
Art as a strategy for the preservation of 20th Century concrete shell structures

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Abstract

The Faculty of Architecture at the University of Puebla (BUAP) in Mexico was built in 1969 within the main university campus. Several concrete shell structures were built at that time for different university buildings. Some are domes or cylindrical barrel vaults hyperbolic paraboloid shells; and other structures are inverted umbrella-type hyperbolic paraboloid reinforced concrete shells. The latter offer shading and rain protection in corridors. These umbrellas have survived despite suffering some changes like a steel structure located on top of them. In order to preserve these structures, academics and graphic design students implemented in 2023 a painting workshop. The activity was painting on the inverted umbrella-type concrete shells, images about architecture history and some drawings about the Faculty of Architecture's iconic building, which is another reinforced concrete shell structure. These education and art activities are a strategy that allow students to appreciate and to know the history, design, and materials of these 20th Century concrete shell structures. The main objective is to preserve historical structures so future generations would be able to enjoy and appreciate this beautiful building heritage that BUAP possesses.

Keywords: Hyperbolic paraboloid concrete shells, building heritage, umbrella-type concrete shells, building preservation.

1. Introduction

Concrete shell structures were widely designed and built during the 20th Century in Europe, USA, Japan, India and in some Latin American countries [1][2][3]. Technology advances in the use of steel and reinforced concrete allowed designers to build structures of different geometry and typology. In Mexico, Félix Candela has been the main builder of concrete shell structures. In 1950 Candela established a company called "Cubiertas Ala", building around 900 structures [4]. Other concrete shell builders in Mexico were Enrique de la Mora, Fernando López Carmona, Fernández Rangel brothers, Alfonso Ramírez Ponce. The city of Puebla is located 127 Km away from Mexico City. Puebla's city center is a World Heritage Site but is also a vibrant city in constant growth housing some of the best universities of Mexico. During the 1960's the University of Puebla (BUAP) built its main campus in the south of the city. The campus was designed by architect Miguel Pavón Rivero and Jorge Belches Landero. In 1969 the first university buildings were occupied [5]. Among those buildings were a few reinforced concrete shell structures: a cultural center called La Monja, the engineering lab building, structures at the campus entrances and some inverted umbrella-type hyperbolic paraboloid covered the corridors.

Some of the BUAP reinforced concrete shell structures still exist and are in use [Figure 1]. However, some of them have been demolished, in particular two inverted umbrella-type hyperbolic paraboloids that covered the pedestrian entrance of the Architecture Faculty. Instead, today there is a cube shaped building with any architectural or engineering value. Although some of these buildings, for instance La Monja [Figure 2] and the Engineering Lab building, are considered iconic university buildings, there is a lack of preservation interest and therefore there are no strategies for their conservation.



Figure 1 left: Umbrella-type hyperbolic paraboloids in the sports area of the BUAP university campus [2013].
Figure 2 right: Umbrella-type paraboloids and La Monja building at the Architecture Faculty of BUAP [2013].

Tang [2] mentions nine reasons for the disappearance of concrete shells: the passing of the great masters (Torroja, Candela, Isler, Maillart, Nervi, Tedesco, etc.), changes in fashion, elevated labour costs, building physics, non-practical morphology of shells, complex form finding analysis, material opacity, building codes and lack of regulations for shells, and new competing materials with good lighting or acoustic properties, cheaper or shorter construction times. Moreover, Alarcón [4] points out humidity and mold as constant pathologies found in concrete shells in Mexico. Humidity is caused by deficient maintenance of rainwater tubes within the building as well as cheap waterproofing materials [Figures 3, 4].

In a previous study regarding how people value concrete shell structures at BUAP [6], 74% of students and academics responded that these structures are innovative, useful, and interesting and they must be preserved. However, they also reported that urgent maintenance work is needed, that some structures look like they are going to fall.

Concrete shell structures represent the 20th Century history showing important technical and technology developments. Hence, it is essential to preserve these buildings so new generations can testify that part of history. In addition, preserving them prevents building new structures which is expensive and non-sustainable. At the university it is important to educate future building professionals so they can understand the structural and architectural advantages of shells, such as: minimum use of materials, lightweight, and covering long spans without intermediate supports. An important strategy for their preservation relies on having professionals with technical skills to design and build concrete shell structures.

2. Art as a strategy for preserving concrete shells

Recently, there has been an art and education initiative at the Faculty of Architecture. Its main objective was to promote the history of the Architecture Faculty through wall murals, to leave a legacy for future students and academics. At the beginning of the project in 2019, the idea was to use spaces that were perceived as abandoned. However, after asking permission to the university infrastructure office, they banned the project arguing the university buildings must be white. Before the project was shuttered down, 21 students did some paintings on six hyperbolic paraboloids.

Four years later, the new Head of the Architecture Faculty, Professor Santiago, granted permission to Graphic Design Professor Dr Jesús Barrientos to carry out the murals project. However, this time the

only selected built space were the inverted umbrella-type hyperbolic paraboloid concrete shells that cover the exterior corridors of the Faculty. A public invitation to architecture, graphic design and urban design students was published. The topic of the paintings was the 70th anniversary of the Architecture Faculty and its impact in Puebla and Mexico.

In the summer of 2023 six teams formed by undergraduate students were selected to paint six paraboloids [Figures 5, 6]. A total of 25 students participated; a local company donated 100 Lt. of paint and brushes. Due to the difficulty of painting on an inverted paraboloid, participants attended a workshop on perspective and colour, offered by lecturer Miguel Ruiz Arenas¹. The project called *Parabolarte* was officially opened during the 70th anniversary of the Architecture Faculty in February 2024.



Figure 3 left: Umbrella-type hyperbolic paraboloids at the Architecture Faculty of BUAP [2013].

Figure 4 right: Paraboloid in the sports area of the BUAP university campus [2013].

In order to know students' perception towards the *Parabolarte* project, a 14 questions survey was distributed among students who participated in the project. A total of ten people answered the questionnaire, nine women and one man, all are enrolled between the third and fifth year of the undergraduate studies at the university. Students were asked about their perception towards the concrete shells before painting the murals, 4 of them said that they did not pay attention to those structures, the rest said the umbrella-type shells are useful for solar and rain protection, and one of them thought they were ugly and dated, and only two students referred that concrete shells are part of the university's building heritage. Then, students were asked about their current beliefs towards the preservation of concrete shells, all participants agreed on the importance of preserving these structures for various reasons: their architectural history, for representing the culture of the Architecture Faculty, for linking the present time with the past, and to continue their function as solar and rain protection. It is noticeable that four students pointed out that now, after their intervention on the paraboloids, these structures have more meaning to them [Figures 7-9].



Figures 5 and 6: Sketches and colour application on concrete shells [June 2023].



Figures 7, 8 and 9: The *Parabolarte* project results show iconic Puebla's buildings, La Monja, the city's cathedral, and a detail of a student's signature [June 2023].

3. Conclusion

According to Dr Barrientos the art intervention added value to the Faculty's inverted umbrella-type hyperbolics. He recommends registering concrete shells with the paintings as part of BUAP's building heritage so they would be protected and preserved. Students commented on other strategies to preserve BUAP's concrete shell structures, such as: lightweight structures workshops, design contests, other art activities involving concrete shells. They are very grateful for having being part of the *parabolarte* project as it allowed them to leave a signature in their university, so future students could learn about the history of the Faculty of Architecture at BUAP.

This paper presents an innovative way of involving university students on the preservation of 20th Century concrete shells. Artistic expression and aesthetics are major topics taught in architecture, graphic design, and urban design programs. Taking advantage of students' art abilities made possible to change their perception towards concrete shell structures to consider them as a legacy and building heritage that deserves to be preserved for future generations.

Although few reinforced concrete shell buildings have been built at the end of the 20th Century and the beginning of the 21st Century, there are examples of fine contemporary concrete shells. According to Del Blanco and Ríos [7], Candela collaborated with architect Fernando Higuera in Madrid, Spain. Together designed seven projects, one of them is Murcia's airport in 1984. At the end of his life Félix Candela designed the Oceanográfico restaurant located in Valencia, Spain (2000). Japanese architect Toyo Ito in collaboration with Professor Mutsaro Sasaki designed concrete shell buildings using digital form finding and shape analysis and prefabricated plywood framework assembled on site saving time and reducing costs. These buildings are the Grin Grin Park in Fukuoka, Japan (2005) and the Saijo crematorium in Kakamigahara (2008) [2]. These examples show that concrete shell structures can be built using innovative materials and processes, achieving beautiful buildings that respond to today's spatial needs and preferences.

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ⁱ The information about the *Parabolarte* project was obtained through an interview with Dr Jesús Barrientos on 15th March 2024. And through a digital video note available at: <https://images.app.goo.gl/btzETN1E5DYetwW9A> [last accessed on 29th March 2024]