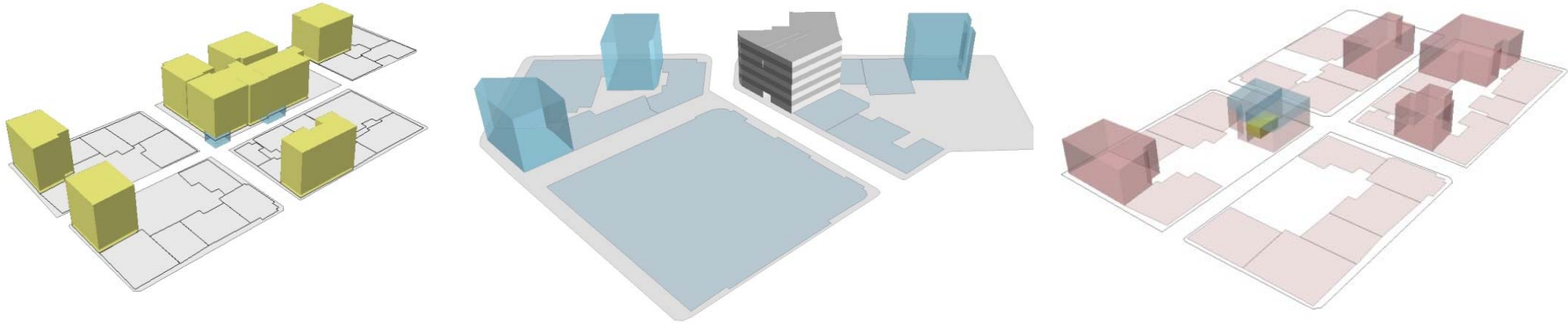
Adjusting the 2D Hellenic Cadastre to the Complex 3D World: Constraints and Possibilities



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Hellenic Cadastre Project

Information on property objects:

- In reference with the land parcel
- Analyzed on the two dimensions of real objects

Although:

- 3D registration has become an imperative need in order to reflect complex cases of multilayer reality of property rights
- Developments in social, technological and economical aspects of modern life require cadastral systems with 3D enabled geometrical and topological models

Finally:

2D registration systems can no longer portray the contemporary and evolving more complex –structured environment, in which cases of development and multiple use of space, as well as the layered distribution of rights is prevalent

Need for 3D Registration

Cases requiring 3D registration :

- ✓ Overlapping Private and Public Properties
- ✓ Special Real Property Objects
- ✓ Overlapping Private Properties
- ✓ Unconventional exploitation of multi-level buildings
- ✓ Condominium rights
- ✓ Infrastructures

Need for 3D Registration

The registration of the 3rd dimension by the H.C. is a necessity considering:

- the intense relief and the inadequate area of Greek land combined with increasing urbanization ⟹ complex constructions and entanglement of property areas
- the historical value of the Greek land ⟹ modern settlements are built on ancients cities
- the registration of Special Real Property Objects and of customary property rights
- the contradictions in Greek legislation concerning 3D objects
- urban planning purposes ⟹ detecting infringements of General Building Code (GBC)
- fiscal and real estate considerations ⟹ high land value in urban and commercial areas

Legal Framework

Laws concerning the registration of private property:

- "superficies solo cedit" in the Roman law: whatever is positioned above or below the surface of the earth belongs to the holder of the related land-parcel(article 954 C.C.)

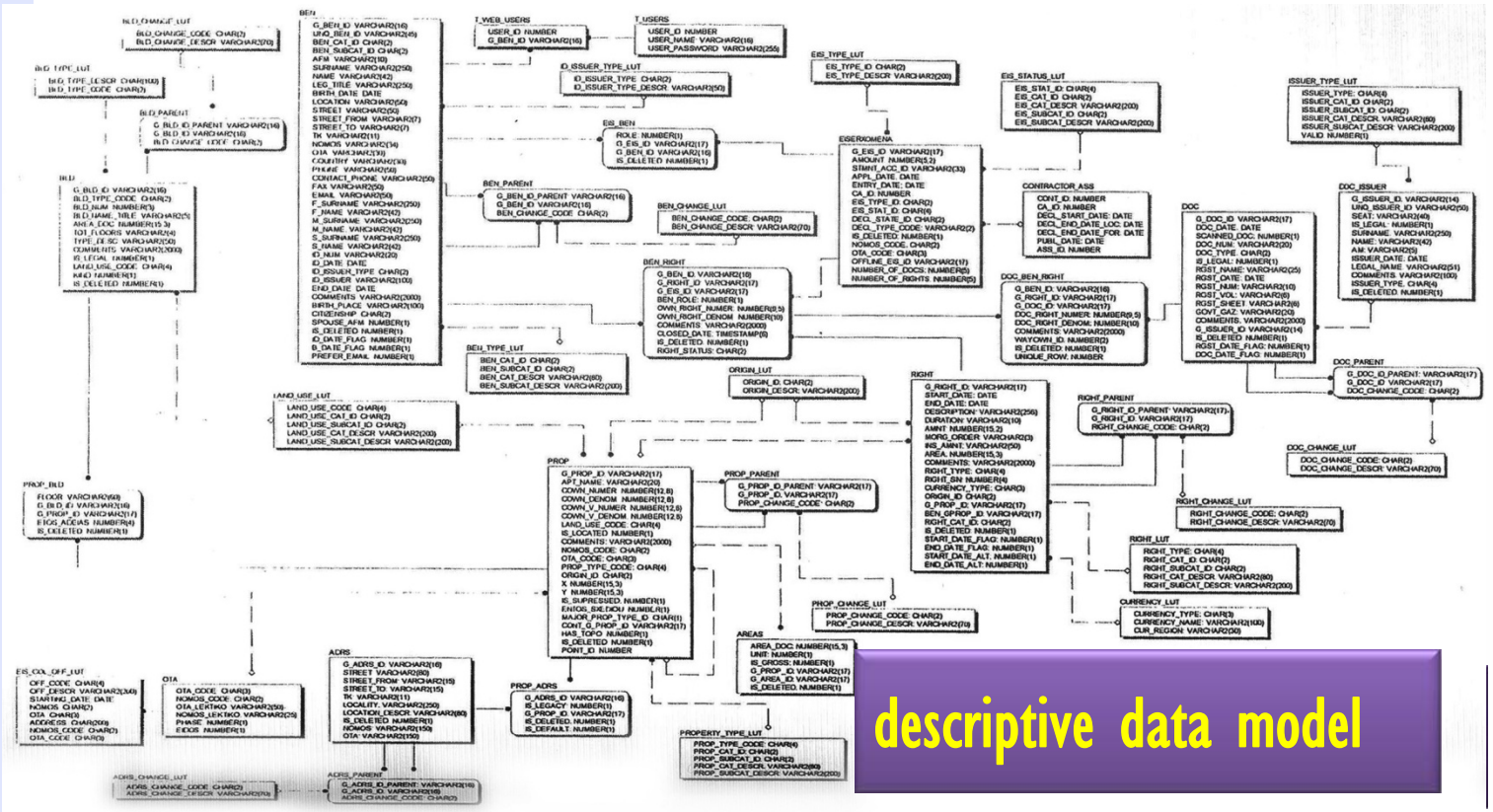
Exceptions to the "superficies solo cedit" principle :

- Law 3741/1929 (article 1002 C.C) :"about ownership per floors", which has determined the fundamental principles of the "horizontal ownership", as well as Law about "Mines' ownership"
- Article 1010 C.C : building party on an outland real estate
- Articles 1118-1141 C.C. : Land interests, such as various servitudes, provide the benefit of holding a part of foreign land
- Customary law : controls legal relations on ownership rights, such as joint properties, implantation privileges, constructions on foreign parcels

Hellenic Cadastre – Data model

Conceptual model:

- Organized on the scheme (person-right-real estate object)
- Parcel based which additionally contains rights applying on the parcel
- Designed using Entity-Relationship diagrams (E-R)



Hellenic Cadastre – Data model

Logical model:

- DBMS Oracle 10g
- Relational model
- Contains additional object-oriented applications

Cadastral Database:

Data are organized into logical sections:

- Digital spatial database: Thresholds of administrative division, land-parcels, buildings, mines, sites of exclusive use, easements, platforms (True-orthophotos, DSM, topographic drawings)
- Digital descriptive database: registered rights and titles, beneficiaries, operations, requests, right-objects

Hellenic Cadastre: Reality and Constraints

The Hellenic Cadastre is responsible for registering:

- Condominium
- Vertical ownership
- Composite vertical property
- Special Real Property Objects (SRPO) and
- Mines

These objects can only be portrayed by making use of the third dimension which enables their location on, below or over the earth's surface

The HC project defines directly or indirectly these objects' third dimension either by descriptive or spatial means, however only SRPO are manipulated as true 3D cases

Furthermore there are certain drawbacks concerning matters of registration and representation of these objects, which cause further confusion

Hellenic Cadastre: Reality and Constraints

✓Registration of Buildings

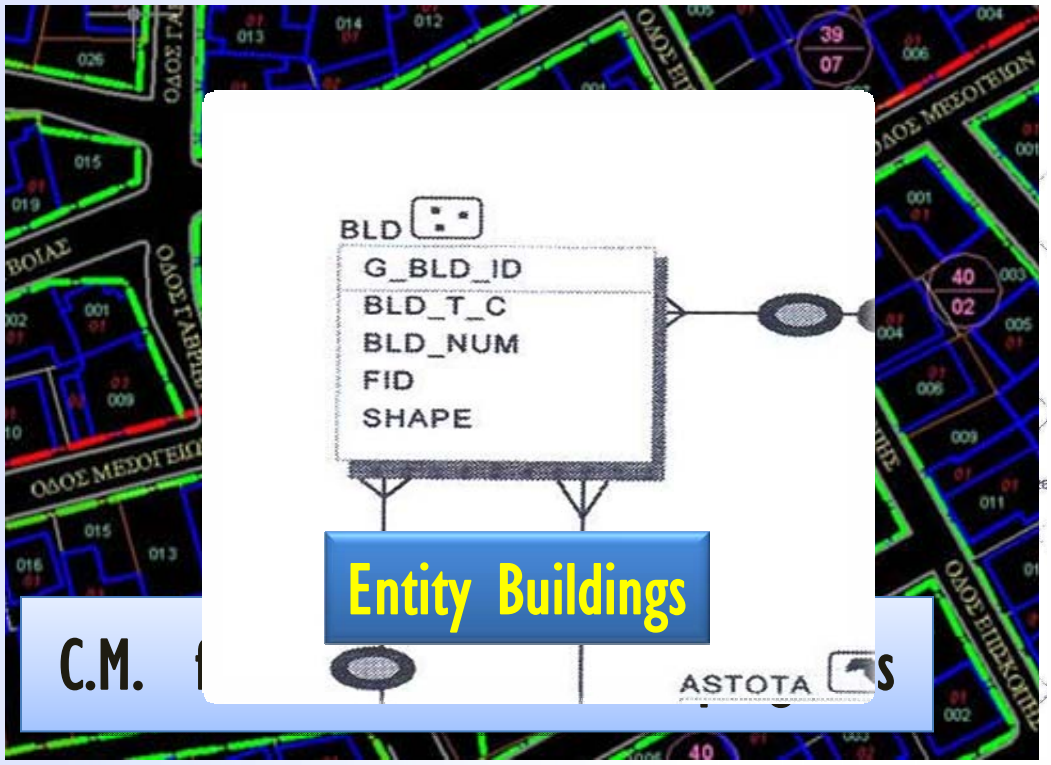
- Legal information of buildings was and still is registered, but it was recently decided by the responsible organization (Ktimatologio S.A.) not to depict the building's outlines on the cadastral maps

Reasons

✓ To avoid legitimizing the arbitrary constructions of any use

✓ Collecting and updating information related to buildings is a long-lasting and expensive process.

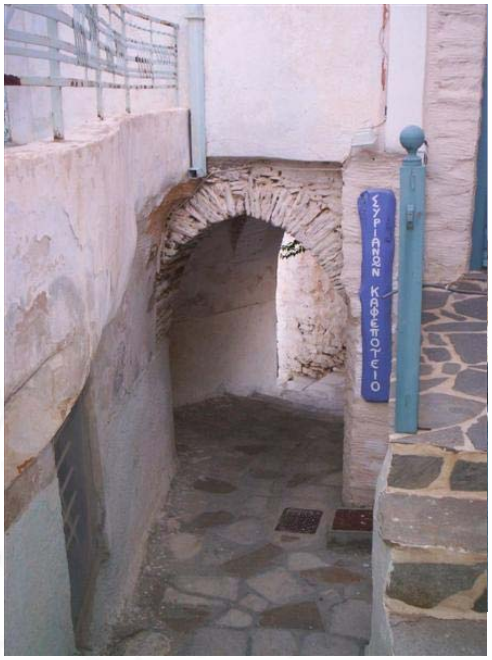
- Spatial model contains an extra entity related to buildings, but this function has not been enabled yet



Hellenic Cadastre: Reality and Constraints

✓ Registration of Special Real Property Objects (SRPO)

- SRPO concern a plethora of objects, characterized by multiple and complex topological relations applying between various properties
- Usually they have no percentage of ownership on the corresponding land-parcel
- Most common in Aegean islands



Arches

Hellenic Cadastre: Reality and Constraints

- According to the H.C. project, they are manipulated as descriptive information in a a topological matrix which includes the description of these objects in a structured manner using words such as ”above” or ”below”

- During the cadastral survey, the surveyors contractors who had been assigned by the H.C. to depict these objects were forced to attach this topological matrix to the deliverables of the survey

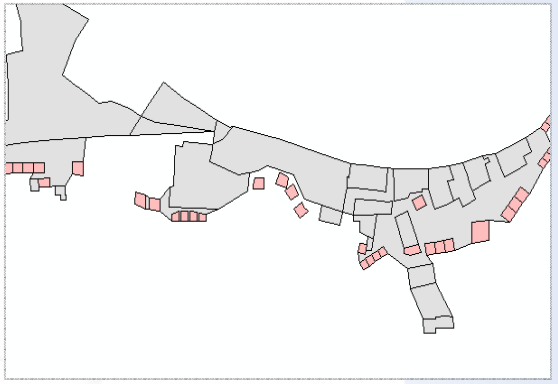
- No other specifications related to the registration of the S.R.P.O. were provided by the H.C., therefore surveyors manipulated various methods to obtain the required information related to these items

Hellenic Cadastre: Reality and Constraints

Methods:

1.Topological matrix with spatial depiction

In this case SRPO are described with a 12-digit Cadastral Number while they can be traced on the cadastral maps using polygons in a different thematic layer than the parcels



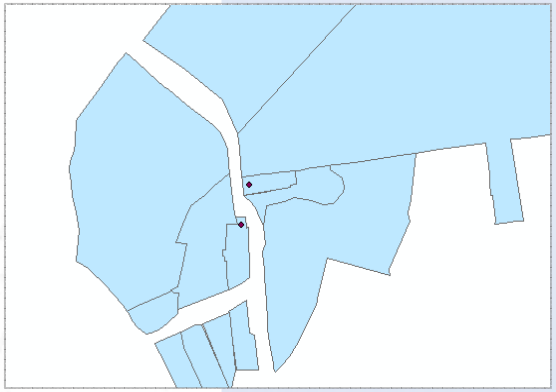
2.Topological matrix but no spatial representation

In this case SRPO are described with a 12-digit Cadastral Number accompanied by a special comment, indicating and relating the cadastral numbers of the other parcels, with which they are involved

Hellenic Cadastre: Reality and Constraints

3.Topological matrix with rudimentary spatial information

In this case SRPO with no percentage of ownership on the land-parcel are described with a 12-digit Cadastral Number and they can be traced in the cadastral map as points which represent servitudes, entries etc

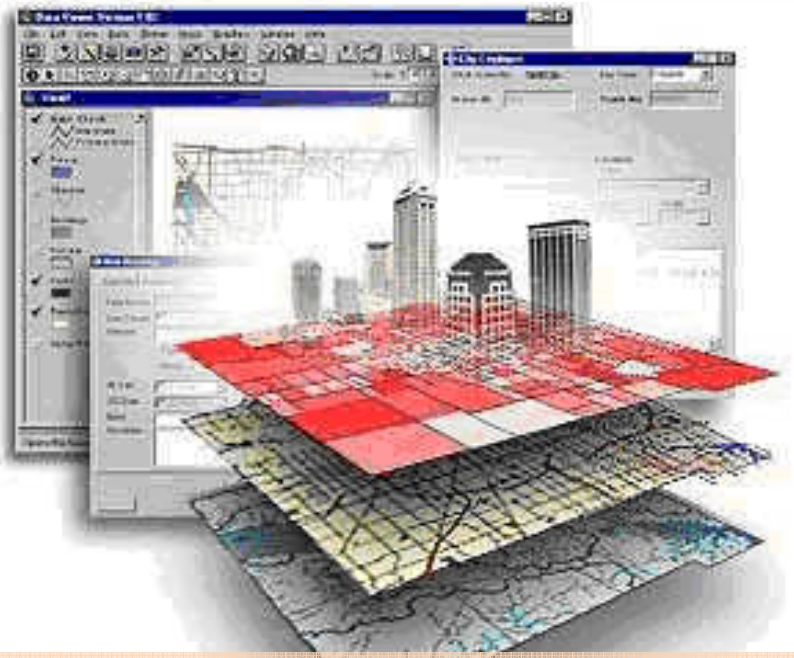


4.Surveyors didn't deliver the topological matrix

In this case SRPO are described with a 12-digit Cadastral Number, which is limited information

Future plans

The future plans of the H.C. project advocate for the resolution of the above issues and the improvement of the cadastral model in order to depict the complex three dimensional reality:



- Cooperation with the Ministry of Environment and Development and the Hellenic Technical Chamber for the spatial depiction of buildings
- Further study of international experience such as the Cyprus Cadastre in order to resolve issues related to the conclusiveness of the Greek Cadastre as well as the principles of e-Government and maintenance of data
- Consideration of LADM (Land Administration Domain Model) which supports the manipulation of 3D data and possible implementation, in respect with the Greek cadastral model in the near future

A first attempt from 2D ⟹ 3D

The hybrid 3D model seems to be feasible and the optimal solution for the HC

A hybrid conceptual model involves the maintaining of the current 2D Cadastre, while simultaneously incorporating the registration of three dimensional cases

Based on international experience (e.g. the Netherlands) we implement a prototype of a 3D Cadastre, in which, rights established on 2D parcels can be represented in 3D, improving accordingly, the insight on the vertical component of the rights *(Stoter and Ploeger, 2002)*

These are acquainted as 3D right-objects or 3D right-volumes, they are a three dimensional representation of rights on two dimensional land parcels and they constitute 3D registration of rights

A first attempt from 2D ⟹ 3D

✓ Objective

The main objective of our research work is the smooth and inexpensive transition of the 2D Greek Cadastral Model to a hybrid 3D model

✓ Data

- Adequate data provided by the Hellenic Cadastre were collected (parcel shapefile, SRPO shapefile, DSM, VLSO, LSO)
- Additional information was collected provided by Land Registries, deeds, surveying plans, architectural plans etc in order to avoid surveying processes and further costs

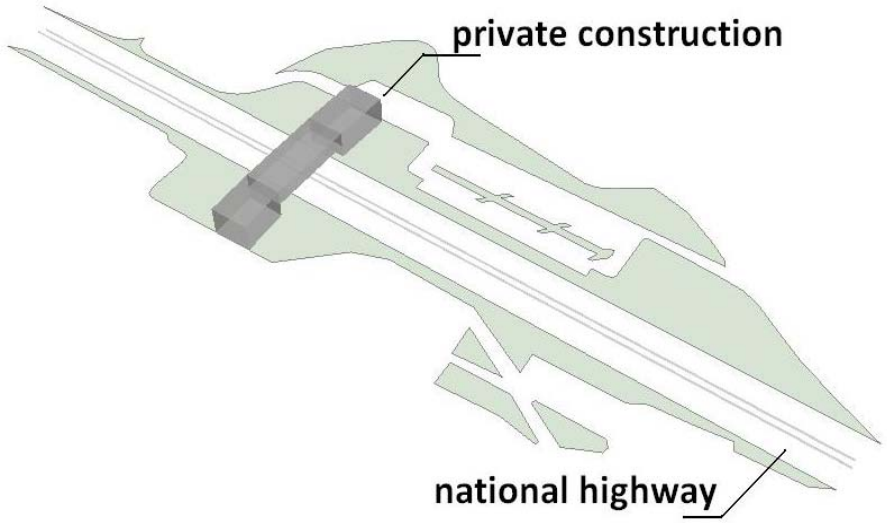
It is very important to consider the cost of this transition, therefore it is necessary to make a cost-effectiveness analysis as a first step.

✓ Examples

The proposed procedures along with final results are illustrated in the following examples which are modified within the ArcGIS environment

Case I-Overlapping private and public properties

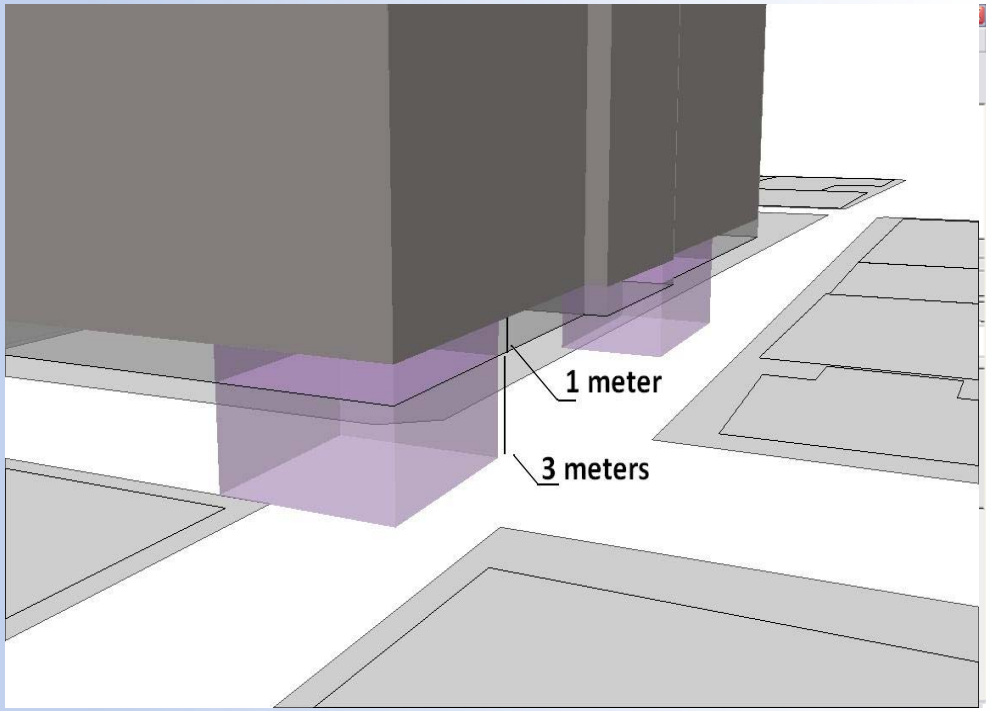
- VLSO were used as backgrounds, to create the constructions' footprints
- Field "height" was added in the attribute table in Arcgis
- Height information was exported from architectural plan and a list with z-values was provided in Arcgis in order to create the construction's volume



A typical case of a private construction over a public property. The main concern is the display of the allocation of rights, not the exact representation of the physical object's shape

Case 2- Privately-owned semi-basement shops

- Data were exported from the parcels' Shapefile
- VLSO were used as backgrounds, to create the constructions' footprints
- The shops outlines were depicted using the coordinates by floor plans
- Field "height" was added in the attribute table in Arcgis
- Height information was exported from floor plans but we posed a conceptual height of 3 meters in order to create the shops' volume

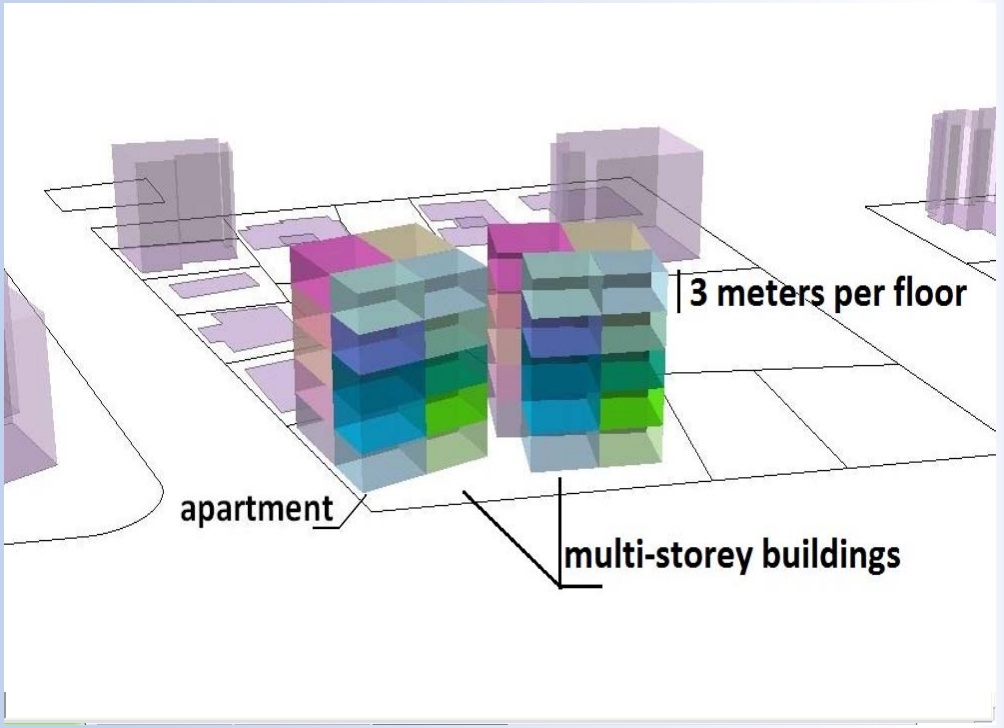


Typical case of condominium.

We posed a conceptual height of 3 meters for the underground part and 1 meter for the over ground part as most stores of this type exceed 1 meter from the ground

Case 3- Multi-storey buildings

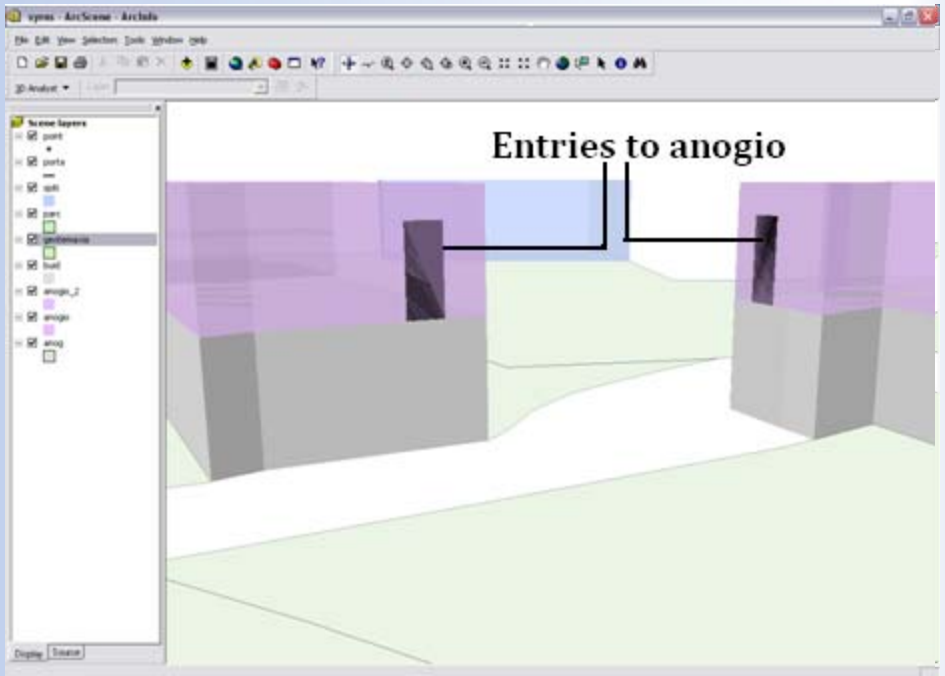
- Data were exported from the parcels' Shapefile
- VLSO were used as backgrounds, to create the buildings' footprints
- Field "height" was added in the attribute table in Arcgis
- Number of storeys was available from deeds
- Posed 3 meters per floor in order to create the building's volume



Typical example of apartment rights. The use of different colors, results in displaying the allocation of different apartment rights in the vertical component

Case 4- Anogia

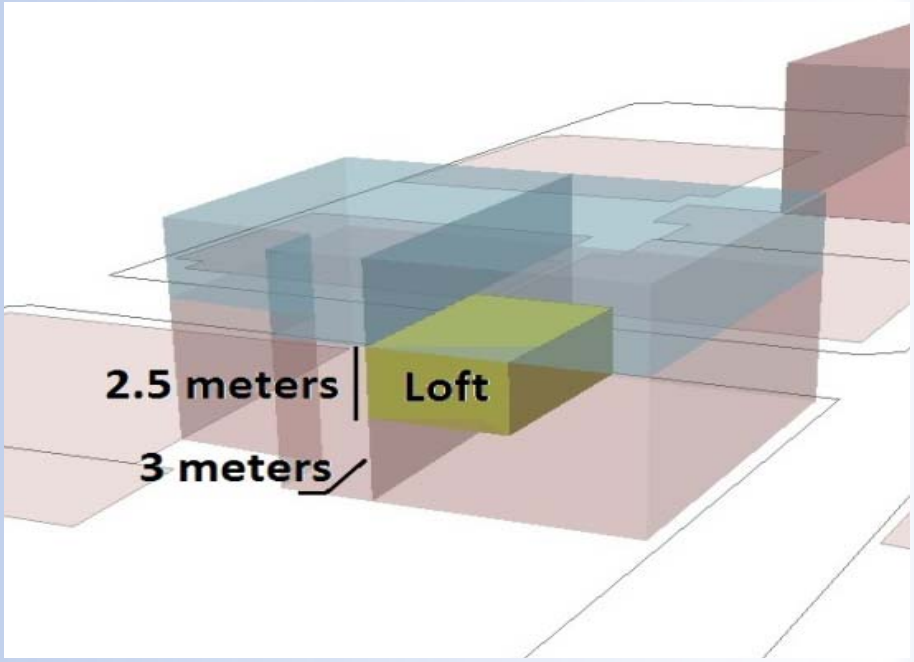
- Data were exported from the parcels' Shapefile
- Selected data (points and polygons) were exported from the SRPO' s Shapefile
- Field "height" was added in the attribute table in Arcgis
- Relational heights were exported from topological matrix provided by the HC
- Import in Arcgis comparable heights to the properties in order to create the house's volume



Anogia are a characteristic case of Special Real Property objects
They are high-level constructions built, very common on Greek islands and traditional villages
Entries to anogia were previously points on the 2D cadastral map

Case 5- Privately-owned store with loft

- Data were exported from the parcels' Shapefile
- VLSO were used as backgrounds, to create the constructions' footprints
- The loft's outlines were designed using the coordinates from floor plans
- Add field "height" in the attribute table in Arcgis
- Export height information from floor plans and a list with z-values was provided in Arcgis in order to create the loft's as well as the building's volume



A characteristic case of unconventional exploitation of a multilevel building

CONCLUSIONS

- Greek Cadastre has a lot of issues to resolve in order to be able to adopt aspects of the 3D reality in the future
- Legal, economical and technical aspects of the Greek reality must be taken into account

Legal aspect:

- No existing legislation stipulating the three dimensional description of objects, even in a 2D way
- Contradictions in Greek legislation concerning 3D objects

Economical aspect:

Considering the cost of this transition, we ought to be careful and precise when planning and designing the new model. It is necessary to make a cost-effectiveness analysis in advance

Technical aspect:

- The hybrid model seems to be a feasible solution for the Greek case

Main drawback concerning the development of the Hellenic Cadastre is that it has a strong legal base and is bounded by legal restrictions, therefore researches concerning the manipulation of 3D cases must include the consideration of both the technical and the conflicting legal aspect

Thank you for your attention!