

ASPECTS OF A 3D CADASTRE IN THE NEW CITY OF MODP'IN, ISRAEL

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ABSTRACT

3 Dimensional Cadastre is a relatively new sphere in property registration, intended to enable registration of underground and above-the-ground lands. This paper describes a large-scale project, in the city transportation center of Modi'in, Israel, which includes buildings, bus station and parking, a tunnel and railway station, roads, public areas and more. This complex structure, with its many layers and different ownership, is a good example for construction projects that could not be registered by orthodox cadastral procedures. Further discussed is the land registration system in Israel - its drawbacks and limitations. Finally, a short overview of the work accomplished so far in this specific project and general progress in 3D Cadastre by our office.

INTRODUCTION

Armi Grinstein – Geodetic Engineering Ltd., functions since 1991 as the site surveyor of most parts of the new city of Modi'in, located amidst Tel-Aviv and Jerusalem (40 kilometers from Tel-Aviv), and currently being established. Our primary role is the establishment and management of the entire planimetric and altimetric geodetic network in the city, inside and outside construction sites in the neighborhoods.

The city was developed in quarters containing 2,500 – 6,100 apartments (10,000 - 15,000 residents in each quarter). Between the years 1994 – 2001, the building of 16,000 apartments, out of 24,100 planned for this stage, was completed (or reached last stages). The expected city population is approximately 200,000.

Quarter	Area [dunam]	Appart- ments	Parcels	Building Companies	Boundary Points	Develop- ment Budget [million \$]	Construc- tion Budget [million \$]
A	920	3,900	142	-	751	-	-
B	1,100	5,100	232	49	1,142	-	-
C	1,900	3,000	243	33	1,226	-	-
D	890	2,500	251	26	929	-	-
E	2,200	6,100	409	28	2,170	-	-
F	1,830	3,500	-	-	-	-	-
	8,840	24,100	1,277	136	6,218	750	4,000

Table 1: Statistical Data (first stage) – the City of Modi'in.

The legal registration process in Israel is usually executed by the building companies, and is extremely slow. This process may take as long as 8 to 10 years, and sometimes even more. Currently, more than 700,000 apartments in Israel are not registered. This constituted the primary reason for the Ministry of Construction and Housing to initiate land registration in this project by the site surveyor. This was a first experiment of its kind in Israel and was concluded as very successful.

The land registration process in Modi'in was performed methodically, parallel to the beginning of construction and separately for each quarter. As this registration is a primary stage to common houses and tenant privileges registration, we intended to finish registration of the division at the same time as the delivery of apartments to the tenants. In the years 1997, 1999 and September 2001 our company finished the registration procedures in quarters D, B and E – approximately 13,000 apartments altogether. This is considered a very short period, in Israeli standards, for such scales. We are currently working on quarter C and the main city center, which also contains the city transportation center.

THE CITY CENTER

The city center is planned to contain principal municipal functions, such as the city council building, a museum, a theater, office and trade buildings, a hotel, academic college, a library and the transportation center.



Figure 1: A model of the Modi'in City Center.

Establishment of the transportation center is divided into several stages: the first two stages, which are supposed to last 48 – 60 months, include the structure of the center, roads and the level of the bus station including all docks and ramps for entry and exit of busses and pedestrians. This stage also includes the foundation of the underground railway station. The third stage is intended to conclude all the work required for the operation of the underground railway station, below the bus station level.

During the same 48 – 60 months of development in the city center, additional construction will take place in all neighboring parcels, including buildings, access roads (mostly 2 - 3 levels) and mainly underground parking installations, some of which are 5 stories. According to the city master plan, the building area in the city center will be approximately 100,000 sq. meters and the roads and bridges approximately 40,000 sq. meters. The project was promoted by the city council by not granting building permits, in the neighboring parcels, until the completion of the first two stages of the transportation center.

The city transportation center, located in the main city center, will be mostly underground and include the following layers or levels:

- Layer [-4] (+210m): A railway station with two platforms and entry and exit tunnels.
- Layer [-3] (+216÷225m): A multi-level public garden.

- Layer [-2] (+221m): Central bus station and bus parking.
- Layer [-1] (+227m): A suspended access road to the bus station.
- Layer [0] (+232m): The surface / Public areas.
- Layers [1-5] (+256m): Public and commercial buildings.

This project's estimated cost is 150,000,000 US\$, with the principal part being the railway station.



Figure 2: City Master Plan of the Main City Center.

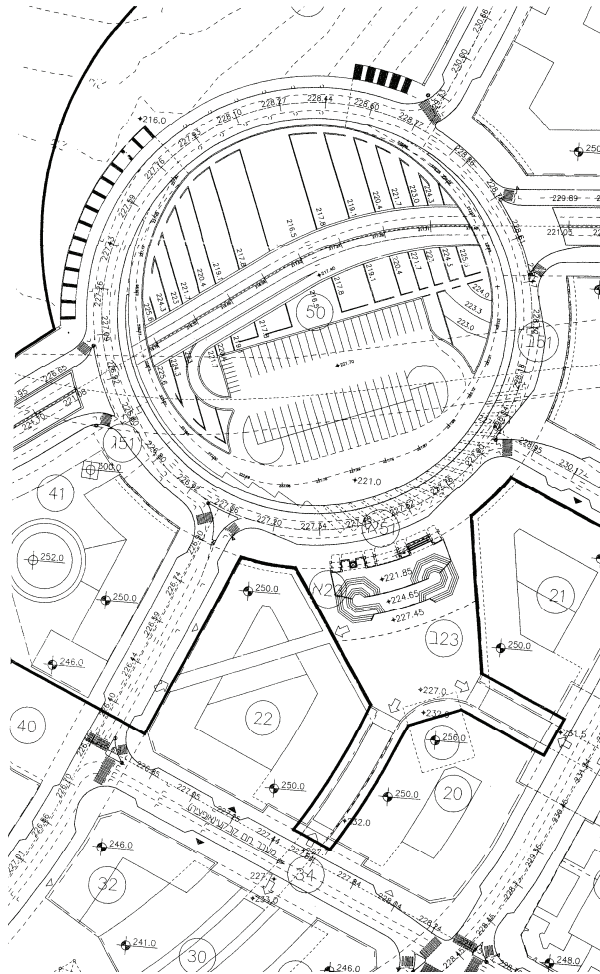


Figure 3: Building Plan of the Main City Center.

DESCRIPTION OF LAND OWNERSHIP IN THE MAIN CITY CENTER

Land ownership in Israel usually falls under one of these categories: the State of Israel, the Development Authority, Keren Kayemet, municipal authorities or private ownership. Generally, the process of re-division is relatively simple in cases of merging state lands. Involvement of private lands complicates the process and Modi'in is no exception. Most of the land in the city is owned by the state, apparently the easier scenario; however, the registration process becomes very complex due to multi-level construction in projects such as the city center.

Described below are land ownership, according to the specified layers:

- The State of Israel will own the railway station.
- The Municipal Authority will own the public garden.

- The Municipal Authority will own the bus station, after expropriation according to the real estate statute – 1969, sub-sections 5, 7, 19, and leased for a long term (49 years) to the bus transportation company.
- The Municipal Authority will own all the suspended and ordinary roads.
- The Land Development Authority will own the parcels on the ground, with the option to sell them to private investors.
- The State of Israel, the Land Development Authority or the Municipal Authority will own the public areas and buildings.

THE CURRENT LAND REGISTRATION SYSTEM IN ISRAEL

Current statutes allow land registration in layers only according to property registration in common houses. This type of registration is 2D and in best scenario describes an average layer, upon which all the layers are projected. Elements between layers, such as: access ramps, ventilation shafts, elevators, moving stairs and others, are overlooked.

The current land registration system has several technical and legislative limitations requiring changes:

- Current surveying regulations (1998) enable surveys and inspection of registration programs in 2D only. Beyond planar coordinates, these programs do not contain any information regarding heights. Land registration is also in 2D. A change in legislation, enabling 3D surveying and 3D program inspection by the Survey of Israel, is essential.
- When regulations for 3D registration do not exist, the only practical option is registration as apartments in a common house. Can we really define a house as: “a multi-layer building including an underground railway station, a bus station, a complex road system, a commercial center and a hotel”?
- Currently, land division on the surface extends to the earth’s center (according to the real estate statute – 1969, sub-section 11). When parcels on the surface have only one owner, they can be merged and then the sub-surface can be regarded as a single unit. However, how can we cope with multiple ownership? Is the ownership extension from the surface to the sub-surface still practical?
- Some statutory arguments state that the dependence between the surface and the sub-surface is stronger than the dependence between neighboring parcels on the surface. In case of a deep underground tunnel, a functional disconnection is possible. This solution was adopted for the transportation center (the tunnel is 30 meters below the surface), but can not apply where the tunnel gets proximate to the surface.

The Survey of Israel states that all future Cadastre will be digital. As all 3D mapping will also be digital, preliminary adjustment of the 2D Cadastre to 3D Cadastre is essential.

Regarding the financial issue of establishing the future 3D Cadastre, the most logical solution is to finance the project by landowners that will benefit from realizing their underground real estate.

LAND REGISTRATION OF THE TRANSPORTATION CENTER AND THE MAIN CITY CENTER

As previously mentioned, our company executed the land registration in Modi'in after the accomplishment of planning and with the beginning of construction. The registration process can only begin after the approval of the city master plans, which may take up to 2 – 3 years. The authorization process of the plan regarding the city center started in 1998 and is about to be completed next month.

It was obvious to us that the conventional 2D registration procedures were inappropriate for the registration of the multi-level city center. Our conclusion was enhanced by the fact that most of the spaces in the city center master plan, defined by the Safadi architects office from Boston, Massachusetts (USA), could not be registered.

In March 1999 we visited the Norwegian National Mapping Authority and studied the Norwegian approach towards 3D Cadastre in Oslo. In late 1999 we presented our company's preliminary approach to 3D surveying and mapping and the ability to present 3D underground objects, based on conventional surveying, in a surveying conference in Haifa, Israel.

3D measurements are practically executed regularly for many years, but are not exploited for registration plans due to the fact that Israel surveying regulations for registration plans only require planimetric presentation and thus heights are omitted.

Surveying in the transportation center is executed in 3D and all measurements, above or under the ground, with either Total-Stations or GPS receivers, are connected to the national control network for position and height. The more complicated issue is visualization of the project and the 3D registration plans, specifically to offices involved in the registration process, such as the Survey of Israel and the Bureau of land registration in the Ministry of Justice.

After the field surveying, we executed 3D computation and drawing of architectural plans and 3D visualization. The animation of the city center was prepared with the 3D Studio software by Kinetics. It includes production of a short video based on a model and 1,450 perspectives, to visualize the different layers and separate objects in the city center. The first perspective is shown in figure 4. This, however, is not an optimal solution and we currently focus on analysis of different software for 3D CAD and visualization.

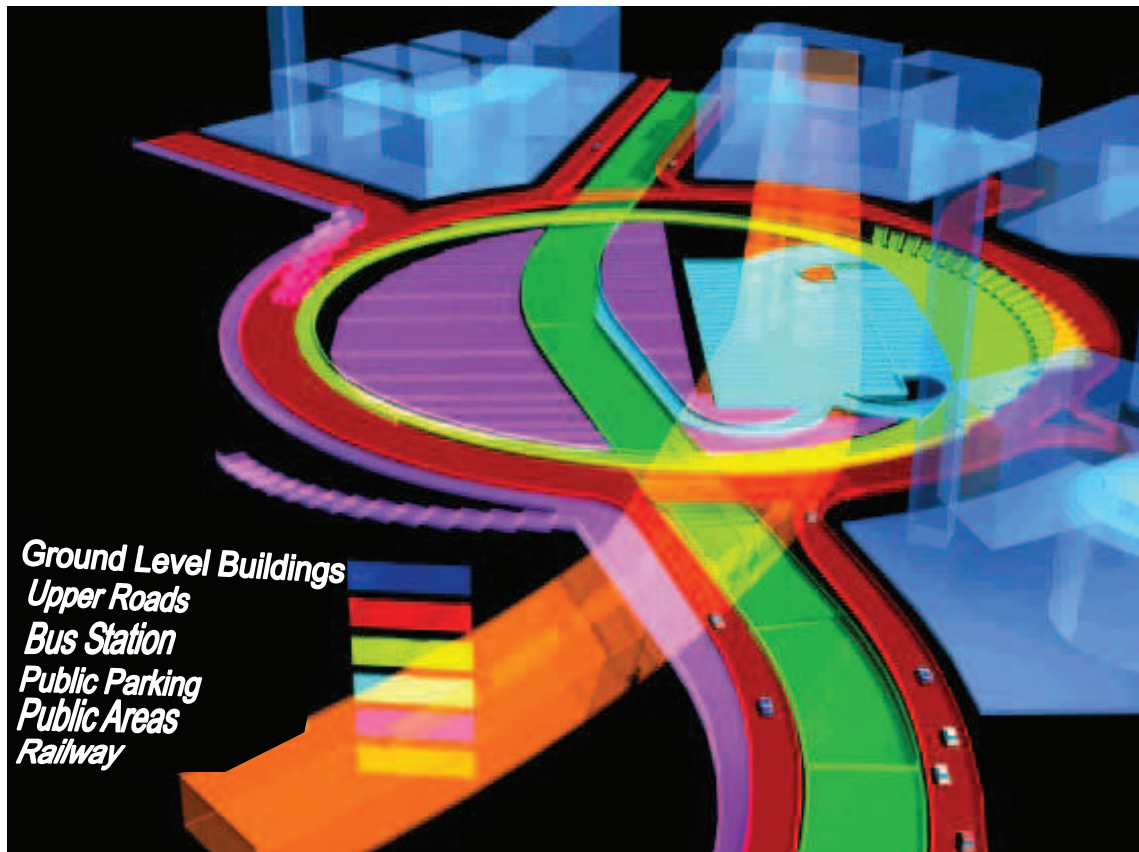


Figure 4: Visualization of the layers in the City Center.

CONCLUSION

3D Cadastre is at our fingertips; surveying, computation and drawing technologies and techniques are long and well known. State efforts should be concentrated on legislation and assimilation of those technologies and techniques among surveyors and professional government departments responsible for mapping, program inspection and ownership registration.

ABOUT THE AUTHOR

Armi Grinstein is the general manager and owner of Armi Grinstein - Geodetic Engineering Ltd., one of Israel's leading and experienced companies in geodetic services. As a geodetic engineer and a licensed surveyor, with 35 years of experience in Geodesy, Armi Grinstein has special expertise in Cadastre and is responsible for the largest registration operation conducted in Israel by a private company.

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