An Interdisciplinary 3D Cadastre Development Project in Practice

Joseph FORRAI and Gili KIRSCHNER, Israel

Key words: Cadastre, 3DCad, R&D, Survey of Israel.

SUMMARY

In September 2002, a two year long R&D project started at the Survey of Israel, aimed at the exact characterization of a three dimensional cadastre system.

Six leading professionals, forming an interdisciplinary team, were appointed to specific positions, as follows:

- Project Manager (cadastre expert)
- 3D Cad geodesy expert
- GIS expert
- Urban planner and architect
- Underground engineering expert
- A legal (real property) expert

The total number of financed working hours of the team for two years is 9700. The total budget of the project is 800 000 US $.

The main goal of the project is the definition and promotion of the application of a 3DCadastre in land management practice.

Three practical experiments will be completed. One in the old city of Acre, the second in the center of Tel-Aviv, and the third in a planned urban center of a new town. These three sites represent different cadastral realities and a range of complicated property problems in space.

The principal results of the first six months of activity are briefly summarized in the paper.

An Interdisciplinary 3D Cadastre Development Project in Practice

Joseph FORRAI and Gili KIRSCHNER, Israel

1. INTRODUCTION

Israel is a relatively small and crowded country. The general density of the population in the northern part is some 480 inhabitants per square kilometer, which is higher then in many European countries. The highest density of population is in Tel-Aviv district: 6660 inhabitants per square kilometer. (State of Israel, 1999.)

The problem of the intensive use of land and the growing demand for it in the central and northern parts of Israel has many aspects: social and political, economical and environmental, and others which are related to engineering, planning, architecture and other topics. This is the reason why discussions regarding land are in the focus of deep and essential debates within the Israeli society. The relevant background of the complex problem has been detailed in (Forrai and Kirschner, 2001).

The interest of the government in improving land use efficiency is clearly reflected in its resolution of 1999/144, declaring that "the Minister of Justice … is to submit proposed guidelines for implementing and amending legislation with the aim of facilitating more efficient land use, including subterranean space, and integrating several infrastructures and various applications in a single locality". The decision also decrees that "a solution for ownership problems, registration of rights and surveying…" should be developed also for underground space.

The existing cadastre in Israel is a two dimensional one (Doytsher et al., 2001). Consequently, all the cadastral regulations and standards are related to this reality (Forrai et al, 2001). The transition to a three dimensional cadastral system demands a very careful, interdisciplinary procedure of research and development. More and more prominent persons in the governmental, public and private sectors realize, that for considerable improvement of underground land use efficiency, this transition is essential.

The Survey of Israel (SOI) is the governmental institution responsible for cadastral mapping in Israel. SOI checks and collects all the cadastral mapping and is also responsible for issuing the instructions and standards for cadastral mapping. The main goal of the current 3DCad R&D project initiated by the SOI is the elaboration of regulations and standards regarding a digital, three-dimensional cadastral system, including registration of rights in strata. The research also considers the methods (and costs) involved in the implementation the 3DCad as a conclusion on the basis of different practical experiments.

In the middle of 2001, the plan of the R&D was presented to the Treasury for approval of its budget. Realizing the existing interests of the governmental, public and the private sectors, as well as the benefit to the economy, the project was approved by Budget Department, and

professional and management preparations for forming an interdisciplinary R&D staff began in the middle of 2002. The staff started working on December 1, 2002.

The legal reality strengthened these decisions. On the 22/1/2003 the high court of appeals decided (Akunes vs. The State of Israel, 2001), that an order to expropriate land for the purpose of the Carmel- Tunnels was illegal because (inter alia) of the absence of concrete descriptions and measurements of the sub-terrain property. It was also decided that there is no legal objection to order a partial - vertical expropriation (an expropriation only of the surface beneath the existing buildings that was needed for the tunnels). In an interesting and encouraging remark the president of the court mentioned that the Land Law should be adjusted in order to comply with the changing needs and the improvement of technology.

2. THE CHARACTERISTICS OF THE R&D PROJECT

2.1 The Research Staff

The interdisciplinary, 3DCad research staff is composed by six professionals as follows:

Project Manager. A leading cadastre expert, with rich managing, professional and academy practice and experience of decades. Well versed in legal real property subjects.

3D Cad geodesy expert. A candidate for Ph.D. degree at Israel Institute of Technology, who completed his doctoral dissertation on 3DCadastre topic.

GIS expert. Well experienced in academy research and education.

Urban planner and architect. A leading professional in these disciplines in Israel. Well versed in legal aspects of various planning issues.

Underground engineering expert. Geologist, mining- and civil engineer, well experienced in underground development.

A legal (real property) expert. (Joined the team in the seventh month of the project.) Serves as a legal advisor to one of the biggest towns in Israel, with outstanding knowledge in urban planning laws and commercial practice.

2.2 A brief Outline

The main goal of the project is the elaboration of regulations and standards regarding a digital, three-dimensional cadastral system, including the development of an operational model of registration of rights to properties in strata. Experiments (at Acre, at Modi'in and in Tel-Aviv, detailed in paragraph 4. below) will support practical applications.

The 3DCad R&D project is planned for a two year long period, divided into four semesters. The goals to be achieved and the main subjects to be treated are detailed in (Forrai and Kirschner, 2001). 9700 working hours of the R&D staff and the cost of application

experiments are financed directly by the Budget Department of the Treasury, investing some 800,000 US $ in the project.

2.3 The Project Management

The project is managed on two levels. On higher level, an interdisciplinary Steering Committee is responsible for conceptual guiding of the R&D staff work. The steering committee members were nominated by the Director General of the Ministry of Justice. The chief scientist of the Survey of Israel holds the position of the head of the Steering Committee. On second level, the R&D staff coordinator is responsible for continuity of the project, controlled and supported by Survey of Israel professional representatives. (See fig. no.1.)

STEERING COMMETTEE							
Head (Survey of Israel)							
Representatives of...							
Israel Land Administration	Treasury	Ministry of Justice Land Registration Office	Ministry of Interior	Ministry of Infrastructure	Ministry of Construction and Housing	Ministry of Environment	Academic Institution

R&D TEAM				
Coordinator: The *Project Manager*				
M-odi'in site surveyor	Cadastral and GIS- experts	Lawyer – real property expert	Urban planner, architect	Underground engineering expert

Fig. 1 The steering committee and the R&D team of the project

The activity of the Steering Committee is coordinated with an inter-ministry judicial committee, headed by a senior representative of the Ministry of Justice, and responsible for elaboration of the juridical background for a 3 dimensional cadastral system.

3. THE MAIN TASKS OF THE FIRST PROJECT-SEMESTER

The main tasks of the first six months can be summarized as follows:
- Elaboration of a realistic 3DCad concept.
- Creation of provisional regulations for surveying, mapping, processing and managing digital 3DCad data, integrated with National GIS database. These regulations should consider legal, engineering and planning constraints and/or their necessary changes.
- Establishment of an initial 3DCad database frame.

- Characterization of an engineering and planning expert system, instructing the user according to the designation, status, etc. of the spatial land property.
- Preparation of specific instructions for practical experiments (see paragraph 4).

The achievements in the first task is detailed below.

3.1 The Basic Concept

An initial concept of registration of rights to land in strata has been elaborated by the 3DCad R&D research team (Shoshani et al., 2002).

A partial list of the principal points of the concept is as follows:

1. Registration of rights in space will be carried out by dividing the three dimensional space belonging to the surface parcel, into spatial sub-parcels, above or below the surface parcel.
2. Any above- or underground development project will be bounded by a "spatial envelope" having a simplified geometry.
3. Each spatial sub-parcel belongs to the surface parcel and block, below or above it.
4. Physical objects sprawl out a number of surface parcels, under or above them, will be divided into a number of spatial sub-parcels, according to the existing surface parcels. (The unification of these object parts into one unit will be considered.)

The conceptual model described above is illustrated by figures 2-5, designed by Mr. Eri Goshen.

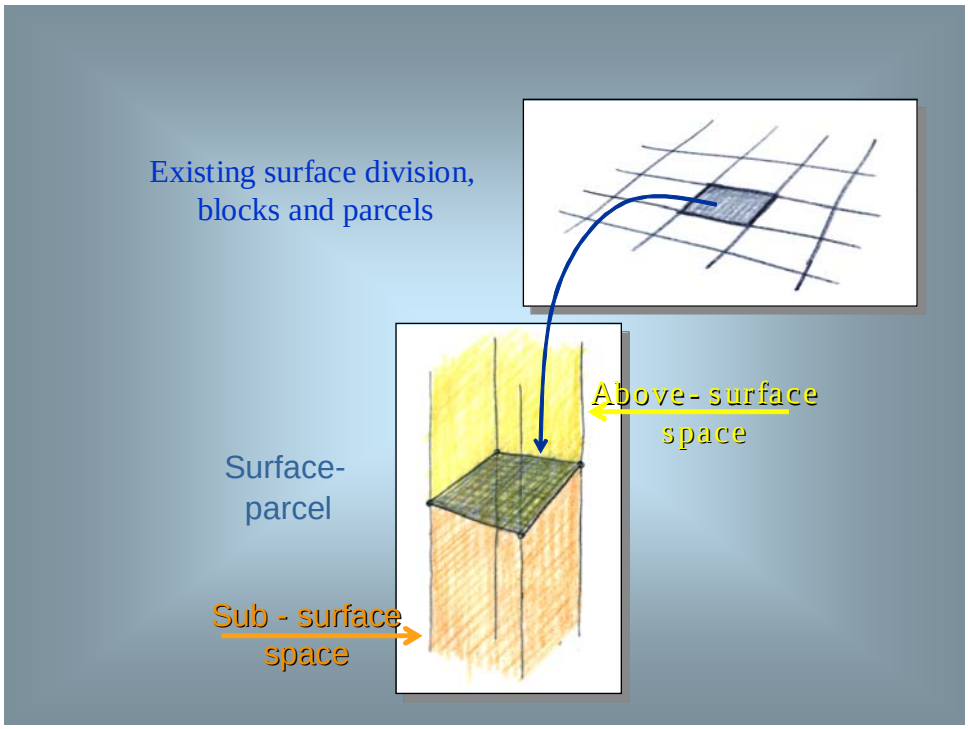

Fig. 2 The division of space, definitions (1)

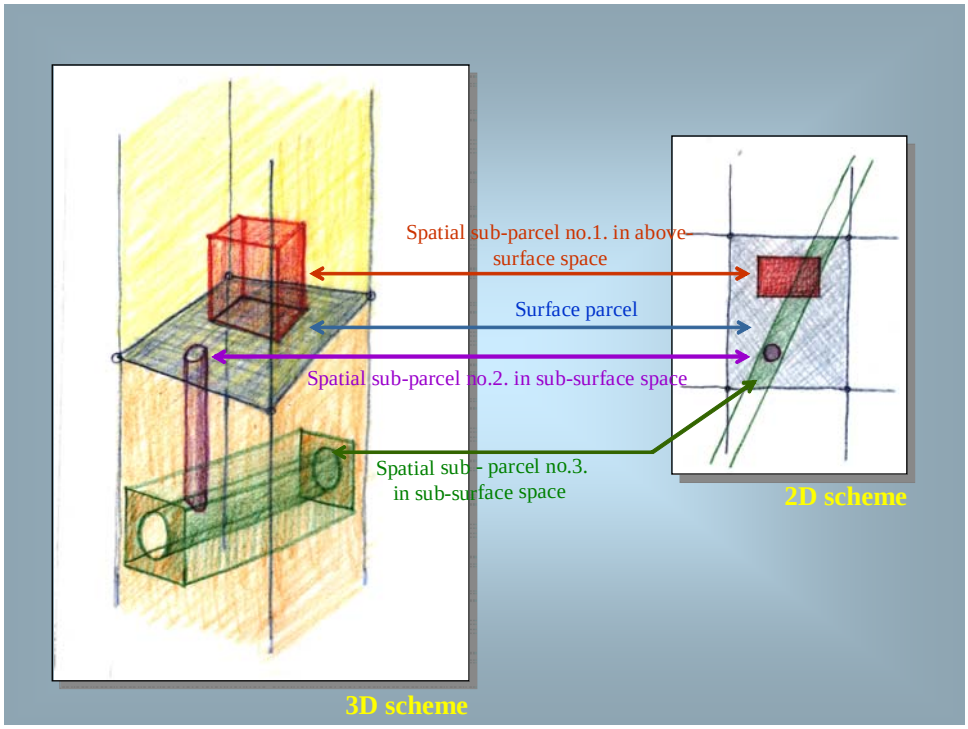

Fig. 3 The division proposed (example)

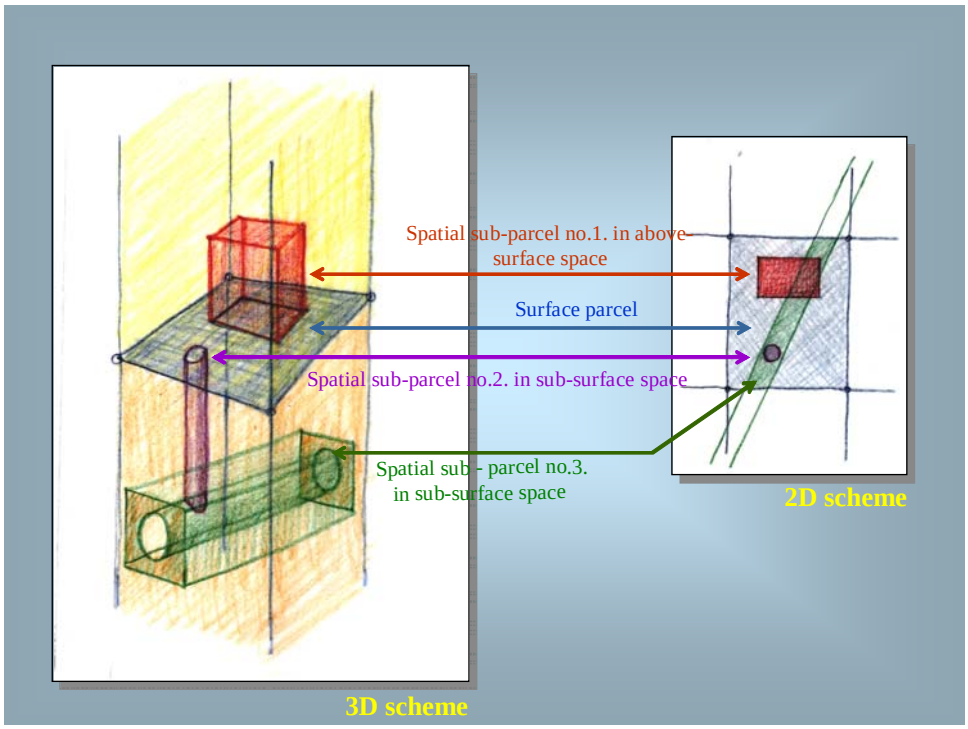

Fig. 4 The division of space, definitions (2)

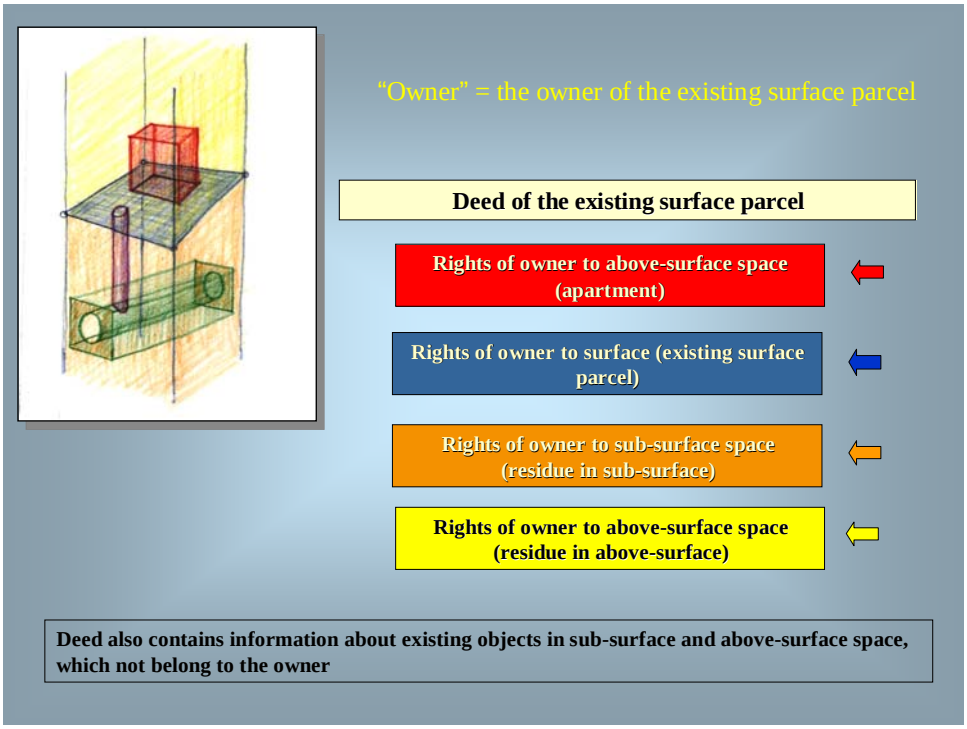

Fig. 5 Categories of rights to land is space

4. PRACTICAL EXPERIMENTS TO BE COMPLETED

Three experiments of practical applications are included in the project. One in the old city of Acre (antique constructions in a multi – layer position). The second in the center of Tel-Aviv (a modern building complex). The third site is the new urban center of Modi'in (presently in planning). These three sites represent three different cadastral realities and a range of various problems.

4.1 Acre

Acre is a historic walled port-city, with settlement since the Phoenician period. Acco city is characteristic of a fortified town dating from the Ottoman 18th and 19th centuries. The remains of the Crusader town, dating from 1104 to 1291, lie almost intact, both above and below today's street level, providing a unique combination of rights to land in space. (See fig. no. 6.) Various "property layers" are ruled by various laws and regulations concerning, water, oil, mines, minerals etc.

Fig. 6 Typical site in Acre old city

4.2. Modi'in

The second experiment will be completed in a planned area of a multi-layer and multipurpose transportation-, commercial- and residential center, where three-dimensional registration of the property rights is required in practice, in a brand new city named Modi'in (Grinstein, 2001). (See fig. no.7.) Modi'in pilot project represents, a relatively "easy case" from the legal point of view, because the allocation of rights has not been defined yet and therefore no ownership rights will be influenced or restricted. It can serve as a model for future multi – purpose planning and registration.

BY COURTESY OF MR. ARMI GRINSTEIN

Fig. 7 Modi'in site (planned city center)

4.3. Tel-Aviv

The third experiment site is placed in the middle of Tel-Aviv. A brand new, 20 floor Africa-Israel building complex (see Fig. No.8.), containing six additional underground parking floors, was measured by geodetic methods. (It is clearly proven, that some of the parking floors extend to the vertical space of a neighboring surface land parcel situated above them.) Measured data are managed in a data base, and attractive visualization have been carried out. (See Fig. No.9.) Furthermore, initial attempts were completed for ensuring local spatial topology. (Grinstein, 2002.) This project, as a complementary development for SOI (see paragraph 5. below) supplies data "ready to application" for the R&D team.

Fig. 8 Africa-Israel building. By courtesy of Mr. Ronen Grinstein

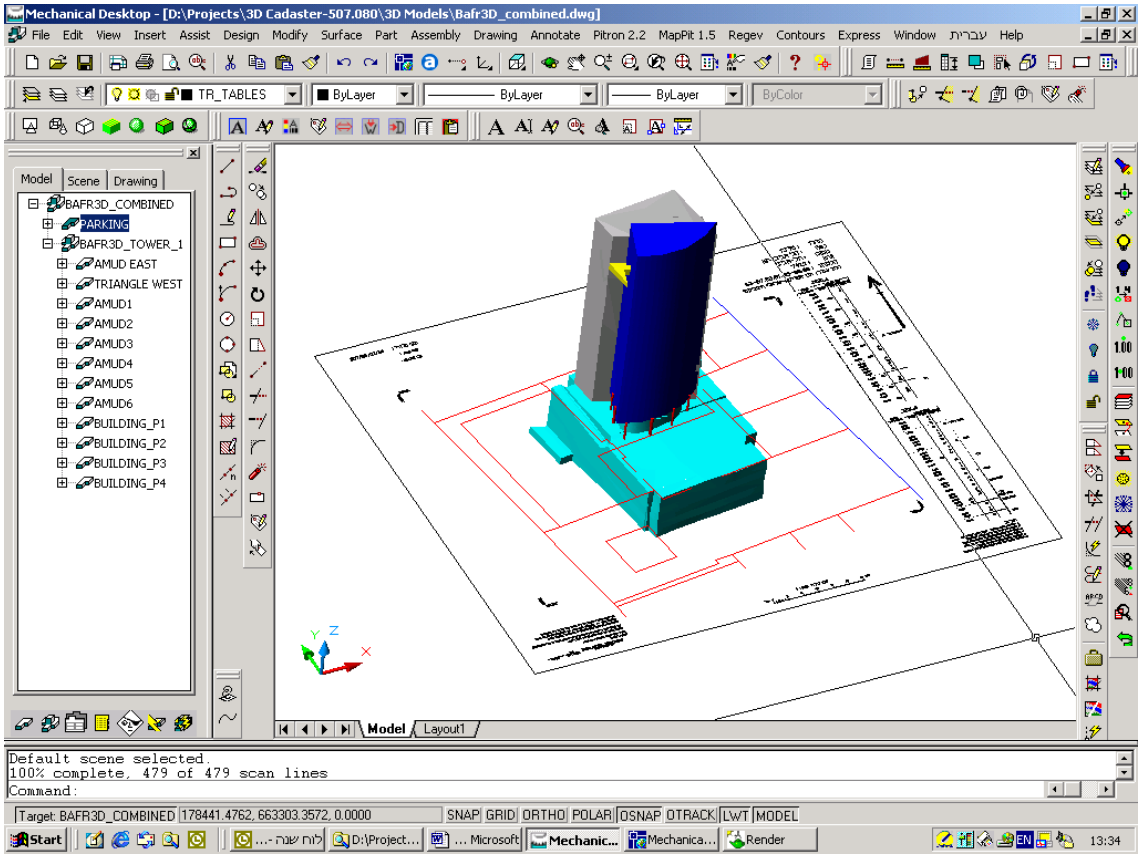

Fig. 9 Africa-Israel building image reconstructed by measured data. By courtesy of Mr. Ronen Grinstein

5. COMPLEMENTARY RESEARCH AT SOI

Two complementary, smaller size R&D projects are carried out for SOI. One was briefly described in paragraph 4.3. above. The second is dealing with various aspects of spatial topology for establishing a 3DCadastre in a GIS environment. The researchers' activity of both R&D projects is coordinated with the 3DCad R&D team work, bringing mutual benefits to each other.

6. NEAR FUTURE TASKS

The basic, conceptual ideas of the interpretation of spatial rights to land property have been established, and preparations for their practical application in three experiment sites, representing different cadastral realities, have been carried out. The experiments are about to start.

The next, critical phase of the development will be an extensive juridical investigation and verification of the proposed model and its application. In the same time, spatial data management and visualization alternatives will be tested, chosen ad applied.

ACKNOWLEDGEMENT

Authors thank all the people involved in the 3DCad activity in Israel for their contribution. Special thanks to 3DCad R&D staff members (in alphabetical order): Mr. Moshe Benhamu, Dr. Shaul Denekamp, Mr.Eri Goshen, Mr. Uri Shoshani and Dr. Yair Gabay. Thanks to Mr. Eri Goshen, Mr. Armi Grinstein and Mr. Ronen Grinstein for the figures, and to Dr. Ron Adler for his comments and help.

REFERENCES

Akunes and 17 Others vs. The State of Israel, C"A no. 119/01, see: www.court.gov.il, (in Hebrew).

Beller, A., Doytsher, Y., 2002, Aspects of Spatial Topology for Establishing a 3D Cadastre in a GIS Environment. Research reports no. 2002-7/1 and 2, funded by The Survey of Israel.

Doytsher, Y., Forrai, J., Kirschner, G., 2001, Initiatives toward a 3D GIS-related Multi-layer Digital Cadastre in Israel, FIG Working Week 2001, Seoul, Korea, Session 27 – 3D spatial Information.

Forrai, J., Doytsher, Y., Krupnik, A. ,Shoshani, U., Melzer, J., Steinberg, G., 2001, The New Israeli Regulations for Surveying and Mapping: Integrating New Technology and Methods with Existing Mapping Routines, Submitted to The Australian Surveyor.

Forrai, J., Kirschner, G., 2001, Transition from Two-dimensional Legal and Cadastral Reality to a Three-dimensional Case. International Workshop on "3D Cadastres", Registration of Properties in Strata, Proceedings, pp.9-23, Delft, The Netherlands.

Grinstein, A., 2001, Different Aspects of 3D Cadastre in the New Town Modi'in, Israel. International Workshop on "3D Cadastres", Registration of Properties in Strata, International Workshop on "3D Cadastres", Proceedings, pp.25-33, Delft, The Netherlands.

Grinstein, R., 2002, Research Report no. 2002-12/2, funded by The Survey of Israel, (in Hebrew).

Shoshani, U., Gabai, Y., Benhamu, M., Denecamp, S., Goshen, E., 2002, 3DCad R&D Project, progress report No.1., funded by The Survey of Israel, (in Hebrew)

State of Israel,1999, Central Bureau of Statistics**,** Statistical Abstracts of Israel, No. 50. Jerusalem, Israel

BIOGRAPHICAL NOTES

Dr. Joseph Forrai was awarded an M.Sc.(1974) and D.Sc.(1980) degrees at Technical University of Budapest, Hungary. Dr. Forrai was Lecturer and Senior Lecturer at TU Budapest, Tel Aviv University, Israel Institute of Technology (Technion) and Bar Ilan University (Tel Aviv) since 1976. Appointments at the Survey of Israel: Chief of Research Division (1987-1992); Head of Photogrammetry Department (1989-1993); Deputy Director General (1993-1994), and Chief Scientist (since 1995). Professional and research background (partial): crustal movement detection; photogrammetric data acquisition (national GIS topographic data base); permanent GPS station network; GPS support for geodynamics. Memberships of the Israeli Society of Photogrammetry and Remote Sensing (president

between 1995-2001); Association of Licensed Surveyors in Israel; Israeli Cartographic Society.

Advocate **Gili Kirschner** was awarded LLB (1989) and LLM (1996) degrees at Hebrew University, Mount Scopus, Jerusalem. Between 1990 and 1998 worked with several law offices in Israel, engaged with supervision and management of acquisition and registration of dwellings for social residence, legal advice to urban renewal and restoration projects and to real estate developers. Since 1998 fills the legal advisor's position at the Survey of Israel. Member of the Israeli Bar, the Israeli Society of Photogrammetry and Remote Sensing and the Israeli Cartographic Society.

CONTACTS

Dr. Joseph Forrai
Survey of Israel
1, Lincoln St.
Tel-Aviv 65220
ISRAEL
Tel. + 972 3 623 1900
Fax + 972 3 561 0866
E-mail address: forrai@mapi.gov.il
www.mapi.gov.il

Advocate Gili Kirschner
Survey of Israel
1, Lincoln St.
Tel-Aviv, 65220
ISRAEL
Tel. + 972 3 623 1940
Fax + 972 3 562 4766
E-mail address: gili11@mapi.gov.il
www.mapi.gov.il