PATTERN AND PERFORMANCE: A CASE STUDY OF THE NYU GLOBAL CENTER FOR ACADEMIC AND SPIRITUAL LIFE

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INTRODUCTION

This case study looks at the design, fabrication and installation of a unitized curtain wall for a new academic building at New York University, the Global Center for Academic and Spiritual Life. After a general introduction to the building and its program, I will focus on how the design-assist project delivery method used on the project changed the manner in which the design and construction teams developed the façade. This method allowed for greater material and technological innovation than would likely have been possible with a traditional design-bid-build process.

The Global Center for Academic and Spiritual Life is a 91,000 GSF, multi-purpose building with five floors above grade and two basement levels. It contains university classrooms, meeting and events spaces including a high-profile colloquium room on the top floor. It also houses offices for many of the university's faith-based organizations. The building connects to the adjacent Kimmel Student Center on most floors for egress and programming purposes. The design and construction lasted about three and one-half years, and the building was completed during the spring of 2012 for a budget of approximately $91MM.

Project Team

The project was designed by Machado and Silvetti Associates in Boston. Jorge Silvetti was the Principal-in-Charge, and I was Project Director during the design phases of the project. However, as anyone who has worked on a complex project knows, the architect is one member of a much larger team that make such projects possible, starting with the client. In this case of the Global Center for Academic and Spiritual Life, NYU began the project with great ambitions for the building and equally great expectations of the project team. This dual expectation reflected the two "clients" to whom we reported at NYU, the offices of Strategic Assessment, Planning and Design, and Facilities and Construction Management. In terms of the façade, the design team included the curtain wall consultant Front, the structural engineer Robert Silman Associates, and MEP engineers Thomas Polise Consulting Engineer. NYU hired the general contractor Structuretone to provide pre-construction services beginning in schematic design, including estimating and scheduling. After the schematic design set was issued and approved, Structuretone, NYU and MSA interviewed and subsequently hired Permasteelisa as the curtain wall sub-contractor. All of these groups were essential in helping to realize this project.

Project Site

The Global Center for Academic and Spiritual Life sits on the south side of Washington Square Park, in the heart of NYU's Greenwich Village campus. It is on the corner of Washington Square South and Thompson Street, at a point of dramatic shift in building scale along the park. Directly to the east are the 12-story Kimmel Student Center (Kevin Roche John Dinkeloo Associates, 2003), and the 10-story Bobst Library (Philip Johnson, 1972). To the west, across Thompson Street, are the smaller-scaled Judson Memorial Church, designed by Stanford White of McKim, Mead and White in 1893, as well as the university's four-story Kevorkian Center and the NYU School of Law.

Although the 12,650 SF site is relatively small given the adjacent building footprints, it is on axis with the arch and fountain of Washington Square Park, and 5th Avenue to the north, giving it an outsized urban prominence. Such an axial view toward a building is very unusual in a gridded city like this part of Manhattan. This site gave great urban emphasis to the building's north elevation. It also provided a real opportunity from within the building to allow for dramatic views to the north.

DESIGN AND CONSTRUCTION PROCESS

Our earliest design investigations explored possible formal expression within the building's limited zoning envelope. However, we abandoned these complex shapes when we realized that a simple rectangular form created a clearer identity for the building next to the much larger and formally more exuberant Kimmel Student Center. Instead, we focused on the building's skin as the place to develop its architectural expression.

We were able to articulate three principal design interests for the skin, all of which are most clearly manifest on the building's north elevation. First we wanted to use material to help create an identity for the building. This was most directly inspired by the Judson Memorial Church, to the west of the site, a Roman Brick and terra cotta building, and also more generally by the history of innovative facades in Greenwich Village, starting with the cast-iron facades of the nineteenth century.

Figure 1. The Global Center for Academic and Spiritual Life. The Kimmel Student Center is in the background to the left. Photo ©Anton Grassl/Esto

Figure 2. The view from the fifth-floor meeting room, through the curtain wall and stone screen, looking north across Washington Square Park and up 5th Avenue. Photo ©Anton Grassl/Esto

Our second interest was in developing the façade as a screen. In part, this was inspired by the architectural role of screens in some religious architecture, and also in their ability to simultaneously mask and reveal what is behind them.

Finally, we developed an abstract figuration on the north façade, recalling the image of a tree, or the depiction of foliage. This related to several aspects of the project: the canopy of trees across the street in the Washington Square Park, the image of ivy-covered buildings found on many east coast university campuses and the iconography of the tree of life, a symbol important to many of the religious groups who would meet in the building.

Figure 3. The Global Center for Academic and Spiritual Life and the Roman brick and terra cotta Judson Memorial Church (Stanford White, 1893) in the background. Photo ©Anton Grassl/Esto

As we developed the schematic design package, we focused on determining the perforation pattern, the minimum openness the pattern needed to have in order to see through it from inside of the building, and the ideal panel size. In large part, the answers to these questions revolved around the material choice. In direct response to the Judson Memorial Church, we started working with terra cotta, while also investigating anodized aluminum, bronze and GFRC. To do this, we contacted suppliers, fabricators and installers to understand the opportunities and limitations of each material. We also asked them to fabricate samples for us. Particularly helpful were samples that we received from Shildan, Zahner and Permasteelisa.

In the office, we worked digitally and with full-size mock-ups. We digitally tested different screen patterns, both in isolation and on the building model. We then laser cut the more promising options from foam boards to determine how much of the panel we needed to remove to create the desired openness. These panels were also useful tools to explain the façade to the client and other project stakeholders.

We learned three important lessons from these investigations. First, that a panel about 16”x24” would work in many different materials, and with the basic module of the building. Second, that with 35% openness, we could get the transparency we wanted through the material. And third, we were able to achieve a smooth transition between panels when the pattern was able to bridge over its top and bottom edges. Unfortunately, the terra cotta was not able to do this without significantly increasing the thickness, and therefore weight and cost, of the panel.

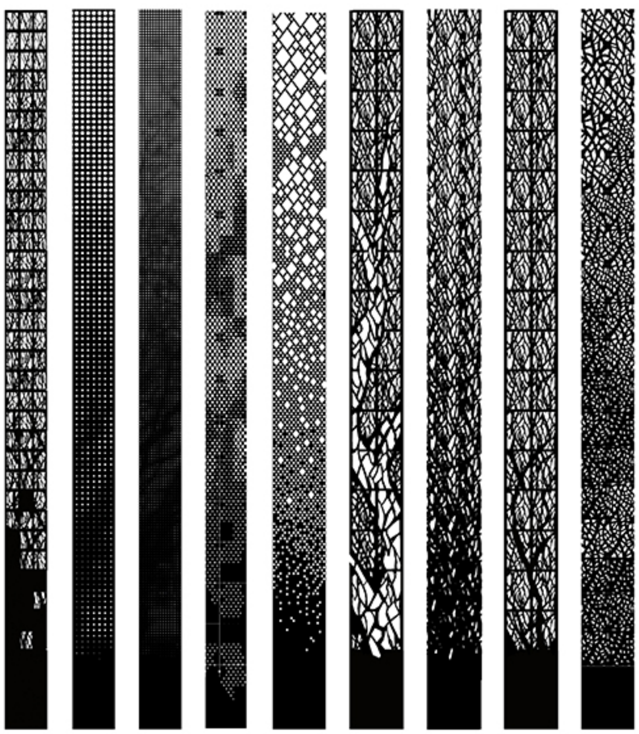

Figure 3. Pattern studies for the façade tiles. Each ranges from solid to about 35% openness. These studies also looked at the panel sizes and the effect of eliminating the “frames” around individual panels. Image courtesy of Machado and Silvetti Associates

The Design-Assist Process

After the schematic design package was issued, and its cost estimate approved, the client, contractor and we agreed that it would be prudent to hire the curtain wall sub-contractor to provide design-assist services starting at the design development phase. We prepared a schematic curtain wall bid package and interviewed several sub-contractors. Permasteelisa won this bid. In addition to their track record fabricating and installing high-end curtain walls, they brought to the table strong ties to the Italian stone industry and the idea of using stone for the outer leaf of the curtain wall.

Permasteelisa had an established process of cutting stone to 20mm thickness, laminating it to aluminum sheets and installing them as part of a standard curtain wall package. However, such a stone-to-aluminum laminate was not appropriate for our application since, in some instances, the rainscreen panels would be visible from behind when seen through glass from inside of the building. What Permasteelisa proposed was to laminate stone-to-stone using a fiberglass mesh interlayer, and then water-jet cutting the panel with the desired patterns. Working with Italian testing facility, Permasteelisa began experimenting with how to fabricate this composite material and testing its performance. We gave them a pattern sample at 35% openness and they proceeded to test this pattern with both finite element analysis and physical testing using a quartzite stone. We wanted to know how to develop the pattern in a way that minimized the chance of the stone breaking, and what would happen if it did break. Would it fall off of the building, or would the interlayer retain it?

The finite element analysis showed that the pattern was fairly stable, although we needed to avoid having acute angles close to one another. The physical testing also produced a very promising result. The first test sample did not break even when loaded to twice the required lateral load. In fact the only way the lab could get the panel to come apart was to repeatedly run it over with their forklift.

Reassured by these results, we continued to develop the façade, focusing on finalizing the pattern and determining how many unique tiles we would need to get the gradation from solid to open that we wanted to achieve. By flipping panels top to bottom, and side to side, we were able to edit the pattern to seven water jet cut panels plus a solid panel.

Since the back of the stone would be visible from inside the building, we also carefully considered the panel hanging system. Permasteelisa proposed an expansion anchor that would be inserted from the back of the panel to a depth that allowed it to engaged both stone laminates. Working with the buttons on these anchors, we developed an attachment system where the button was held off of the back-up wall by a bracket, much like an adjustable shelf bracket. A small amount of adjustment could be made to each panel before it was locked in place with a setscrew. By allowing a consistent ¾” gap between the stones, any individual stone panel could be removed and replaced.

At this point, we conducted a second round of testing to address two concerns, first that birds would roost between the inner and outer leaves of the rainscreen and second, that ice would form in the openings on the stone and possible fall off of the building when it melted. The design was adjusted slightly to address both of these concerns.
At the end of Design Development, we had completed much of the curtain wall design. The outer leaf of the curtain wall rainscreen was made entirely of the laminated and water-jet stone. The perforation pattern was overlaid with a series of openings that were smaller at the building’s base and grew larger toward the top—the typical pattern found in load-bearing stone walls. This outer stone leaf overlaid the inner leaf of the rainscreen, which went from smaller punched-

type windows at the base to a completely glazed curtain wall at the top floor. The openings in these two leaves loosely aligned so that sometimes you would look out from inside of the building to see the lace-like stone screen pass in front of the glazing.

Fabrication and Installation

Based on stone samples that we provided, Permasteelisa began to search for a quartzite stone that met the project's design, performance and economic goals. Our initial stone samples were chosen to work with the terra cotta and buff Roman brick of the Judson Memorial Church. Permasteelisa eventually identified a stone in northern India that met our needs, thus beginning the international process of procurement and fabrication for the curtain wall.

The stone was quarried in Northern India as blocks. These were then shipped to Carrara, Italy (a long-established center of stone quarries, craftsman and stone-working technology), where Permasteelisa had a facility. There the blocks were cut into 20mm slabs, laminated together with a fiberglass mesh, cured and water-jet cut based on the digital files we had provided. The finished panels were then crated and shipped to another Permasteelisa facility in Montreal, Canada, where they were assembled as part of a unitized curtain wall.

Unitizing a curtain wall moves the process of assembly from the job site to a factory, where labor rates are lower and working conditions are improved. Fabricating a unitized curtain wall off site also allowed the contractor to compress the construction schedule, since the curtain wall could be fabricated while the building's steel frame was being erected instead of waiting for the steel to be finished before starting on the curtain wall.

From Montreal, the panels were trucked to the contractor's yard in New Jersey, and from there they were brought onto the job site on an on-demand basis. This significantly reduced the need for lay down space on an already very small job site.

The tower crane picked the curtain pieces directly from the crates and lifted them into position on the building. The unitized sections basically snapped together at the job site. We were able to maintain the ¾" spacing that we had established between stone panels also between the unitized curtain wall sections so, once assembled, the construction joints disappeared.

CONCLUSION

The NYU Center for Academic and Spiritual Life can be seen as a reinterpretation of the traditional material of stone. We were not trying to suggest thickness and mimic solidity, but paradoxically to push the stone in the opposite direction, to an extreme of thinness and porosity. This transformation is most noticeable at dusk, when the reading of the façade hovers between opacity and transparency.

The design-assist process used to deliver this project shares the same goals as the more traditional design-bid-build process, which is to deliver the best project for the best price in the shortest time. However the design-assist process differs substantially in some important ways. First, it creates a contractual relationship between the owner and the sub-contractor to provide assistance to the design team. (This may also affect the architect's contract with the owner, although that is not always the case.) This contractual relationship breaks down the typical division of labor between the design and the construction teams.

Second, and as a direct result of this contractual relationships, channels of communication are opened between designers and subcontractors, allowing knowledge to flow between these two typically separate groups earlier in the design process so that their combined knowledge can be incorporated into the construction documents. Ultimately, this should lead to fewer unexpected and unwelcome surprises during construction that typically result in change orders and construction delays. The process can make a risk-averse client more comfortable with the construction process.

Figure 5. The offsite fabrication process for the unitized curtain wall system (from left to right): quartzite stone being quarried in northern India; water-jet cutting process in Carrara, Italy; finished laminated stone tiles crated and ready for shipment; assembling the unitized curtain wall sections in Montreal, Canada; craning the sections into place on the building façade in New York. Image courtesy of Machado and Silvetti Associates

Finally, and most importantly with regard to this case study, the design-assist project delivery method affects the design process itself. By having such a breadth of expertise available and invested in the project during the design process, we were able to explore material solutions, and their technical opportunities and challenges, very early in the project. The process of developing, testing, detailing and fabricating the water-jet cut laminated stone panels would not have been possible without such collaboration. Ultimately, such a process offers great opportunity for material exploration and innovation that consequently allow for the architect to play a larger role on the project team.