

Recording Streetscapes

Salim Elwazani and José Luis Lerma

The Qaysariyyah Souq (market) is a historic ensemble of urban structures in Muharraq, the original capital city of Bahrain. Besides the evident buildings and open spaces of the souq, the ensemble is in an area long considered a cradle of societal transformation and political events in Bahrain's history. Exposed to the elements, neglect, and inappropriate building additions and development, the souq has deteriorated. In 2005, a preliminary study was conducted to assess the souq in order to address these issues.

Under stringent time and financial constraints, how can the souq be recorded quickly to provide information to aid in its revival and conservation?

The corner of Sheikh Hamad Avenue and Tujjar Street, Qaysariyyah Souq, in the heart of Muharraq, Bahrain. The souq suffers from exposure to the natural elements, neglect, and inappropriate development. Photo: © Salim Elwazani and José Luis Lerma.



Qayseriyyah Souq, Bahrain

The Qayseriyyah Souq sits in the heart of Muharraq, the sprawling commercial center of the old capital. History suggests that the construction of Muharraq was at the behest of Sheikh Ahmed Bin Mohammed Al-Khalifa, also known as Ahmed Al Fateh (the Conqueror), in 1810. Later, tribal groups, some formerly nomadic, emigrated from Arabia under the leadership of the Khalifa dynasty and settled in this new place. In a societal sense, the souq is a testimony to this transformation of the inhabitants' way of life and a direct response to their commercial needs. By 1889, urbanization had reached an advanced stage and many of the physical characteristics of the souq seen today had been established.

Roughly rectangular in shape and stretching in a north-south direction, the souq is bounded by paths of contrasting urban character. On the north, the busy, dominant city artery known as Sheikh Hamad Avenue contrasts with a modest pedestrian alley on the south. Traffic-burdened and commercially bustling Tujjar Street, on the west, contrasts with the spacious, lightly trafficked Boomaher Avenue on the east. About 80 meters in length and 30 meters in width, the souq is composed of rather simple one- and two-story structures. The market features a covered central alley running north-south along the ground plan that, with another auxiliary alley, bisects the souq into four parts. This central alley and, to a lesser extent, the auxiliary alley provide access to the inward-facing shops, while the bounding avenues provide access to the outward-facing businesses and upper levels.

The buildings are made primarily of rubble, gravel, and gypsum cement. Wooden members, reed rods, and palm-leaf weaves were used for the roof

structures and ceilings. The conditions of the structures within the souq vary markedly, but the buildings are generally in disrepair. The souq suffers from exposure to the natural elements and neglect, and from inappropriate development that affects the integrity of the architectural character. Three-fifths of the buildings have retained their original character and are more than fifty years old, with many estimated to be more than one hundred years old. Vestiges of these important older buildings now predominate only in the poorest and most dilapidated sections of the market. The remaining two-fifths of the buildings have been erected within the past fifty years. It is clear that this newer, historically incongruent class of buildings, particu-

larly those erected in the past decade, are slowly replacing the original structures. A sizable vacant lot within the market clearly shows traces of an original structure that probably was demolished to make way for new construction.

Not only are the still-visible original buildings at risk, but archaeological vestiges also are said to be buried within the souq, including remnants of a historic city wall. Ahmed Al Fateh had decreed that walls be built with three gates. One hypothesis suggests that one of these walls was subsequently adapted as a foundation for buildings at the eastern edge of the souq. A city gate also may have been integrated into the buildings at the northeastern corner of the market.

Map of the Qayseriyyah Souq, showing major avenue boundaries, central and auxiliary alleys, and building components of heritage value. Not only are the original visible buildings at risk, but archaeological vestiges are said to be buried within the souq. Map: Steven Rampton.



Rectified Photography

Realizing the risks to the souq and its importance, the Research and Studies Section of Bahrain's Ministry of Municipalities and Agriculture Affairs conducted a preliminary study for conservation and development. The ministry then commissioned a consultant as project manager to prepare a detailed, implementation-oriented redesign of the souq, taking into consideration conservation issues and urban integration of the historic fabric with the modern surrounding city. This project was one component of a larger, two-phase pilot project, Capacity Building for Enhancement of Urban Governance, funded by the United Nations Development Programme and implemented in collaboration with Bahrain's Ministry of Municipalities and Agriculture Affairs.

Although site plans of the market existed, the project manager lacked information on individual building facades and the extended streetscapes. In order to understand and propose strategies for this complex marketplace, it was necessary to obtain additional information. Facing limited time and financial resources, as this was only a preliminary study, the project manager and a small team composed of the authors and four junior architects were tasked with this work.

The team chose rectified photography for the Qaysariyyah Souq project because it is inexpensive and quick to carry out, requires minimal training, and does not require high-tech equipment. In addition, the resulting images of each building facade could be later converted into measured drawings. Rectified photography is based on the concept of bringing the surface of an object, say a building facade, and the plane of the image (photograph) into parallel. Rectification removes



Unrectified photograph of a storefront, taken at an angle. Photo: © Salim Elwazani and José Luis Lerma.



Rectified photograph of the same storefront. Rectification removes perspective, angle, and camera lens distortion to create an image that is on one plane and measurable. Photo: © Salim Elwazani and José Luis Lerma.



Mosaic of Souq West elevation on Tujjar Street.
Photos: © Salim Elwazani and José Luis Lerma.



Mosaic of Souq North elevation on Sheikh Hamad Avenue.
Photos: © Salim Elwazani and José Luis Lerma.

perspective, angle, and camera lens distortion, and creates a measurable image that is on the same plane as the building. This method is the most appropriate when the building surface is geometrically flat. Buildings having multiple flat surfaces positioned in different planes can also be rectified: each plane is separately rectified, then brought into one reference plane. Rectified imagery worked particularly well in the souq, as the building facades are relatively flat and images had to be taken at extreme angles with a wide-angle lens in the narrow streets and alleys.

Image rectification can be carried out with or without measurement control points on the object. Control points can be measured using a tape measure or with survey instruments (total station). These measured distances correct the angle or tilt in the original image while retaining the correct proportions of the building. Without these control points, it is still possible to rectify an image by visually approximating its shape and proportions; however, accuracy is compromised.

Rectified images have several advantages in the field of architecture, urban planning, and conservation. Not only do they provide measurable images of flat surfaces that show surface material conditions, but they also can be stitched together to form an entire facade elevation of a large building or several adjacent buildings. Other recording tools, such as a total station or stereophotogrammetry, can provide some of these results; however, they are time consuming and somewhat expensive, and require specialized training.

Constrained by the limited time available to deliver a final product (only twelve days total, including training for the junior architects), the project manager was asked to prioritize the areas needed for rectified photography. In addition to the imme-

diate area of the souq, he chose several adjacent street scenes for their value and impact on the overall study, resulting in an even tighter time frame to accomplish the work. The team decided to divide the work into three parts: images to be rectified, images that could be rectified in the future, and pictorial photographs not to be rectified but to provide context.

The project began with a day of touring and exploring the souq with the directors of the participating organizations and the project manager. For five days, images were captured and building measurements taken. Then, in the time remaining, images were rectified. The team prepared a final report and collaborated with the project manager on his preliminary study. The junior architects received training throughout the entire process of acquiring and processing the data.

An Answer

Images were captured using a Canon EOS D60 digital camera with a resolution of 6.3 megapixels and a 15mm Sigma wide-angle lens mounted on a small tripod. Image capture was initiated from across the street at one end of the building row, typically coinciding with a street corner. As the photographer moved toward the other end of the building row, a series of digital images was captured in such a way as to maintain an overlap of 20 to 30 percent between images of adjacent buildings. The team also emphasized the continuity of the linear “scene,” including empty lots, alleys, and objects between buildings. This type of information was as important as the buildings in order to assess the souq and carry out the preliminary study in an urban environment.

Uniform lighting conditions were taken into account, as well as precautions such as avoiding photography of moving objects in front of the facades. Multiple frames of the same areas were taken in order to ensure complete coverage and to capture enough detail. Care was also taken to keep the camera level, and attempts were made to maintain a uniform distance perpendicular to the buildings. These measures later minimized corrections to the rectification process. While collecting the images, the team also took several horizontal and vertical measurements of the buildings by hand, noting significant features to be used as control points.

In this case, the camera’s automatic image numbering system was used as the identifier for each image, correlated by hand on a map of the souq. This linkage enabled the retrieval, selection, arrangement, and measurement of the series of sequential images. Rectification of selected images

was carried out in a repetitive, structured procedure using Adobe Photoshop CS2 (Creative Suite). The procedure began by rectifying a series of adjacent images of each separate building facade, using the souq map and the measurements taken in the field. Using the overlap between images, individual rectified images were then fused into a combined image called a mosaic. This process produced a new, expanded mosaic of the entire streetscape. Color processing was necessary in order to maintain some homogeneity throughout the composition. Panorama Tools, a free plug-in added to Adobe Photoshop CS2, was also used to correct lens distortion. Adobe Photoshop CS2 software has a special filter called Lens Correction that performs the same correction function.

The team strove to establish a rate of progress that would help the project manager realistically estimate the amount of work that could be accomplished in a given time. The documentation process resulted in more than two hundred images, of which twenty-six were rectified and combined to produce mosaic streetscapes of the souq. It also resulted in some general context images, but more important, it yielded more than one hundred fifty images that could be rectified in the future, an important consideration given the limited time available for the preliminary study. The pace of the work was rapid, as it was unclear from the outset how fast the photography and rectification would proceed.

Although more work is required, rectified photography provided the project manager, the city, and the ministry with another dimension to the Qayseriyyah Souq beyond the site plan and single unrectified images. It allowed the streetscapes to be viewed in their entirety in a measurable, organized way to improve conservation planning and design.

The parties involved also sensed the potential value of continuing the work beyond the souq and enriching their presentation and reports.

The photo rectification work also fulfilled the needs of the larger project with future capacity building through the training of the junior architects. While the training component was intense and time consuming, and distracted somewhat from the primary goal of recording the facades of the souq, it was a valuable exercise that holds promise for future projects. The junior architects formed the nucleus for continuing the work and creating additional streetscapes of the souq as well as other sections of the city. To reap additional benefits, another training program should be initiated to include other tools beyond rectified photography.

The digital rectified images and combined mosaic images also provide a lasting, measurable record of the Qayseriyyah Souq as rapid changes take place even today.

Salim Elwazani is a professor of architecture at Bowling Green State University, Ohio. A licensed architect with degrees in architecture, planning, and architectural engineering, his area of concentration is heritage conservation and documentation. A frequent speaker in international forums, he has also been published extensively. He is a member of numerous international professional associations and is an invited reviewer for Fulbright Award applications and conference papers. Dr. Elwazani was a Fulbright Visiting Scholar to Bahrain.

José Luis Lerma is an engineer and professor at the Higher Technical School of Geodesy, Cartography and Topography, Polytechnic University of Valencia, Spain. He is the Spanish National Delegate for CIPA Heritage Documentation and a member of its executive committee. His research activities focus mainly on documentation of cultural heritage. Dr. Lerma is the author of five books on aerial and close-range photogrammetry and has presented and published extensively at national and international meetings. He serves as an international consultant on photogrammetry and documentation.