Residential Gallery Exhibits Private Art Collection in Adaptive Environment

Architect's Parametric Design Embeds Building Performance Goals To Create Display Components That Deploy Based on the Environmental Cues

Project Summary

Organization:
Point B Design

Solution:
Building

Location:
Gladwyne, Pa., U.S.

Project Objective:

- House private art collection in an environment that responds to changes in the interior and the exterior environment
- Design a system of display components that deploy throughout the gallery's lifecycle
- Design a programmable lighting system that can shift over periods ranging from seconds to 16 days
- Generate an expanded set of design considerations to explore legitimate constellations of building solutions
- Analyze numerous changes in each design iteration

Products used:
GenerativeComponents

Fast Facts

- Point B Design employed multiple design strategies to accomplish primary objective
- The building and surroundings were analyzed for levels of permanence and adaptability
- An emergent display system interweaves new configurations and experiences that are responsive to the environment
- The display system is based on a kit of parts

Multiple Design Strategies Accomplish Goal

Imagine an art space so attuned to the environment that building components respond to the natural evolution of the landscape and lighting automatically adjusts to seasonal changes. A private collector achieved this synchronicity in D.gallery, a unique structure digitally fabricated in China and shipped to its location in the United States. It features art displays and gallery space that relate profoundly to the larger context of the residential building grounds.

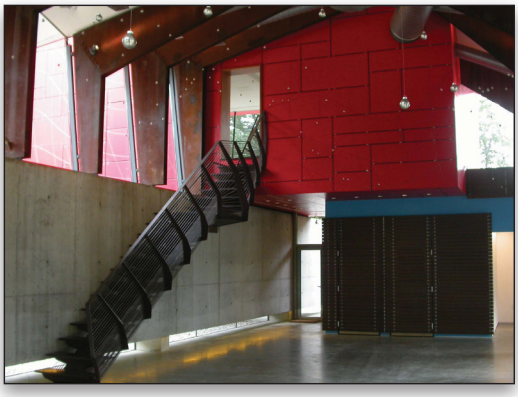
The building and surroundings were analyzed for relative levels of permanence and adaptability. For example, the easily changeable skin elements were a short duration relative to the life of the project, whereas the monolithic concrete elements had a longer-than-human life span.

Located in the Philadelphia suburb of Gladwyne, PA., D.gallery was designed by John Shields, AIA, principal of Point B Design, using GenerativeComponents. "The primary goal of this project was to house the owner's private art collection in a dynamically changing environment—an environment that responds to changes in, and creates temporal associations between, the interior content and the exterior environment," Shields said.

Point B Design employed multiple design strategies to accomplish this goal. The building and surroundings were analyzed for relative levels of permanence and adaptability. For example, the easily changeable skin elements were a short duration relative to the life of the project, whereas the monolithic concrete elements had a longer-than-human life span. With this analysis in mind, Point B designed a system of display components that deploy throughout the gallery's lifecycle in harmony with natural conditions that change over time. This "emergent display system" interweaves new configurations and experiences in a way that is responsive to the environment.

An Erector Set for Gallery Managers

The display system is based on a "kit of parts" that is somewhat like an erector set for gallery managers. The parts include anchors, cables, meshes, carabiners, cord, panels, and other components designed for deployment in multiple, unpredicted configurations. "The mesh and floor anchors provide structural support and opportunity for engagement by the client," Shields said. Point B also purchased a scissor lift to be stored at the gallery and facilitate installations.



Interior looking east.

The display components, by design, do not respond automatically to seasonal changes. Instead, they require deliberate intervention by the client or his designees. The lighting system, however, can be automated. "We designed the lighting with the potential for scene setting and augmentation, and for event scripting," Shields explained. Lighting can be programmed to shift over periods ranging from seconds to 16 days. The system is topology free (not tied to rooms or other spaces), with about 50 control nodes. All of these elements have been provided so that the gallery space can be programmed to respond to natural shifts in the color, texture, and density of outside landscaping.

GenerativeComponents enabled the project team to use an iterative design process.

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Point B retained design flexibility well into the project's construction documents phase. This allowed changes in response to challenges, such as figuring out cost-effective ways to build the complex façade elements. GenerativeComponents enabled the project team to use an iterative design process. After initial conditions were set, for example, façade elements were automatically reconfigured around requests for changes due to observations made late in the process—without losing sight of overall design goals.

Upper gallery bar and door.

"We wanted to generate a maximally expanded set of design considerations to explore legitimate constellations of building solutions, while maintaining highly integrated details," explained Shields. "We built a GenerativeComponents model to analyze iterations in context studies throughout the design process at many scales and to gauge effects on structural and mechanical systems, lighting, cost, and constructability."

Cost Considerations a Factor

Using GenerativeComponents, data was extracted from the model for pricing, while leaving many details fluid. As the design evolved parametrically with cost as a constraint, details were adjusted to conserve material and time, and job costing solutions at varying scales were fed back into the model and forward into construction drawings. The model also helped the designers work with conservative local contractors, whose concerns were often addressed with changes rather than the adoption of unfamiliar construction technology.

When the custom façade and multifaceted building shell threatened to be prohibitively expensive to fabricate locally, Point B looked to overseas manufacturers rather than compromise on the design concept. "Priced in local markets, this project would not have been able to be realized," Shields said.

The entire structural steel assembly and glass façade were digitally fabricated in China. The complexity involved in fabricating, detailing, and installing required a high degree of geometric precision and handling consistency. "We used a GenerativeComponents model as our control for geometry output and feedback to structural consultants and fabricators," explained Shields. "The sophistication of the model allowed us to evolve rigorous methods for data control and information transfer."

To achieve the exceptionally high level of precision required for U.S. residential construction without prohibitive cost, Point B exported geometric information from the model in both graphical and spreadsheet form. This helped educate the fabricator about the expected production values. Data was also used for take-offs, to understand framing, and to template complex framing in the field, thereby reducing costs.

Some work was made cost effective by keeping it in house. The specified steel mesh, for example, was a new and unique product. Designers wanted a beautiful mesh that would support the emergent system envisioned, but there were no meshes on the market that would support double-curved surfaces under the expected loads without an overly-seamed appearance. So instead of changing the design to accommodate existing technology, Point B wrote a GenerativeComponents script for a whole-cloth mesh based on constraints supplied by the model. "The geometric information from the script was used to drive our custom computer numerical controlled (CNC) machine," said Shields. "Both the CNC machine and the mesh were fabricated by Point B."

GenerativeComponents An Effective Tool

One credo of Point B is that for effective design evolution to take place in a reasonable amount of time, numerous changes have to be analyzed in each design iteration. GenerativeComponents proved to be an effective tool for implementing this philosophy. Working with the model, Shields was able to explore and capture information from dozens or hundreds of possibilities at each iteration of the design.

"This high solution count was legitimated at many scales and levels of detail because the model was properly built," he explained. "Our model was robust enough to take input and provide analysis in many forms. This is the only way this project could have been realized successfully and ethically."

For example, the kit-of-parts building logic was realized through digital fabrication as a direct result of output from GenerativeComponents models—models that underwent countless parametric iterations. The direct correlation between the study geometry and final geometry ensured that the required precision and tolerances were achieved. The same is true for every other building component.

Shields said, "Today the building elements are responding to the landscape as desired. The arrangement of elements, so rigorously studied through our iterative process, present the built structure to visitors in dramatically different ways as they move about the site."

The successful application of GenerativeComponents to residential design, fabrication, and construction will have lasting ramification for the team members. "The understanding that evolved through the development of this project has influenced many individuals and practices in our local region and beyond," Shields concluded. "There is an amazing amount of innovation in materials and technology, as well as advancement in making buildings more sustainable."

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