Combining 3D Cadastre and Public Law – An Austrian Perspective

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SUMMARY

3D cadastres as currently designed aim at providing information on private rights (ownership, easements, etc.). However, from an economic perspective, public-law restrictions are at least equally important because they might restrict different kinds of use on the land. This has a dramatic impact on the value of the land. Since land value is crucial for investors or credit institutes, they are equally interested in public-law restrictions as they are interested in private rights.

In addition, the 3D objects defined in a cadastre are typically seen as legally independent of each other. This is not always the case, e.g., each apartment in an apartment building must support the structure (apartments and other structure like the roof) above. This must be taken into consideration when defining separate 3D objects. The use of a public-law restriction would provide a simple solution to this.

Other regulations may have more unpleasant effects. Asking adjacent land owners to provide land for public services is a standard method in spatial planning. The extent is determined by the planned structure and may be limited by legal rules. The same would be true for 3D structures because spatial planning usually does not only deal with 2D arrangements but also with height information. It is an unfortunate situation, for example, if a small building with only a ground floor is created in an area intended (and suitable) for skyscrapers. However, compulsory purchase could have unwanted effects in 3D systems and finally leads to the question of value: What is the value of a volume floating freely in space?

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1. INTRODUCTION

Historically, the purpose of cadastres was providing an objective basis for land tax. Land tax is usually paid by either the owner or the possessor of land and thus these persons must be identified in the cadastre. The tax also depends on the size of the land and the easiest way to reduce fraud was mapping the pieces of land. The resulting large-scale maps have later been found useful for spatial planning, spatial information management, environmental protection, and other tasks (compare Muggenhuber, Navratil et al. 2011). Especially in dense city areas spatial planning now deals with the problem of scarce space (compare, e.g., Eckert and Schinkel 2009). This requires efficient use of available space. Vertical separation between different kinds of usage, like underground public transport, shopping on the ground floor, and apartments on higher levels, is a solution that is currently applied. Documentation of ownership rights in such a situation is difficult with the classical 2D approaches for cadastral mapping. The systems may be able to store the information, but they cannot communicate the spatial relations in a clear and concise way. Stoter et al. presented an example of a building complex in Amsterdam, which clearly shows this issue (Stoter, Ploeger et al. 2011). Modern architecture, too, stresses the existing cadastral systems. The currently used free forms and interlocking of buildings requires more relaxed shape conditions for cadastral objects. The solution is the extension of the 2D cadastral systems to the third dimension (also compare Stoter and van Oosterom 2006, pp. 3 ff).

The information stored in classical cadastral systems (ownership and associated rights) belongs to private law. Law is subdivided into two categories. Private law regulates the interaction between citizens. Ownership is one of the classical examples of private rights. Another example is a rental contract, which is an agreement between two persons that one person may use an object owned by the other person for a specific time under defined conditions. The persons can be natural or legal persons. The author of this paper is an example for a natural person and companies, associations, or administrative bodies are examples for legal persons. The parties interacting in private law are on the same legal level and have to agree on the rules of interaction even if one of them is an administrative body like the Republic of Austria. A thorough discussion of private rights including a comparison of the situation in different countries has been published by Paasch (2011). The second category of law, called public law, subsumes norms defined by various authorities to regulate everyday life. In public law, the authority is in a higher legal position than the affected person and can punish the person for misbehavior. Examples are tax law or driving regulations. Since cadastres typically also provide data for determination of land tax, they are dealing with both legal categories. There is a separation between binding and counseling rules of public right. In the scope of this paper, only binding rules are discussed.

The use of land is affected by rights based on both private and public law. Typical private rights are ownership, use rights, or liens. Ownership, for example, requires recognition by all

persons to be effective (Freyfogle 2007, p. 10). An owner of land can provide rights to others, e.g., to walk across the land or to put supply lines for water or electricity on his ground. There are no restrictions on such agreements unless they contradict legal norms or cross moral boundaries. Private rights on land are sometimes also called interests on land (McLaughlin and Nichols 1989). However, each land owner may also be restricted in his actions by public regulations. It may be prohibited, for example, to create buildings higher than 20 meters because the land is located in the approach path of a nearby airport. Sometimes even international regulations impose such restrictions. The historic centre of Vienna, for example, is part of the UNESCO world heritage list since 2001 (UNESCO 2001). The protected city centre has a size of 371 ha and there is an additional buffer zone with 462 ha. Additional rules for the permission of new buildings are in place within the protected area and the buffer zone. This is necessary to protect the cultural heritage and keep the ensemble intact. Each land owner in the affected area is bound by these regulations. A discussion of different kinds of public restrictions and a classification of them has been published by Paasch (2012).

Finally, one of the emerging topics in land administration is land valuation and the land market. Land is one of the assets that cannot be moved outside the country. Thus land tax is a reliable income for countries. The land tax must be connected to the value and productivity of the land to be fair. The allowed and prohibited ways of using the land are a key factor for land value. Real estate properties with ban on construction, for example, do not have the same value as real estate properties with building allowance even if both lie in the same place. As mentioned above, such restrictions emerge from public law regulations. Most restrictions are effective for specific parts of a country only. The spatial extent of the restrictions is typically defined in two dimensions only. The extent may be defined precisely, e.g., by referring to specific land parcels. The extent may also be defined by attributes, e.g., in Austria forests are publicly accessible, or even be vague, e.g., when referring to the area endangered by flooding (compare Spangl 2012, pp. 68ff). Sometimes these restrictions may require consideration of the third dimension, for example building restrictions imposing height limitations for constructions.

The goal of this paper is to discuss the consequences of public law restrictions on 3D cadastres. There is an understanding, how public law restrictions influence the 2D cadastres. However, this is not clear yet for 3D situations. The current discussion is usually on the level of “documenting 3D objects”. Dependencies between the objects and constraints on forming objects are not yet sufficiently addressed. The paper is a first step in this direction.

2. DOCUMENTATION OF RIGHTS

Private rights on land are defined by contracts, which may be in oral or written form. Oral contracts are rare nowadays, because in case of dispute it may be difficult to reproduce the exact original content. Thus, most contracts are defined in written form. Many jurisdictions provide a system to store and publish such rights, typically called land register, land book, or (legal) cadastre. This system may be compulsory or optional. In the latter case, the system can only provide evidence, not proof leading to more complicated decision processes (Navratil and Frank 2004). The documented private rights either affect one or more pieces of land separately or commonly (e.g., a mortgage) or they connect different pieces of land (compare

Paasch 2011). An example for rights connecting pieces of land is the right allowing the owner of one piece of land to access his property by passing over land owned by somebody else or the right to place supply lines in another person's property.

Public rights are usually not registered in a central place. Public rights are a product of various administrative and legislative processes and decisions at various levels from communes to international or trans-national organizations. There may be general rules that are applicable to all properties in a specific area like nature preservation or it may be case-based decisions valid for only a number of explicitly stated properties like a building permit. Thus there are a large number of different sources, where public rights affecting ownership of land can be found. In Austria, Twaroch identified more than 40 laws with a direct influence of the use of land (Twaroch 1998, pp. 7-10). The situation in other countries is similar. Thus, Switzerland initiated the development of a cadastre for public law restrictions (Kaufmann 2010).

A complete documentation of public law restrictions like obtained for public law in some jurisdictions is currently not realistic. In Switzerland, only 17 public law restrictions on a federal level will be provided, which are grouped in 8 categories: Spatial planning, national roads, railways, airports, contaminated sites, groundwater protection, noise, forests (swisstopo 2009). However, an implementation of such a system would be beneficial for other countries, too, e.g., for Austria (Spangl and Navratil in print).

3. MECHANISMS CONNECTING RIGHTS IN 2D SYSTEMS

The basic mechanism connecting private rights is simple and straightforward: There is an agreement between persons, this agreement is documented and – if necessary – registered. There are only some restrictions in that process, e.g., the owner(s) of the affected land must be part of the group of persons and the content of the agreement may not be illegal. The result is typically a document. Most of these documents are text only, e.g., a rental contract. However, graphical elements are possible, e.g., to specify the exact spatial extent of an area that the leaser may use.

However, this is not always the case. Surface water, for example, flows downwards and may cross the boundary to land owned by someone else. In terms of private law that would be an intrusion into private property. However, the owner of the land has to accept the result of the physical property. This rule is not defined in private law but is a general rule applicable to all natural (physical) processes. The rule creates chains of automatic permissions for water runoff from higher pieces of land to lower pieces of land. The rule thereby creates a restriction where the owner of the higher land is the beneficiary and the owner of the lower land the obligated party. Obviously, there have to be some limitations. It is not allowed, for example, to heavily modify the flow of water by construction, e.g., to create a wall that lets the water pass only in one small section. This could have negative effects of the lower piece of land because the large amount of water in one place could lead to erosion. However, an agreement between the neighbors can overrule this limitation by specifying where the water should be transferred in order to provide the least amount of negative impact.

Public law restrictions do not only have an impact on how the land is used, they also affect the formation of the cadastral objects themselves. The simplest form of influence is the definition of minimum sizes. This is the case in Austria for land parcels for residential buildings and forests. The goal is to avoid producing land parcels that cannot be used because they are too small. It does not prohibit the creation of smaller land parcels but the law stipulates that these land parcels cannot be used for construction. Figure 1 shows an example of a (fictitious) subdivision in a residential area in Vienna. In the centre is a new road running from southwest to northeast, which will provide access to the new land parcels. The space for this new road is provided by the land owners of the adjacent land. The numbers with circles around them identify areas, which may become separate land parcels or which may form land parcels together with other areas. “Bauplatz 4”, for example, consists of area 89 and will become a separate parcel whereas the road will consist of areas 27, 28, 29, 30, etc. However, since the owner of the land parcel at the corner (Eisner GmbH) does not participate in the restructuring process, a part of the area required for the road would not be available (area 69 at the corner). The solution in Austria is compulsory purchase. The public purchases the areas from Eisner GmbH at market price and provide the area for the creation of the road. As soon as Eisner GmbH applies for a building permit for this land parcel, they have to repurchase the area (for the original price) and provide it to the public. Thus each land owner adjacent to the road provides an area based on road width and lad parcel width. The rules change slightly between the Austrian federal states but the general principle is the same: The land owners cannot refuse to provide the land. The only parameter open to discussion is market price but this is a general problem with compulsory purchase (Kalbro and Lind 2007; Navratil and Frank 2008).

From the example in Figure 1 it is also evident, that the placement of boundaries is not completely arbitrary. Spatial planning determines where roads should be placed and thus these boundaries are fixed with a precision that corresponds to the precision of the planning geometry. However, also the size of the created land parcels is influenced by spatial planning. As mentioned before, there is a minimum size for land parcels in residential areas. However, there are also definitions like the height of buildings and a range of percentages that have to be covered with buildings. This determines how small a land parcel may become. Buildings with a height of 50m or more require a reasonable footprint size. In addition, there are regulations on exposure to light thereby limiting how close two buildings may be. This, too, has an impact on reasonable land parcels size.

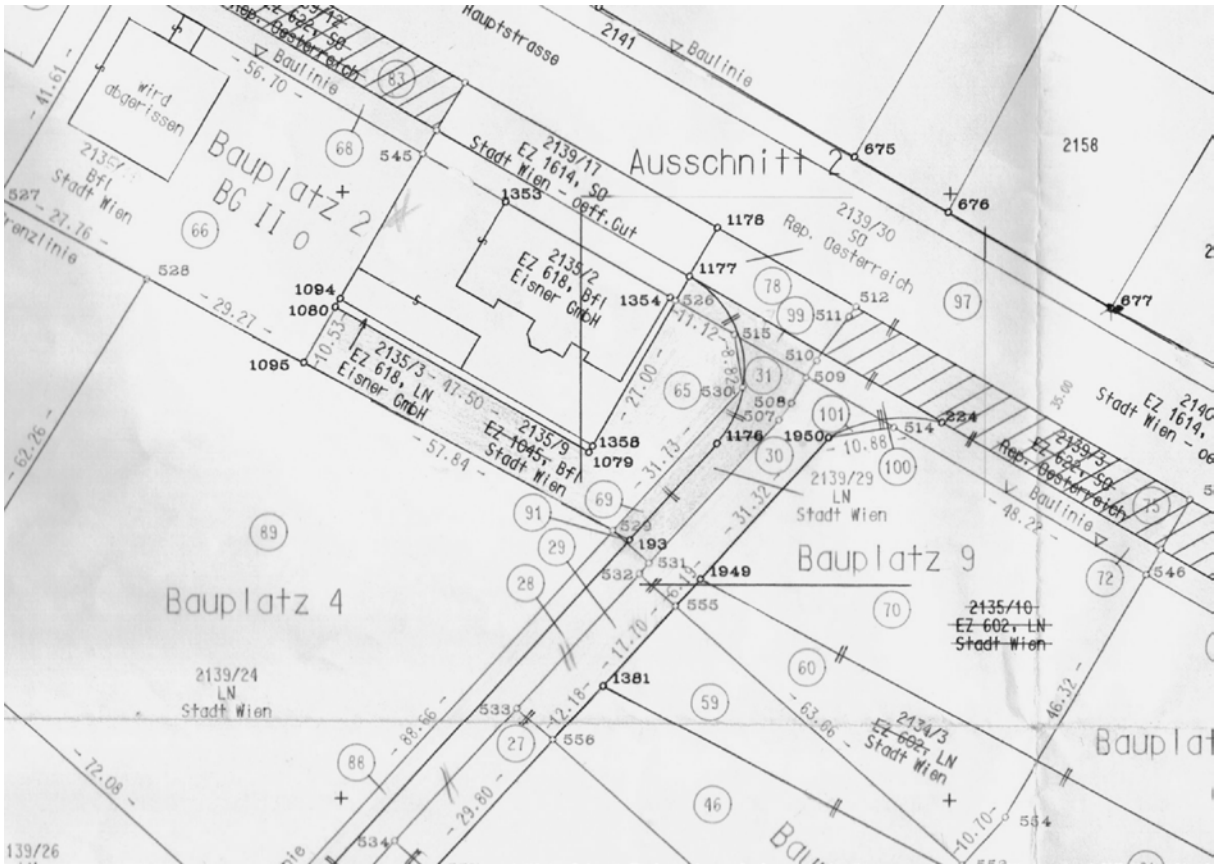

Figure 1. Example of a subdivision based on a spatial development plan

4. MOVING TO 3D

In a 3D system similar principles apply as in 2D. Private rights are attached to volumes in the same way they are defined in two-dimensional systems. However, new restrictions may emerge automatically. An obvious example of automatic restrictions between ownership objects is condominium. Being the owner of an apartment within an apartment building does not include full control on everything within the extent of the private property. Ownership includes the right to destroy the property. Land itself cannot be destroyed but the right of ownership includes the right to destroy all objects like buildings connected to the land. In the context of condominium this would allow the owner to eliminate all interior walls. This would obviously lead to problems with statics. Thus there has to be a restriction even if it is not explicitly stated. However, what are the limitations of this restriction? It would not be fair to increase the weight on the superstructure of the building by adding more floors taking it as granted that the owners of the apartments below will reinforce the walls to withstand the additional pressure. There has to be a limitation of how much weight is supported. This could be stipulated in the building permit, for example. The mechanism is the same as used for water runoff: The walls of each apartment must be strong enough to support the weight of the upper floors, the roof structure, and all weight that may be added to it, e.g., by furniture in the apartments or snow on the roof. This idea can also solve situations where buildings on a slope are built such that they overlap partially (compare Tsiliakou and Dimopoulou 2011).

If this mechanism is not used, then ownership of building superstructure and ownership of apartment must be separated. One approach would be to separately model building superstructure and interior of the apartments. The problems of this approach are that the objects become extremely complicated and the demands on spatial accuracy are high. The complicated objects may lead to misinterpretation by inexperienced users and other challenges in communication. The demands on – especially vertical – spatial accuracy may also be difficult to meet (compare Navratil and Unger 2011). The solution currently used in Austria is the following: Each condominium owner is co-owner of the whole building and has an exclusive use right for an apartment. This use right could then be easily represented as an approximate 3D object.

The example in Example 1 in the last section showed how spatial planning influences the shape of land parcels. It may even trigger compulsory purchase if otherwise a land owner could not fulfill his obligations. The same principle would also be applicable to any 3D cadastre. Assume the situation depicted in Figure 2: A person owns the two land parcels A and B. His house is located on land parcel B and he enjoys an unblocked view. He then wants to sell parcel B but not risk that his view is blocked. The obvious solution in a 3D cadastre would be horizontally splitting land parcel A into land parcels A1 and A2 and only selling land parcel A2. Since he is still owner of land parcel A1, his view is still unblocked. However, what happens if land development plans request specific heights for buildings on land parcel A2, which would exceed the height of A2? If the Austrian solution in the 2D case is applicable for 3D as well, then the person would be forced to sell the required vertical extent of land parcel A1 resulting in a blocked view.

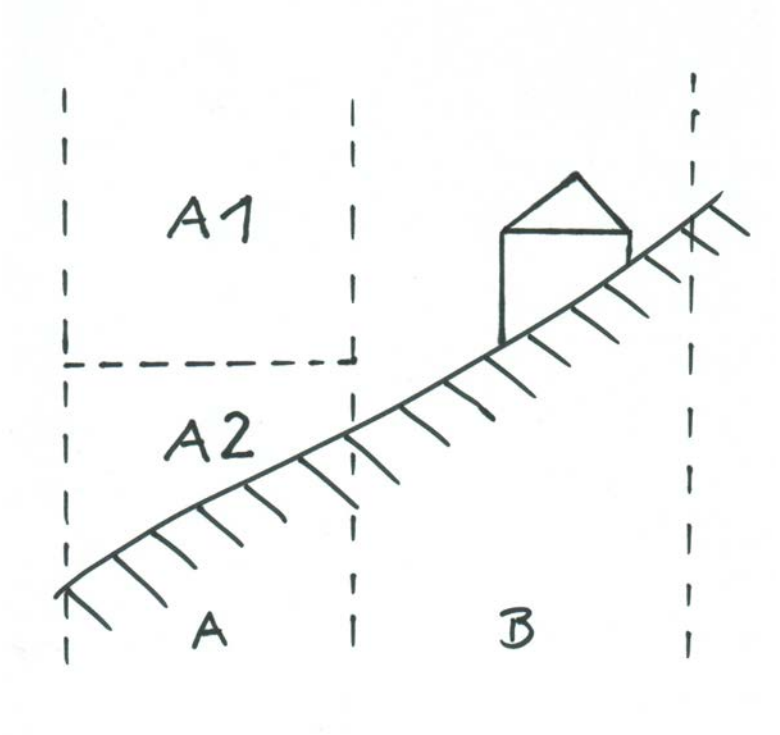

Figure 2. Vertical separation to protect an unbuilt view

The legal question here is about priorities: Has the right of the owner higher priority than the goal of the society for sustainability, which also includes efficient use of available space. This question is not definitely solvable because it touches basic concepts of the society. Thus different societies may prefer different solutions. Both concepts, however, have advantages and disadvantages.

The owner of land parcel B in Figure 2 would be protected if the ownership right has priority. That would result in two facts, though: The value of land parcel A2 is low, since it cannot be built and the area of the original land parcel A would not be used for construction. The not built-up land parcel A2 would lead to more dispersed settlements and thus larger residential areas. That may be beneficial for the current inhabitants because they enjoy less crowded areas but may lead to allocation problems for future generations.

The opposite decision (higher priority to sustainability) would restrict the right of ownership. This can be problematic in a European context because private property is one of the foundations of society. Although the principle does already exist in Austria, a 3D cadastre would attract more attention than the current solution. The outcome of any political debate triggered by this attention is unpredictable and could affect more than just the 3D cadastre. It also leads to the question of value. How shall the value of this piece of space be determined? This is necessary because compensation is a mandatory part of compulsory purchase (Navratil and Frank 2008).

In general, however, the representation of public-law ownership restrictions is equally important as the private rights (Frank, Navratil et al. accepted). Public-law restrictions are important for a large number of people. Private rights are mainly relevant for the involved persons (beneficiary and obliged party), although information on these rights may be relevant for determination of the land parcel's value. Public-law restrictions, however, are relevant for all persons living in the affected area or interested in gaining rights in that area. Land in the vicinity of an Austrian airport, for example, is not only affected by noise but also suffers from height limitations on constructions and more complicated authorization procedures for constructional alterations.

5. CONCLUSIONS

The paper discussed some problems related to public regulations and investigates the applicability of existing solutions from the 2D world. Two practical examples show relations between objects and how rules from the public law may be used to solve them.

It has become evident, that 3D objects cannot be independent. The condominium example is probably an extreme case but the same is true for constructions on top of railway stations (Stoter and van Oosterom 2006, p. 40) and similar situations. Only in cases where no forces are transferred into the ground, these dependencies can be ignored.

One of the currently used arguments pro 3D cadastres is – apart from the legal solution of otherwise unprotected cases like building across highways – that it provides better protection of personal interest of land owners. However, the discussion following the vertical

subdivision example (Figure 2) showed that this may not be true for all jurisdictions. The balance between personal interests of the individual and society needs is delicate and may change with increasing pressure of population growth and shrinking resources. However, this is a discussion that cannot be solved by technicians. It requires involvement of lawyers and maybe even political leaders. A problem in the discussion will be that the answer must lead to a sustainable society and it may be challenging to identify and evaluate long-term effects.

This directly leads to another challenge: Private rights are different based on the local understanding of terms. Throughout the world, there are some variations in the understanding of terms. An example for the worldwide variety of opinions can be found in the proceedings of the 2nd International Conference on the Development and Maintenance of Property Rights in 1999 (Vázquez-Caro 1999). However, the bandwidth for public-law restrictions is even larger and the rules applied in the processes can lead to different outcomes in different countries. It is thus necessary to provide technical solutions, which support different legal implementations.

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BIOGRAPHICAL NOTES

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