ADVERTISEMENT

THE GRACEFUL DEFIANCE OF THE HEYDAR ALIYEV CULTURAL CENTER

This Zaha Hadid masterwork delights the eye thanks in part to glass fiber reinforced concrete cladding.

BUILD WITH STRENGTH
A COALITION OF THE NATIONAL READY MIXED CONCRETE ASSOCIATION

Photo Credit: Hufton + Crow Photographers

Photo Credit: Hufton + Crow Photographers

For the 10 million citizens of Azerbaijan, the architectural symbolism couldn't be more poignant or liberating.

There, gleaming in defiant contrast to the dull architectural dreariness of capital city Baku's Soviet-era buildings, rises the swooping, twisting, and parametric joy of the Heydar Aliyev Cultural Center. The building's fluidity and playful form openly mocks its rigid, monolithic neighbors, a 619,000-square-foot reminder of the country's break from the Soviet Union in 1991.

Few structures display as much architectural daring and heart as the eight-story Aliyev Center. London-based Zaha Hadid Architects (ZHA) is the design team.

CONSTRUCTION CHALLENGE

"The client really wanted something different and ambitious. All credit to them for thinking so boldly," says Sara Sheikh Akbari, senior ZHA associate and a key member of the design team throughout the five-year project.

The design, engineering, and construction team rallied around the $250 million neo-futuristic design. The motivation and determination to realize the ZHA vision was high in spite of one big question: How do we build it?

The interior and exterior construction challenges were daunting. To maintain fluidity and spatial continuity, the use of columns was ruled out. The building is a mixed-use venue, hosting an assortment of functions within the curvilinear form: a conference hall that contains three auditoriums, a library, and a museum. The absence of columns freed the designers to create a fascinating interior vocabulary that greets visitors with an immersive passage of crosswalks and other unexpected forms.

SPACE FRAME SUPPORT

It was decided a space frame structure composed of a vast steel tube-and-node system would form the endoskeleton (just under 25 miles of steel tubing). The space frame supports the grand architectural feature: the cladding system.

"We had to ensure the space frame could support the freeform roof structure and how it responds to different environmental requirements, like wind loads and seismic events," Akbari says. To make double certain of their space frame ideas, computational analysis was rendered on two separate 3D finite element programs.

CLADDING PANELS

Another concern was the cladding panels. The panels shouldered many requirements—environmental, structural, maintenance, color, and texture, for starters. What should they be made of? What composition offered the least risk with the most aesthetic reward?

"Everyone was involved in that process very, very deeply from early on," recalls Akbari. "There are so many considerations in our investigations. Could we even manufacture whatever we selected at scale, for example? How would we transition the panels that seamlessly link the plaza with the structure? What are the joint requirements? UV radiation? Temperature extremes? What about cleaning? The city of Baku has large oil refineries nearby. How would the panels stand up to oil and dirt after years of exposure? The panels had to check a lot of boxes."

GFRC SELECTED

Numerous options were thoroughly tested and considered. The team settled on two panel compositions: glass fiber reinforced polymer and a material ZHA increasingly specifies for their award-winning work, glass fiber reinforced concrete (GFRC).

What is GFRC? As the name indicates, fine glass fibers are blended together with portland cement and water to create a surprisingly lightweight and exceedingly durable material (ancient Roman engineers used horsehair as their "glass" fiber). GFRC has been actively used for about 30 years and is utilized in many applications beyond cladding panels, including domes, statues, planters, and fountains. More prosaic applications include fireplace surrounds, kitchen countertops, and artificial stonework.

GFRC UP CLOSE

What drew the ZHA team to GFRC are its characteristics:

- Light. Casting is available in thin sections up to 75% lighter than similar casting using traditional concrete.
- Strong. GFRC can achieve a flexural strength as high as 4,000 pounds per square inch.
- Self-reinforced. There is no need for reinforcing agents, making it well-suited for complex shapes.
- Tough. GFRC won't crack easily and can be cut without chipping.
- Smooth. GFRC can be sprayed on, eliminating bugholes and voids.
- Adaptable. GFRC can adapt to nearly any geometry.
- Durable. GFRC will outlast precast concrete, cast stone, and even some natural stone, thanks to low alkaline cement and pozzolans.
- Sustainable. GFRC qualifies as a sustainable material because it uses far less cement than other concrete and frequently uses significant quantities of recycled materials, such as pozzolan.
- Economical. At a thickness of about ¾ of an inch, GFRC is typically less than $2 per square foot.

The extreme geometries of the Aliyev Center also required another attribute: mass off-site fabrication with fail-safe precision. All told, the Center's skin comprises 16,150 panels. No two are alike. Some are single curve, others double curve. Each one is roughly 1.5 meters wide by 7 meters long. To help keep track of thousands of meticulously fabricated panels, each one was embedded with a microchip for fast electronic recognition.

IT JUST MADE SENSE

There's little dispute today that the Heydar Aliyev Cultural Center achieved "different and ambitious" at a scale few could have imagined. A great many things had to come together to make it possible. One of them, Akbari says, was the unifying force of concrete. "Concrete was part of the planning process so long, it's hard to imagine anything else in its place. It just made sense."

That sense is now about to be on worldwide display once again. Sometime early next year, it's expected that the Bee'ah Headquarters—another ZHA design that delights the eye and breaks new ground in environmental responsibility—will open in Sharjah, UAE.

"We've been using GFRC quite a bit since [the Aliyev Center]. We explore a different aspect of the material in every job. For the Bee'ah project we're focusing on it in a different way. I guess you could say we love concrete," she says.

As for the Aliyev Center, Akbari vividly recalls her last visit to the finished structure. "There were a lot of tourists walking the plaza with selfie sticks," she smiles.

To learn more, visit BuildwithStrength.com.

Location: Baku, Azerbaijan
Owner: The Republic of Azerbaijan
Architect: Zaha Hadid Architects
Main Contractor: DIA
Structural: AKT, Tuncel Engineers
Space Frame: Mero
Façade: Werner Sobek
Mechanical: GMD Engineers

Photo Credit: Luke Hayes

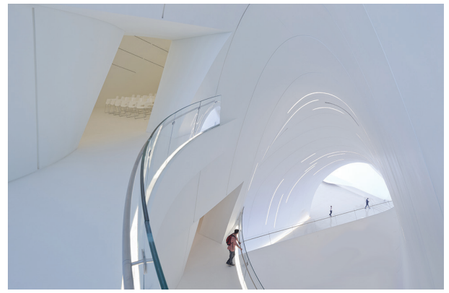

Photo Credit: Iwan Baan

Photo Credit: Photography by Hélène Binet

Produced by Hanley Wood Strategic Marketing Services Group
hanleywood.com