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Original article

Historical coastal urban landscapes digital documentation and temporal study with 2D/3D modeling functionality: The case of Thessaloniki, Greece

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ABSTRACT

The study refers to the visual representation of the coastal front of the historical center of Thessaloniki in northern Greece and its changes that have occurred through the years. Most of the old town was destroyed by fire on August 18, 1917. A few years later, the French architect and archeologist Ernest Hébrard proposed the reconstruction of the city centre, but his plans were never fully implemented. Since then, a series of interventions changed the form of the old town and consequently the coastal cityscape. The research was initially based on the photogrammetric processing of archive aerial images (1938) of Thessaloniki's city centre. Besides the vertical images, high oblique aerial images dated back to 1932, proved to be a significant source of information. A rich archive of old photographic material, sketches, drawings and gravures of the coastal forehead of the city was also used. Ortho-images of the coastal front, derived from laser scanning (2010), and a 3D model of the historical city center, derived from the stereo photogrammetric process of aerial images (1990), contributed decisively at the multi temporal study of the city front. The main outcomes of the present documentation study are the 3D representation (at scale of 1:200, accuracy 5 cm) of temporal changes of a part of the coastal front of the historical center of Thessaloniki and the 2D representation (at scale 1:100, accuracy 1–2 cm) of these changes with respect to variations on skyline, lacunas, interventions in old buildings, etc.

1. Introduction

High technology tools, used in the production of geometric information, virtual environments, spatial information systems and Internet applications, are also widely used for the documentation of historical cities. The quality of data, the processing methods and the display techniques, which are applied in spatial recording and management, represent the major factors for a detailed documentation, analysis and visual reconstruction of the past. Therefore, cultural heritage protection and planning of historic urban environments are closely related to the methodology and the tools used in various case studies.

The complexity, concerning the cultural heritage documentation and management of an urban historical context, tends obviously to increase when this context has gradually transformed or even completely changed. In this case, the lack of cartographic and mainly photogrammetric data, renders the graphic restitution and visual representation of the "past" difficult or quite impossible task. This case applies either when the object of study is a single entirely destroyed building or a block of structures of the same condition.

Coastal fronts and coastal urban cityscapes are often dynamic, living entities, continually changing because of natural and human-influenced social, economic and cultural processes. Coastal historic environments reflect the maritime history and the unique and distinctive character of many communities, as well. The study of temporal changes of such environments involves, on the one hand, the knowledge of local architecture and urban morphology and, on the other, the development and the application of up-to-date techniques for their documentation, essentially during the restoration process. Nowadays, innovative approaches are required to research and record the past and the present of these coastal urban cityscapes in order to create a platform for their regeneration and revitalisation.

2. Aim and methodology

Most of the old town of Thessaloniki, in N. Greece, was destroyed by fire on August 18, 1917. Since then, a series of interventions changed the form of the old town and consequently the coastal cityscape (Fig. 1). In particular, as regards the building stock along the coastal front of the historical centre of Thessaloniki, a radical change can be observed from the beginning of the 20th century

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Fig. 1. Aerial images of Thessaloniki: a: before the fire of 1917; b: after the fire; c: in 2010.

until today. The White Tower, the unique monument of the 15th century along the waterfront, a two storey building, widely known as Olympos-Naoussa, built in 1926, Aristotle's square and other individual buildings built in the 1950s, testify the rich urban and architectural history of the coastal cityscape. Nowadays, the various morphological aspects of the silhouette of the coastal front indicate a series of changes and consequences concerning the quality of life in the historical centre. A dense urban environment can be observed. Two storey buildings have been replaced by eight storey apartment buildings, although the urban tissue along the waterfront remained quite intact for almost a century.

In bibliography, one can find studies concerning the photogrammetric reconstruction of individual historical buildings facades [1–3]. In many cases, single amateur photographs and postcard in books or private collections were a unique source of information for documenting or reconstructing a destroyed building [4–6]. Instead, the purpose of this study is not the documentation of an individual destroyed building but the visual representation of the entire coastal front of the historical center of Thessaloniki and its changes that have occurred through the years.

The research for suitable cartographic, photogrammetric and historical data has been proved to be indispensable for the temporal study and visual representation of changes occurred along the waterfront. Finding and acquiring this divers kind of data has not always been simple. Based on data and information collected, the most proper-to-follow methodologies have been chosen. Within this framework, vertical aerial images, dated back to 1938 up to 1990, and high oblique aerial images of Thessaloniki's city centre, dated to 1932, have been used. A rich archive of old photographic material, sketches, drawings and gravures, dated back to the beginning of the 20th century, representing destroyed buildings that don't exist anymore, have been collected. Finally, ortho-images of the coastal front, derived from laser scanning of the coastal forehead of the city, are been used. It is obvious, that the processing of this heterogeneous data demanded the combination of a wide variety of photogrammetric techniques.

3. A case study: the historical coastal urban landscape of Thessaloniki

3.1. Historical evolution of Thessaloniki

Thessaloniki is Greece's second major economic, industrial and political centre, a major transportation hub and an important commercial port for the rest of southeastern Europe. Thessaloniki was founded around 315 BC and due to the city's rich and diverse history, significant changes took place through years, forming its urban structure and social and spatial character. Thessaloniki still houses a great amount of architectural treasures, especially Christian and Byzantine monuments. Several early Christian and Byzantine monuments of Thessaloniki were added to the UNESCO World Heritage list in 1988.

Most of the old center of the city was destroyed by the Great Thessaloniki Fire of 1917 (Fig. 1b), started accidentally by an unattended kitchen fire on August 18, 1917. A few years later, the French architect and archeologist Ernest Hébrard proposed the reconstruction of the city centre, but his plans were never fully implemented. During World War II, the city suffered considerable damage from bombing. After the war, Thessaloniki was rebuilt with large-scale development of new infrastructure. Since then, a series of interventions changed the form of the old town and consequently the coastal cityscape.

3.2. Present architectural character of the city and of the coastal front

Thessaloniki was rebuilt and recovered fairly quickly after the war. This recovery included both a rapid growth in its population, as well as an impressive development of new, modern infrastructure and industrial enterprises throughout the 1950s, 1960s and 1970s. Most of the urban development of that period was, however, without a proper plan, causing traffic and zoning problems that remain to this day. The city's historic centre includes axes, diagonal streets and monumental squares, with a street grid that can channel traffic hardly. The centre houses a significant number of Byzantine monuments but also the remaining monuments of the recent past (1850–1930), influenced mainly from eclecticism.

The coastal front (Fig. 2) of the city's historic centre expands from Eleftherias square, then meets Aristotle's square, and ends near the White Tower. Eleftherias Square, where the Jews of Thessaloniki were rounded up to be sent to the death camps during World War II, is located on the west end of the coastal front of the city's historic centre. Aristotle's square, with its monumental axis so that looking uphill from the square one can see the city's Byzantine walls and the Upper Town, is the main city square of the city.

It is located on Nikis avenue, on the city's waterfront, in the city center. It was designed by Ernest Hébrard in 1918 and most

Fig. 2. Images taken along the coastal front of Thessaloniki showing: a: Eleftherias square; b: Aristotle's square; c: the White Tower.