

Drawn in Code, Cast in Concrete: The MCIC Monumental Stair

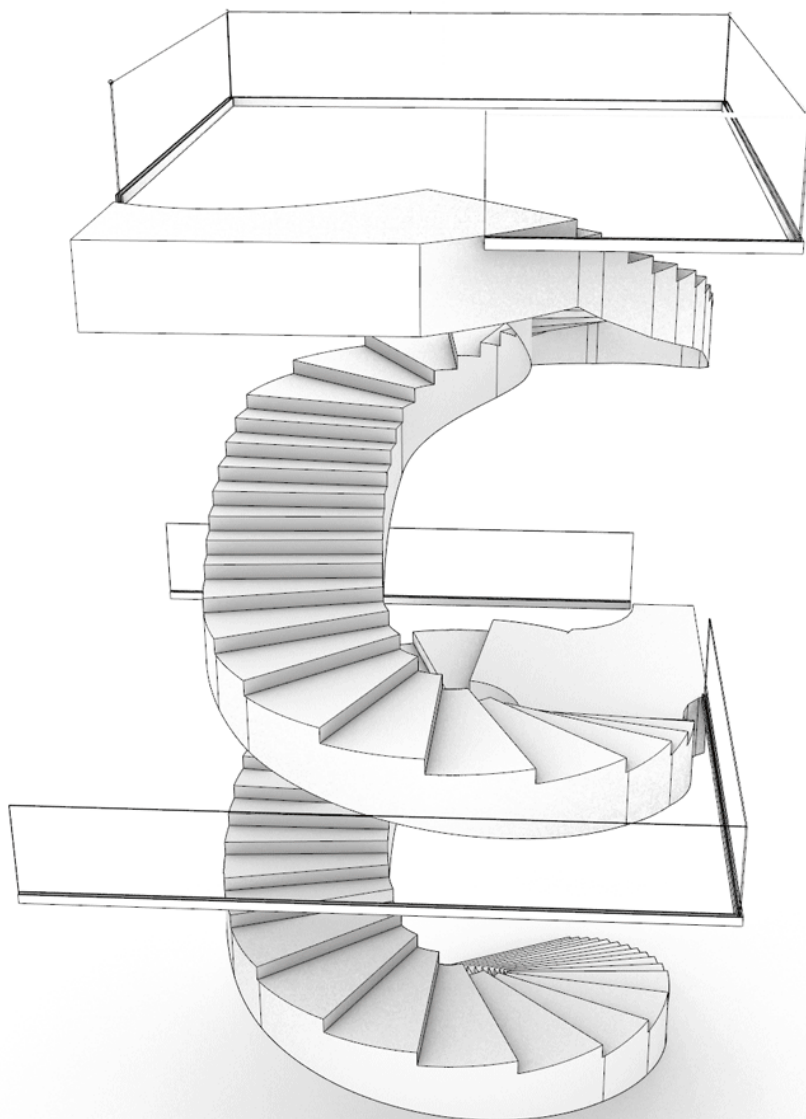
The [Madera Cyber Innovation Center \(MCIC\)](#) at the U.S. Air Force Academy stands as both a bold architectural statement and a functional facility for cutting-edge education. Nestled within a campus recognized for its mid-century modernist heritage, the MCIC brings together military, academic, and industry expertise to train future leaders in fields like cybersecurity, robotics, and artificial intelligence.



Rationalized tangent-arc curvature enabled the bent glass panels to follow the complex geometry with fabrication accuracy. © Mark Herboth Photography

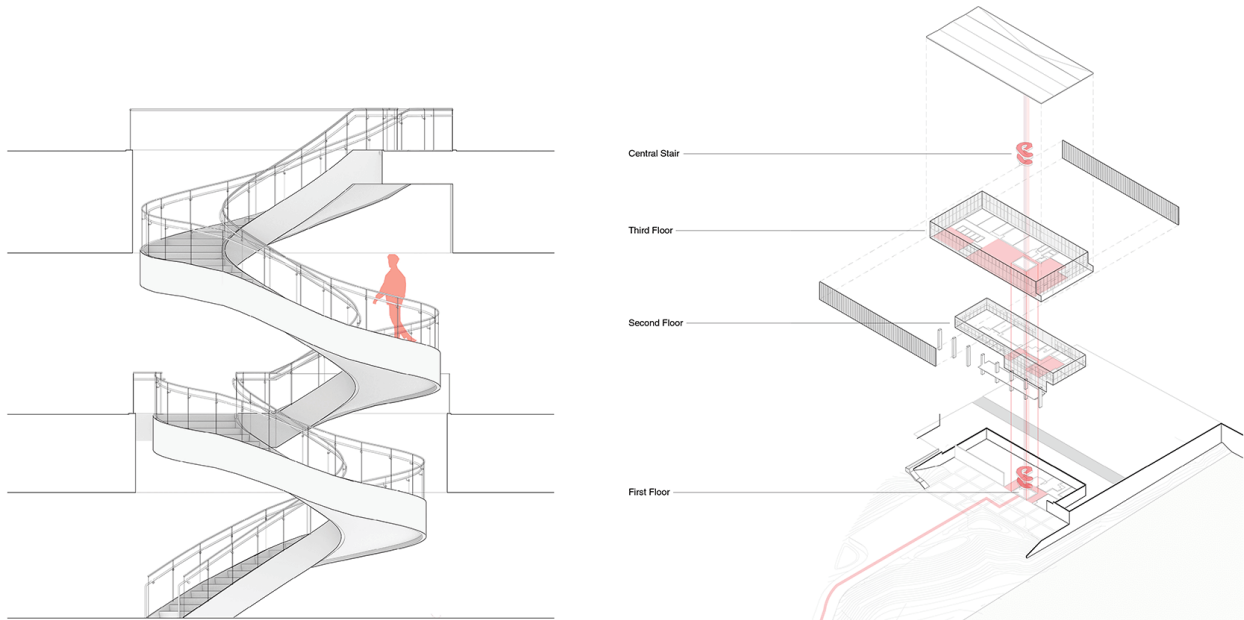
Central to the building's design is a striking sculptural staircase, a feature that bridges tradition with technological ambition. Inspired

by the historic spiral stair of the McDermott Library, the MCIC's monumental stair reinterprets this classic form as a flowing, self-supporting concrete structure wrapped with a curved glass guardrail.



*Coordinating trades through a shared digital model, aligning concrete, steel, and glazing within a single parametric framework. **Courtesy Clark Nexsen***

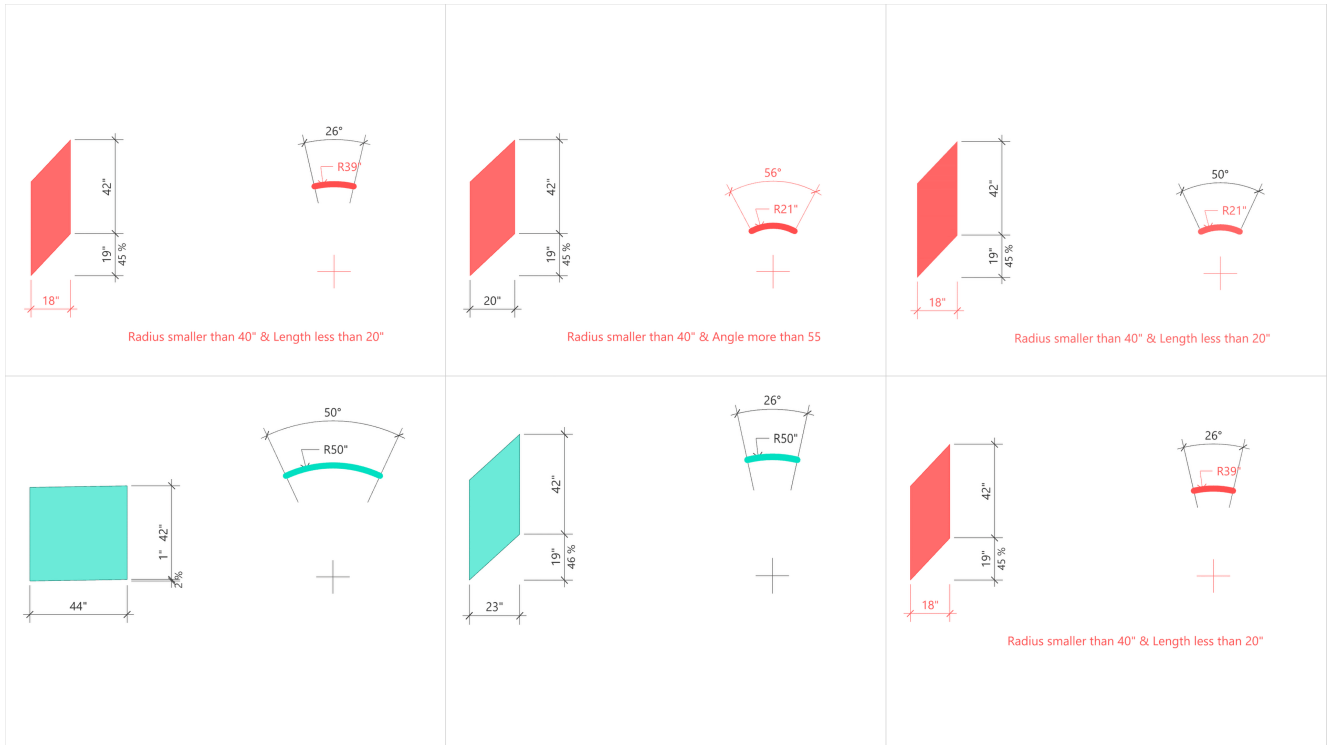
Unlike conventional spiral stairs, this design had to fit within a rectangular structural opening, presenting a formidable geometric challenge. The outcome is a free-form stair that balances material heft with a sense of movement, enhancing circulation while acting as a symbolic core of the building.



Positioned as the building's vertical spine, the stair physically and visually connects collaborative zones across all three levels. Courtesy Clark Nexsen

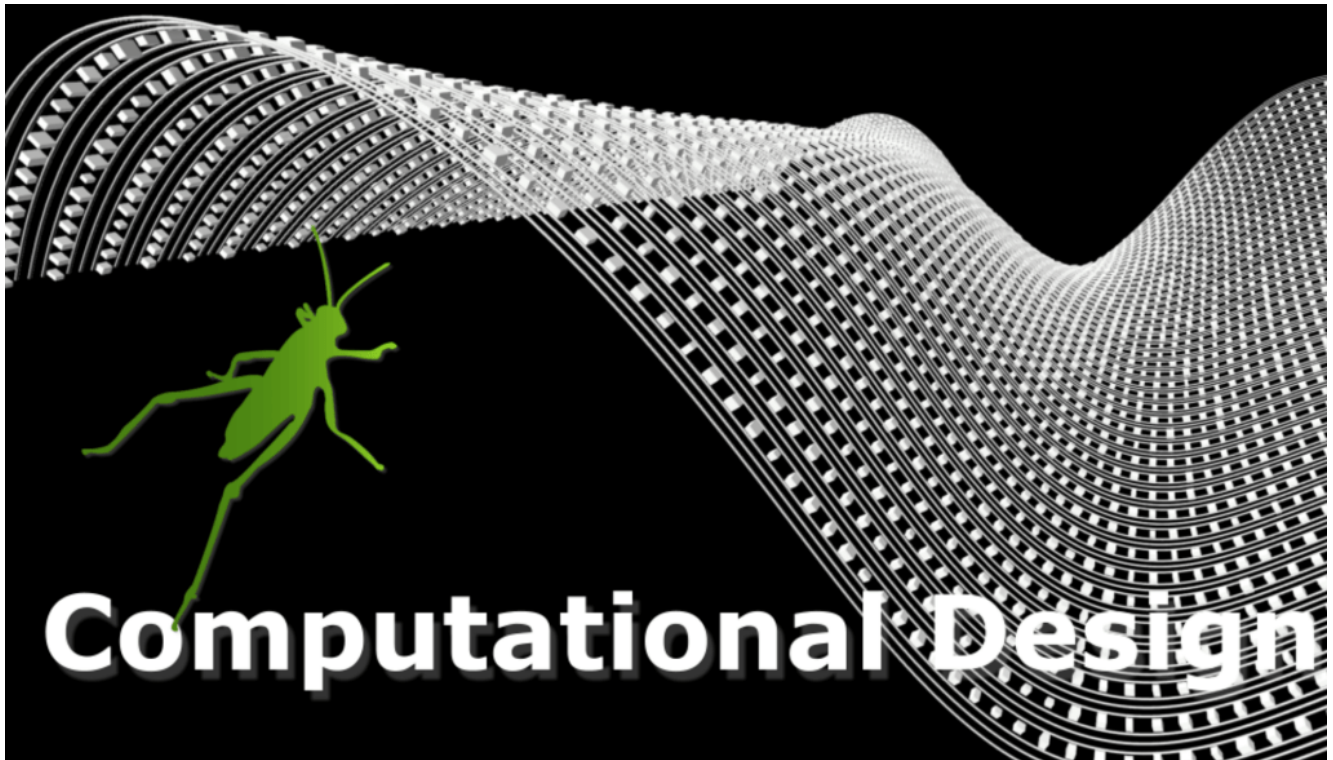
FROM DESIGN AMBITION TO BUILDABLE FORM

While the stair was envisioned early in the project, its confirmation came late, after substantial donor funding allowed the team to pursue ambitious design enhancements. This left little flexibility within the established structural framework. A typical circular geometry would not suffice. The team needed a strategy to create a complex, flowing stair within a rigid footprint, one that met code, respected fabrication limits, and delivered on aesthetic expectations.



Manufacturer glass bending limits encoded directly into the Grasshopper script, automatically identifying panels that exceeded fabrication constraints. Courtesy Clark Nexsen

[Clark Nexsen's Creative Practice Technology \(CNCPT\)](#) group took the lead, relying on [Rhino](#) and [Grasshopper](#) to encode design intent into a parametric model. This computational approach allowed the team to define the stairs' freeform shape while accounting for critical constraints, such as the bending limits of the glass panels and structural requirements for the self-supporting concrete. The stair's geometry was rationalized into a sequence of tangent arcs, ensuring manufacturability without sacrificing the flowing visual effect.



[See Also](#)

[COMPUTATIONAL DESIGN WITH GRASSHOPPER](#)

Beyond form generation, Grasshopper scripts managed an iterative process of design validation, checking compliance for tread dimensions, structural thickness, and glass curvature. As design adjustments arose, particularly when the final glass subcontractor introduced stricter bending requirements, the team could quickly update parameters within the script. These updates, which might have delayed construction by weeks in a traditional workflow, were resolved within hours.



CNC-milled plywood formwork precisely captures the double-curved geometry defined in the computational model. **Courtesy Clark Nexsen**

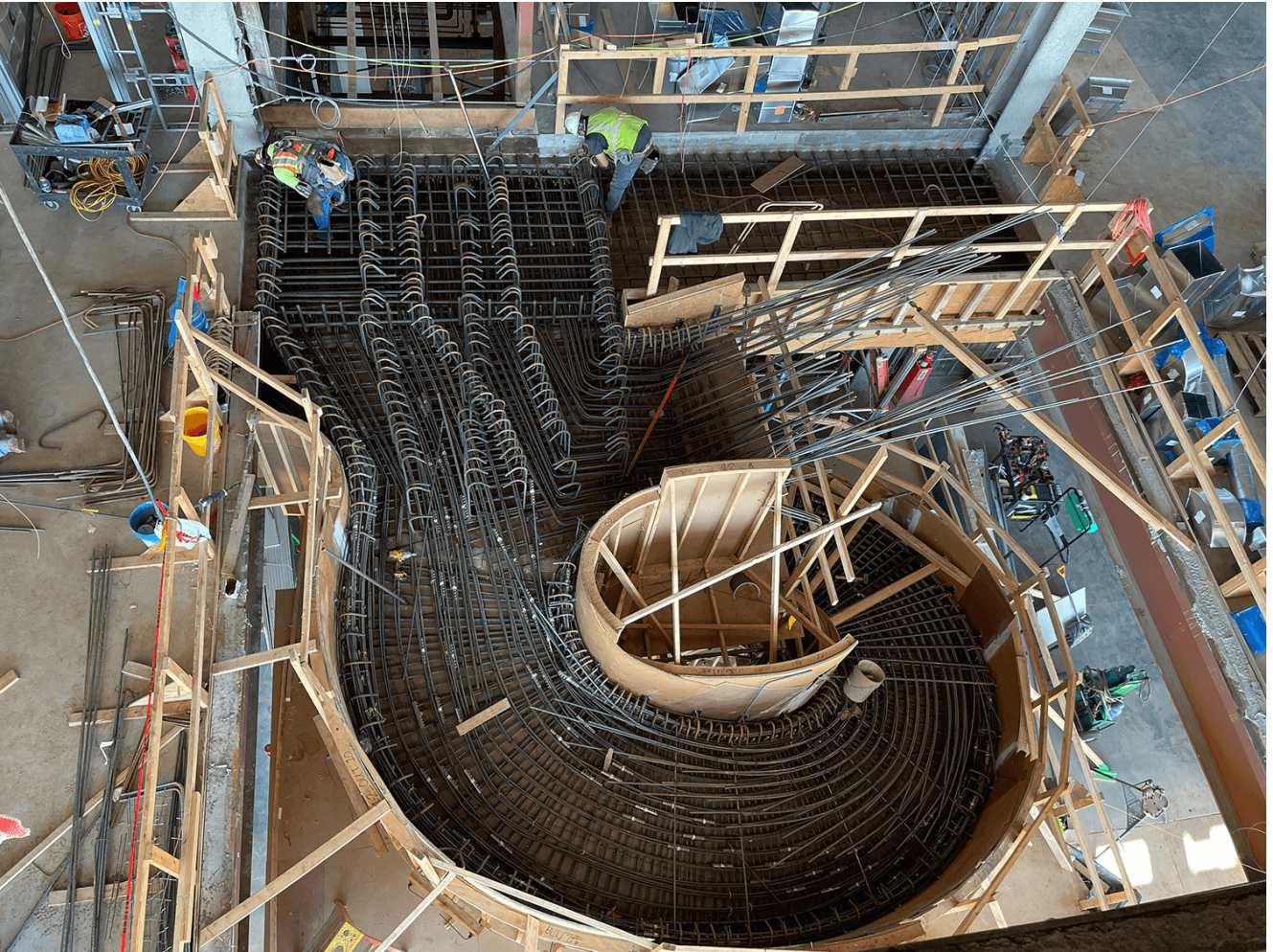


On-site surveying technology translated digital 3D coordinates into real-time layout guidance during construction. Courtesy Clark Nexsen

COMPUTATIONAL DESIGN AS COLLABORATIVE FRAMEWORK

The digital model didn't just guide design; it became the project's shared language across disciplines. During weekly coordination meetings, the model served as a visual and technical reference for engineers, contractors, and fabricators. Specialty subcontractors, such as those handling the concrete formwork and custom glass, relied on outputs directly extracted from the Rhino model. [UFP Concrete Forming Solutions](#) used digital geometry for CNC milling of intricate formwork, while on-site surveyors used coordinate data for precise layout verification.

Laser scanning further supported this collaborative approach. The as-built concrete was scanned to capture its exact geometry, informing the fabrication of the twisting steel guardrail supports. A second round of scanning provided the reference geometry required for the glass manufacturer to shape the final panels with millimetric precision. This digital feedback loop (from model to fabrication and back again) allowed the project team to navigate construction challenges with agility.



Reinforcement detailing follows the fluid geometry established by the CNC-milled formwork. Courtesy Clark Nexsen



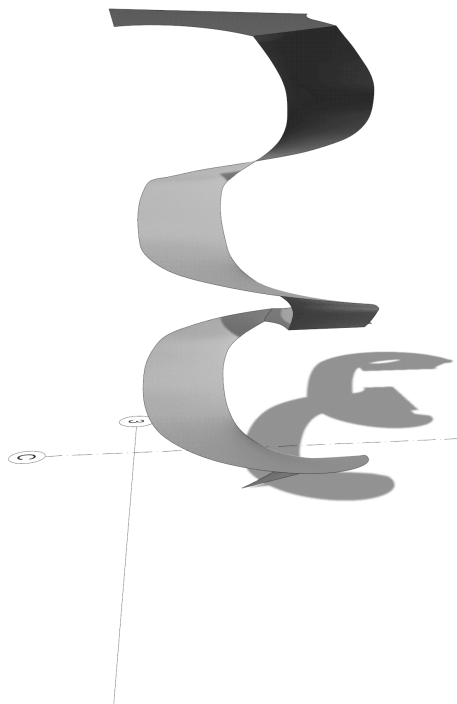
The stair's flowing computational geometry contrasts with the

rigid orthogonal grid of the surrounding curtain wall. © Mark Herboth Photography

MELDING TRADITION WITH MODERN TOOLS

The MCIC's stair is more than an architectural centerpiece. It exemplifies how computational design can translate ambitious ideas into built reality within a demanding, real-world context. The ability to adapt to shifting constraints, maintain precise control over complex geometry, and coordinate with multiple stakeholders reflects a broader shift in how contemporary design and construction operate.

Rather than serving as a static representation, the Rhino model became a dynamic tool, a conduit for communication, problem-solving, and decision-making throughout the project's life cycle. This approach proved especially valuable given the MCIC's context: a new facility in dialogue with one of America's most iconic modernist campuses, requiring both architectural sensitivity and technological sophistication.



Architect-generated surface geometry directly informed CNC milling of the custom concrete formwork. Courtesy Clark Nexsen

A NEW STANDARD FOR DIGITAL CRAFTSMANSHIP

Ultimately, the success of the MCIC stair stems from the combined strength of design intent, computational precision, and collaborative execution. It stands as a testament to how digital tools, when applied thoughtfully, can empower design teams to meet complex architectural challenges without compromising vision or buildability.



Anchoring the east edge of the historic Cadet Area, the Madera Cyber Innovation Center overlooks Stillman Parade Field with the Colorado Front Range beyond. © Mark Herboth Photography

For the cadets who will ascend these stairs, future officers trained at the forefront of cyber operations, the structure offers more than just vertical circulation. It embodies the Academy's forward-looking mission, blending craftsmanship, computation, and collaboration into a single architectural gesture that connects past, present, and future.

CREDITS

Project Name: The Madera Cyber Innovation Center

Client: United States Air Force Academy

Location: Colorado Springs, CO

Design Build Contractor: Bryan Construction, Inc

Architecture/Interiors: Clark Nexsen, a JMT company

Structural Engineer: MGA Structural Engineering

Stair Contractors:

Guardrail: Livers Bronze

Glass: El Paso Glass

Steel: RK Steel

Concrete: GH Phipps

Formwork: UFP Concrete Forming

Images:

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