topographic maps, prove the context/reference for the legal spaces. This is true for both the 2D, but perhaps even more for the 3D case. Performing an overlay, if needed after proper orientation, it is easy to combine geodetic and cartographic products in today's digital environment (eg. SGA Geoportal).
- Special attention is needed for the tunnels, overpasses, underpasses, bridges and other objects to be registered in 3D cadastre because their 2D cadastral description does not meet the needs of modern society.

# CONCLUSION

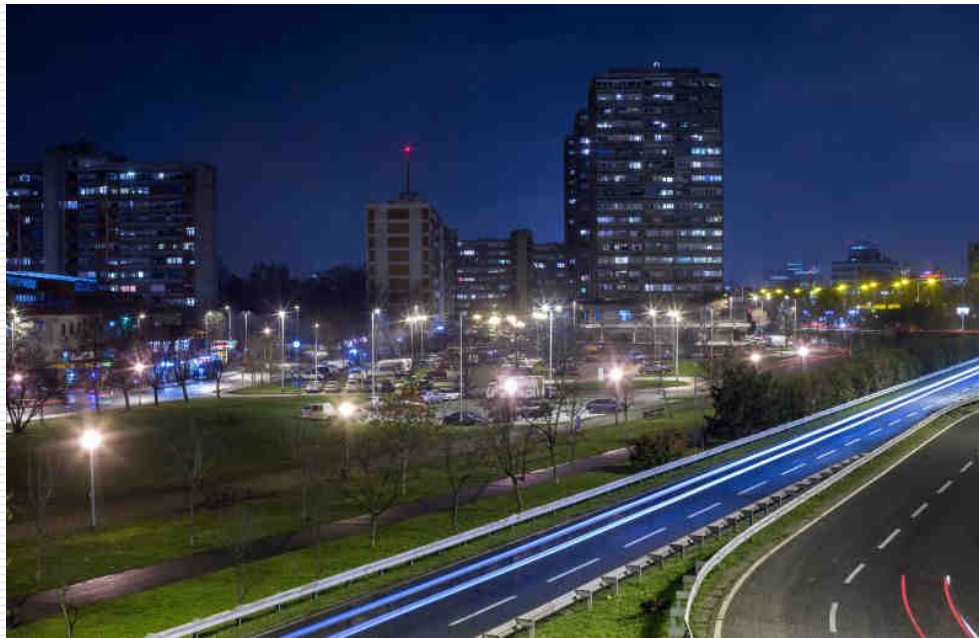
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- In case of 3D topographic data (e.g. 3D CityGML model), then it would also well possible to use this into 3D cadastre and combine 3D legal spaces with the 3D real world items from the 3D topographical model.
- This spatial overlay based combination/integration is usually not feasible with the cadastral plans (survey plans, field sketches) as those are not draws to scale (in both 2D and 3D).
- They need explicit (manual) links to relate these 3D legal spaces with the 3D real world items.



# THANK YOU FOR YOUR ATTENTION!

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source: PIXELL

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