The Magic of Pomona Skyspace

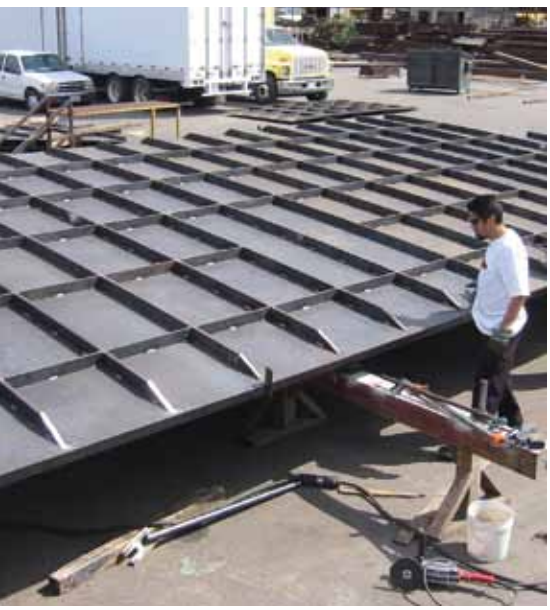
By Ramon Gilsanz, S.E. and Anders Carlson, S.E., Ph.D.

Gilsanz Murray Steficek was an Award Winner for the Pomona Skyspace project in the 2010 NCSEA Annual Excellence in Structural Engineering awards program (Category – Other Structures).

Spanning 38 feet, with a depth of 3.5 inches and an arch 18 inches deep, structural engineers helped to create a piece of art that is "elegant and spectacular". While not taking credit for James Turrell's amazing artistry, the *structural* mastery is evident by simply observing visitors who do not seem to notice they are sitting under 25 tons of steel.

Pomona Skyspace by James Turrell is the first Skyspace in Southern California regularly accessible to the public. For his alma mater, he created an open courtyard with a seemingly floating canopy that shades seating and provides the frame for viewing the sky. The Skyspace is located at Pomona College in Claremont, CA.

LEDs hidden in the steel frame bathe the underside of the canopy with programmed changes in color and intensity, as the sky transitions from twilight to night. The lighting changes the observer's perception of the sky viewed through a square opening in the center of the canopy. The sky appears to change hue as the canopy "frame" transitions colors and alters one's perception of it as object or void. A shallow pool with an infinity edge, centered beneath the opening, mirrors both daytime light and nighttime canopy lighting, and compliments the void above.



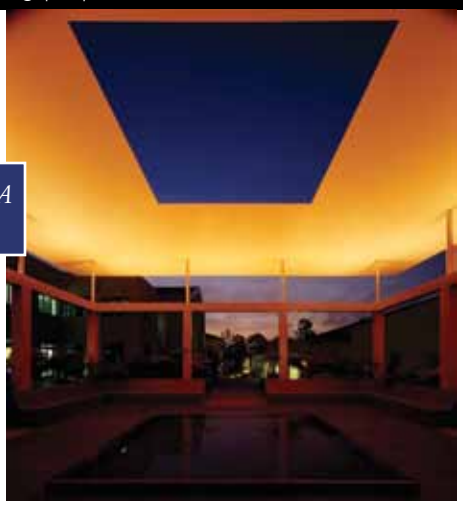
Segments of conopy during fabrication.

Gilsanz Murray Steficek structural engineers worked with Turrell's collaborating architects Marmol Radziner + Associates to develop a structure that appears to effortlessly support the thin steel canopy, while simultaneously hiding the lighting. Because of the unusually thin profile of the canopy, the design team worked closely with the contractor Hathaway Dinwiddie Construction and the steel fabricator Mitchell + Amazing to ensure constructability within the mostly enclosed courtyard.

The canopy consists of ¼-inch curved steel plates with curved stiffeners to create a thin arched shell similar to an airplane wing. The relative size of the plates and stiffening elements was optimized to minimize the total weight of the shell and therefore minimize the size of the supporting posts, governed by seismic loading. The weight of the canopy is similar to wood-framed residential roof construction even though it is steel.

The canopy is 49 feet wide at its outer edges and supported by 12 steel round hollow sections less than six inches in diameter that extend up from a square 38 foot wide steel frame below. A 14-foot-square opening in the middle of the canopy is the oculus through which the sky is observed. Four curved trapezoidal shells meet at the diagonals, forming gently kinked seams. The four pieces were determined to be the largest size that could easily be brought into the confined courtyard. The inner and outer edges are built of machined steel to create a razor edge, making the shell appear even thinner. The edges were also detailed to make a proper drip edge.

The six-foot tall round tube posts, or piloti, supporting the canopy are designed to resist axial, shear and bending forces at their rigid top and bottom connections. The canopy and its piloti are in turn supported by a steel frame consisting of wide flange columns and matching wide flange beams turned with the web horizontal. The beams are located approximately 12 feet above grade and create a ring beam moment frame that resists induced lateral sway to which the canopy will be subject under seismic, wind and thermal loading. The beams double as hidden shelves for the LEDs illuminating the canopy above. Steel



Exposed steel frame and canopy form the Pomona Skyspace. Courtesy of Florian Holzherr.

plates are welded to the underside of beams and to columns to hide electrical conduit and give them the appearance of square tubes with sharp corners.

The canopy and support frame were analyzed for live load, seismic and wind lateral loading, as well as thermal gradient loading between the top surface exposed to the sun and the shaded surface below. Buckling analysis of the shell was performed considering its extremely slender profile and thickness.

The connections were designed with input from Mitchell + Amazing to ensure a fabrication that would not warp under the heat and sequence of welding, and to minimize the work that needed to be done to the exposed underside of the canopy shell. Three layers of coatings provide for corrosion resistance and a flat smooth finish.

The goal in engineering the Skyspace was to make the structure unnoticed even though every visitor stares right at it. In a Los Angeles Times review, Skyspace was named "one of the best works of public art in recent memory." Pomona College Magazine's review lists quotes from visitors: "It's like magic."▪

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