

DIGITIZATION OF THE O'GORMAN'S MURAL AT THE CENTRAL LIBRARY OF THE NATIONAL UNIVERSITY OF MEXICO

1. DESCRIPTION OF THE PROJECT

1.1 *The relevance of the mural*

The campus of the National University of Mexico was built at the beginning of the fifties in the south area of Mexico City. It was conceived as an architectural masterpiece in a wealthy time for the country. Its planning and construction were given to the most important architects of the time and its style is embedded with the aim to integrate an international functional expression with a nationalistic character. In these years, the country was living an important artistic movement led by Diego Rivera, Orozco and Siqueiros.

The thematics of their work, retake the indigenous past, the history of the independence war and the revolution under the communist ideal. Their work is accompanied by the social presence that is depicted on the walls of public buildings. In the constructions of the National University, the buildings make extensive use of local materials and the integration of different aspects of the plastic such as architecture, sculpture and paintings.

The central library (Fig. 1) is the element of higher hierarchy within the whole set of buildings, as revealed by its spatial location within the campus urban conception, his volume and decoration. It was meant to be a symbol of culture, of the University itself, in a country whose progress was largely based upon the importance given to higher education.

1.2 *Description of the mural*

The part of the library that holds the bulk of the book collection is a blind parallelepiped, whose walls bear the huge mural (3712 m²) created by O'Gorman. It is composed by 1 m² plates (5 cm thick) (Tav. XXXIV, a) built on the ground and further affixed to the wall through a metallic structure.

The different colors of the mural were achieved using natural colored stones (2-4 cm) with exception of blue materials which were taken from blue glass. Eleven types of stone were used according to O'Gorman, although now only ten of them are clearly distinguished. The set of colors is composed by red, yellow, pink salmon, violet-pink, violet-grey, dark-grey, black, white, dark-green, light-green and blue.

In the northern façade the prehispanic past is depicted in a symbolic fashion, with Tenochtitlan, the lacustrian city and Quetzalcoatl, the feathered serpent.

The southern façade depicts the colonial past. In the upper part of the

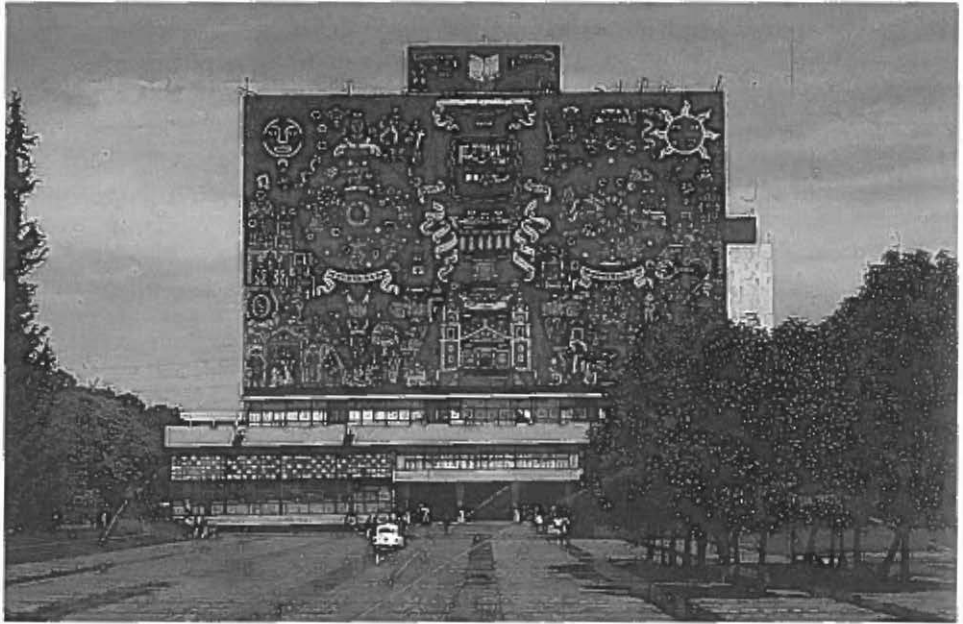


Fig. 1 – General view of the Library.

central axis, the heraldic of the Habsbourg family, kings of Spain during the XVI century can be seen, while in the lower part, the typical constructions of the occidental architecture are represented. On the right side, the Christian concept of The Good illustrated by the Franciscan rope and the sun. On the left side, the evil, the world of the Moon. The colonial time is represented by the map of Mexico City that was sent by Cortes to Charles V, descriptions of military towers and baroque churches of the XVIII century.

The east façade contains a description of modern world that includes the atom picture, history as symbolized through the red star, the open book of culture and a nationalistic sense given by the picture of the last Aztec emperor, i.e. Cuauhtemoc.

The west side portrays the actual country, with a landscape illustration of the valley and the blazon of the university; the students are illustrated in an allegory, fed by knowledge, the strength of arts and national wealth.

1.3 *The registered damages*

After 45 years from its construction, the mural has suffered a number of problems with different causes i.e. defects in the construction, weather and pollution. Some of the most important are:

– the falling of stones, which in the particular case of the blue color is attributed

- to the loose binding between glass and cement, but also, to the use of a dry cement during the preparation of the plates to avoid cement staining of the stones.
- desintegration of some of the green stones favored by their great porosity. In the case of light green, the stones are partially lost leaving behind those parts closely bound to the cement.
 - the change of color, in particular that of the green stones.
 - the "explosion" of concrete after corrosion of the iron frame.
 - the convexity of some plates after compression of the metallic structure.

1.4 Aim of the work

Our work is aimed to document and evaluate the overall damage prior to intervention of restorers. This includes a first stage that needs the elaboration of a suitable methodology for the acquisition of images which can also be used "a posteriori" for registering the state of the building after restoration, the follow up of aging and the efficacy of the employed techniques. The storage of graphic information in digital media has a number of well-known advantages, such as durability of the media, an inherent low cost of reproduction, the possibility of printing multiple hard copies of material, the ease of virtual modification and the sharing of information through networks.

Nevertheless, while digitization techniques are now of common usage, our particular purpose posed several problems that required analysis and decision making which are presented herein. A further stage will be concerned with the development of algorithms for correction and analysis of images in order to evaluate the damages.

2. SCIENTIFIC OBJECTIVE

A number of factors have to be taken in account prior to the decision making step in relation to the digitization process.

- 1. Choice of precision level.** This is concerned with the compromise to achieve the necessary level of precision knowing that the selection of inadequately low resolution will cause loss of information and that a too high resolution involves the handling of archives of inconveniently large size. The intermediate solution is based in the principle of economic use of the media. A convenient resolution which has been adopted to digitize common size paintings can reach 10 pixels/mm, although this is not applicable to the case of the mural.
- 2. Surface covered by each digitized image.** Once a suitable resolution is chosen according to the capacities of the computing equipment and the processing power, the correspondence between actual surface and digital images can be setup.
- 3. Surface captured in each photography.** The surface covered by each final image may not correspond to the surface initially captured photographically

since various images may need to be grouped or a large one may need to be divided. To calculate the surface covered by each photographic capture, the features of the digitization system have to be considered.

4. Position of the camera and the lens. The position of the camera has to be set in function of the surface to be captured, the type of lens and available space.

5. Visible and Invisible. It will be necessary to define the spectral width that will allow the obtention of useful data and to decide the use of visible or invisible spectrum. The usefulness of infrared light for the study of paintings is well documented.

6. Analog-Digital acquisition. In order to obtain an image in digital form, various alternatives are available such as digitization of video, photographs, or direct digital captured with digital cameras or CCD. The latter has the advantage of reducing the variables that may affect each step, including the chemical development of photographic films.

7. Digitization. When using analog acquisition, a careful selection of the digitizing equipment has to be made allowing reproducible use of parameters for color control and acquisition time for each snapshot.

8. Distortion control. A normal distortion during capture has to be taken in account starting from the camera, the lens, the digitization system and perspective effects. If calibration of images is necessary, the system should provide the indispensable tools to allow the modelling of distortion.

9. Light Control. In order to compare the digital images, group them and analyzed them, a uniform illumination is necessary and plays an important role in designing the overall strategy. Just as geometric and optical distortions are to be considered, the control of light conditions will be a key parameter on its own.

10. Organization of images. Finally, once the object is registered as multiple images, the logical ordering of the graphic material should be arranged as an easily accessible set.

Each of the mentioned aspects has to be analyzed independently for a correct setting, although there is an obvious connection among all of them for a successful outcome.

3. SOLUTIONS

One of the most important aspects for the decision making process concerning digitization of the mural was to make possible the automatic correction, a key step for future correction and analysis as well as batch processing.

The chosen resolution for images was decided in relation to the main objective of the work i.e. to document the damages of the mural, and to the digitization system used. Thus, considering that the stones measure between 2 and 4 cm, that their gap is ca. 2 mm, and that digitization of a 35 mm negative is 2048x3072 pixels, a resolution of 1.5 per pixel mm was adopted.

Concerning the location of the camera, two possibilities were consid-

ered: a detached capture from the ground with a telescopic lens, or a closer one from a structure which can be slide along the wall surface. While the first possibility saves many efforts, the second one was chosen since it offers several advantages. For example, the desired precision can not be matched with the first alternative; also, those elements not captured due to perspective effects would not be present at all. Finally, control of illumination would be rather difficult as well as its correction.

Therefore a light metallic structure was designed which hangs from its gravity axis to avoid putting pressure upon the wall; its vertical and horizontal movement can be controlled from the roof of the building. The structure has a platform so a person can position the frame prior to each photographic capture. The frame has to cover 1.10 m height that corresponds to the dimension of each plate of the mural, plus 5 cm extra per side, to ensure that two images can be overlapped. In the horizontal sense, two configurations can be chosen: the first with a frame of 1.40 m length to allow the capture of the 0.30 m plates at the edges of the building while capturing at the same time the neighboring 1.0 m plates; the second one is 1.10 m length for normal plates.

The use of such frame provides the coordinates to control parallelism and scale of the picture. The camera is affixed at a constant distance of 1.65 m from the façade. It has a 50 mm lens that introduces minimal distortions. The capture of larger areas was examined as a mean to economize the amount of movements and pictures, though it was ruled out since it implies the use of great angle lenses (and greater distortions) or the capture from a longer distance from the wall and a heavier metallic structure.

The best procedure to ensure uniform illumination when dealing with exterior photography is working at night. Flash and light bulbs are affixed to the structure and each snapshot can be taken with the same light conditions. The distribution of light upon the surface can be monitored before by studying the light distribution on a gray plate.

Distortions due to the lens (aberration), the camera and to the analog/digital converter has to be modeled in order to perform corrective calculations. Information to calibrate images is furnished by a prior photography of a black and white checker-board like drawing.

The spectral range chosen was the visible part since most of the damages are detectable to the human eye. Therefore, normal color photography is satisfactory for the present purpose.

The surface covered by each image corresponds to a slightly larger area than each square plate and this is useful for the numbering of files. Each side of the façade has been divided into a matrix whose origin is the upper left corner. The columns are registered by letters and the rows are assigned numbers. Those archives that correspond to specific sides of the façade carry the prefix corresponding to the geographic orientation. For example, archive S_B5

belongs to the plate of the second column of the fifth row of the south façade. Once corrected, the archive measures 1650 x 1650 pixels and ca. 8.2 MB.

When the issue about the type of camera to be used was examined, it was found that a digital camera or CCD is not recommended for exterior photograph as it is our case since the acquisition times are relatively long. Therefore, classical (analog) photography was chosen.

For digitization purposes, the PhotoCD commercial system will be used for its speed and constant output with a relatively low cost.

In order to store in digital form the complete 3712 m² of mural before and after restoration, using a resolution superior to 1.5 pixel by mm², a storage media of 54 optical disks was estimated.

4. CONCLUSION

The digital recording of a subject which is to be submitted to restoration is in the present time a useful resource as long as its inherent advantages are profited maintaining a high quality of images. Once this requirement is met, the studies in conservation will be stimulated. This will allow us to increase our knowledge in a field relevant to any culture willing to preserve the historic memory associated to the objects that constitute their cultural patrimony.

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ABSTRACT

A discussion is made about the problem of the graphic registering of a large mural, symbol of the Mexican culture of the fifties. Vantages of digital information are well-known. Nevertheless, digitization of a 3712 m² mural in order to capture information of the state of the mural before and after restoration, and analyse damages applying image processing tools, oblige to a solution that takes into account the particularities of the problem. The solution must ensure high precision of the survey to be a tool for restorators and must control general snapshot conditions to obtain images with equal characteristic that will allow the repetition of the same algorithm for the "Computer Aided Restoration" step.

How were selected pixel definition, image size, camera location, image acquisition and digitization systems, and enlightenment condition was controlled? These are the topics developed in the present work.