

The Shells of Félix Candela

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Architect Félix Candela became internationally renowned for his surprising, innovative reinforced concrete shells—known in Spanish as *cascarones*—built in Mexico in the 1950s and 1960s. He lived his life, marked by the Spanish Civil War and exile, in Spain, Mexico and the United States.

Born in Madrid, January 27, 1910, in his youth he was an outstanding student and athlete, a member of his country's

in France, Franz Dischinger in Germany and Eduardo Torroja in Spain. In 1936 he won a scholarship to study this specialization in Germany, but at the outbreak of the Spanish Civil War (1936-1939), he gave up those plans to volunteer for the army to defend the legally elected Republican government from Francisco Franco's fascist army.

Candela served as captain of engineers on different fronts. In February

The intellectual loss that Spain suffered after its civil war was sharply felt in the field of architecture. Under the Falangists, the postulates of rationalist architecture that the Republican government had begun to officially accept were banned. About 50 Spanish architects, among them those who subscribed to the most advanced, progressive ideas, went into exile. Twenty-five ended up in Mexico, many with long professional and political careers behind them, like Bernardo Giner de los Ríos, Francisco Azorín, Tomás Bilbao, Roberto Fernández Balbuena, José Luis M. Benlliure and Jesús Martí. The younger exiles, like Juan de Madariaga, Arturo Sáenz de la Calzada, Enrique Segarra, José Caridad, Juan Rivaud, Francisco Detrell, Esteban Marco, Oscar Coll, Ovidio Botella and Eduardo Robles Piquer, would develop most of their work in their new homeland.

Félix Candela, among the youngest of these, arrived in Veracruz June 13, 1939, aboard the *Sinaia* in one of the first of many expeditions prepared by aid organizations for the Spanish Republic that facilitated the transport of thousands of refugees to Mexico. When these architects arrived in the early 1940s, Mexico was experiencing an economic boom, which propelled the construction industry, thus favoring their integration into the milieu.

The first steps in Candela's professional career in Mexico were difficult. A month after he arrived he was appointed



Photos by Juan Ignacio del Cueto

The Bacardi bottling plant, Naucalpan, 1959.

national downhill ski and rugby teams. He graduated from the Madrid Higher School of Architecture in 1935 amidst the vibrant cultural upsurge Spain experienced during the Second Spanish Republic, from 1931 to 1939.

From his youth, Candela was attracted by the reinforced concrete shells being built in the first decades of the twentieth century by Eugène Freyssinet

in 1939, when the Falangist victory was practically complete, he led his battalion across the Pyrenees into exile. After several months of detention in Saint Cyprien, one of the concentration camps the French government had prepared for the thousands of Spanish refugees, he received the surprising news that a country he was totally unfamiliar with, Mexico, would admit him thanks to President Lázaro Cárdenas' administration policy to grant a great number of Republicans exile.

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head of construction for the Colonia Agrícola Santa Clara, in the northern state of Chihuahua, an attempt by Republican officials to found a model colony of agricultural production to be populated by Spanish exiles. The experiment failed a year later and Candela went to Acapulco, where he built part of the Papagayo Hotel, owned by Emilio Azcárraga Vidaurreta. In 1941, Candela became a Mexican citizen and was given his first stable job in the Vías y Obras construction company, headed up by his countryman Jesús Martí.

In late 1946, he left Vías y Obras and went into partnership with his brother Antonio, a technical architect, to put up some buildings in Mexico City, among them the Cathedral Hotel on Donceles Street. Fortune smiled on them in those years, and they also won the first prize in the lottery, but they lost the money venturing into the movie business with the Películas Paricutín production company, where they made two movies (Candela himself called them “two real bombs”): *La venenosa* (Poisonous Woman) and *La virgen desnuda* (The Naked Virgin).

Candela never lost interest in shells, and he devoured all the information he could get about them. In 1949 was able to put his dreams into practice when he built his first experimental shell. Encouraged by its success and convinced that a myriad of possibilities were opening up in this field, together with his brother Antonio, his sister Julia and Mexican architects Fernando and Raúl Fernández, he opened up the first Cubiertas Ala construction company to introduce concrete shells into industrial architecture. Acting as architect, engineer, consultant, calculator, contractor

and builder, Félix Candela put up the first shells that would make him world renowned: ruled surfaces (built using straight segments) with double curvature which, given their hyperbolic paraboloid geometric —or hyper— form, exclusively transmit compression stress, making it possible to create continuous surfaces of minimal thickness, in the form of a shell.

The covering most often requested from Cubiertas Ala by businessmen and architects was the “umbrella,” which consisted of four hyper segments held up by a central support that looked like an open umbrella. Quick to make —the same center framework was used to make



Los Manantiales Restaurant, Xochimilco, 1958.

several pieces— and effective, several “umbrellas” could be used to very economically put up buildings that required large covered surfaces, like factories, warehouses and markets. Many gasoline stations throughout Mexico have this kind of roof. But the shells that made Candela’s international reputation were those whose twisted forms were very complex, with spectacular, soft, sinuous forms.

Most of his coverings were 4 cm thick, although on special occasions he made them as thin as 1.5 cm. This is the

case of the University City’s Cosmic Rays Pavilion (built in 1951 in collaboration with Jorge González Reyna), the first to bring him prestige nationwide. After that, many architects approached Cubiertas Ala to include different kinds of shells in their projects. Thus, most of Candela’s work was done in conjunction with his Mexican colleagues as an advisor on their projects and proposals for coverings; they usually presented a general sketch that Candela then defined geometrically, systematized and turned into blueprints ready for building. All this won him the name of “the magician of the shells.” His collaboration was fundamental for the execution of these pro-

jects. His firm’s client list reads like a “who’s who” of contemporary Mexican architecture, including names like Mario Pani, Juan Sordo Madaleno, Enrique Yáñez, Pedro Ramírez Vázquez, Enrique de la Mora, Federico Mariscal, Alejandro Prieto, Max Cetto and Vladimir Kaspé. His reputation spread abroad and he carried out projects and construction in the United States, Cuba, Puerto Rico, Colombia, Venezuela, Honduras, Guatemala, Spain, Great Britain, Norway, Kuwait and Saudi Arabia.

One of Candela's emblematic works, and the only one considered completely his, is the Church of the Virgin of the Miraculous Medallion, built in Mexico City in 1953. This building, with a traditional, three-nave church foundation, is covered with a daring combination of twisted surfaces that create a fantastic interior space reminiscent of the spaciousness of the gothic and the work of Gaudí.

Outstanding among the constructions that he did in collaboration with other architects are the customs warehouses that he built in 1953 with Carlos Recamier; several Mexico City markets, done from 1955 to 1958 together with Pedro Ramírez Vázquez and Rafael Mijares; the Los Manantiales Restaurant, built in Xochimilco in 1958, with Joaquín Álvarez Ordóñez; and the Palmira Chapel, built in Cuernavaca in 1959 with Guillermo Rosell and Manuel Larrosa.

Candela's collaboration with architects Enrique de la Mora and Fernando López Carmona, beginning in 1955 with the roof of the Mexican Stock Exchange, deserves special mention. De la Mora's capacity for design and the analytical, practical minds of Candela and López Carmona combined to create innovative solutions for churches built between 1955 and 1960: the Altillo, San Antonio de las Huertas, San Vicente de Paul and Santa Mónica Churches in Mexico City, and the San José Obrero Church in Monterrey.

In 1963 De la Mora was commissioned to build the Our Lady of Guadalupe Church in Madrid, which was the first work commissioned to a Mexican architect in Spain and signalled the professional—though not personal—return of Candela to his country of birth.



Church of the Virgin of the Miraculous Medallion, Mexico City, 1953.

At the Bacardí plant in Naucalpan, built in 1959, Candela used different solutions to cover several buildings. Outstanding among them are the “umbrellas” that he put up over the open-air cask storage area and, especially, the bottling plant where he put up the largest shells of his career: six parabolic vaults, each clearing 30 meters on each side, covering more than 5,000 square meters. This work is on the same piece of land as the only building that the famous German archi-

tect Mies van der Rohe ever built in Mexico: the corporate headquarters of the “bat brand” (so named for its label), Bacardí.

Over the 26 years Cubiertas Ala served the public, from 1950 to 1976, its portfolio grew to impressive proportions: the firm designed almost 1,500 projects, more than half of which were actually built. The key to building the shells was the complicated construction of the wooden frame for the arch, made of straight pieces of wood that made a double-curved ruled surface that gave it its form. Above the frame, the concrete was poured into a fine rigging of rods, and after it set and the frame was removed, the shell took on its final form. Many low-paid, skilled construction workers were needed for this. A government decreed wage hike in 1964 made labor more expensive, at the same time that the price of construction materials rose, rendering shells unprofitable. At that point, Cubiertas Ala went into decline.

Candela's last important work in Mexico was the Sports Palace, built in collaboration with Enrique Castañeda and



Palmira Chapel, Cuernavaca, 1959.

Antonio Peyrí for the 1968 Olympic Games. For that, they substituted concrete shells for a more economical, ingenious metal structure that made it possible to put it up in record time. From the time it was inaugurated, its great copper roof, reminiscent of an armadillo's shell, shining in the sunlight, became a symbol of Mexico's capital.

In their heyday, photos of Félix Candela's work were published in specialized magazines the world over. In 1961, the International Union of Architects gave him the Auguste Perret prize for excellence. That initiated an uninterrupted flow of prizes, homages and invitations to lecture throughout the world. The architects' associations of Spain and Mexico fought over his origins, each claiming him as their own, which he dealt with by saying he was an architect trained in Spain, but realized in Mexico.

In 1971, the University of Illinois at Chicago offered him a full professorship, something the UNAM National School of Architecture had never given him since he had begun teaching there in 1953. Candela, who had married his second



Interior, Church of the Virgin of the Miraculous Medallion, Mexico City, 1953.

wife, U.S. architect Dorothy Davis in 1967, decided to accept the offer. He went to live in the United States—in Chicago, New York and Raleigh, North Carolina—and acquired U.S. citizenship, his third.

Félix Candela remained faithful to the Spanish Republican cause and participated in many activities for the restoration of democracy in Spain. This led him to reject many invitations to visit the country of his birth, saying that he would

not step on Spanish soil as long as Francisco Franco was in power. In 1969, he decided to heed the voices that suggested that his return could help hasten the fall of the dictator, and he accepted an invitation from the Eduardo Torroja Foundation to attend an international congress on shell structures. Thirty years after being forced to leave it, then, he returned to his homeland. In 1977, once Spain's transition to democracy had been normalized, Candela bought an apartment in downtown Madrid in the neighborhood where he had grown up, and from then on he alternated between the United States and Madrid.

In the mid-1990s, his fervent admirer architect Santiago Calatrava invited him to participate in the project of the Oceanographic Park of the City of Arts and Sciences currently under construction in Valencia. This would be his posthumous work: Félix Candela died in Raleigh, the last of his many homes, in the early hours of December 7, 1997, just before turning 88.

In 1964, at the height of his career, Candela wrote about his work, "My greatest satisfaction is not in having executed certain spectacular structures—although I must confess I enjoyed making them very much—but having contributed, even if minimally, to solving the prodigious problem of economically covering habitable spaces, demonstrating that the construction of shells is not an extraordinary feat that immortalizes its creators, but a simple, flexible construction procedure."¹ **NMM**



Sports Palace, Mexico City, 1968.

NOTES

¹ Félix Candela, "Arquitectura y estructuralismo," *Arquitectos de México* 21 (Mexico City) (January 1964).