

3D Registrations in the Hellenic Cadastre

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SUMMARY

In Greece, a cadastral project is in progress. Within this project, cadastral registration is based on the 2D parcel and therefore is unsuitable for representing some cases of multiple use of space or of separate ownership rights above or under the reference cadastral surface. This reflects to inadequately registering the multilayer reality of property rights. Moreover, the emergence of new technologies in 3D modelling, analysis and visualization seems rather challenging, to extend current cadastral registrations, in order to improve understanding of complex property situations.

This paper presents a methodology so that registrations in the ongoing Hellenic Cadastral (HC) project better reflect property rights and restrictions. The present study starts with the description of the existing institutional and legislative framework for cadastral registrations within the HC project and the associating problems. The study refers on complex cases where the third dimension is required, to improve insight into these 3D situations.

The international experience and practice so far, are also considered, along with the HC's database logical and physical data model, regarding the manner in which it could be extended to 3D objects, when required. This may necessitate some transformations and adjustments to support new data types and lengths for 3D registrations. In addition, the registration of 3D cases also requires some modifications to the way the relevant cadastral information is collected, by adding e.g. the vertical dimension and details needed for 3D visualization.

For the present research, characteristic cases of complex property rights and restrictions, within an evolving urban environment were examined. The study results in a conceptual model and recommendations for 3D extension of current cadastral registrations, to enable the registration of properties that are not on the cadastral surface, thus improving the insight to the constanly increasing multilayer activities.

1. INTRODUCTION

In recent years, an expanding growth of the building environment is taking place in Greece, based on changing legal regulations and accompanied by an increased “unconventional” mixture of privately and jointly owned parts of land and public properties (such as, infrastructures in subterranean areas and above the existing surface constructions).

A modern cadastral system should always reflect the existing situation of all property rights, including the above-mentioned mixture of private and public properties. This provides better means for a rationalized management of the built environment, including regulations of legality of use or of economic applications. In order to better represent this evolving reality, it is necessary to develop a case driven 3D cadastre. Of course there is no unique solution to the problem of defining and referencing these multilayer activities or complex property rights. Each country should develop its own solution that meets its own needs. According to the Guidelines on Real Property, provided by UN/ECE (2004), most European countries define the parcel as extending from the center of the Earth to the ‘sky’, although some countries limit private ownership to certain levels. Hence parcel boundaries are in reality not lines on the ground but vertical planes. The boundary lines that are marked on the ground are where these vertical planes intersect the surface of the Earth. Depending on the jurisdiction, the definition of land may or may not include all things attached to it such as buildings on the surface, or vegetation growing on it, or minerals below the ground. Most cadastres, however, in effect regard the Earth as flat and record land in two dimensions.

Current cadastral registration systems, based on 2D topological and geometrically described parcels, have shown limitations in providing insight in (the 2D and 3D) location of 3D constructions (e.g. pipelines, tunnels, building complexes) and in the vertical dimension (depth and height) of rights established for 3D constructions (Stoter and Ploeger, 2002; Stoter and Ploeger, 2003).

2. LEGAL FRAMEWORK

2.1 Rights in Real Property

In Greece, the Property law, as part of the Greek Civil Code, regulates the main issues related to ownership. Apart from the Civil Code, other Greek Codes (e.g., Code of Civil Procedure, Commercial Law, etc.) and various special laws (such as laws “on ownership per floors”, “on compulsory expropriations”, or “on the provision of mines, caves and archaeological sites) contain rules regarding property rights. Some recent reforms affecting real estate property in Greece are more associated with environmental issues, residential needs and better land organization, within the framework of information society, and of course the ongoing project of the Hellenic Cadastre, which will undertake the registration of all real property in Greece according to Laws 2308/1995, 2508/1997, 2664/1998 and 3127/2003.

Under the Greek legislation, whatever lies above or beneath the surface of the earth (with the exception of some mines), belongs to the owner of the corresponding land-parcel. Therefore, the ownership of a part of land generally includes all the buildings that have been constructed on it (article 954 C.C.). An exception to this principle consists the establishment of horizontal and vertical property according to article 1002 C.C. in combination to L.3741/29 “on property per floor” and to the Legislative Decree 1024/1971 “on divided property” on buildings that are built on a uniform plot” correspondingly. After the introduction of the Greek Civil Code the articles 1002 and 1117 have set the basic principles of the “horizontal ownership”. As a result, exists the individual ownership of the apartment combined with the joint ownership of the land. The owners of the land where the block of flats is built or shall be built can set up this separate ownership only with a notarial act, which must be registered, or with a will in an existing apartment or in a future one (Mattheou, 2004).

According to the UN/ECE Guidelines, condominium ownership comes in a variety of forms from multi-apartment buildings used exclusively for residential purposes to those that contain both residential units and space used for commercial purposes. They may extend vertically as in tower blocks or horizontally as in terraced houses. Essentially such buildings have two components – privately owned units and jointly owned parts (for example service areas and equipment such as lifts, electricity and heating supply, etc.). The right in freehold to a separate apartment in a tower block breaches the idea that land, as real property, extends from the center of the Earth to the infinite of the sky. The concept that the land is a single unitary object may work in legal theory but in practice it needs to be modified, especially in the case of ownership of individual apartments in a block of flats (UN/ECE, 2004).

Another exception to the principle that “the objects lying above belong to the objects lying underneath” (mentioned as “superficies solo credit” in the Roman law), is established by the article 1010 C.C.: building party on an outland real estate. Apart from this stipulation, other interests in land, such as different servitudes, give the benefit of the owner or possessor of other land (e.g. easement of passing through, sewers and other utilities). They are distinguished in negative and positive ones and are regulated by the articles 1118-1141 of the C.C.

2.2 Customary property rights

In several parts of Greece, like the Cyclades (and other places following a similar pattern), the customary law regulates most legal relations on property rights. A review of the evidence about the Cycladic system of dowry and inheritance in the early modern period starts from the general truth that customary law was the regulator of the transmission of property from one generation to the next, resulting in the structure of the type of property devolved. In order to give dowry and secure the best possible their children, parents adopted various customary strategies, concerning their family property. (Kasdagli, 2004).

Joint ownerships, implantation rights or constructions on foreign land and ownership on a specific part of property, are some of the custom derived cases. In some of them, the owner of the legal right might have no percentage on the ownership of the land-parcel, while the owner

of the ground floor is the 100% sole owner of the land parcel and its subsoil, and the owner of the upper floor is the sole owner of the “air”, unless it has already been transferred to another person (Papaefthymiou, et al., 2004).

2.3 Registration of Property Rights

Until recently, the system of land registration was completely undertaken by the Land Registries “Ypothikofilakia” throughout the entire state, with the exception of the islands of Rhodes, Kos and part of Leros Island, where a Cadastre, remaining from the Italian occupancy, is in force. In these Land Registries, the registration and transfer of property rights are taking place within the district of the relevant Court of Peace “Eirinidikio”.

All the real estate must be registered in the Land Registries and every transfer of rights is conducted through an official copy of the deed to be transferred.

Since the Hellenic Cadastre has not been compiled yet, the old system of Ypothikofilakia is still valid, thus providing the simultaneous co-existence of the two Register Systems (Arvanitis and Hamilou, 2004).

2.4 Special Real Property Objects (SRPO)

According to a strategic study conducted by IT and other experts for the cadastral model that will be adopted by the Ktimatologio S.A, a new concept of “Special Real Property Objects” (SRPO) has been introduced in accordance to the Statement of FIG for Cadastre 2014. (Kaufmann, 1999 and Rokos, 2001). These SRPO include:

- Dug-in houses (village houses that are hewed into the earth) called “Yposkafa”, very common in many Greek islands (see in the photo, fig 1)
- Above constructions, called “Anogeia”, also very common in Greek islands and traditional villages (see in the photo, fig 2)
- Mines, extending under the earth’s surface and
- Tiny buildings, typical seaside settlements particularly in Milos and other islands of Cyclades. They are called "Syrmata" because they have a special mechanism to "syroun" (=draw) the boats inside during the winter (see in the photo, fig 3).

The above SRPO do not have property right percentage on the ground and are not spatially represented in the HC model. To each SRPO a cadastral id number is assigned, different from the land parcel they relate to.



Fig. 1 Yposkafa



Fig 2. Anogeio



Fig 3. Syrmata
(Photo by H. Milas)

3. ENUMERATING 3D CADASTRAL CASES IN GREECE

The SRPO are the only 3Ds included in the existing cadastral model in Greece. The HC does not register the evolving property reality of urban areas, characterized by an increased building density and a complicated use of space in different levels. It is therefore necessary for the existing 2D cadastral model to provide a solution for registering and representing multilayer property activities in order to better reflect the property rights on land in Greece.

This has been already realized by many countries worldwide, where an extended use of space is taking place the last years (Shoshani et al., 2005). This growing interest for 3D cadastral registration is caused by a number of factors (Oosterom et al., 2005), such as:

- the increase in property values
- new subterranean infrastructures (e.g. tunnels, cables and pipelines)
- multilevel buildings and parking places and
- an upcoming 3D approach in other domains (e.g. GIS, GPS) that makes a 3D approach of cadastral registration technologically realizable.

3.1 Cases requiring 3D Registration

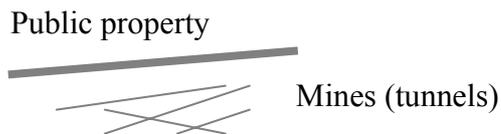
In Greece, property situations most requiring a 3D registration can be summarized as follows:

3.1.1 Overlapping Private and Public Properties

Public properties (e.g. infrastructures, open spaces and squares) are sometimes entirely or partially overlapping with privately owned land parcels and buildings. The following two cases are briefly presented:

1. Public properties over private areas:

In the country side, the most typical cases of public properties lying below private ones are the mines, which do not depend directly to the corresponding land parcel, although their use should not block the exploitation of the mine.



In urban areas –especially in heavily urbanized ones- with constantly increasing car density, privately owned parking places are usually located under squares or public buildings, in order to handle this acute problem. This is illustrated in figure 4.



Fig 4. Overlapping private (parking facilities) and public properties (free space and public buildings).

2. Public properties below private properties

The most characteristic cases of public properties lying under private land parcels with or without constructions on them are the roads, as shown in figure 5.

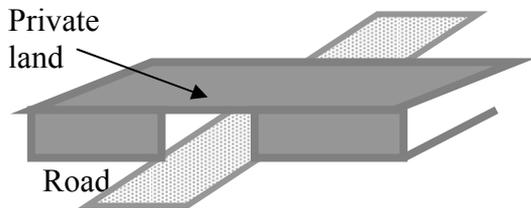


Fig. 5. Athletic facilities (football stadium) situated over a public road (Attiki Odos).

In many islands and traditional settlements in Greece, privately owned constructions of upper floor (called “anogia”) are located over communal roads, as shown in figure 6.

Construction over public road

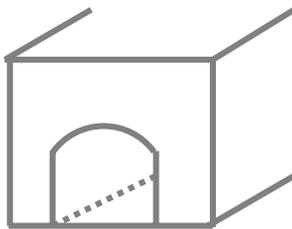


Fig 6. Private, upper floor buildings (anogeia) extending over a public/ communal road.

In urban areas of increased building density, special type public areas (such as galleries or passages, mainly in multistory departments or office buildings), although public, are within the vertical boundaries of the corresponding building.

Public area within the building's footprint



Examples of galleries below privately owned buildings are illustrated in figure 7. These areas, although used by the public, they are not separately registered, but within the above building's footprint.



Fig 7. Public areas included within the vertical boundaries of privately owned buildings.

3. Infrastructures below privately owned land

Subterranean networks such as gas pipelines, or telecommunication lines, mainly supplying industrial areas usually extend under the built environment.

For these utility networks, a separate registration should be considered, in relation to the surface land parcels and constructions. This 3D registration facilitates their proper and safe maintenance. An example of this case is illustrated in figure 8.

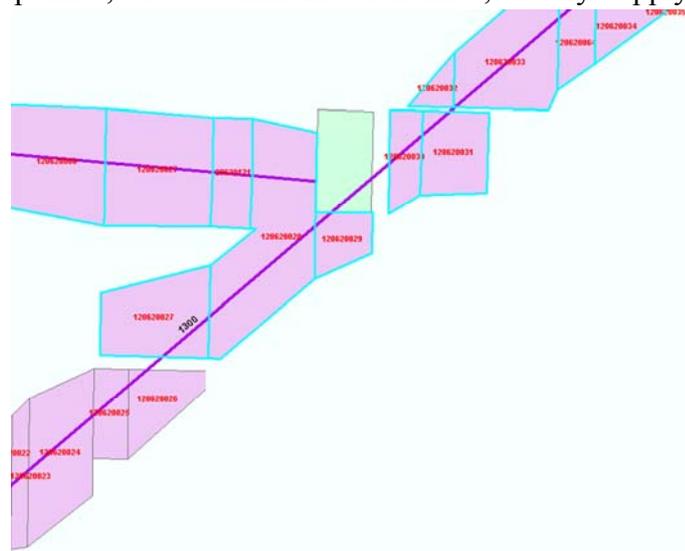
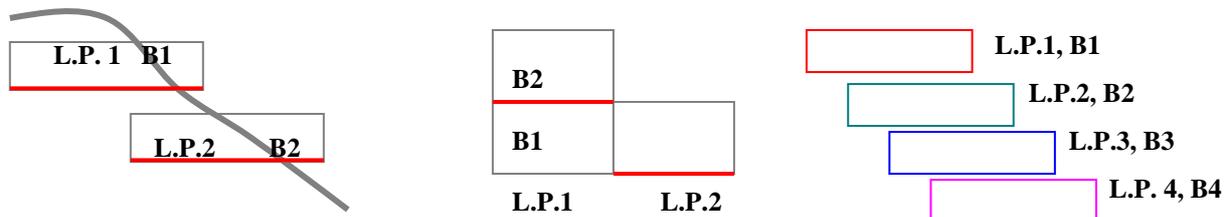


Fig 8. A typical case of gas pipeline network under existing land parcels.

3.1.2 Overlapping Private Properties

It is very common in several Greek Islands (e.g. in Santorini, with steep slope, where most houses are dug in the volcanic soil), that land parcels and buildings, are partially or totally overlapping to each other. The following schemas illustrate cross sections of three characteristic cases of real properties (land parcels and constructions lying within or extending beyond their parcel) on top of each other. These property rights are mainly based

on customary laws, that regulated the transmission of property from one generation to the next, resulting in the structure of the type of property devolved.



The horizontal projections of land parcels 1 & 2 and buildings 1 & 2 comprised are overlapping.

The horizontal projection of building 2 extends its parcel.

The horizontal projections of land parcels 1, 2, 3 & 4 and attached buildings 1, 2, 3 & 4 are overlapping.

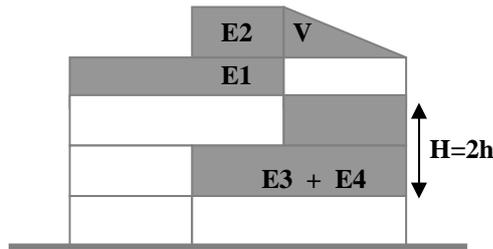
Typical examples of the aforementioned overlapping real properties are shown in the following photo of Santorini Island (figure 9).



Fig 9. Overlapping real properties in Santorini.

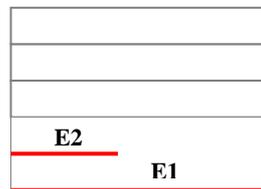
3.1.3 “Unconventional” exploitation of multistory buildings

In many complex buildings, privately owned space of apartments has diverse heights, different from the “standard” (usually of three meters), due to special constructions, such as lofts and top roofs. This results in unequal shares of privately owned space, as illustrated in the following schema. For example, the apartment on the third and fourth floor is registered as E1+E2 in area, while extending by the unregistered area of the roof, having lower height than the standard. Another example is shown in the first floor’s apartment, with total registered area E3+E4 and double height above space, not registered.



3.1.4 Differences in surface registered and realized

In many department stores, the floor plan's surface area is different from the one legally realized, according to the building permit. This is mostly the case in ground floor stores, as illustrated in the following schema, with mezzanine (E2 in area) not requiring a cadastral registration. For ground floor department stores constructed before 1985, with mezzanine area $E2 = 1/2 E1$, the total area to be registered is $E1$, although the one realized is $E1+E2$. After 1985, the new regulations oblige a cadastral registration for the total area $E1+E2$ realized, (where $E2=\lambda * E1$), when $\lambda = 0 \div 1/2$ and $E1 < E1 + E2$.



4. INCORPORATION OF 3D REGISTRATIONS IN THE HC

In our study we created new 3D real properties, within the existing conventional 2D cadastral registration. Taking into advantage the above cases presented, we examined several characteristic real estate properties and we gave rectangular coordinates (x, y and z) in the related land parcels corners. By adding heights to the existing land parcels, the constructions above or below the surface are volumetrically defined. In order to incorporate 3D cadastral registrations, we used data provided by used field measurements, indicated on the survey plans, floor plans of constructions, declaration of types of use or of economic exploitation. The 3D representations also included neighbour parcels, to have an overview of certain complicated situations.

For the implementation work we used Oracle Spatial 9i database (DB) and Geomedia Professional (Intergraph) GIS, for the spatial representation of data. These products are effectively cooperating within an open Consortium framework.

The first step was to transfer cadastral data from the Access cadastral DB to the Oracle Spatial 9i. Then we created in Oracle a new feature class where all 3D properties were registered. The items included: the surface area, the cadastral id code, the volume and an item containing the geometry of 3D objects and all changes that take place.

4.1 Greek Cases Studied

The characteristic cases, presented in 3.1, were further examined, in order to be incorporated into the cadastral map as 3D registrations. The results of this effort are summarized as follows:

4.1.1 Overlapping Private and Public Properties

Property V2 is registered in Parcel 3 and property V3 in Parcel 6. Property V1, although part of the building, is registered in Parcel 6. The mixture of private and public land in a multilayer environment is inadequately described by a 2D model. The volumetric definition of parts V1, V2 and V3 in relation to each other is necessary, as illustrated in figure 10.

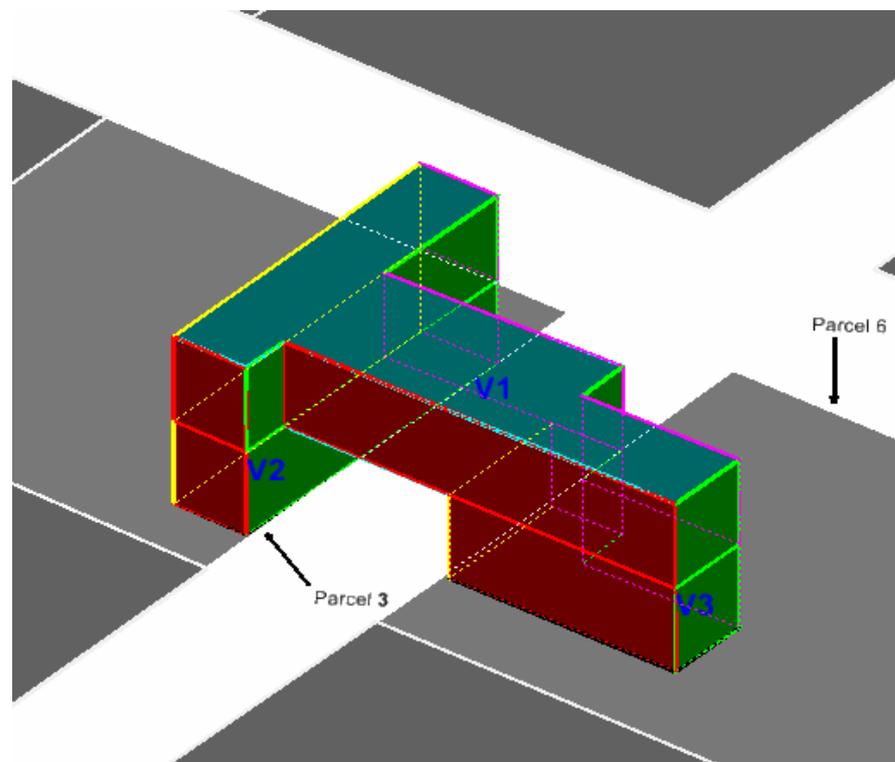


Fig 10. Constructions over road and land parcels

Similarly, figure 11 presents another mixture of private and public real properties, where V3 is a private parking area, extending beyond the borders of its relevant parcel 7 to the road.

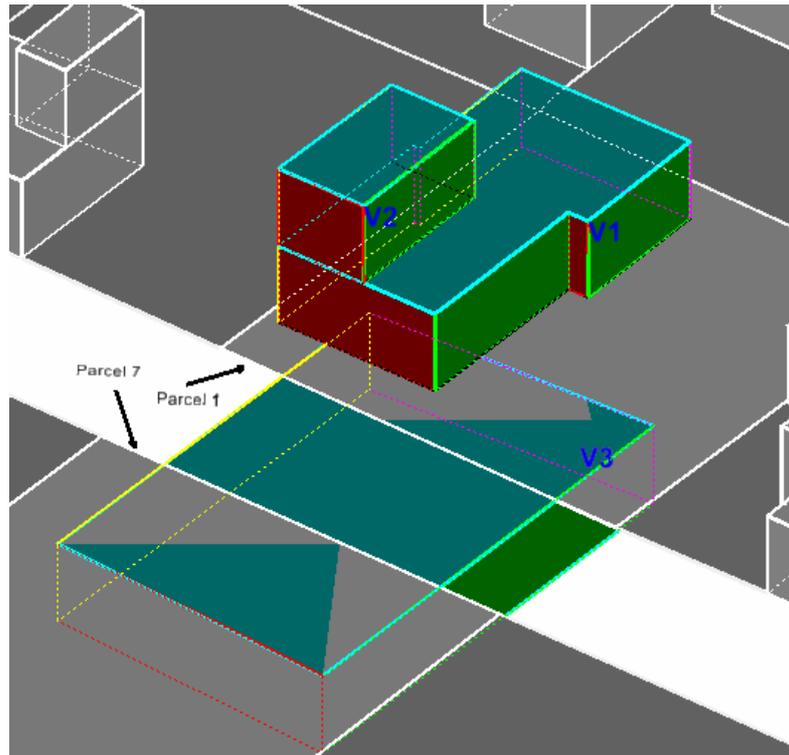


Fig 11. Parking places below both private and public land

4.1.2 “Unconventional” exploitation of buildings’ interior

These cases refer on real properties, sharing unequally the private space, taking advantage or misleading specific regulations of the Building Code. (See fig. 12)

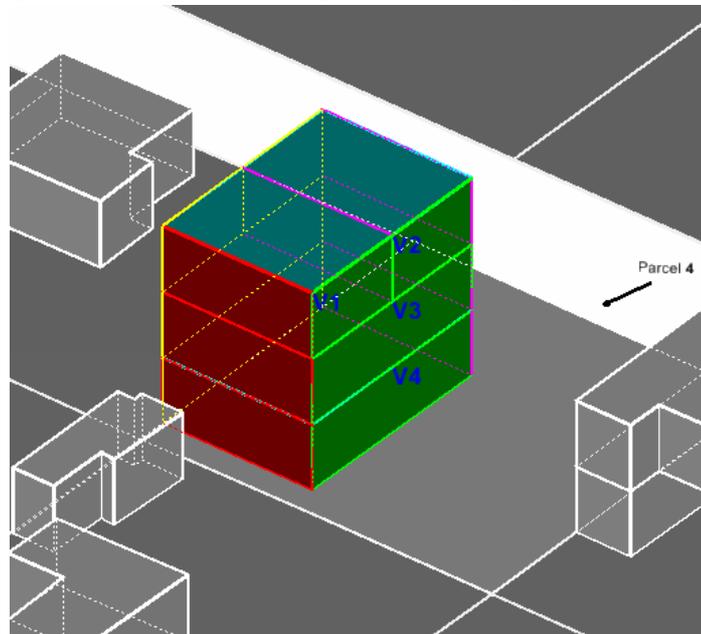


Fig 12. Unequally shared private space

4.1.3 Neighbor properties of the same owner

The exploitation of the building shown in figure 13 includes both areas V1 and V2, although the property's cadastral registration, not having insight into the situation, is excluding volume V2.

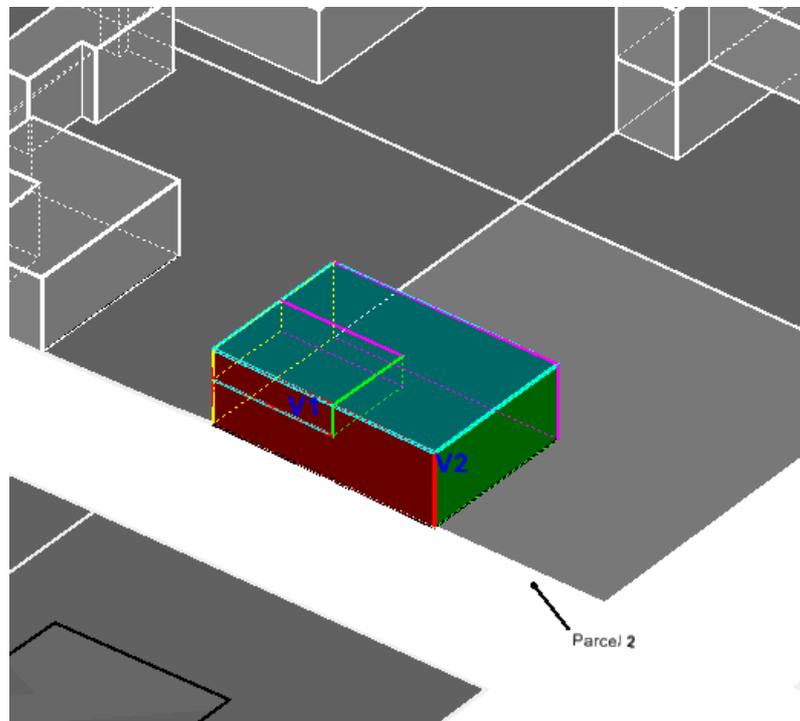


Fig. 13. Subdivision of property

5. CONCLUSIONS

A 3D approach for registration can provide better means to manage our modern world. Having the 3D real property objects in the same environment as the 2D land parcels is very important in the ongoing HC project. A third dimension added in the cadastral registration, can clearly define property rights and restrictions within an evolving urban environment, characterized by an increasing number of multilayer infrastructures and economic activities resulting in new constructions and complex property situations.

In this paper we briefly presented selected characteristic cases where the third dimension is necessary to be incorporated into the cadastral registration. This will require several modifications to the actual property rights' registration procedure as well as to the relevant legal framework. Our study resulted in illustrating the selected 3D cases, fitted in the existing 2D cadastral environment.

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BIOGRAPHICAL NOTES

Dr. Surveying Engineer, Lecturer, Lab. of Photogrammetry and Cadastre, School of Rural & Surveying Engineering, NTU of Athens. She graduated from NTUA in 1983, Ph.D. Thesis "Evaluation and potential use of existing Cadastral Information", NTUA, 1996. Member of the Technical Chamber of Greece (1983+), the Hellenic Association of Surveyors (1983+), the "Agence pour la Cooperation Technique, Industrielle et Economique" –ACTIM (1984+), the Hellenic Society of Photogrammetry and Remote Sensing (1987+), the International Federation of Surveyors –FIG, as correspondent member (1998+) and the Hellenic Geographical Information Society –HellasGIs, as elected member of the Bureau (1999+). She has been trained in the French and German Cadastral System and reform techniques.

She participated in scientific committees of the Technical Chamber of Greece (1986-88) and the Hellenic Mapping and Cadastral Organization –HEMCO (1987+), in 16 Funded Research Projects (1988+) and in 7 seminars as instructor. From 2000- 2005 she was also Visiting Assistant Professor, in the School of Architecture, University of Patras. She has published 36

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