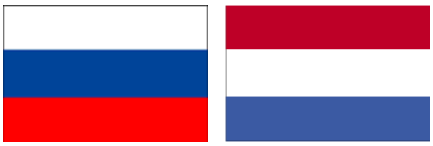

3D Cadastre Modelling in Russia
G2G10/RF/9/1 Report Work Package 1

Legal framework and organisation of 3D-cadastre

Version
1.0 (18 oct'11)

Auteurs
Hendrik Ploeger & Peter van Oosterom

Report summary

This report documents the first work package of the G2G project '3D Cadastre Modelling in Russia'. The report starts with an international comparative analysis (among others based on the recent questionnaire of the FIG working group 3D-Cadastres). The report further contains an analysis of the current legislation in the field of the state cadastre of immovables and state registration of rights in immovable properties and transactions with them in the Russian Federation. Next an overview is given of the options for cadastral recording within the Russian 3D-Cadastre and based on the current system and the future 3D requirements, the most appropriate option is selected. Finally, the report concludes with the main findings of the first work package and summarizes the results.

3D-cadastre modelling in Russia

G2G10/RF/9/1

Report Work Package 1

Contents

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1. International comparative perspective

The increasing complexity of infrastructures and densely built-up areas requires a proper registration of the legal status (private and public). This can only be provided to a limited extent by the existing 2D registrations. In the past decade various scientific activities have been conducted related to 3D-Cadastres. This was paralleled by on-going developments at cadastral organizations in many countries to provide better 3D-support. Two countries that very recently introduced specific legislation aimed at registration of 3D property rights are Sweden and Norway. Sweden introduced "3D-property" (*3D-fastigkeit*) in 2004.[1] The main aim of the legislation was to introduce the division in ownership between apartments and shops on street level. But it can also be used for bridges, tunnels, etc. According to the Property Formation Act, 3D property units will be formed through a cadastral procedure, and are subject to approval under the existing land policy requirements in the same way as other property units. In Norway the Law on the Cadastre (*Lov om eiendomsregistrering*) of 2010 makes 3D "construction property" (*Anleggseigedom*) possible.[2]

1.1 General observation

Recently the FIG Working group on 3D-Cadastres performed a research on the current situation on 3D-cadastres world wide by means of a questionnaire.[3] However the concepts "3D cadastre" and "3D parcels" are still ambiguous: what exactly is (or could be) a 3D parcel dependent on the legal and organizational context in the specific legislation. A 3D parcel is defined by the FIG Working group on 3D as the spatial unit against which (one or more) unique and homogeneous[4] rights (e.g. ownership right or land use right), responsibilities or restrictions are associated to the whole entity, as included in a Land Administration system. A 3D parcel is a 'legal object' describing a part of the space. Often there is a relationship with a real world/physical object, which can also be described in 3D. Please be aware of the difference between these two types of objects and that the focus in the context of 3D-Cadastres is on 3D parcels (spaces of legal objects). A general conclusion is that in nearly all jurisdictions 3D parcels can be registered. But in most cases these 3D parcels are (or even limited to) apartment units. Despite all research and progress in practice, no country in the world has a true 3D-Cadastre, the functionality is always limited in some manner; e.g. only registering of volumetric parcels in the public registers, but not included in a 3D-cadastral map, or limited to a specific type of object with ad hoc semi-3D solutions; e.g. for buildings or infrastructure.

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[1] Göran Eriksson and Cecilia Adolfsson, Experiences of the 3D Cadastre Legislation, XXIII FIG Congress 2006; Göran Eriksson and Lars Jansson,Strata titles are introduced in Sweden, FIG International Congress, 2010 http://www.fig.net/pub/fig2010/papers/ts05a%5Cts05a_eriksson_jansson_3909.pdf.

[2] Tor Valstad, Developments of the 3D Cadastre in Norway, XXIII FIG Congress 2006 http://www.gdmc.nl/3DCadastres/literature/3Dcad_2006_03.pdf.

[3] See the FIG questionnaire on 3D cadastres by the FIG joint commission 3 and 7 working group on 3D-Cadastres (2010-2014) www.gdmc.nl/3DCadastres and the paper "World-wide inventory of the status of 3D Cadastres in 2010 and expectations for 2014" by Peter van Oosterom, Jantien Stoter, Hendrik Ploeger, Rod Thompson and Sudarshan Karki for FIG Working Week 2011, Marrakech, Morocco.

[4] Homogenous means that the same combination of rights equally apply within the whole 3D spatial unit. Unique means that this is the largest spatial unit for which this is true. Making the unit any larger would result in the combination of rights not being homogenous. Making the unit smaller would result in at least 2 neighbour 3D parcels with the same combinations of rights.

1.2 Recording of 3D parcels in the cadastral database

3D parcels as such do not exist in any cadastral registration. The description of the 3D space will be found in the survey plans or in the legal documents. The standard seems to be that "floor plans" that the boundaries per floor are listed in the title deed or the appropriate public records (Land Book, Land Registry, public records) or survey plans but not in the cadastral database (map). It may be possible to make a reference to the 3D parcel in the cadastral map in the form of a 2D polygon in a single layer as in the case of Australia, Cyprus, Croatia (where is spoken of a “2.5D representation”) , Norway and Sweden.

In Queensland, Australia 3D registration is supported by the titling system and 3D parcels are registered as either a “Volumetric parcel” (see Figure 1) or as a “Building Format parcel”. The legal and technical requirements for registration are given in the Land Title Act 1994 and the Registrar of Titles Directions for Preparation of Plans Section 10.2.2.).[5] In the digital cadastral database, the strata are shown as an attribute and all 3D related information exists in the plan. Building Format plans are not created for every house, but only those requiring strata title. The title database is held separately to the cadastral database and updates are part of a sequential workflow. 3D data is not represented in the viewing tools of the database.

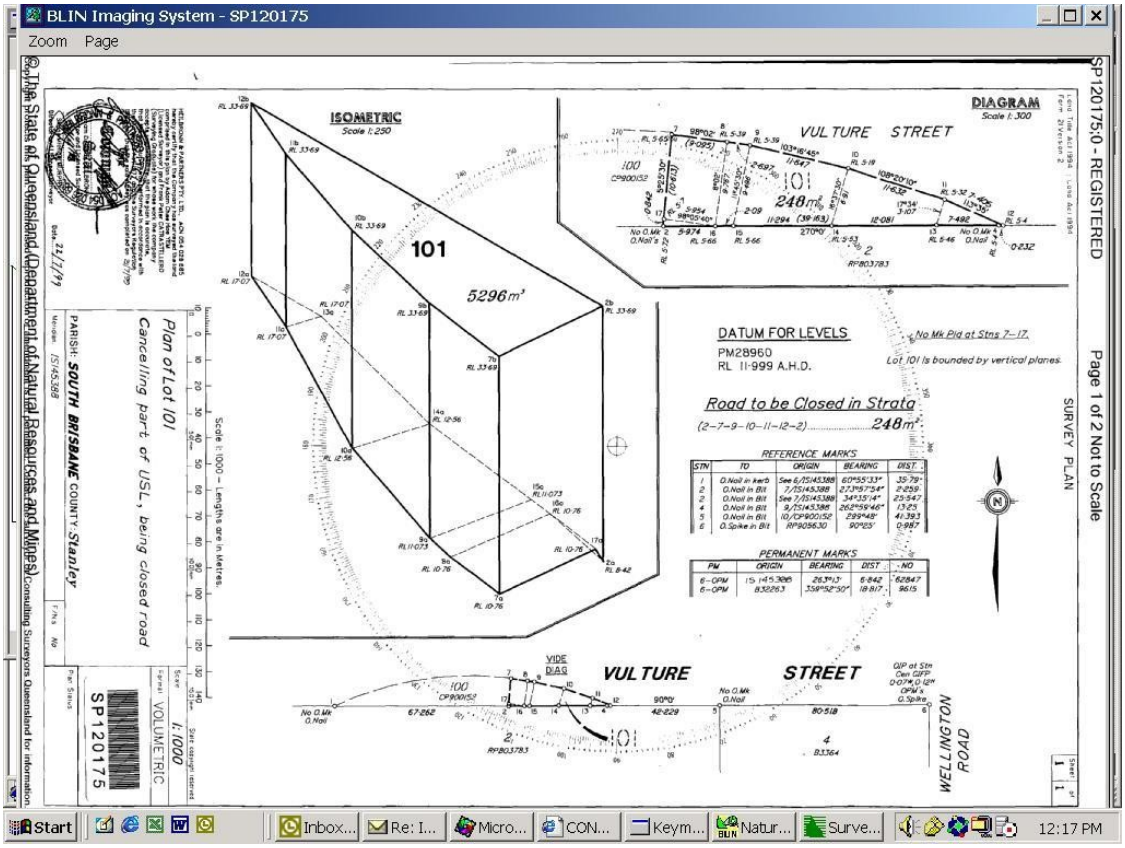


Figure 1: Volumetric parcel, Queensland (Australia)

In Italy 3D Cadastre is represented by the Cadastre of Buildings that exists next to the “Land Cadastre”. This holds an inventory of every building. A very interesting system of 3D visualization exists in Spain. Here on the

[5] < http://www.derm.qld.gov.au/property/titles/rdpp/pdf/section_10.pdf>

cadastral map a 3D model of the buildings can be shown, including the boundaries of rights inside the buildings. But this is not a 3D representation of the actual height of the units. In fact the representation is based on a standard height of 3 meters from floor-to-floor. Although this is a limitation, this solution does offer a more or less a realistic view of the buildings and property rights within buildings in urban areas, see Figure 2.

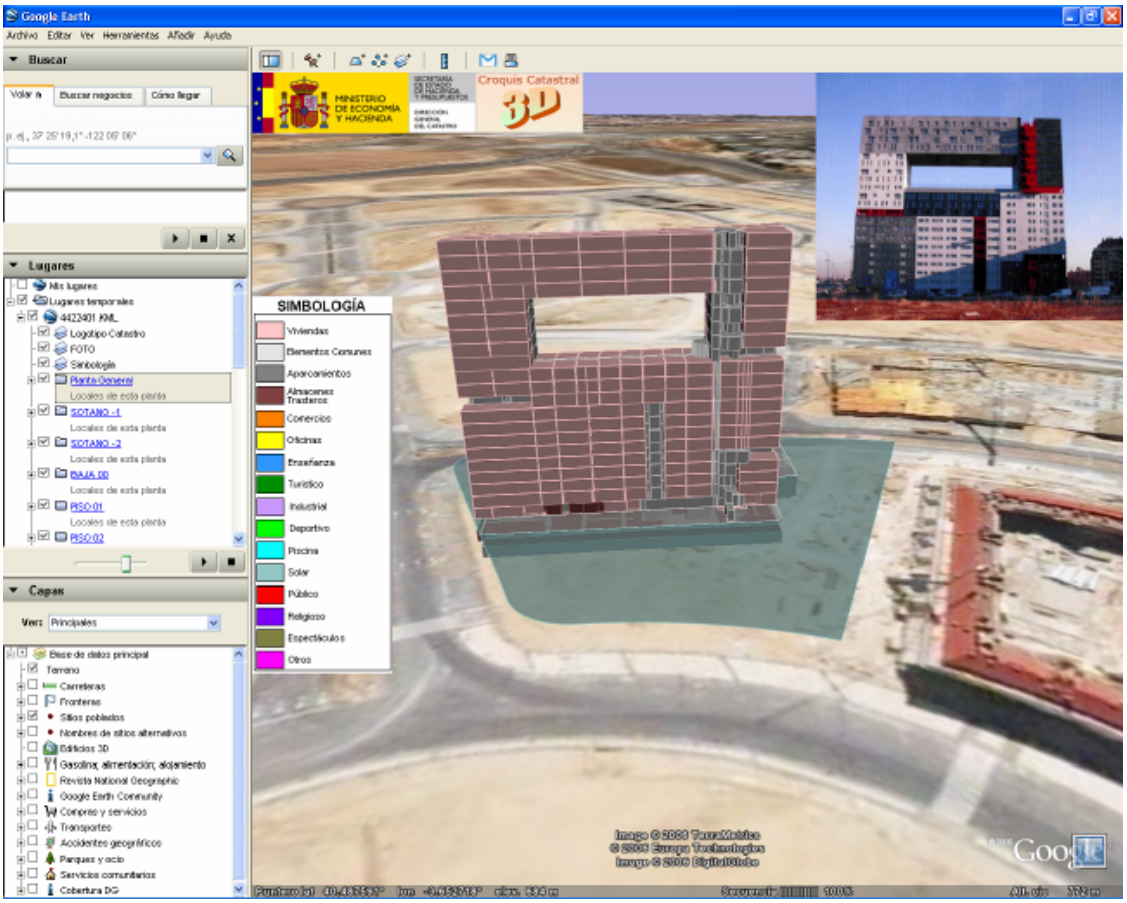
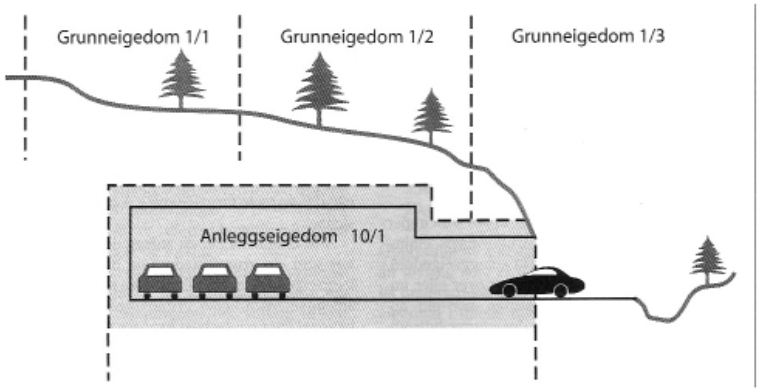


Figure 2. 3D visualisation of buildings in the Spanish cadastre (based on a standard floor-to-floor height of 3 meters.

1.3 3D parcels and 2D parcels

In general a 3D parcel must be located within the boundaries of a (2D) parcel. This does not exclude that the building to which the right refers may be situated on several land parcels. It might be possible that - as in the case of the Netherlands - a legal 3D description of right refers to various 2D land parcels. The responses on the FIG questionnaire are not always clear on the question what will happen if the land parcel is subdivided later. In Australia, 2D parcels are subdivided to reflect 3D ownership, however if the 2D parcels are subsequently subdivided or amalgamated it does not affect the status of the 3D parcel which in that case may span several 2D parcels. 3D easements or leases may exist on part or the whole of 2D parcels, may extend to other parcels, may be subdivided, amalgamated or wholly or partly extinguished and may have full or partial overlap with another interest. In Norway and Sweden, 3D properties may be created that extend over or under different 2D parcels; see Figure 3. In Finland this possibility is foreseen for the future.



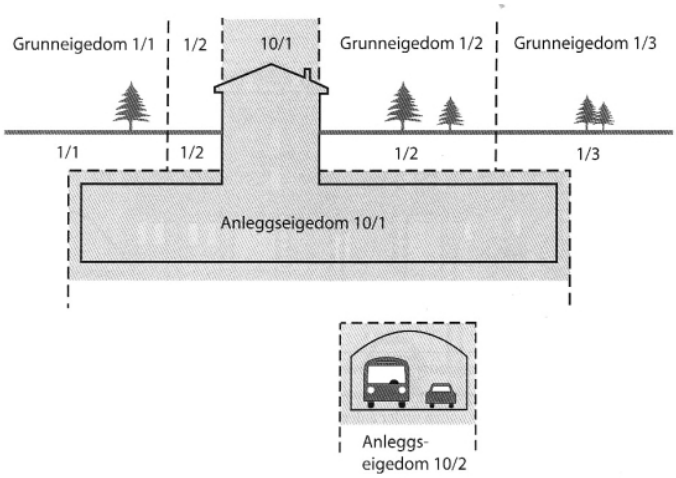


Figure 3a & b: Norway: 3D parcel (Anleggseigedom) under several 2D surface parcels. Source: Tor Valstad, 3D Cadastres in Europe

1.4 Registration of empty spaces?

An important interesting question is whether registration of rights to empty spaces - such as air spaces or subsurface volumes - is allowed (e.g. to protect an existing panorama) or that the registered right compulsory refers to an existing or future construction. In most countries explicit rules for this do not exist, but in general the rights will refer to a construction. Explicitly the possibility of registration of rights for empty spaces is mentioned in Australia. 3D rights are permitted as in the case of 3D easements, limited height parcels or Building Format parcels.

In Finland empty spaces are limited to subsurface volumes. By contrast, in Norway and Sweden the laws expressly exclude this possibility. In these countries there must be a construction, or a building permit issued for future constructions before a 3D property can be registered. In Norway 3D parcels can be nullified in the case construction has not started within three years after the building permit has been issued.

1.5 Boundaries of the 3D parcel

Generally the boundaries of 3D parcels refer to walls, ceilings and floors. The respondent for France expressly states that in the absence of guidelines in this area virtual boundaries would be possible. With respect to the z-axis (height) it appears that in the vast majority of systems directives on this issue does not exist or the height is not registered. Among the countries that do register the height (in survey plans or in a legal deed) it may be observed that Australia and France make use of an absolute level while in Sweden reference is made to a height relative to ground level. Canada (Quebec) has both, elevation from Z datum (absolute level) for each floor of an apartment for example and H (Height between each floor). Some complementary plans only have altitude (absolute level). Absolute level is the main part.

1.6 Registration of cable and pipeline networks

Cable and pipeline networks occupy a special place within the registered 3D objects and rights. These networks often extend over several land parcels and thus have – apart from the height or depth of the structure – a 3D character of their own. In recent years the Netherlands introduced the possibility to register rights to all types of cable and pipeline networks; see Figure 4. The networks have a cadastral number of their own. The network is represented on a map that is registered in the Public Registers. In cases of changes in the network (e.g. an extension) a new network map must be registered. On request the registered network can be projected on the cadastral base map. Due to practical problems, such as the way to legally prove the ownership of the network, until now only a limited number of networks have been registered.

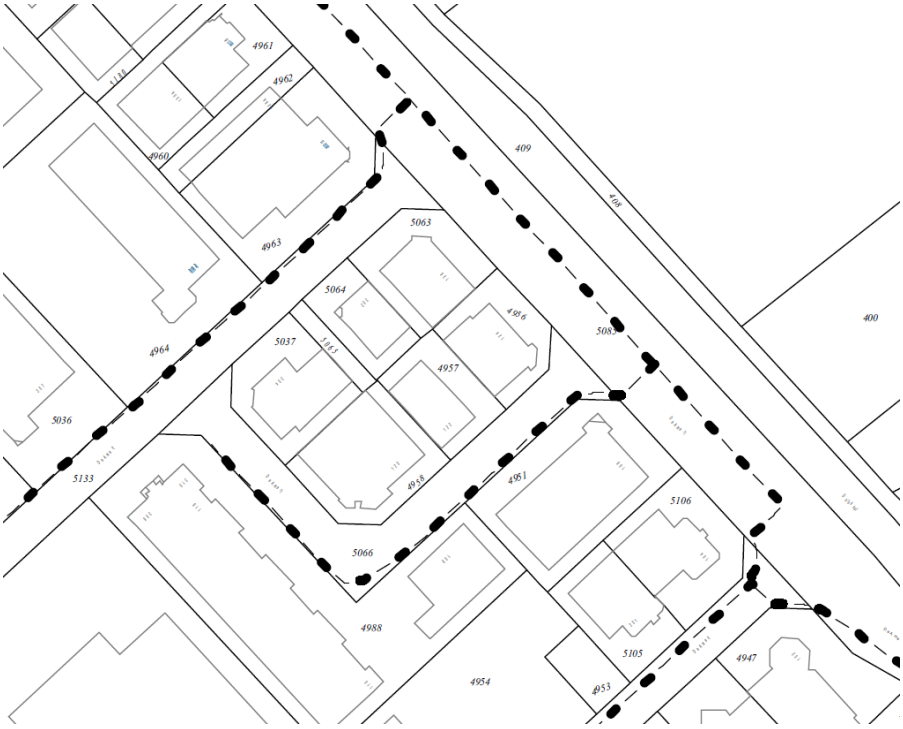


Figure 4: Registered electricity network in The Netherlands; small part of a “network map”, registered in the public registers.

In Switzerland, especially in Geneva networks are included in the cadastral database in a similar way. In the Russian Federation, a network can be registered by the Land Registry, but in practice this is not done. In Kazakhstan, all networks are registered "as legal objects". However the respondent also mentions that underground networks are not registered but only shown on maps. Furthermore, in Canada (Quebec) cable and pipeline networks, rail networks are recorded in public registers (Register of real right of State resource development). It can be requested by the owner that the network is displayed on the cadastral plan, but this rarely happens. The network as such can not be found in the cadastral database, but indirectly through the land parcels in which the network is constructed.
There seems to be quite a number of ways network parcels are registered in Australia. While some create 3D easements, others subdivide the surface parcels and some do not capture them on plans. 2D parcels generally have a minimum size restriction determined by zoning rules but there is no such restriction on the minimum cross-section size of a 3D parcel.

In other countries registration of networks does not happen, or is just possible in limited cases, as in Turkey where only high voltage power lines are registered in the cadastral database. Registration of other networks find place at municipal level, and combined with cadastral data, see Figure 5 example from Istanbul, Turkey.

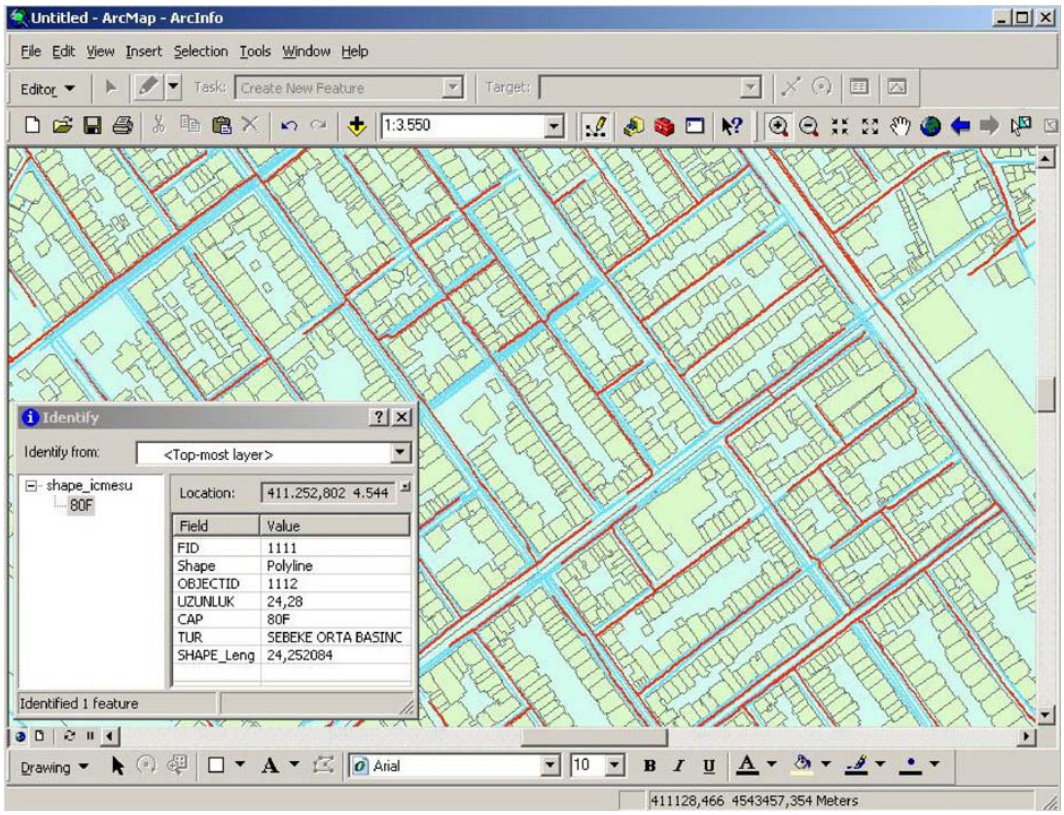


Figure 5: Turkish example of registration of ‘3D utility network’: gas (red) and water (blue) map fragment Istanbul reregistered utility data in combination with cadastral map; translation: ‘uzunluk’ = ‘length’, ‘cap’ = ‘diameter’, ‘tur’ = ‘pressure’; source (Döner e.a. 2010).

A general registration of (underground) networks does not exist in Norway, where telecommunications, water and electricity networks are not registered, but roads and railways are. Some jurisdictions have "utility maps”

(Australia, Victoria) or a "utility register" as Croatia. In the latter country is expected that this register will be integrated in the cadastral database in 2014. Also in other countries we see developments towards the cadastral registration of networks, especially in Denmark, Hungary, Israel and Italy. In the latter country this would take place in the context of pilot projects leading to the development of a subsurface cadastre.

1.7 International summary

The solutions for registration of rights with 3D characteristics are very different. Broadly, one can observe that apartments are registered with drawings in the deed registration. But a true 3D registration in the cadastre does not exist anywhere. This has been approached by Spain, although the visualization is based on a standard height per floor layer.

In short, the weaknesses of the international solutions are:

- Documents in Land Registration (public registers, land books) are still necessary to get insight in the 3D properties
- It is not possible to view the 3D parcel interactively
- There is no 3D overview, only per parcel
- 3D parcels cannot be validated
- 3D functions cannot be applied.

2. Analysis of the current legislation and registration in the Russian Federation

2.1 Relevant laws

Applicable laws and articles to 3D cadastre modeling are:

- Civil Code, Article 130;
- Land Code, Article 11.1
- Urban Development Code, Article 1
- Federal Law “On state registration of rights in immovable properties and transactions wth them”;
- Federal Law “On state cadastre of immovables”, art. 1;

Other relevant by laws and instructions that elaborate on the principles laid down in the laws mentioned are:

- Regulations for management of the integrated state register of rights in immovable properties and transactions with them (approved by an order of the Government of the Russian Federation from 18.02.1998 3 219).
- Routines for management of the state cadastre for real estate (approved by order of Ministry of Economic Development of Russian Federation from 04.02.2010 №42).
- Form of technical plan of a building and the Requirements for preparation of technical plan of a building (approved by order of Ministry of Economic Development of Russian Federation from 1 Sptember 2010 N 403.)
- Form of technical plan of premises and the Requirements for preparation of technical plan of premises (approved by order of Ministry of Economic Development of Russian Federation from 29.11.2010 N 583).
- Content of data of cadastral maps (approved by order of Ministry of Economic Development of Russian Federation from 19.10.2009 № 416).

2.2 Definition of parcel

The Land Code, Article 11.1, does not mention 3D boundaries as such. A parcel is defined by boundaries in 2D:

A land parcel is the part of the earth's surface, whose boundaries are determined in accordance with the federal laws.

Article 64 of the Routines for management of the state cadastre for real estate provides description of the content of information about location of boundaries of land parcel in more detail (2D boundaries):

“The Register shall contain the following information about the location of the boundaries of land parcel:
1) a list of coordinates (refer to specific points on the boundary of land parcel, a description of their reference at the terrain, the coordinates of specific points on the boundary of the land parcel in meters, rounded to 0.01 meters and with an indication of the error in determining the system of coordinates);
2) The cadastral numbers of adjacent land parcels;

3) Additional information clarifying the description of the individual parts of the boundary of land parcel (names of natural objects and (or) artificial objects, including linear facilities, if the location of individual parts of the land boundary coincides with the location of the external borders of such objects)".

2.3 Cadastral object types

The current parcel system is 2D polygon based, implying that the boundary between adjacent parcels is repeated. There are rules to avoid overlap between parcels. The database contains the full history of the polygon since its creation. The scale of the cadastral maps differs for pragmatic reasons from 1:2,000 in urban areas up to 1:10,000 in rural areas.

The Russian Cadastre records more than land parcels. According to article 1 of the Federal Law 'On State Cadastre for Real Estate' the Russian cadastre (maintained by Rostreestr) records information about five types of objects (see Figure 6):

1. Land parcels
2. Buildings
3. Apartment Units
4. Facilities (bridges, pipelines etc.)
5. Unfinished objects, i.e. objects under construction (buildings, bridges, pipelines, etc.).

The objects 2-5 all have clearly a 3D characteristic. Interesting to note is that a building or an other structure may be located on several land parcels. See article 73 Routines for management of the state cadastre for real estate:

"The register shall contain the following general information about the building:
(…)
7) the cadastral number of the land parcel on which the building is situated. If the building is located on several land parcels – the cadastral numbers of all such land parcels".

Article 76 provides a same rule for other structures.

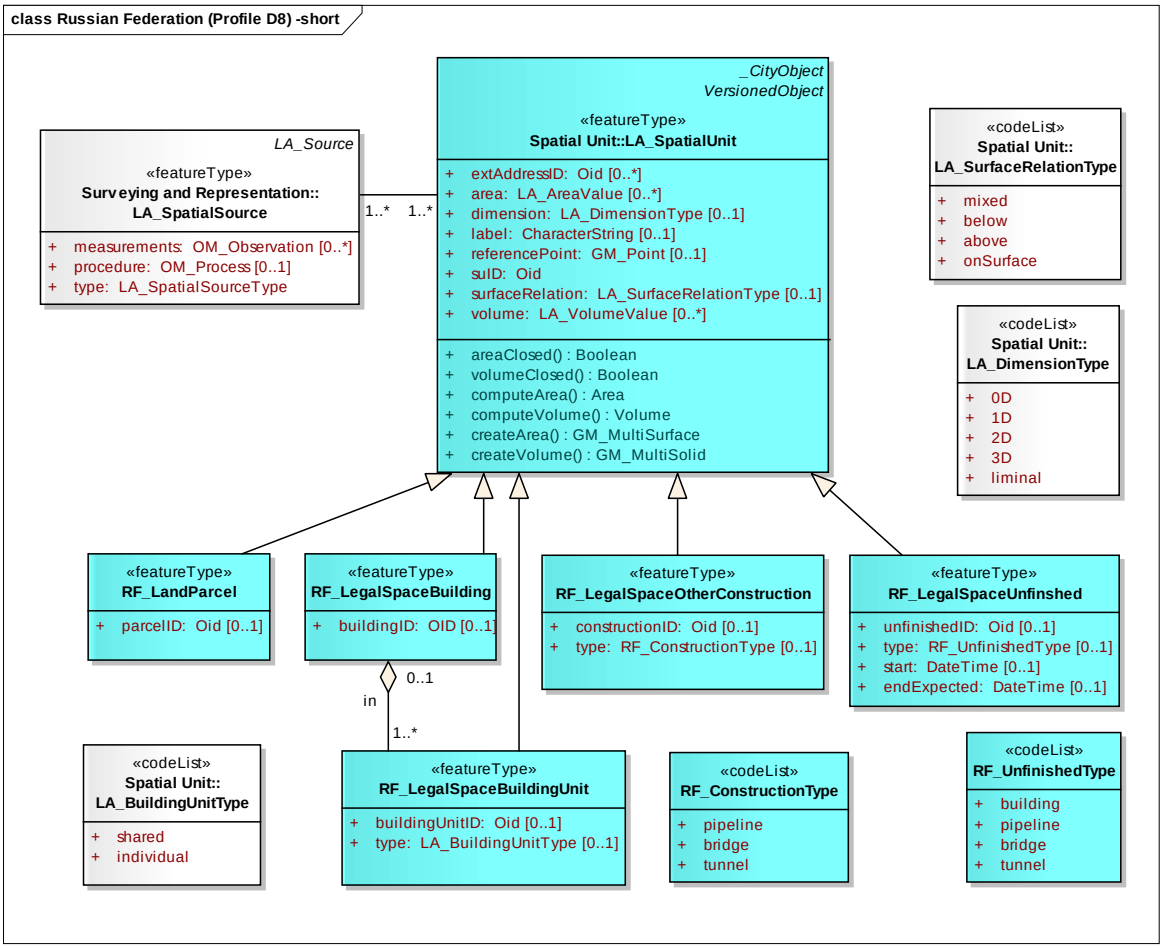


Figure 6: The initial Land Administration Domain Model (LADM) for the 3D cadastre pilot project in the Russian Federation, with five different types of cadastral objects (LA_SpatialUnits LADM in terminology)

2.4 Content of data about immovable objects

Article 7 of the Law on State Cadastre for Real Estate contains an exhaustive list of data, subject to recording in the Russian cadastre. E.g. the type of property and the cadastral number. Interesting from the perspective of a future 3D Cadastre is that the cadastre also contains 'a description of the location of the boundaries of the property, if the subject property is a plot of land', 'a description of the location of the property on the land, if the subject property is a building, structure or facility under construction' and 'the cadastral number of buildings or structures in which the premises are located, number of floors on which it is located the premises (if any number of storey's), a description of the location of the premises within a given floor, or within a building or structure, or the relevant part of the building or structure, if the subject property is a room' (Article 7.1. sub 3, 4 and 5).

See also Article 7.2:

"2. The state cadastre of real estate made the following additional information about the property:

(…)
4) the cadastral number of the land parcel, within which a building, structure or facility under construction is located, if the real estate object is a building, structure or facility under construction;
5) cadastral numbers of buildings, structures or facilities under construction located within the plot of land, if the real estate object is a plot of land;
6) the cadastral number of the apartment, in which the room is located, if the real estate object is a room;
(…)
10) information about a part of the property covered by the restrictions (encumbrances) of rights in rem, if such a restriction (encumbrance) shall not apply to the entire property;
(…)
19) the number of floors (floors), including underground floors, if the real estate object is a building or structure (if any number of floors of a building or structure)
(…)"

All these requirements are elaborated in the Routines for management of the state cadastre for real estate, esp. articles 73, 76, 77, 80 and 81.

2.5 Technical Plan

Details on buildings, premises and sites under construction contains the technical plan (Технический план). This offers a graphical and a textual description of the registered object. Article 41 of the Federal Law 'On State Cadastre for Real Estate' describes this technical plan as 'a document which reproduces certain information included in the state cadastre of real estate, and giving details of the buildings, premises or on site under construction, necessary for registration of such property or information about a part or parts of such an object property, or new necessary for inclusion in the state cadastre of real estate information on such a property that is assigned inventory number.' The technical plan consists of a graphic part and a textual part. The graphic part may contain 'a floor plan or part of the floor of a building or structure indicating the location on this plan of such a premise, and in the absence of storey's of a building or structure plan for the building or structure or plan of the relevant part of the building or structure indicating the location on this plane, such premises.' (Article 41.4).

See in more detail Article 41.6: 'The location of the premises is set through a graphical display boundary of the geometrical shapes formed inside the outer walls of the room, the floor plan or part floors of a building or facility, and in the absence of storey's of buildings or structures on the plan of a building or structure or the terms of the relevant part of the building or structure.'

Article 41.8 provides information on data, subject to recordation in the Technical Plan:

'8. For information about the property specified in the technical plan submitted by the customer on the basis of cadastral work permit to enter such a property in the operation, design documentation of such property or a technical certificate for such property. In the absence of these documents, such information, except for information about the location of building or facility under construction on the land and the location of spaces within the floor of a building or structure or within a building or structure, either within the relevant part of the building or structure are indicated in technical terms based on the declaration, drawn up and certified by the owner of the property. This declaration is attached to the technical plan and is an integral part of it.' (see Figures 7a, 7b and 8 for examples).

The requirements for the preparation of the technical plan of building or apartment are approved by orders of the Ministry of Economic Development of the Russian Federation from September 1, 2010 N 403 and November 29, 2010, N 583.

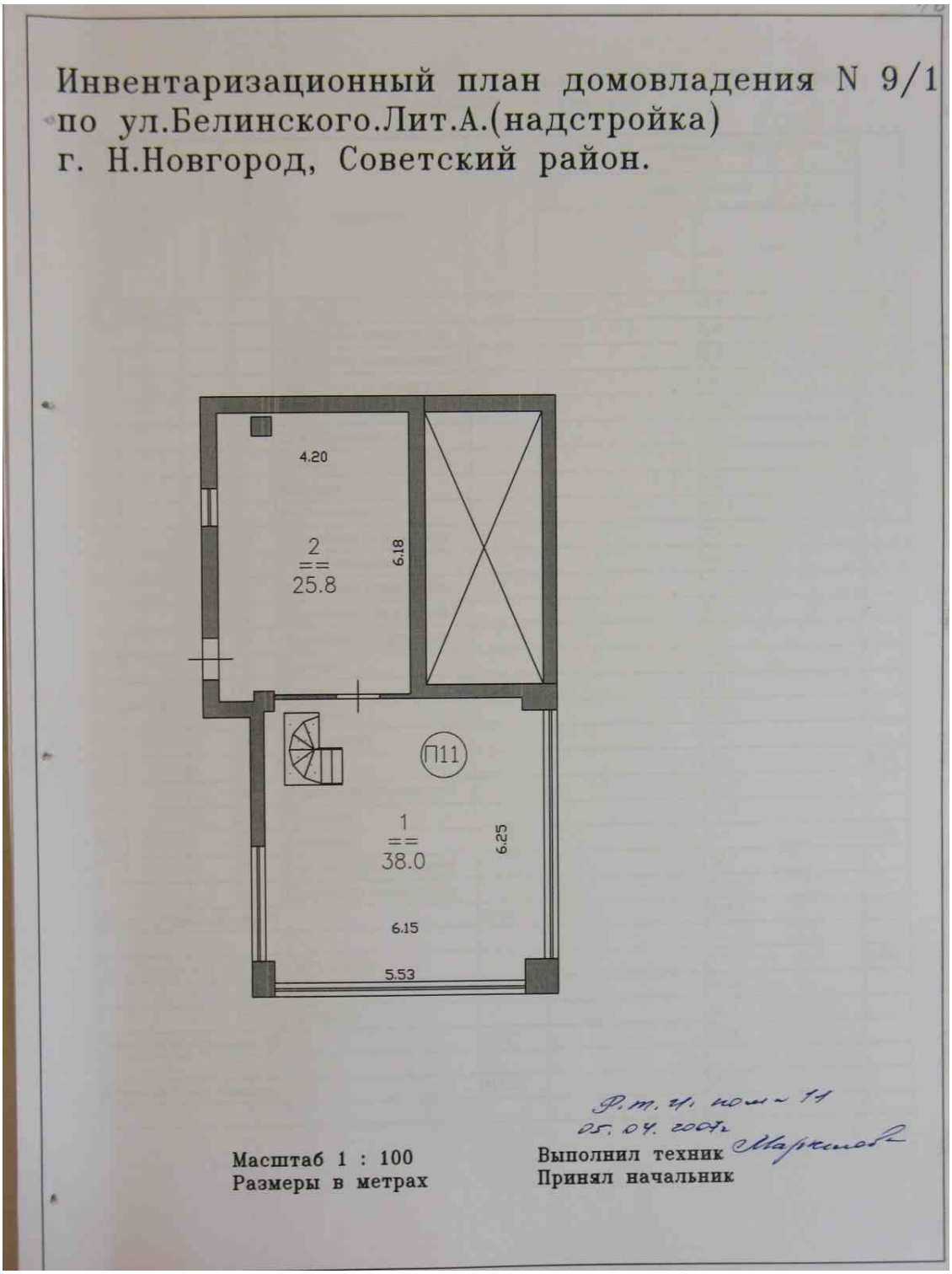
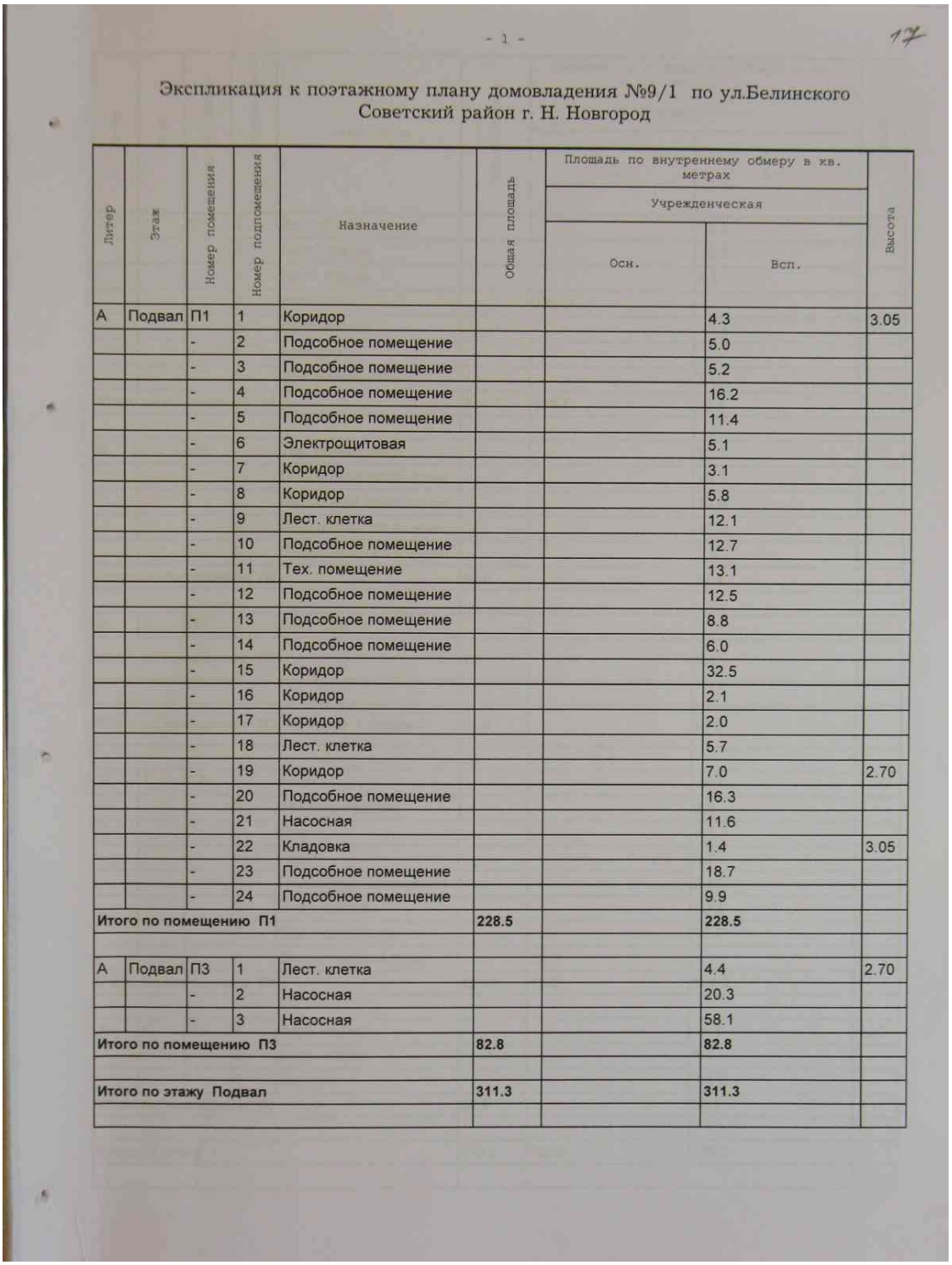


Figure 7a. Apartment building: part of the Technical Plan.



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17

Экспликация к поэтажному плану домовладения №9/1 по ул.Белинского
Советский район г. Н. Новгород

Литер	Этаж	Номер помещения	Номер подпомещения	Назначение	Общая площадь	Площадь по внутреннему обмеру в кв. метрах		Высота
						Учрежденческая		
						Осн.	Всп.	
А	Подвал	П1	1	Коридор			4.3	3.05
		-	2	Подсобное помещение			5.0	
		-	3	Подсобное помещение			5.2	
		-	4	Подсобное помещение			16.2	
		-	5	Подсобное помещение			11.4	
		-	6	Электрощитовая			5.1	
		-	7	Коридор			3.1	
		-	8	Коридор			5.8	
		-	9	Лест. клетка			12.1	
		-	10	Подсобное помещение			12.7	
		-	11	Тех. помещение			13.1	
		-	12	Подсобное помещение			12.5	
		-	13	Подсобное помещение			8.8	
		-	14	Подсобное помещение			6.0	
		-	15	Коридор			32.5	
		-	16	Коридор			2.1	
		-	17	Коридор			2.0	
		-	18	Лест. клетка			5.7	
		-	19	Коридор			7.0	2.70
		-	20	Подсобное помещение			16.3	
		-	21	Насосная			11.6	
		-	22	Кладовка			1.4	3.05
		-	23	Подсобное помещение			18.7	
		-	24	Подсобное помещение			9.9	
Итого по помещению П1					**228.5**		**228.5**	
А	Подвал	П3	1	Лест. клетка			4.4	2.70
		-	2	Насосная			20.3	
		-	3	Насосная			58.1	
Итого по помещению П3					**82.8**		**82.8**	
Итого по этажу Подвал					**311.3**		**311.3**	

Figure 7b. Apartment building: the plans with distribution of the use of apartments and sizes (measured internally between walls).

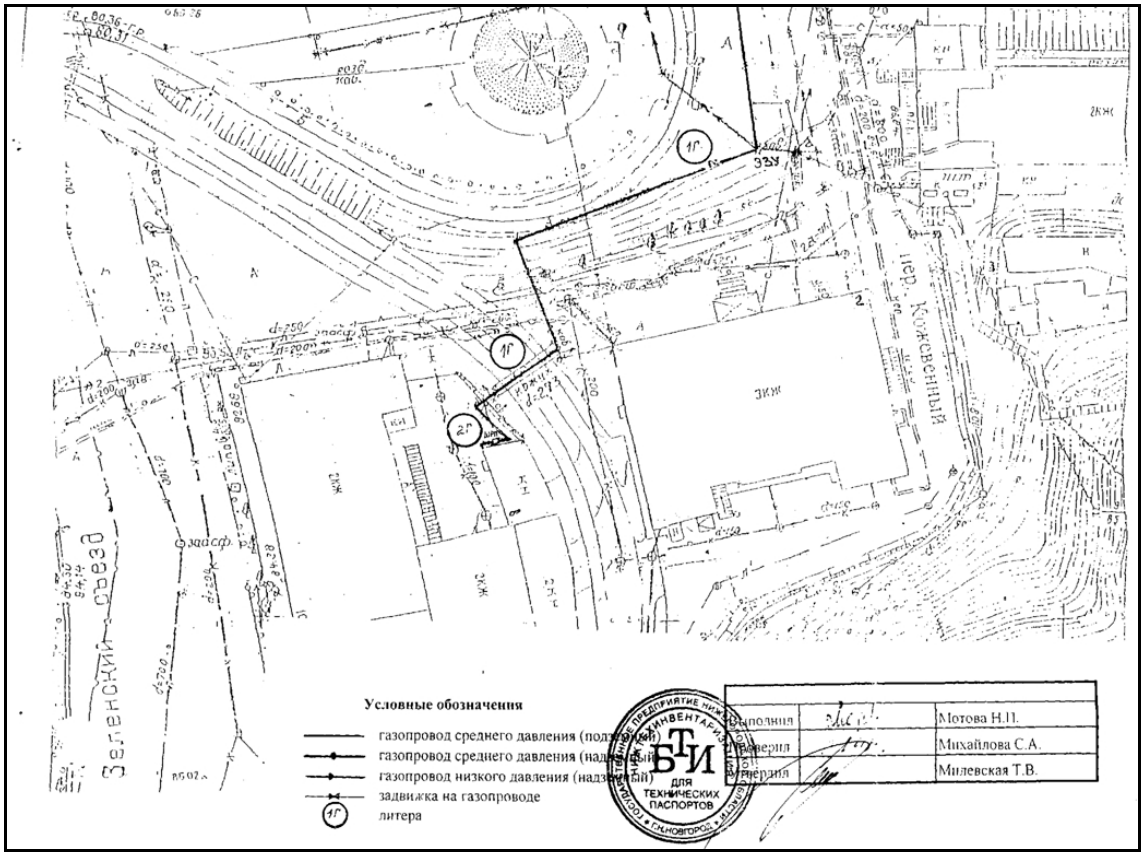

Figure 8: Page from a document of transfer of ownership of a pipeline. Map of the pipeline (part of the Technical Plan).

2.6 Summary of analysis of the legislation

We make the conclusion that the Russian Federation law in the field of state cadastre of immovables and state registration of rights in immovable properties and transactions with them does not explicitly mention 3D objects, and at the same time the cadastral recording and state registration of 3D parcels is not prohibited.

The Federal Law on State Cadastre for Real Estate offers a good foundation for development, aiming at setting up of 3D cadastre. First of all the Russian Cadastre not only registers (2D) parcels, but also immovable objects that will have 3D characteristics: buildings, facilities (like pipelines), apartment units and also buildings that are under construction. The Technical Plan contains also information on the boundaries of those objects. Although under the current law the Technical Plan does not contain 3D information as such, apart from floor plans in case of apartments, this way of recording offers scope to develop towards a 3D cadastre in future.

3. Selection of the best option for the Russian 3D-cadastre

3.1 Overview of the main options

The basis of the Russian 3D Cadastre model is formed by the ISO 19152 Land Administration Domain Model (LADM) (ISO, 2011). However, LADM is still allowing many options and these should be investigated. The following options for a 3D cadastre model can be identified:

1. Minimalistic 3D cadastre: do not consider cables, pipelines and (rail) roads as real estate objects (and do not register them in the cadastre), this eliminates the majority of subsurface objects. For apartment buildings: make them available via layers (by clicking on a symbol on 2D map/floor plans as in Spain), this takes care for the majority of above surface objects. For all other 3D objects add a symbol to the 2D map and refer the spatial source document (and other tricks to make the situation 'clear'). Advantage: easy to implement. Drawback: the minority of 3D exception cases (non layered apartments or pipelines and cables) may give the majority of problems.

2. Topographic 3D cadastre: do not create own geometry for the legal objects, but define the legal objects by referring to (boundaries) of physical objects (topography, including pipelines and cables). Advantage: when a reliable 3D topographic data set is available, this can also form the basis of the 3D Cadastre. Drawbacks: This implies that a legal object can only exist if there is a topographic counterpart to refer to. The topographic 3D cadastre is non-consistent with the design principle of the current 2D cadastre (based on legal parcel boundaries).

3. Polyhedral Legal 3D cadastre: 3D volume parcels have their own geometry, similar as in the current 2D database (via polygons). However, this time the geometry is represented by a polyhedron (volume bound by flat faces). Advantages: relatively easy implementable with current technology (database, GIS/CAD), and similar to polygon approach in 2D. Drawbacks: no topology structure (for better quality guarantees) and no curved faces.

4. Non-polyhedral Legal 3D cadastre: similar to the previous model alternative, but now allowing curved faces, such as cylinder and spherical patches (which can be the result of buffers) of even more complicated curved surfaces, including NURBS. Advantage: more type of 3D shapes can be registered (as needed in Queensland, because the law and regulations do not enforce restrictions on the geometry types). Drawbacks: no so easily implemented with current technology and also still no topology structure.

5. Topological Legal 3D cadastre: 3D volume parcels are described by a topological structure based on nodes, edges, faces and volume primitives. It is assumed that, and most useful when, the 3D objects are to be considered a partition of space. That is, the 3D objects have touching neighbours on all sides: Advantages: no redundancy in storing the boundaries, good quality control (no overlap and gaps). Drawbacks: less well supported by current technology and also not consistent with the current polygon parcel approach in the 2D Russian cadastre.

3.2 Most appropriate option

Of these five options, option 3 (legally 3D Land Registry based on polyhedron volume objects, flat planes) seems to be the most obvious. This in a mix with option 4 for volumes with curved surfaces such as around pipes or buffers around objects (multi-polyline with diameter). Option 1, the minimalist approach to 3D Land Registry does not solve the sometimes complex 3D situations. Option 2, topographical 3D cadastre (3D plots define referrals of 3D physical objects), is not conform to the current 2D Land Registry which is based on properties with own geometry. And Option 5, a topologically structured 3D Cadastre, is not conform to the current 2D Russian Land Registry, which has no topology.

4. Conclusion

Despite all research and progress in practice, no country in the world has a true 3D-Cadastre, the functionality is always limited in some manner. Around the world the solutions for registration of rights with 3D characteristics are very different. Broadly, one can observe that apartments are registered with drawings in the deed registration. But a true 3D registration in the cadastre does not exist anywhere. This has been approached by Spain, although the visualization is based on a standard height per floor layer.

The Russian Federation law in the field of state cadastre of immovables and state registration of rights in immovable properties and transactions with them does not explicitly mention 3D objects, and at the same time the cadastral recording and state registration of 3D parcels is not prohibited.
The Federal Law on State Cadastre for Real Estate offers a good foundation for development, aiming at setting up of 3D cadastre. First of all the Russian Cadastre not only registers (2D) parcels, but also immovable objects that will have 3D characteristics: buildings, facilities (like pipelines), apartment units and also buildings that are under construction. The Technical Plan contains also information on the boundaries of those objects. Although under the current law the Technical Plan does not contain 3D information as such, apart from floor plans in case of apartments, this way of recording offers scope to develop towards a 3D cadastre in future.

The basis of the Russian 3D Cadastre model is formed by the ISO 19152 Land Administration Domain Model (LADM) (ISO, 2011). We discussed five options for the Russian 3D-Cadastre. Our conclusion is that option 3, a Polyhedral Legal 3D cadastre, with volume objects with flat planes, is the most appropriate option. This might be mixed with a Non-polyhedral Legal 3D cadastre (allowing curved faces, such as cylinder and spherical patches) for volumes such as around pipes or buffers around objects.