The Surveyor's Role in the Development of an Urban Construction Plan in Israel

Orit SHWARTS and Moshe FELUS, Israel

Key words: Cadastre, Land Management, urban planning.

SUMMARY

Mapping and information technologies have rapidly changed and developed in the recent years, thus creating a new workflow in urban design and planning. The traditional workflow which used to be graphic and paper-maps directed has changed into a digital process.

Planning involves an adequate knowledge of engineering, the legal systems, and significant local facts. These local facts include the characteristics of the natural environment, such as relief and topography, and information about the existing statutory conditions of land use, particularly as it relates to the land rights. Hence, there is a need for systematic data collection phase that includes topographic mapping at a proper scale, and compilation of statuary and local maps and data of the project area. The phase is critical to the success of the project since the planning team depend upon these data to be of reasonable degree of exactness and completeness.
This article focuses on the role of the surveyor in the development of an Urban Construction Plan in Israel starting at the initial architectural sketch through the detailed engineering planning which will leads smoothly to the construction phase. It describes the planning and land rights registration procedures and the duties of the surveyor in these interrelated processes.

The Surveyor's Role in the Development of an Urban Construction Plan in Israel

Orit SHWARTS and Moshe FELUS, Israel

1. INTRODUCTION

Surveyors have always played a key role in urban planning, responsible for data collection and for the management of different design and engineering plans such as transportation, water system, and power system plans using proper metric standards (e.g., coordinate system, accuracy, drafting specifications, etc.). Technological advancements such as Geographical Information Systems (GIS) and Global Positioning Systems (GPS) have created an even greater need for surveyors in urban planning as spatial data administrators, organizing the different raster and vector files from the project inception till the final step of As-Build mapping and infrastructure maintenance using GIS. The diagram in Figure 1 describes the different steps of urban development; steps that are performed by surveyors are drawn in ligh blue.

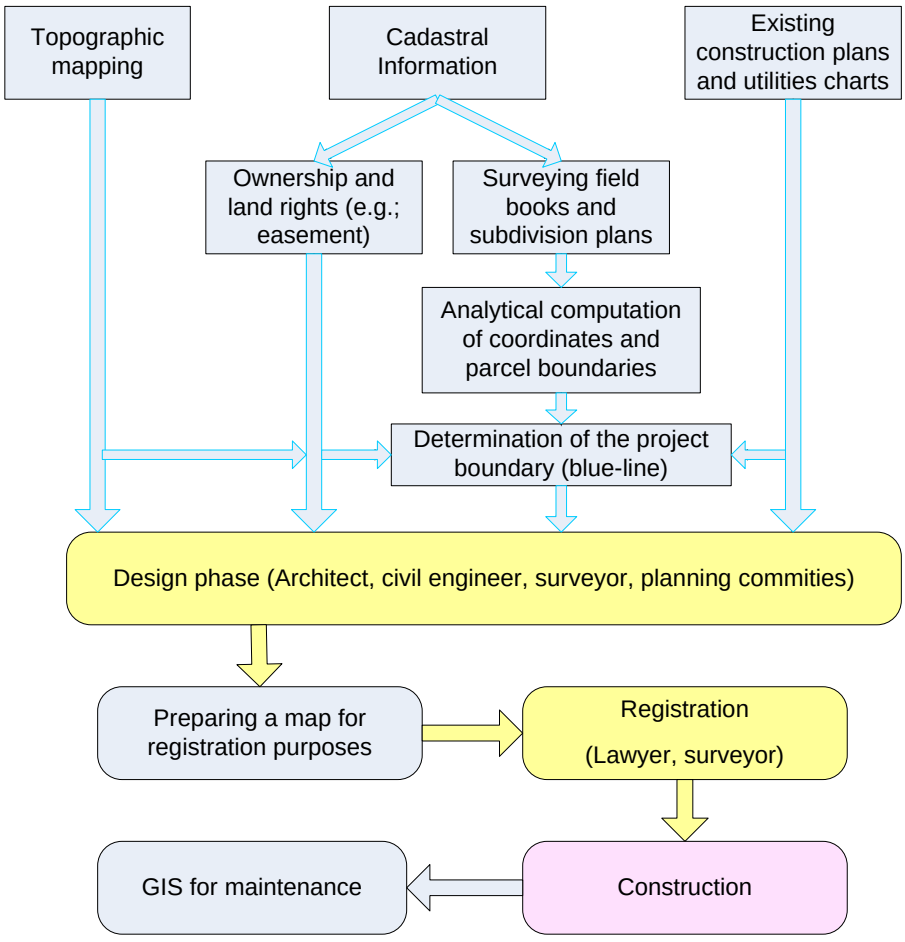

Figure 1: The different steps in the urban development workflow. Blocks in light blue are tasks that are performed by the surveyor.

In the following presentation we will review these various steps in the urban development workflow and focus on the significant part of surveyors in it with specific examples from the State of Israel. Consequently, this paper is organized as follows: section 2 describes the data collection and compilation phase; section 3, discusses some unique issues that are important in planning. Section 4 presents how an urban construction plan is converted into a map for registration purposed. Section 4 concludes the discussion with final comments and an outlook on the future.

2. DATA COLLECTION AND COMPILATION FOR URBAN PLANNING

As can be seen form Figure 1, the data collection and compilation phase includes three key components: topographic mapping, cadastral information compilation, and integration of various urban plans and engineering charts.

Topographic mapping is performed according to the conditions of the specific project area; namely, in a rural open area a 1:5000 scale map is drawn with elevation points at low resolution to delineate major landforms and patterns. In a densely populated urban area the mapping is performed at a larger scale for example at a 1:500 scale and includes an elevation point every 10 meters, transportation, structures, hydrology, utilities, vegetation, and other layers of information. On the average most mapping is performed at a scale of 1:1250 which presents a compromise of the amount of detail and accuracy and cost. Surveying methods vary but should be chosen to meet the accuracy requirement of the given map scale (see Table 1).

Type of spatial database	Type of area	Basic layers	Output map scale	Contour interval	Surveying method
Large scale	Densely populated urban area	Structures, transportations, hydrology (curb and gutter), land-use, utilities (manholes), vegetation (single tress and bushes)	1:500	0.5m	Land Surveying (Total Station) and Photogrammetry
Intermediate Scale	Moderately built-up and developed area	Structures, transportations, hydrology, land-use, utilities, vegetation.	1:1000 1:1250	1m	Photogrammetric mapping using low altitude aerial photographs.
Small scale	Rural area	Structures, transportations, land-use, hydrology, major utilities	1:2500	2.5m	Photogrammetric mapping using high altitude aerial photographs.
Very small scale	Open area (agriculture)		1:5000	5m	

Table 1: Different topographic maps are used in the planning process according to the various terrain conditions.

A complete compilation of all the available *cadastral information* is a key for the success of urban planning process. In Israel, the cadastre system is based on the Torrens principles of Titles Registration (Dale, 1976). This system defines the cadastral blocks and parcels based on official surveying and mapping which was performed by the state using various surveying method since 1920 (the establishment of the system by the British mandate in Palestine). About 21000 square km of the registered area of the state of Israel (about 5% of the area is not registered yet) are divided into about 15000 registration blocks, and about 750000 parcels (Steinberg, 2001). Every block is drawn on a block map at sheet size of 60×70 cm. These block maps vary in scale but most of them are drawn at scales of 1:1,250 and 1:2,500. The accuracy in which the boundaries are defined is quite heterogeneous as a result of the different survey methods and equipment that were used over the years. Surveying field books exist in many areas (during the Independence War of Israel some were lost), these include the recorded surveying measurements of distances and angles from a given set of control points.
The surveyor should obtain all the existing cadastre information from the Survey of Israel (cadastre block maps, surveying field books, and list control points coordinates) and analytically calculate the boundary of the project area (the blue-line) from distances and angles and using the coordinates of the control points. These analytical calculations should be adjusted to fit any physical evidence (monument, fence line, corner etc.) which is found in the field.

Case 1, the Haifa University: In a mapping project the cadastral map was digitized from a map at a 1:2500 scale. This map was used by the architect for planning. The boundary was later calculated analytically and a deviation of 1.5m was discovered. The entire plan had to be altered according to the new and correct boundary.

In addition to cadastral information the surveyor should acquire all the *existing Urban Construction Plans (UPC)* of the project area; these include detailed plans at the local authority level, at the county level, and state wide plan for national infrastructure. The compilation of maps shows the existing land use status of the area and serves as the starting point for the planning. Finally various engineering charts from communication, gas, and power companies provide useful information about underground infrastructure and should also be acquired.

Case 2: The Shoni quarry in Binamina: as part of a legal discussion we were asked to define the boundaries of the Shoni quarry in Binamina. These boundaries were digitized from an Urban Construction Plan (UCP) S/68A, nevertheless, topographic features from the topographic mapping were used to position the map to the correct coordinate system and determine the boundaries correctly (see Figure 2).

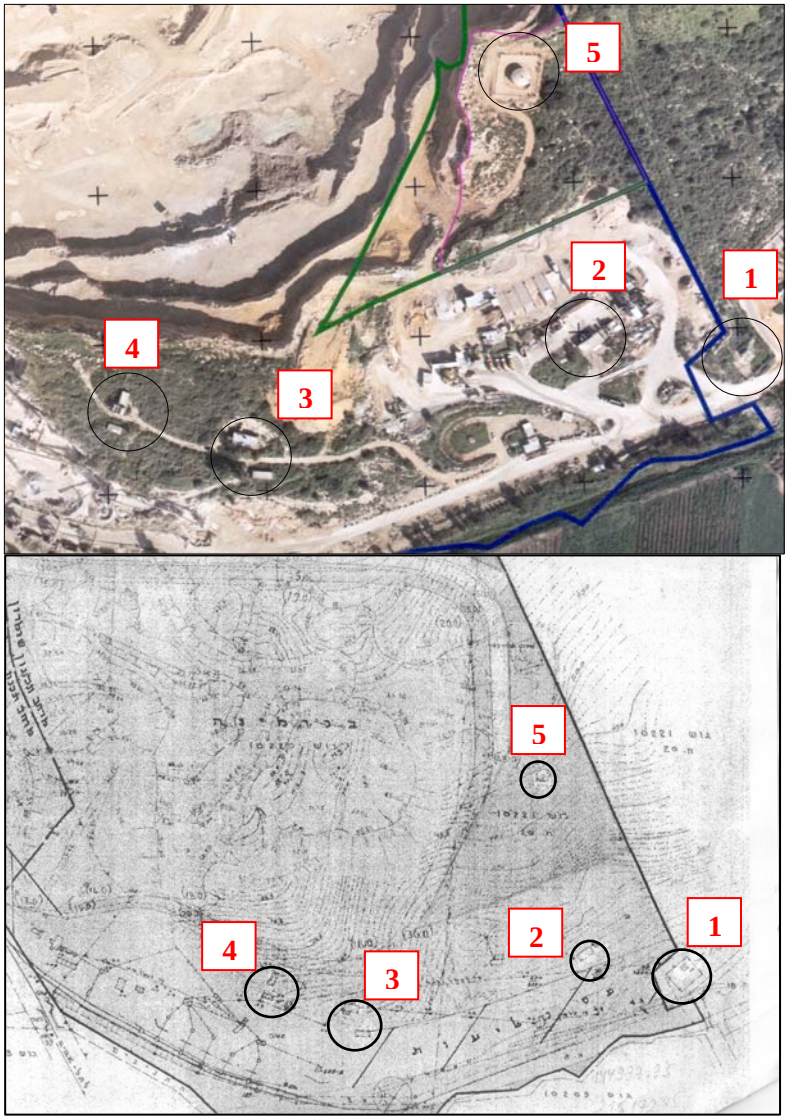

Figure 2: Case 2, the Shoni quarry in Binamina. At the top, the different topographic features used to position the map, bottom the Urban Construction Plan and the various topographic features identified.

The various maps (cadastral, UPC, utilities) may be computerized using manual digitization or by scanning the map and performing a raster-to-vector process. The accuracy of this process vary but depends on the quality of the map, the width of the boundary lines (which is a few millimeters at the map scale), the specified precision of the digitizing tablet or scanner and the experience of the human operator. As a role of thumb, it is often assumed that the accuracy of a digitized point is larger than 0.3mm multiplied by the scale of the map. This inaccuracy is critical in many cases, and therefore analytical calculations of the boundaries are necessary for detailed planning.

3. UNIQUE SURVEYING ISSUES IN PLANNING

The planning phase, an intricate and time-consuming step, is performed by a planning team that includes an architect, a civil engineer or a number of civil engineers with different expertise (transportation, power, water, structure, etc.), and of course the surveyor.

In Israel the planning process is even more complicated since 93% of the land is owned by the government. Moreover the state has wide constitutional rights including expropriation rights, the ability to divide land without the consent of the owner and so on. This system was designed to assist the young but rapidly growing country in controlling the various factors pushing for urban sprawl, to protect open areas, and to achieve long term planning goals

The surveyor has a significance role in making sure that proper metric measures are used in the planning process. We have described the necessity of determining the project boundary (blue-line) analytically from surveying and cadastral data and using topographic data.

The surveyor should also verify that *Right-of-Way (ROW)* lengths are maintained properly. Information about right-of-way is obtained from existing UCPs where the ROW is described in a special symbol termed rosette (see Figure 3), and local authority's regulations.

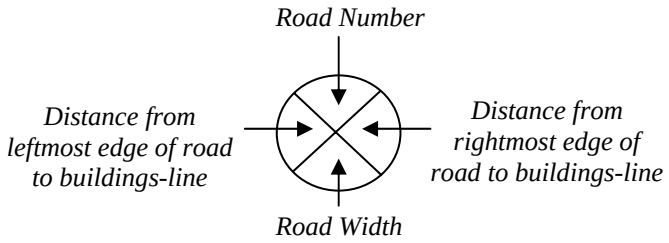

Figure 3 : A special symbol used in Urban Construction Plans to define the ROW.

Case 3, the city of Ramla: The planning of a new neighborhood was conducted along highways 40, in the city of Ramla. The planning team did not verify the Right-of-Way length and as a result the first line of building encroached into the right of way area. The planning had to be modified resulting in loss of time and money.
Water boundaries determination, specifically the Mediterranean shoreline in the state of Israel which constitutes the west border of the country, is an important surveying task. According to the Israeli Act for shoreline preservation of 2004, the shoreline is defined by the Survey of Israel using coordinates at an elevation of 0.75 meters above the mean sea level. A 100 meter wide zone measured in perpendicular direction from the shoreline is defined as coastal area where any construction is forbidden. A 300 meter wide zone is considered as coastal environment area on which various planning and zoning limitation are imposed.

To summarize this section, using various geometrical calculations and software tools the surveyor should work with the planning team in verifying the following:

1. Accurate determination of the project boundary (blue-line)
2. Working with the road designer and make sure the Right of Way lengths are maintained.
3. Proportioning parcel frontages in equal and symmetrical manner and according to the local regulation with the project architect.
4. Accurate calculation of parcel areas and verifying that these areas conform with the local authority zoning and land-use regulations.

4. FROM PLANNING TO REGISTRATION

When the UPC is approved by the local authorities, it should be submitted for approval as a map for registration purposes to the Survey of Israel (Ministry of construction and zoning) and then be registered (ministry of interior). The first task can only be performed by a licensed surveyor while the second task can be performed by a surveyor or by a lawyer (often by as a joined collaboration of both). According to the Surveying regulations of 1998, every map submitted for registration purposes should follow the relevant Urban Construction Plan (UCP) as close as possible. Specifically the following criteria were defined:
Regulation 53A:

(1) "The area of every parcel in the registration map will not be different than the area in the UCP by more than 3% of the are or 10 m^2 (the largest of both). As long as the parcel area is greater than the minimum area as defined in the zoning regulations of the specific area.
(2) The ratio of the sum of all parcel areas which are designated for public use and the sum of all the parcels in the map will not be smaller than 2%
(3) The difference between frontage length in the UPC and in the registration map shell not be smaller than 1% of the total frontage length.
(4) The shape of the parcel in the map submitted for registration shell be maintained as best as possible to the UCP."

In addition to the above regulation strict drafting and formatting guidelines should be adhered to in order to obtain approval from the Survey of Israel.

Following the registration, the construction phase can begin with the surveyor stacking put the corners of every parcel. At the end of the construction all the information is integrated in a Geographical Information System which is being used for maintenance and further development. These steps will not be described here but can be found in standard textbooks such as Wolf and Ghilani (2005).

5. CONCLUSIONS AND FUTURE OUTLOOK

The role of the surveyor in Urban Planning is becoming more important than ever since there is an ever increasing need to expedite the planning process. The collaboration between the surveyor, the architect, and the civil engineer is crucial for a successful and efficient planning process, with the surveyor overseeing the quantitative, metric aspects of the design. It is important that these basic principles be common knowledge shared in the architecture, urban planning, engineering, and –obviously- surveying communities. In the future it is expected

that Geographical Information Systems Technologies will be part of the urban planning process with new software tools designed to facilitate the process and with spatial decision support system technologies. Application of GIS in the planning process will necessitate proper and accurate spatial data bases formatted specifically for GIS use; this will call for an even grater involvements of surveyors in the urban planning process.

REFERENCES

Alterman R., editor **National-Level Spatial Planning in Democratic Countries**: *An International Comparison of City and Regional Policy-Making*. Distributed for Liverpool University Press. 302 p. 2001 Series: (LUP-TPRSS) Liverpool University Press - TPR [Town Planning Review] Special Studies

Alterman R., 2001. National-Level Planning in Israel: Walking the Tightrope Between Centralization and Privatization, Reprint from a book.

Dale P.F., 1976. Cadastral Surveys within the Commonwealth, London, HMSO.

Steinberg G. 2001. Implementation of Legal Digital Cadastre in Israel, Proceeding of the FIG Working Week, New Technology for a New Century, Session 10, Seoul, Korea 6–11 May 2001.

Wolf,P. R. and Ghilani C. 2005. Elementary Surveying: An Introduction to Geomatics (11th Edition) , Prentice Hall; 944 pages

BIOGRAPHICAL NOTES

Orit Shwarts, a Geodetic Engineer and a Licensed Surveyor in the state of Israel, is the manger of the Cadastre Department at Halperin-Felus Surveying and Photogrammetry Ltd. She holds a MS degree in Urban Planning from the Technion, Israel Technical Institute of Technology.

Moshe Felus, a Licensed Surveyor in the state of Israel, is the founder and manager of Halperin-Felus Surveying and Photogrammetry Ltd. He has more than 35 years of experience in surveying engineering and cadastral work for planning and construction.

CONTACTS

Orit Shwarts and Moshe Felus
Halperin-Felus Surveying and Photogrammetry Ltd.
10 Hachsarat Hayeshuv St,
Rishon LeZion, 75612,
ISRAEL
Tel: + 972 3 9627082
Fax: +973 3 9626874
E-mail: mail@hf-mapping.co.il
Web: http://www.hf-mapping.co.il