Droplet Pavilion

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The pavilion explores the development of a novel hybrid façade system combining the fluid and ornate qualities of Ultra High Performance Concrete (UHPC) with the ephemeral and performative qualities of an Aluminum Composite (ACM) rainscreen system.

Situated in one of the city's oldest ravine networks, the project seeks to develop a distinct narrative thread in celebration of the area's local heritage, highlighting the important connections with this site's history and its natural environment. Within this region, 4 large ravines converge as three tributaries merge into the main river resulting in a series of river streams and undulating topographic conditions. The resulting rivers and creeks had a significant impact on the area's history, representing an important source of energy for early European settlers and shaping the physical and social fabrics of the region.

The development of the pavilion within the urban park, consisting of a reflecting pool in the summer and community ice rink in the winter, speaks to this thematic direction. As water is an integral element to the ravine systems, which serves to shape the landscape and the area's history, it is equally significant within the context of the community park, speaking directly to the importance of engagement, encouraging involvement and activity on the part of residents and visitors alike.

Accordingly, the translation of this idea towards the development of the pavilion's façade begins with a simple pixelated representation of animated water to commemorate its significance to the site, both past and present. The imagery is reinterpreted and extrapolated to generate a unique set of 3-dimensional sculptural shapes that give formal expression to the pavilion. The result is a series of self-similar modules that fit together and form intricate, three-dimensional UHPC façade

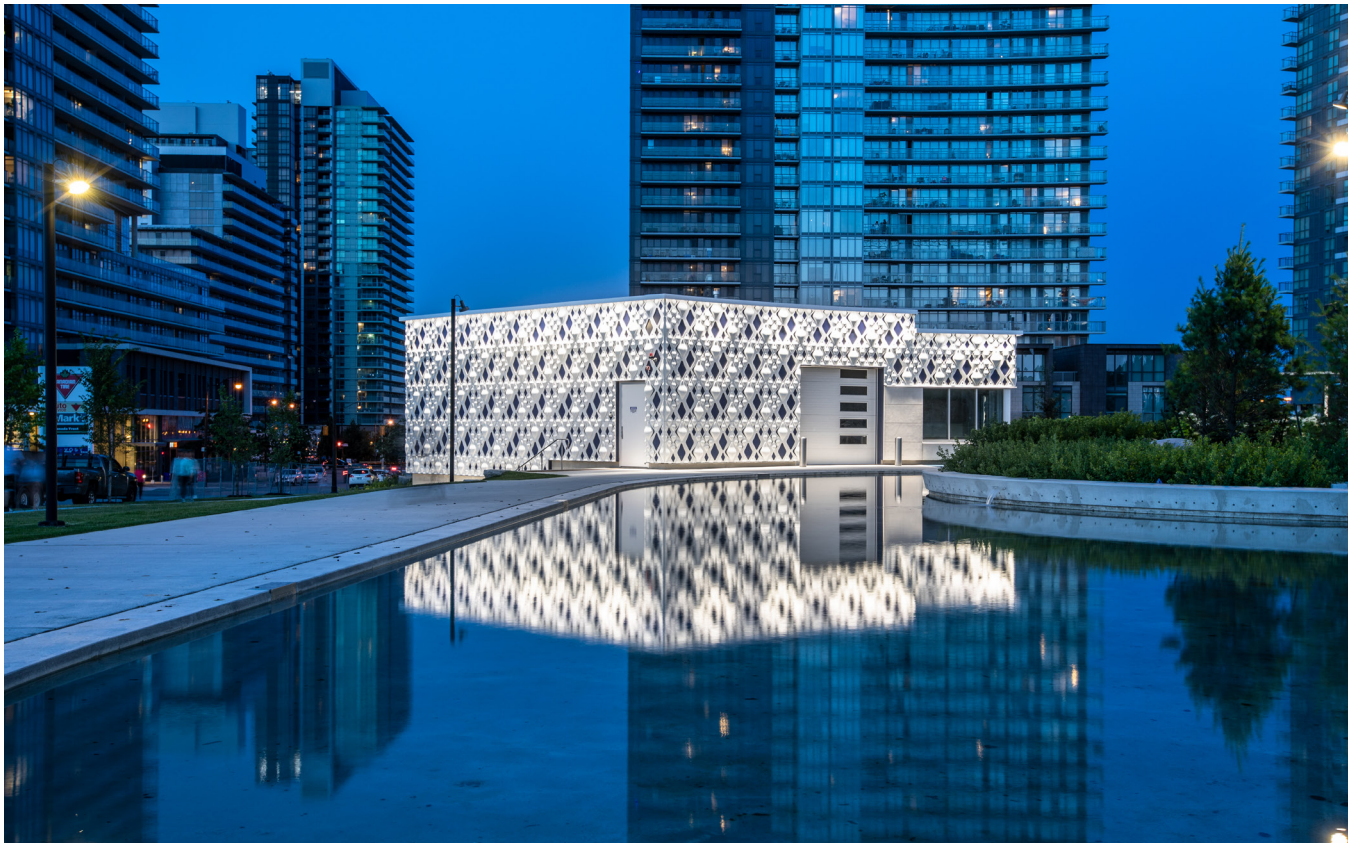

Figure 1. North-East Corner View. Image courtesy of Concord Adex Inc.

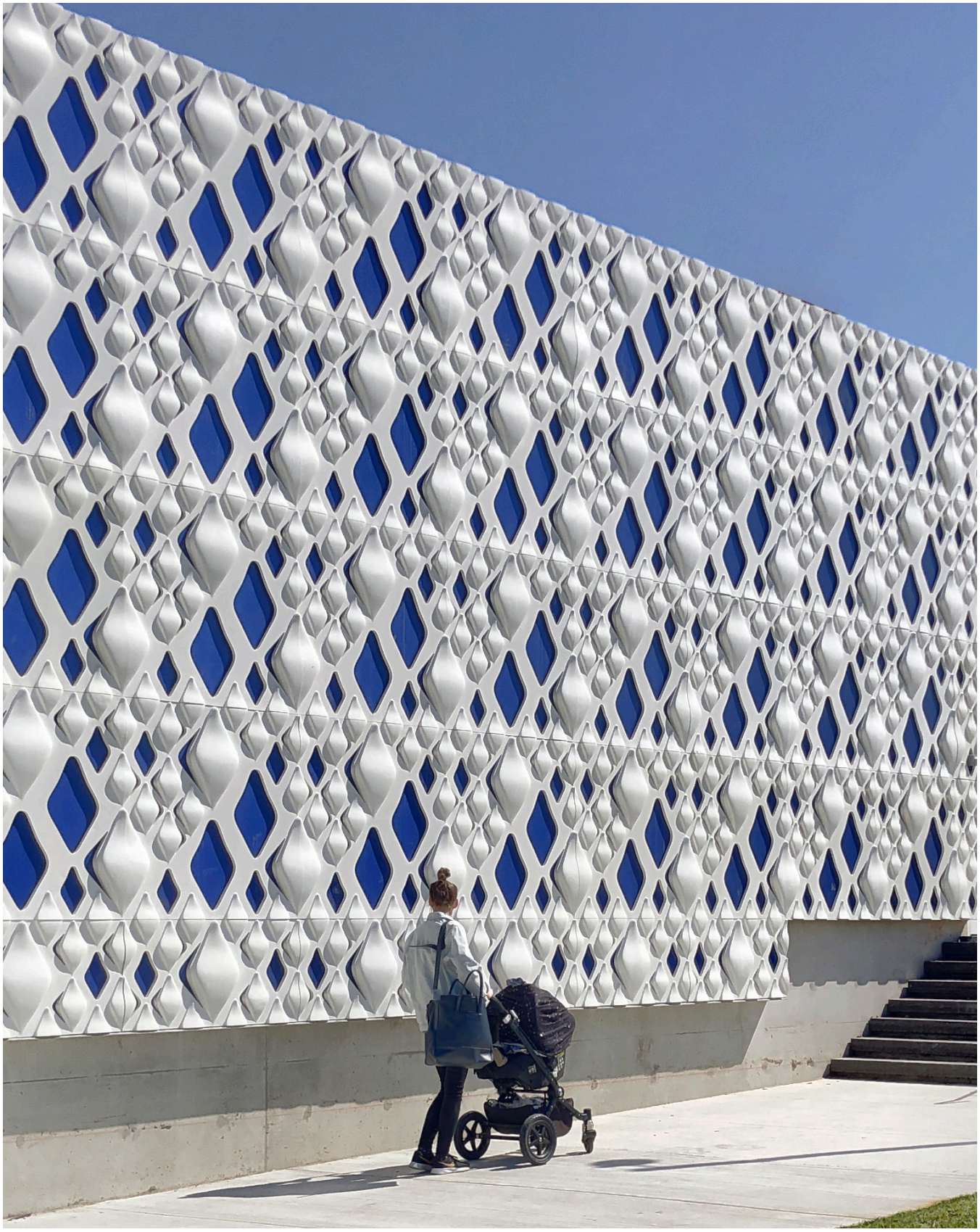

Figure 2.ACM-UHPC Façade system - North Elevation. Image by author.

Figure 3. South-West Corner View. Image courtesy of Concord Adex Inc.

panels. The combinatorial pieces are formally similar yet characteristically different; operating at different scales, the pieces come together to form a varied yet uniform waterscape across the pavilion. A series of openings are introduced into the UHPC modules giving way to a blue anodized aluminum material. As the viewer moves past and around the pavilion, different wavelengths of light are reflected back to the audience. The result is an ever-changing colour gradient with iridescent highlights that create the illusion of light fluttering across water.

The pavilion demonstrates a novel ACM-UHPC composite rainscreen system that employs a double-wall construction to protect it from the elements through its outer layer and simultaneously providing thermal insulation and preventing air leakage through the inner cavity. The motivation for a composite system resulted from the challenges associated with traditional concrete applications in the development of ventilated façades, notably in resolving the edge conditions to ensure a properly sealed system. This is further complicated by the nature of the panel geometry and the formal configuration of the pavilion which contained both concave and convex curved wall conditions. In a typical rainscreen system, the UHPC panels would act as the first line of defense against water and all other environmental elements. The success of such a system is based on the water tightness of the panel joint thus requiring the application of a sealant (Henriksen, 2017). Due to the need to accommodate relative movement between UHPC panels, mortar was not an effective option, and gaskets or compressible foam were not ideal due to their aesthetic appearance and the challenges associated with their implementation on curved geometries and angled edges. As a result, a novel ACM-UHPC composite façade system was developed to meet both the performative and conceptual requirements of the project. The use of ACM as a functional rainscreen system allows for all performance requirements to be met, which lends more flexibility to the UHPC elements. The formal potential of the UHPC panels work together with the ACM system to add an additional layer of weather protection adding much needed depth and fluidity to the organic design that ACM panels alone could not achieve. While the formal qualities of the UHPC speak to the design ambitions, the anodized ACM evokes the ephemeral qualities of moving water as seen through the openings in the UHPC panels.

Within the composite system, the concrete panels are designed to work with the standard grid of the faceted ACM system, while offering a more monolithic appearance. The continuous water droplet pattern assists in concealing the ACM panels' seams through an edge to edge condition requiring no gasket or sealant. Furthermore, the structural support system is

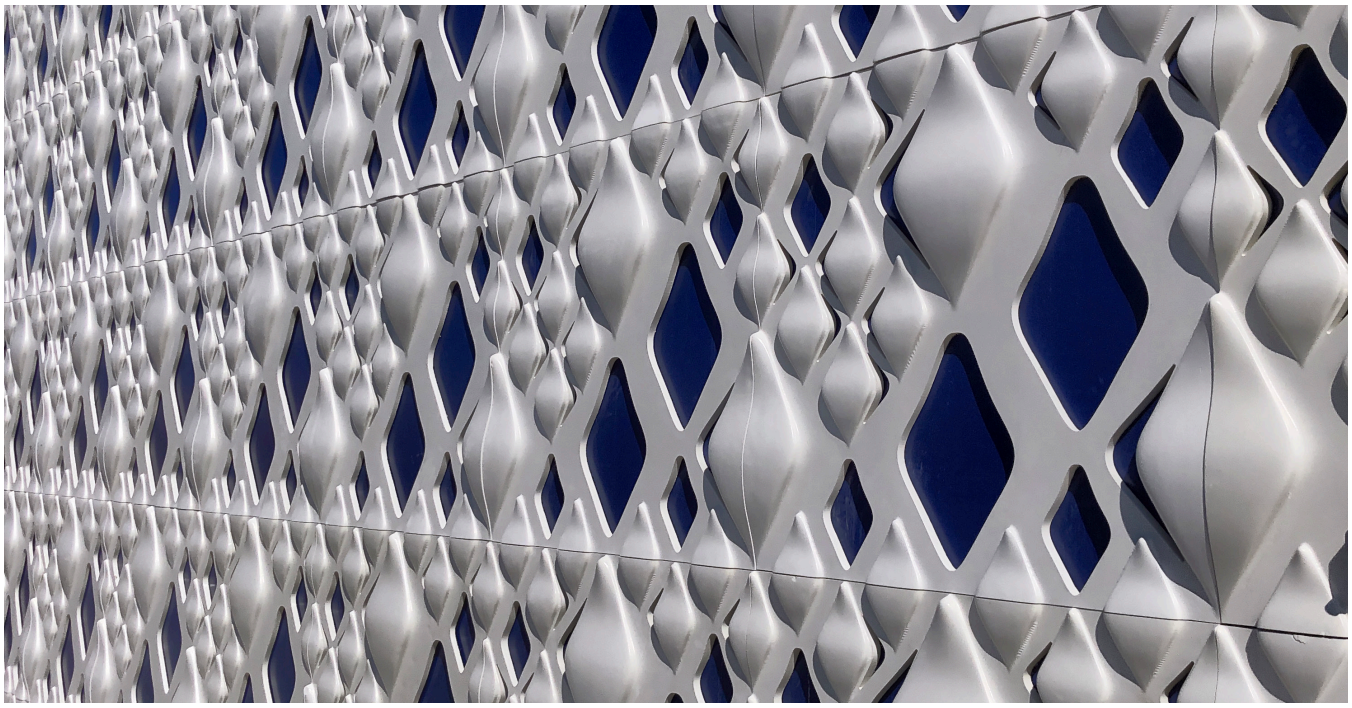

Figure 4. Close-Up of ACM-UHPC Façade system. Image courtesy of Concord Adex Inc.

Figure 5. Droplet Pavilion - Curved Wall. Image courtesy of Concord Adex Inc.

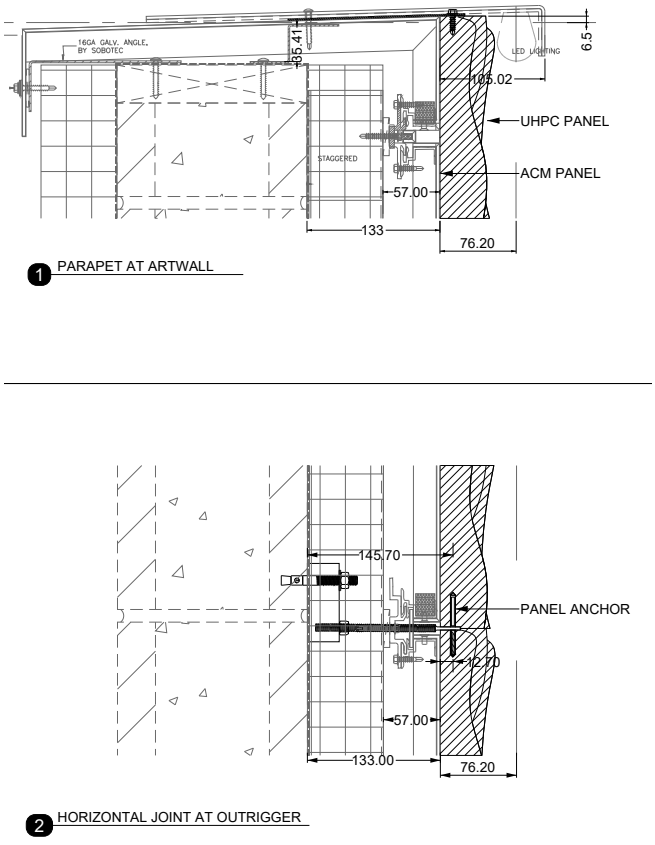

Figure 6. Connection Detail. Image by author.

Figure 7. Panel Mock-Up | Connection Anchor. Image by author.

engineered to allow for the entire UHPC façade elevation to move as one, eliminating the need for tolerance between panels and ultimately dissolving the joint lines. The fastening and support system at the back of the UHPC panels ties back into the pavilion's exterior walls through the breaks between ACM panels, designed and coordinated to maintain the performative qualities of the rainscreen façade. The result is a hybrid façade system that acts as a traditional rainscreen grid system with standardized panel sizes however utilizes fluid geometry of the UHPC material to allow for an organic, non-uniform appearance. Speculating on future applications, this hybrid system could extend not only to ACM rainscreen facades but to curtain wall grids, where the UHPC could become a layered screen over glazing, tying back through the mullions and providing shading, screened views, and visual depth to the building.

The Droplet Pavilion, through the development of its hybrid façade system, explores composite materials, computational tools and digital fabrication within a performative and conceptual framework. The design underpins the importance of the area's distinctive ravine system and the community activities in and around the pavilion. By combining UHPC with ACM, the two systems work together to achieve the performative requirements of a rainscreen system while simultaneously being visually and aesthetically connected to achieve a deeper realization of the conceptual ambitions. The result is a project that explores the potential of rich material effects as a means to address performative criteria in the production of enhanced architectural spaces.

ENDNOTES

1. Henriksen, Thomas. "Advancing the manufacture of complex geometry GFRC for today's building envelopes." A+ BE| Architecture and the Built Environment 5 (2017): 1-194.

2. Anderson, John Maxwell, and J. R. Gill. Rainscreen cladding: a guide to design principles and practice. Butterworth-Heinemann, 1988.

Figure 8.South-West Corner View. Image courtesy of Concord Adex Inc.

Figure 9. Droplet Pavilion. Image courtesy of Concord Adex Inc.