RECORDING FOR URBAN PLANNING: A CASE FROM MANAMA, BAHRAIN

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ABSTRACT:

Urban planning process depends on the quality of data obtained, which, in turn, depends on the quality of data collection and data processing. Urban planners and designers strive for ways to secure information, and in this regard reach out for specialists in data recording and documentation. A case in point has materialized in the context of planning urban areas in Bahrain during 2005-06. A collaborative undertaking between the United Nations Development Program (UNDP) and the Ministry of Municipal Affair and Agriculture of Bahrain (MoMAA) called for revitalization of urban areas in Manama and Muharraq, the largest cities with conspicuous heritage assets. The initial phase of the undertaking has culminated with a comprehensive report reflecting the expertise of several international consultants in specialty areas of planning including land use, economics, and information technology. The second phase of the undertaking involved urban design projects where consultants completed pilot designs. The authors acted as documentation consultants to provide congruent information for urban design activities. In this capacity, they implemented documentation work in service of the "pilot" project Urban Design of the City of Manama Cultural Heritage Area. The documentation activity for the Manama project involved stretches of street facades. The intent of this paper is to review the documentation activity completed for the project with an emphasis on documentation planning considerations and documentation process implementation.

1. INTRODUCTION

Documentation associated with the built environment employs a variety of data acquisition and processing approaches, depending on the context and purpose of the project in hand. This can be easily inferred from documentation for a historic building restoration versus documentation for urban area planning—the latter being the focus in this paper.

Urban planners and designers require quality data to perform planning processes. In an "appropriate" scenario, they use data handled by documentation specialists as in the case of planning urban areas in Manama and Muharraq, the largest two cities in the Kingdom of Bahrain with conspicuous heritage assets. The planning initiative was undertaken by the country's Ministry of Municipal Affair and Agriculture Affairs (MoMAA) and sponsored by the United Nations Development Program (UNDP).

The authors acted as documentation consultants to provide congruent information for urban planning and design activities (Elwazani and Lerma, 2006). In this capacity, they implemented documentation work in service of the "pilot" project Urban Design of the City of Manama Cultural Heritage Area, which was a component of Phase 2 of the larger undertaking called "Capacity Building for Enhancement of Urban Governance". The other components were the "pilot" Urban Design of the City of Muharraq Cultural Heritage Area and the Architectural Re-Design of the Qayseriyyah Souq in Muharraq.

This paper reviews the documentation activity completed for the Manama urban design project with a particular reference to the use and potential of digital rectified photography as a documentation tool for urban planning and design. The discussion explains salient considerations for documentation planning and explains implementation of the documentation through data acquisition and data processing functions performed for a sample segment of the Manama urban environment. These functions were particularly applied to a street strip of buildings for which a series of successive images were taken, rectified, and eventually seamlessly joined to produce a measurable streetscape mosaic scene.

2. DOCUMENTATION PLANNING CONSIDERATIONS

The documentation team was faced with two major questions: what to document and what survey method to use. Although these are not uncommon questions, they were in this case particularly difficult to satisfy owing to the scantiness of time the team had available for carrying out its mission—roughly twelve working days in a two-week assignment period. Documentation activities for the Manama urban design project had to compete for time allotment with those required for the other two mission's projects (not discussed here) and accordingly the documentation work on the Manama project had to be conducted with utmost efficiency.

The geographic area defined by the MoMAA for the project Urban Design of the City of Manama Cultural Heritage Area is vast, and this had significant implications on documentation planning. Through incessant dialogue with the Advisor for the MoMAA's Research and Studies Section and with the urban design consultant, and poising to employ Digital Rectified Photography as the principal method of survey, a realistic scope of work has emerged, not before a few days on the job had passed. The scope encompassed complete documentation for two disparate street strips selected primarily for their heritage import and for their impact on continuing documentation work for the linear corridors of which they are a part. Images capturing information of these two strips (building façade,

objects, and voids between buildings) had been later rectified and "mosaic-ed."

Photographic coverage encompassed other types of images related to documentation: a) images for extended street strip assets to be rectified later by others, preferable immediately after the team's mission ended, and b) images that were not intended for rectification, but for providing contextual information for the assets covered by the first two types of photography. They also could be used for 3D modelling and mapping (Fig. 1).

The question of "how to document" lingered in the team's members minds long before arriving to Bahrain and became easier to answer once the team members were on location. The team had considered the close-range photogrammetry approach of digital rectification and decided on the Digital Rectified Photography method. A number of considerations accounted for the decision:

- Method: characterized by flexible and quick response for both data acquisition and data processing.
- Subject: the targets (building elevations) are essentially geometrically flat, a conducive condition for rectified imagery application.
- Purpose: the products (streetscape elevation mosaics) are appropriate in content and accuracy to urban planning and design needs.
- Information management: the rectification data complements the GIS information available at the Research and Studies Section of the MoMAA.

(a)

(b)

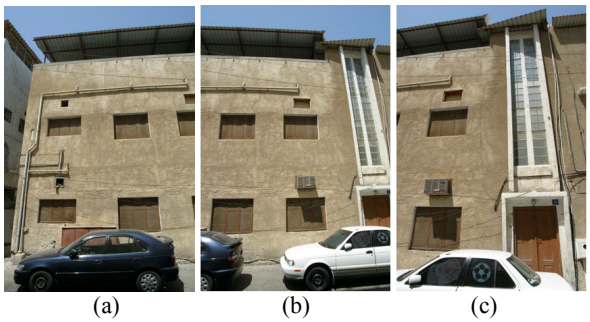
Figure 1. Contextual imagery capturing one building block from the extremes: a) Left; b) Right.

3. DOCUMENTATION IMPLEMENTATION

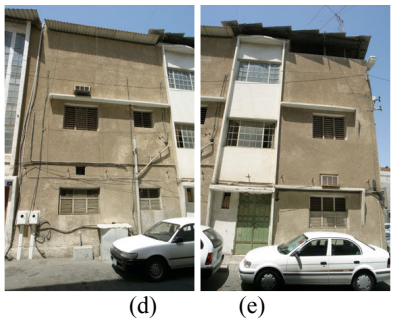
The documentation implementation phases of data acquisition and data processing are discussed here in the context of one of the two urban street strips for which documentation had been realized; and in this context, the discussion focuses on the digital rectification work for the street elevation looking south.

Images were captured by a wide-angle camera, Canon Digital Camera EOS D60, resolution 6.3 MPixels; 15mm Sigma lens. The use of this equipment was dictated by the need to capture as much of the subject as possible with as minimum of images as possible. Photography was carried out linearly, from one part of the extended elevation to the next. Images were generally taken sequentially moving from one end of the street towards the other end, and as applied to our subject, this translated moving from the left end of the strip towards the right end.

A number of conditions were observed throughout the field data collection work. An attempt was made to have the images captured with the camera optical axis pointing as orthogonal to the façade as possible (Fig. 2)—which, to a great degree, hinged on the spread to the opposite façade. Also, photographic action avoided moving or still objects (vehicles, people) in the scene. Further, images were planned to obtain workable coverage overlaps between adjacent images across the linear series of images. Lastly, as much as possible, images were taken under uniform day lighting conditions to guarantee colour homogeneity and to reduce colour balancing when meshing images in the subsequent mosaicing action (Lerma and Elwazani, 2006).



(a) (b) (c)



(d) (e)

Figure 2. Imagery captured for rectification, from left (a) to right (e).

Data processing consisted of a series of rectification steps in the office using Adobe Photoshop CS and plug-in Panorama Tools. Processing involves correcting radial and decentring distortion before tackling the rectification proper. This step is usually mandatory in case the camera is affected by lens distortion (Fig. 2). Figure 3 shows image 2a after correcting radial lens distortion. It can be quickly checked by analysing linearity within the image.

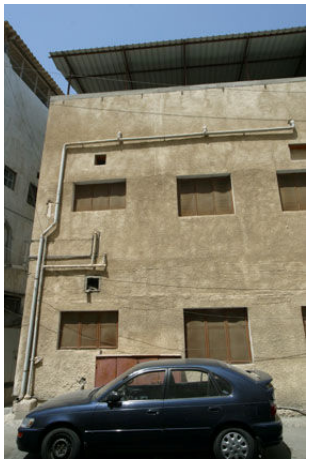


Figure 3. Output image after correcting lens distortion (Fig. 2a).

Image rectification can be carried out either with or without surveying control points. The former procedure requires the knowledge of a minimum of four feature positions (x and y co-ordinates) both in object space and image space. A two projective transformation (Lerma, 2002) can be applied to correct geometrically the tilted photography. The latter procedure, without surveying control points, requires the application of a two projective transformation to correct the tilt inherent in the original imagery, or determine the three vanishing points for tilted imagery to rectify planar features.

Digital rectification of images was completed in a repeated, but structured procedure following the interactive projective transformation sequence without control points. In its simplest structure, the procedure began rectifying series of adjacent images separately (Fig. 4).

Figure 4. Output images after rectification.

Prior to mosaicing, some manual colour enhancements were made in order to equalize pixel colours in the overlapping image areas. After this adjustment step, it was possible to produce gradual transitions between rectified images.

Once individual image rectifications and image enhancements were performed, actions for building up mosaics followed. Image overlapping manipulations sought to yield the best seam lines between adjacent images. Manipulations continued across the series of adjacent images to account for, and finally produce, a seamless streetscape scene (Fig. 5).

Fig. 5. Mosaic after the rectification of four imagery.

The implementation of digital rectified photography resulted in an extended scaled photographic elevation, or mosaic, that can be quickly converted automatically or manually into a measured drawing in a CAD environment. The image in Fig. 6 was obtained by filtering and manually editing the scene to result in targeted and clear information. Emphasizing building edge lines and removing obstructing vehicles from the scene, as depicted in the figure, were useful actions.

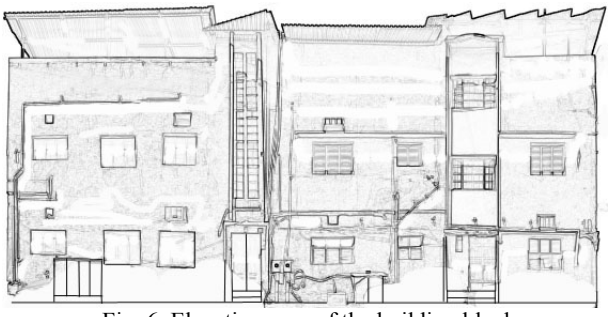


Fig. 6. Elevation map of the building block.

4. SUMMARY AND CONCLUSIONS

A number of issues influenced the progress and the outcome of the documentation activity for the "pilot" project Urban Design of the City of Manama Cultural Heritage Area—as did for other components of the documentation team in general. The most salient of these issues and the team's responses to them are highlighted below.

1. Adherence to the intent of the UNDP/MoMAA undertaking "Capacity Building for Enhancement of Urban Governance." The team observed the information of the Phase One reports of the undertaking in their work, including dialogues with MoMAA Advisor and the design consultants, particularly on interpretation of report information.
2. Uncertainty regarding the scope and progress of work. The team struggled early on to determine what parts of the Manama urban project area were to be covered. A reasonable estimate on the scope of documentation coverage and rate of progress was rendered later on past the one-third point of the mission period. While the scope of work estimate was finally realized, time availability has proved to be the most crucial factor in this regard.
3. Appropriateness of documentation method and outcome. The decision to use digital rectification for documentation for its speed, attuned accuracy, and

compatible application to urban elevations has proved sound. The number of field digital images and the quality of the measurable mosaic output were very satisfactory. The fact that some images were actually rectified and some were slated for rectification at a latter date, attests to the resourceful use of the chosen rectification method.

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