

AGC ACE Award 2015

Category: Best Building Project – General Contractor (under \$10 million)

Denver Botanic Gardens Science Pyramid

GH Phipps Construction Companies

Denver Botanic Gardens opened the new Science Pyramid and immediately found an audience. The futuristic design that seems to spring from a lily pond in the middle of one of the State's top attractions stretches the typical visitor experience. As Gardens' CEO Brian Vogt said during the opening, "This is all about science. A lot of people think we're a display garden, but we're not. This is very much a place about the relationship between people and plants." The Science Pyramid is intended to address the role of biomimicry in our lives, that is, the way in which natural features in plants and animals inspire innovation and actions in people.

The construction itself was a stretch of technique and innovation – ACE-worthy in every respect. During concept discussions the pyramid had 4 faces, a classic pyramid. The project vision, however, blossomed. The 5,258-square-foot structure has 16 sides, connects over 1,000 pieces of structural members (each piece – yes, every one – unique, not a duplicate with another), steel with almost no 90° cuts, covered in honeycomb-shaped plates, electrified with custom photovoltaic panels, and surrounded by rare and sensitive plants. Oh yes, did we mention the Gardens had record attendance during the construction. The construction site was completely surrounded by the garden, guests and caretakers.

The Pyramid exterior is covered in a dark gray cement composite panel material called Swisspearl, often used as siding but here employed as an overall enclosure material for the first time. The structure is bisected by a swath of electro-chromic glass, and windows and skylights are located to focus on selected views. The interior is like that of a shiny, white, angled igloo, and is filled with interactive displays and information about the climate and ecosystem in Colorado. The pyramid offers an innovative scientific presence that reflects the Gardens' work in horticultural and environmental research and conservation that has an impact in Denver and around the world.

Excellence in project execution and management/team approach

The small job site location in the heart of a busy cultural facility presented a series of challenges. First: removing soil during excavation. Because of the pyramid's tight site, it was not possible to deploy dump trucks into the gardens; instead, soil was removed through the Gardens' service tunnel with skid steer loaders, then stockpiled in a parking lot to be hauled away. Second: delivery of concrete. GH Phipps had to pump the concrete from a location on Gaylord Street, a block west of the Gardens. This work had to be done early in the morning, before the Gardens opened, but not so early that it disturbed the surrounding residential neighborhood. Finally: access for fire and emergency vehicles. Construction could not jeopardize the circulation flow of the gardens, and plants and trees could not be disturbed, but a route was established providing access to the pyramid.

The building is the first of its kind; many systems had to be integrated, refinement of the design continued into the construction phase, and the project was being done without previous experience working with the Swisspearl as a total building enclosure. Teamwork was crucial. Every trade worked on the exterior enclosure. Each hexagonal panel had to be measured with modeling software to adjust to the building's sloped faces, and cut with a compound miter to achieve minimal tolerance in order to fit the panels together. The roof layers had to line up with the angular frame below (round primary tubes supported by square secondary tubes), so the panels would appear to fold perfectly over each seam of the pyramid's walls. During installation, four subcontractors – framer, roofer, glazer, Swisspearl installer – had to continually circle the pyramid making sure that each panel was properly installed at the correct angle for a correct fit.

Construction innovations/state-of-the-art advancement

Because of the complexity of the design, the angular nature of the structural frame, the sloped walls, and the intricate panel configuration, the design team developed a 3-D model, as did select subcontractors. The model not only reflected design refinements as they occurred, but also provided a virtual, three-dimensional road map for all team members – from structural steel to the exterior walls. Tablets were used in lieu of paper drawings as the best way team members could quickly coordinate with each other. This enhanced communication provided constant problem-solving to help make the project a success.

The innovative use of hat channels and Cascadian clips helped align the roof layers and provided a thermal layer. The way in which the roof layers were riveted to the structural elements had to conform to the panel configuration. Skylights were installed first, and then the Swisspearl panels were installed around the glass panels. Throughout the project, it was crucial to create a surface that was waterproof. The adaptive roof system protects the interior from rain, sun and snow. A layer of rain screen allows for the building to breath, releasing a flow of hot air that aids in cooling the building.

The use of Swisspearl as an all-over exterior material was a design move that challenged everyone working on the pyramid. It was the first time that anyone involved knew of a structure completely covered with the material, especially one that had no real roof or vertical walls.

Several panels contain electro-chromic glass, which can turn from opaque to clear via a light sensor or manual control switch. The control helps mitigate the sun heat gain and interior glare on the exhibits at certain times of day.

A final innovation involved the installation of photovoltaic panels into the exterior, so that the interactive installations inside could be powered by the sun. The panels are designed to match the Swisspearl panels, and are embedded flush with the surface. The panels were custom designed in Spain and match the hexagonal shape and color as well as providing a thin profile and hidden electric connection.

Environment/Safety

GH Phipps has developed a safety plan specifically for work at the Gardens, which has been a client since the mid-1960s. A hazard communications policy also applied to the Phipps team and subcontractors.

Because all of the walls were sloped, and many trades had to work on them at the same time, it was necessary to create a tie-off at the top point that could support several people (up to eight at any one time). GH Phipps designed the tie-off assembly, and Studio NYL engineered it. All personnel who worked on the exterior had to be tied off, because there was no way to install a handrail.

The Gardens are popular year round, but during the 2014 summer attendance was greater than any botanic garden in North America. The annual concert season was in full force in an amphitheater adjacent to the pyramid job site, and the Gardens hosted a special exhibit of glass works by artist Dale Chihuly. Also, the Gardens was host to the 2014 International Waterlily & Water Gardening Society's annual conference, which required adjustments to the job site. The pyramid is set into a pond, and the team had drained the pond and used the concrete pool for access and scaffold. The scaffold was removed, the pond was refilled, and the waterlilies replaced for the duration of the conference.

For the entire duration of the Pyramid project there were no lost time accidents or incidents with the public.

Excellence in client service and contribution to community

The Science Pyramid project was born in innovation. The Gardens' CEO wanted a unique exhibition space. The form would be pyramidal, and the mission would be to link people to plants and animals in terms of innovation and invention. The science of biomimicry was at the heart of the project: The hexagonal panels reference the structure of a honeycomb, the sun powers the exhibits, and the unnatural shape rising from the lily pond is surprising and yet inviting. The success of the project is not just in terms of the quality of construction, but also to the pyramid's impact on the community as a teaching tool and aesthetic accomplishment.











