John Earley and the Baha'i Temple

By Kimberly Waggle Kramer, P.E.

John Joseph Earley was born in New York City on December 12, 1881, the son of James Farrington Earley, a fourth generation Irish stone carver. As a child, John moved to Washington, D.C., where his father started his stone carving and modeling business – the Earley Studio. There, John Earley entered the parochial schools and studied the classics under the Brothers of LaSalle at St. John's College. At seventeen, he entered his father's studio as an apprentice to learn the demanding crafts of sculpture, model making, and stone carving. At the studio, John met Basil Taylor, his future business partner. When James Earley died in 1906 of pneumonia, Basil Taylor was a well-qualified mentor for John Earley to carry on the business.

John Joseph Earley, left, and Basil Taylor atop the mockup of the Baha'i Temple dome on July 29, 1932. Photo courtesy of Frederick Cron and Fort Collins, Colorado Publishing.

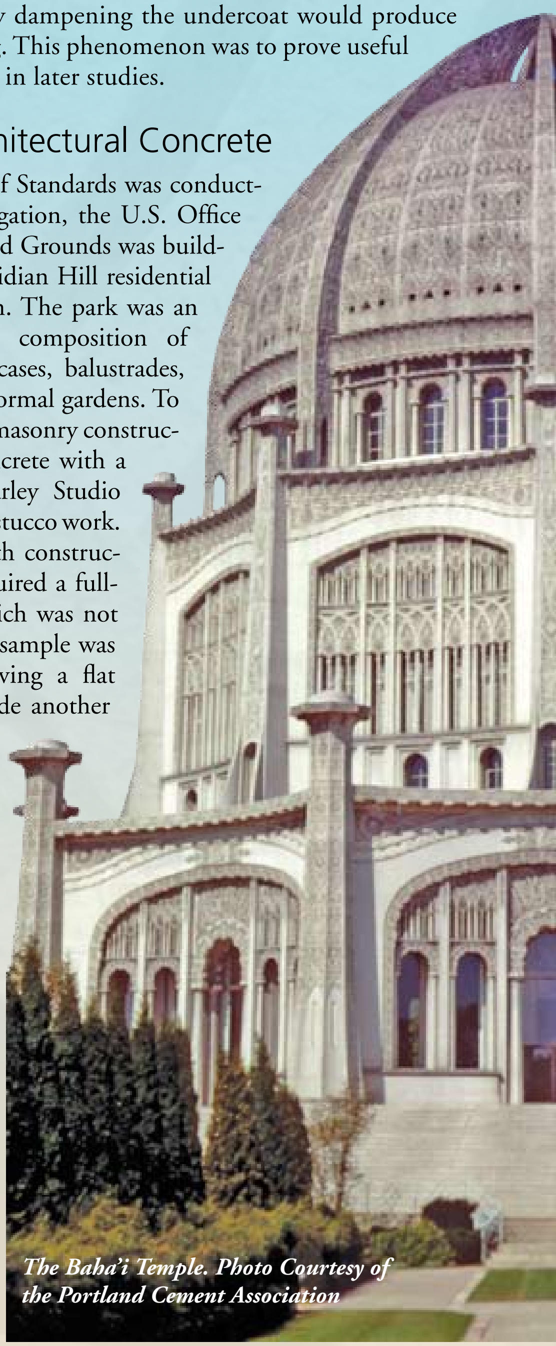
John Earley and Basil Taylor subsequently redirected the Earley Studio – primarily doing plaster and stucco. In the early 1900's, stucco construction was introduced in the United States on a large scale, but numerous failures occurred, especially with portland cement stuccoes laid over metal lath – the lath corroded. From 1911 to the mid-1920's, the Bureau of Standards tested panels on different plaster and lath materials and retained the Earley Studio to do the stucco work under the supervision of the advisory committee, to which Earley himself was appointed. While performing the experiment, Earley discovered that the most effective method to reduce the cracking in the stucco was to change the construction method; instead of liberally wetting the first coat of stucco with water to ensure the adherence of the finish coat, lightly dampening the undercoat would produce no crazing or cracking. This phenomenon was to prove useful to Earley and Pearson in later studies.

The darker spots are the translucent quartz and the white spots are the opaque quartz

Inventing Architectural Concrete

While the Bureau of Standards was conducting the stucco investigation, the U.S. Office of Public Buildings and Grounds was building a park in the Meridian Hill residential section in Washington. The park was an elaborate neoclassical composition of retaining walls, stair cases, balustrades, reflecting basins and formal gardens. To save money, all of the masonry construction was to be of concrete with a stucco finish; the Earley Studio was engaged to do the stucco work. Before proceeding with construction, the contract required a full-scale sample wall, which was not approved because the sample was uninteresting and having a flat gray color. Earley made another wall, casting the piers against plaster molds to produce deep rustication in the concrete, and then giving a rough pebble dash finish to the stucco panels between the piers, although still gray in color.

Making the third sample inspired Earley – why not make the wall only of reinforced concrete, and when this concrete was still green, strip the forms and expose the larger aggregate by rubbing with a

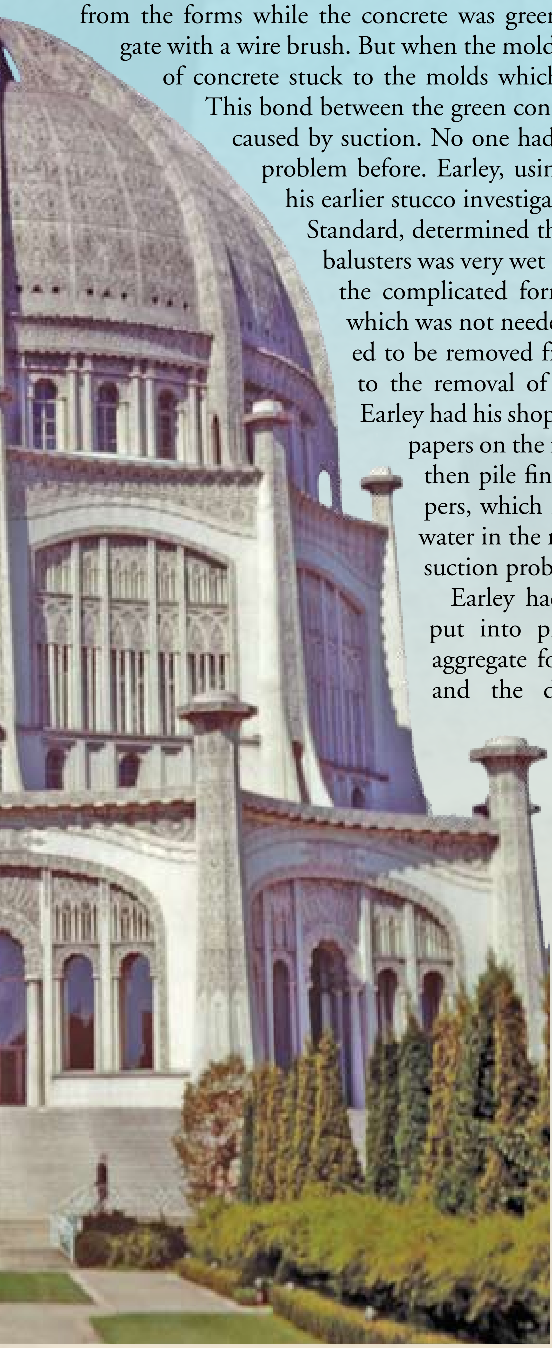


The Baha'i Temple. Photo Courtesy of the Portland Cement Association

wire brush? The result was astonishing; instead of the cold gray color, the wall was creamy tan because the principle concrete aggregate in the area consisted of pebbles dredged from the Potomac River, which had a yellowish-brown color. At first, the aggregate had a tendency to consolidate into pockets surrounded by gray sandy mortar, giving the wall a non-uniform appearance. Earley overcame this by additional experimentation with the mix. In 1916, little was known about mix design; Earley was inspired by French engineer R. Feret to use "step-graded" mixtures of aggregates – the final mix had two particle sizes. Hundreds of square feet of wall were completed with very little segregation.

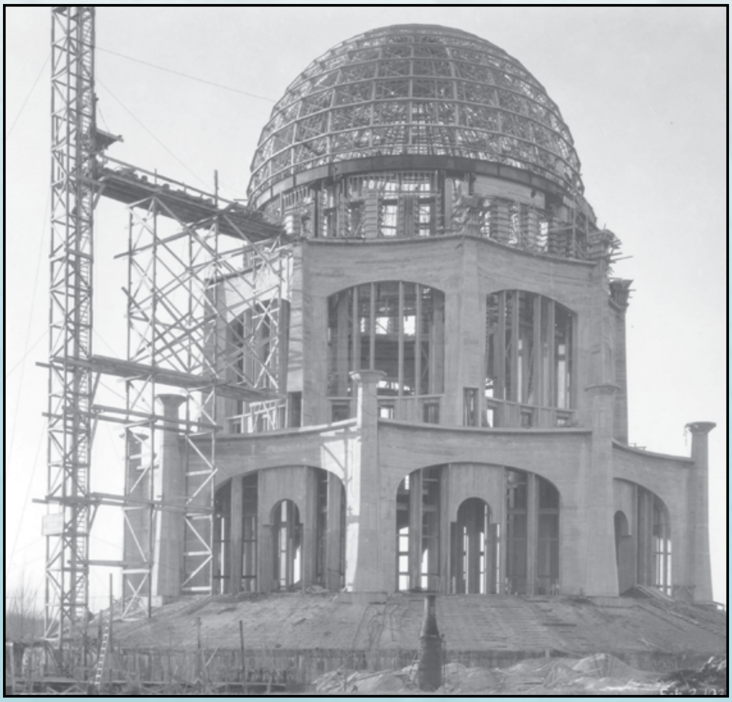
"– why not make the wall only of reinforced concrete, and when this concrete is green, strip the forms and expose the larger aggregate by rubbing with a wire brush?"

The next problem to solve was the balusters. Instead of casting them on-site, they were cast in the Earley Studio. Similar to the walls, the balusters had to be stripped from the forms while the concrete was green to expose the aggregate with a wire brush. But when the molds were removed, pieces of concrete stuck to the molds which ruined the balusters. This bond between the green concrete and the form was caused by suction. No one had ever encountered this problem before. Earley, using his knowledge from his earlier stucco investigations for the Bureau of Standard, determined that the concrete for the balusters was very wet in order to flow and fill the complicated forms. This excess water, which was not needed for hydration, needed to be removed from the concrete prior to the removal of the forms. Therefore, Earley had his shop men pile folded newspapers on the freshly-filled forms and then pile fine sand on the newspapers, which removed all of the free water in the mix and eliminated the suction problem.



Earley had now discovered and put into practice "step grading" aggregate for uniform appearance and the development of early strength by the removal of excess free water. *Architectural Concrete* was born.

During the following years, the Earley Studio was commissioned to ornament many other structures, most of which are in still excellent condition: Chicago's Fountain of Time, cast in 1922; a concrete mosaic with over 300 different colors of aggregates at the Shrine of Sacred Heart in Washington, D.C.; the recreation of the Greek Parthenon, completed in 1925 in Nashville, Tennessee; and mosaic ceilings in the United States Department of Justice building.



The concrete and steel superstructure ready to receive exterior wall panels

Planning the Baha'i Temple

At an annual convention of the American Concrete Institute in 1933, John Earley described his relationship with the Baha'is. Twelve years before that, two gentlemen had come to his studio in Washington seeking a material with which to build the exterior of the Baha'i Temple in Wilmette, Illinois, near Chicago. Mr. Louis Bourgeois, the architect, brought a photograph of a plaster mold of the temple; it was the most exotically beautiful building that Earley had ever seen. Bourgeois autographed the photograph and left it with Earley. Over the next ten years, Bourgeois and Earley studied the temple, with all its ramifications of form. The architectural drawings were among some

Due to the requirements of the finish, several workers at one time were required to wire brush the panels to expose the quartz aggregate prior to the green concrete setting

1933, Earley Studio artists with plaster mold for the Baha'i Temple

of the largest ever made. Bourgeois would stretch a large sheet of paper on his studio floor and draw, at full scale, the lines of the ornament – some of these drawings are seventy feet long. Bourgeois finished the drawings for the exterior ornament of the Temple, but died in 1930 prior to completion of the interior drawings.

Primarily from financial necessity – work was performed only after funds were received – the Temple trustees decided to treat the supporting structure of the Temple and the exterior ornament as separate problems. Their engineers decided on a concrete and steel skeleton on which the ornament could later be hung. These decisions solved a large number of structural problems, plus allotted time to determine the material for the exterior skin. The Temple had become an ideal example of the principle of separation of structure from ornament, similar to Earley's previous work on the Parthenon in Nashville and the campus of Louisiana State University.

> *"Over the next ten years, Bourgeois and Earley studied the temple, with all its ramifications of form"*

In June 1932, the Earley Studio was commissioned to create the architectural concrete for the Temple on a cost-plus basis. The trustees gave Earley wide discretion to interpret Bourgeois' plans. During this time, the Earley Studio moved to Rosslyn, Virginia, across the Potomac River from Washington, D.C. The modern new plant had direct access to the railroad, as well as crushing and screening machinery that could produce aggregates to his specifications.

Although work progressed rapidly, John Earley had to deal with several problems. For example, engineering plans for the final design of the exterior ornamentation or connection to the steel superstructure did not exist. Another problem was to ensure that the perforations were not too large, which would destroy the architectural continuity, or too small, which would cause them not to appear as perforations.

Building the Baha'i Temple

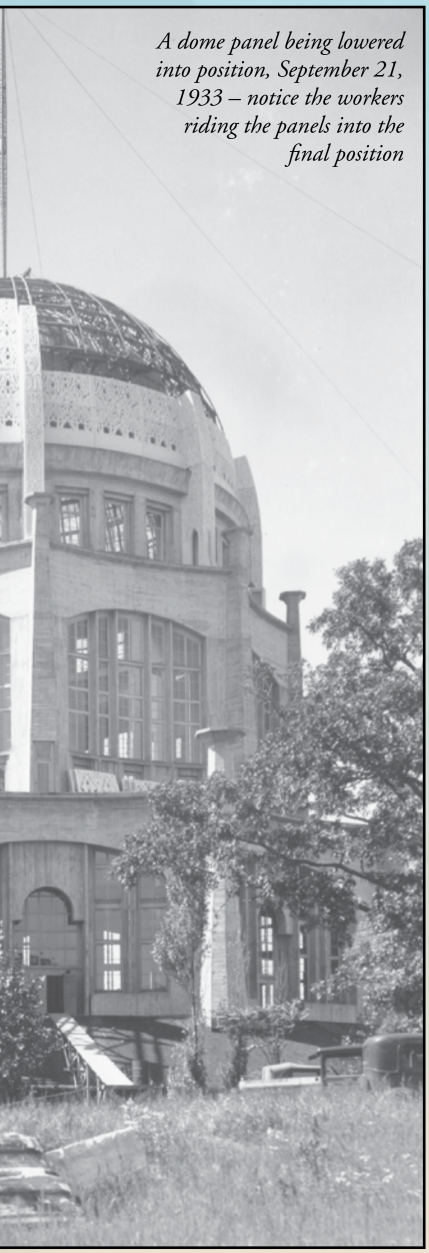
To get the effect of "the whitest thing possible", which Bourgeois often said, Earley tested several concrete mixes. He ultimately settled on white opaque quartz from South Carolina that reflected light from its broken faces, mixed with a small amount of clear translucent quartz from Monita, Virginia, to provide brilliance and life. The quartz was crushed and screened to exact size at the Earley Studio and then mixed with sand and cement to form an extremely white architectural concrete. Seven hundred forty-three tons of quartz was used in the exterior of the dome.

The panels were huge and thin, relatively thinner than an egg shell; shrinkage cracking was one of Earley's biggest fears. He recommended dividing the panels into 100-square-foot sections and leaving a half inch open around each piece to accommodate movement. Basil Taylor was responsible for translating the artistic to the practical. He built a full-sized wooden replica of a one-ninth section of the dome's steel framework, since the dome consisted of nine identical triangular arcs divided by nine identical ribs. Taylor needed only to make one set of forms and use them nine times. To form the basic spherical shape for the molds, the workmen hollowed out a saucer-shaped basin of the right contour in the floor of the casting shed. On this they laid out the edges of each panel. Leander Weipert, the studio sculptor, working from Bourgeois' full-scale sketches, then made a model of the panel in clay, from which the craftsmen made a plaster reproduction. Weipert and his assistant hand-carved this plaster model to sharpen up the detail and make the lines of the design as true as possible. After this operation, each cast appeared as a curved plaster slab four to five inches thick, with one quarter to one third of its total surface perforated.

The workmen assembled the plaster slabs, once completed, on the full-sized forty-degree model, where Earley and his staff could study the decoration for continuity, balance, and fit to the steel superstructure. After the plaster models were checked, the sculptors made the molds, some of the largest ever produced by the Earley Studio, for the final concrete castings. The molds were lined with metal foil and reinforcement, and then the casting began.

> *"The Temple had become an ideal example of the principle of separation of structure and ornament"*

The workmen filled the mold from the back or concave side, and then externally vibrated the form by tapping the edges with wooden clubs to make the concrete fill all of the crevices. Then they applied the "capillary system" consisting of burlap and rags to extract the surplus water. As the extra water was drawn out of the concrete, additional external vibration would be applied, allowing more trapped water to rise. This process would be repeated until no surface water would occur. The castings were left overnight to cure. The next morning, approximately 18 to 20 hours after filling the mold, the casting was stripped from the forms and leaned on edge in a vertical position against posts, where workmen using wire brushes and dilute acid would expose the white aggregate by brushing away the soft surface mortar. The production of the panels was an immense task; the wire brushing alone consumed thousands of man-hours. Once each panel was cast, it was cured for several days in a huge humidity chamber, air dried in the yard, and then carefully inserted into a protective wooden frame before it began the seven-hundred-mile trip west to Wilmette on a railroad flatcar.



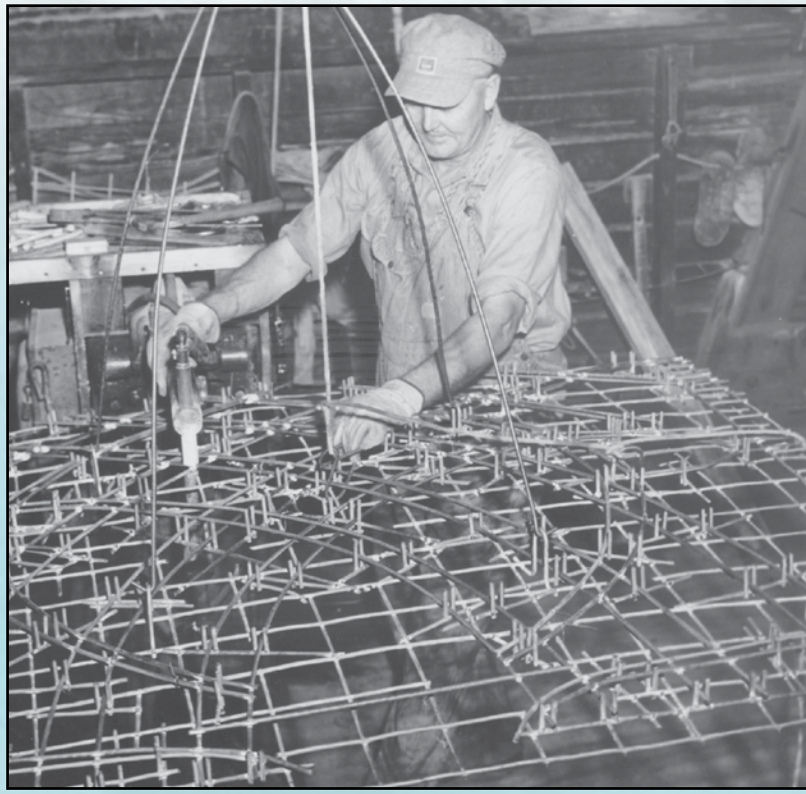
A dome panel being lowered into position, September 21, 1933 – notice the workers riding the panels into the final position

Upon arrival by railway a few miles from the Temple, the panels were transferred to trucks and transported to the construction site. There a crane, erected on top of the dome, lifted the panels into position. Workers bolted the panels to the steel framework by means of stainless steel to eliminate the possibility of rust. Erection continued through the summer and fall of 1933, and the exterior was completed in the spring of 1934.

Conclusion

From 1934 until November 1945, John Earley and the Earley Studio worked on several other notable architectural concrete structures, such as the Thomas Alva Edison Memorial Tower and the Polychrome House – the first precast concrete structure, constructed in Silver Spring, Maryland, in 1934. While on the Edison Memorial project, Earley suffered a massive stroke, and two weeks later, on November 25, 1945, he died. On his deathbed he sold the Earley Studio to Basil Taylor for one dollar.

Frederick Cron summed up the career of John Earley, stating that he was the last of the concrete pioneers. Others before him had discovered how to produce the "magic powder" – portland cement – how to mix it with stone and sand to make concrete, and how to use concrete as a structural material. But Earley was the first to control the exterior appearance of concrete in an important way and to impart brilliant permanent color to the surface. His contribution was unique; he was the man who made concrete beautiful.▪



Reinforcement was designed on the theory that if a section of the dome could be held rigidly around the edges, likelihood of a casting flattening out was low

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References:

Whitmore, Bruce W., "The Dawning Place," 1984, The National Spiritual Assembly of the Baha'i of the United States.

Cron, Frederick W., "The Man Who Made Concrete Beautiful: A Biography of John Joseph Earley," 1977, Fort Collins, Colorado Centennial Publications

Earley, John J., "Architectural Concrete of the Exposed Aggregate Type," Journal American Concrete Institute, March-April 1934, pages 251-278.

Earley, John J., "The Project of Ornamenting the Baha'i Temple Dome," Journal American Concrete Institute, *Proceedings*, June 1933, pages 401-411.