THE 3D URBAN MODEL, A NEW TOOL IN SUPPORT OF URBAN PLANNING

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***Abstract**: In the field of urban planning, an important instrument becomes the use of 3D urban models. Urban planning is concerned with the identification of concrete problems of the city, the determination of available resources for those purposes and to highlight constraints that block their implementation. The 3D urban model is a new tool in support urban planning. This article describes the necessary steps to achieve a 3D urban model. The three dimensional model offers an easy handling, but works with a various and huge amount of data. The results with this new tool are fast, accurate and with a great visual impact. The data stored in a 3D urban model can be integrated and exported into other programs, specialized in a certain field of activity, such as: urban planning, tourism, property, police and security, and so on. The 3D model is used also for various simulations, such as to integrate harmoniously a new building in an area already built or to conserve the image of an „old city".*

***Keywords:** urban planning, 3D models, spatial acquisition data, LoD*

1. Some considerations of integrated urban planning

It is becoming increasingly known that cities are key players in a competitive economy, especially when it comes to increasing knowledge and creating prosperity. Promoting Urban Development is acting to increase various types of potential - economic, social, environmental and cultural towns and urban areas. This involves a wide range of public policies based on multidisciplinary knowledge. The involvement of civil society through actions based on participation and partnerships are also an essential aspect of solving complex problems of urban development.

In recent years, environmental objectives have become priorities in urban development strategies.

Urban planning is all measures of the system controlled development and investment in urban construction and investment in cities. (Romanian Dictionary of Sociology, 1998, p. 425).

Among the specific objectives in an integrated urban planning are:

- Raising the quality of life;
- Improving urban climate and limit pollution;
- Ensure functional requirements lawn-protection required;
- Ensure fitting utilities to current standards;
- Recovery and support natural heritage, architectural and urban design;
- Ensure traffic and transport according to actual requirements;
- Municipal and industrial waste recycling in regional system;
- Protection against natural and technological risks.

In "classical" approach, control is concentrated in urban planning decision makers, which are in principle public authorities. Today, there is need for dialogue between urban actors - elected local officials of local authorities, engineers, designers, users.

An important tool in urban planning decisions is the topographic maps. In recent years these topographic maps were scanned, vectorizated, to be used as data received in making a GIS, which would meet the requirements of urban planning. Software development and remote sensing have allowed obtaining digital 3D maps that can be used as a basis to achieve the above objectives.

2. Making 3D urban models

In recent years, increasingly more designers and architects worldwide have approached this relatively new field, the three-dimensional modelling, 3D design systems, preferring instead the traditional 2D drawing. A 3D model has constituted objects, materials, layers that make up a complex structure. In it we see all the separate parts or components together. Objects and materials have properties easily to reveal, called visual properties, such as colour, light reflection, contrast. As a final product we can get the front of buildings, their roofs or 3D model of the land.

Dimensional model offers multiple opportunities to work: height adjustments, connection of elements that goes into it, creating a new product from the basics. Easy handling and completeness of the information provided facilitates the design process. Finally, data can be integrated and exported into other programs, specialized in a certain field of activity, such as: design, urban planning, tourism, real estate property, police and security, etc. The 3D model is used for various simulations, with the striving to integrate harmoniously the new building in an area already built.

The latest use of the 3D model at the level of urban representation allows preservation, based on available information, of an "old town" that’s architectural or historical monuments we want to keep untouched. The 3D model, in this case, can help save in time the past image of the city.

The results are fast, accurate and with a great visual impact. Designing a 3D model is faster than traditional 2D design. The advantage is that by viewing the model, removes the difficult task of thinking all-three-dimensional, having only classic design plans.

The 3D model has been imposed and will impose in different fields, enabling the design process, the query data set and analyzing the products. Arguments that argue in favour of real 3D model are the projections of real 3D images, views of spatial relations in the building, modelling of various options of design, accuracy required by the client, etc. Steps to implement a three-dimensional urban model are:

- Acquisition of spatial data;
- Acquisition of textual data;
- Obtaining 3D urban models;
- Publication of data on the web.

The basic data for 3D Urban Model are related to the level of detail (LoD - Level of Detail). Thus the level of detail 0 (LoD 0) included information on digital terrain model. Sources of data come from high resolution satellite data or orthophoto mosaics.

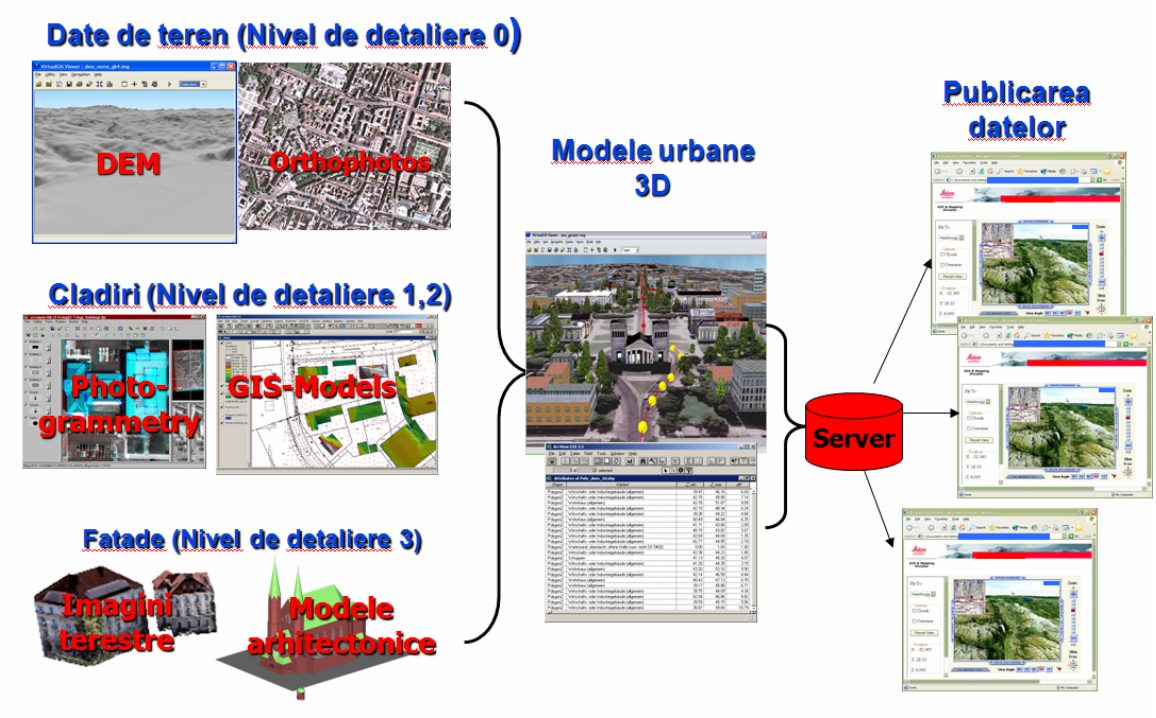

Fig. 1. Steps needed to achieve a 3D urban model.

Fig. 2. Satellite images of Faculty of Geodesy in Bucharest - detail level 1 (LoD 1).

At the buildings level, data can be extracted from existing cadastral databases and these data have to be completed with information regarding heights of constructions.

In the case of facades, detail level 3, is required information for the shape of roofs, architectural models, including lighting, transparency and surface effects. Data can be acquired through topographic measurements or using a new technology, laser-scanners.

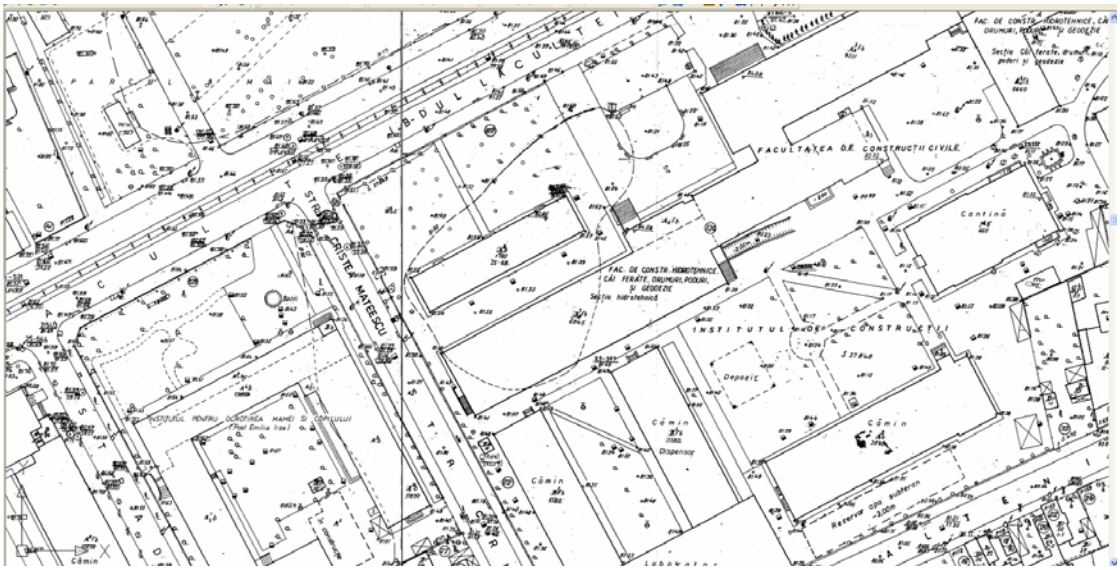

Fig. 3. Extracts from the cadastral database - the level of detail 2 (LoD 2).

Laser-scanners

3-D laser scanning is a device that digitizes shapes and objects from the real world into a virtual CAD environment. Even though each type of scanner is different, all laser scanners emit their own light, unlike a camera that only receives light. Because of this, they can measure long distances with high accuracies, and can even work in the dark. The scanner sits on a tripod and an operator initiates a scan. The device rotates and scans across the entire space to get a panoramic image. Each pixel on the resultant panoramic image contains an x, y and z value. The scanner can record millions of pixels in a single scan. Together, these pixels, or points, are known as a point cloud. Point clouds are then imported to special software that can convert those raw scans into CAD objects.

3-D laser scanning is an advanced technology that uses latest laser distance measurement technique to obtain measurements at thousands of points per second. While the use of laser technology to measure distance has been around for many years, the time-of-flight (TOF) laser scanning became available only in the last few years.

(a) (b)

Fig.4 3-D laser scanners. (a) Trimble GX 3D scanner; (b) Leica ScanStation.

Currently, most 3-D laser scanners employ the TOF method. The laser pulses in a 3-D laser scanner are deflected to different targets by rotating or oscillating mirrors inside the instrument or by rotating the instrument itself. Some instruments deploy two deflection mirrors, one for the vertical view field and the other for the horizontal view field.

Others use one deflector for the vertical view field and the horizontal view field is accessed by rotating the instrument horizontally. These systems can acquire a few thousand points per second with a range of a 200 to 300 m and an accuracy of a few mm for a distance of 100 m.

The horizontal view field for most scanners is 360º and the vertical view field ranges from 60 º to 320 º. Sophisticated field software are used to setup the system, gather data (called "point clouds") and transfer data between field devices and office computer.

The post-processing software allow multiple point-cloud registration; data filtering and checking; 3-D modeling; digital image calibration; multi-ortho projection; contour, cross-section and profile generation; volume and surface calculations; feature code management; and other functions.

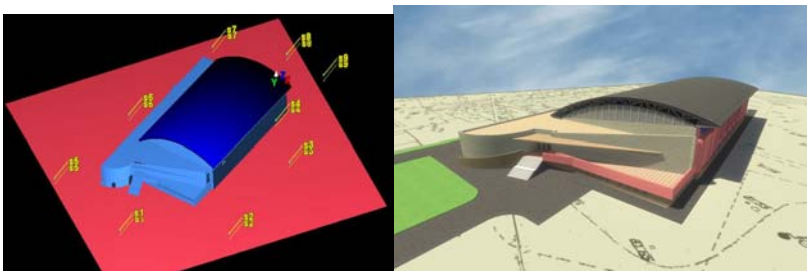

Fig. 5. Data required for the level of detail 3 (LoD 3) from laser scanners

Data acquisition can be done by digitally photographing facades and their integration into the system. This approach is effective and operational for towns with less than 10,000 buildings. These photos should be combined with texture.

Composition of 3D scenes is the penultimate step before publishing on the Web. There is specialized software that allows data compression and texture changes, making computer animation to places of interest.

Workflow technology to achieve 3D urban models is as follows:

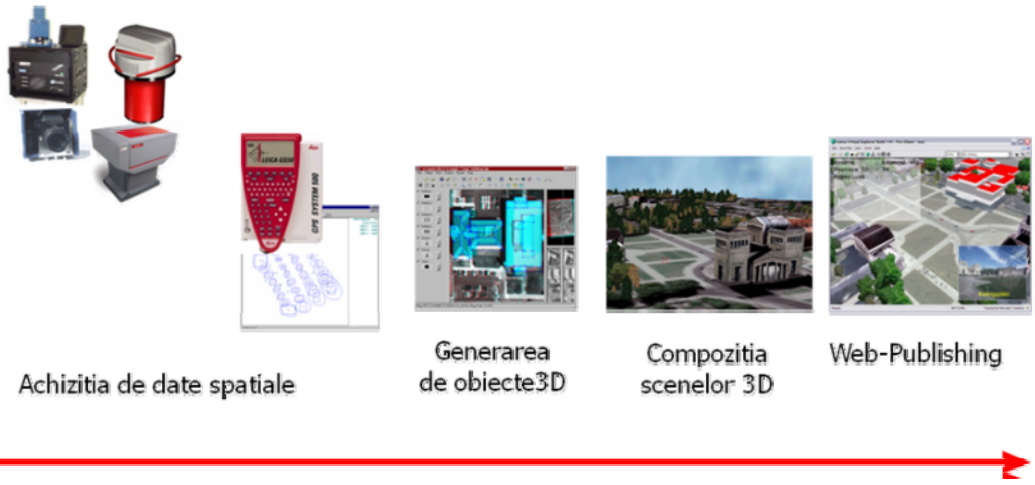

Fig. 6. Workflow technology to achieve 3D urban models

Fig.7. Web Publishing a 3D urban models

Making 3D urban models have many opportunities to manipulate the stored information. The method provides in the same time the possibility to organize the transfer of data of various formats. Current systems facilitate the generation of 3D model, a model that can then be easily manipulated, viewed, analyzed and modified according the requirements and demands.

3. Conclusion

Three-dimensional model can address a very broad public, being accessible and easily understood by everybody, thanks to the visual impact force. The obtained model has a high quality of information and communication, and constructions and selected details are real models that can be easily viewed and treated. Environmental impacts from integration of new buildings in an area already built can be analyzed using the 3D urban models. Using three-dimensional urban models may become an indispensable tool for environmental management projects in urban planning.

4. References

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