

# Custom FRP Arch and Column Forms

Creating a unique façade for a new library at West Point

BY ERIC BRACE

Jefferson Hall Library is the first new academic building constructed in the central Cadet Academic Zone of the United States Military Academy at West Point, NY, since 1972. The new six-story, 148,000 ft<sup>2</sup> (13,750 m<sup>2</sup>) Library and Learning Center has an estimated construction cost of \$59 million and is scheduled for occupancy in March 2008.

## ARCHITECTURAL DESIGN

Located directly opposite the present library in the heart of West Point's historic district, the new library features design elements that link it to the surrounding historic architecture. Among these elements is an entryway incorporating concrete archways and columns.

Springing from a single column at each side, three flattened gothic arches span 7.6 m (25 ft) to frame the entryway. Each arch is unique. In plan, the central arch is straight, but the interior and exterior arches are curved (Fig. 1). Also, the soffit of the exterior arch is 200 mm (8 in.) higher than the soffits for the central and interior arches (Fig. 1). In keeping with the gothic aesthetic, each column includes a cluster of three small shafts on the

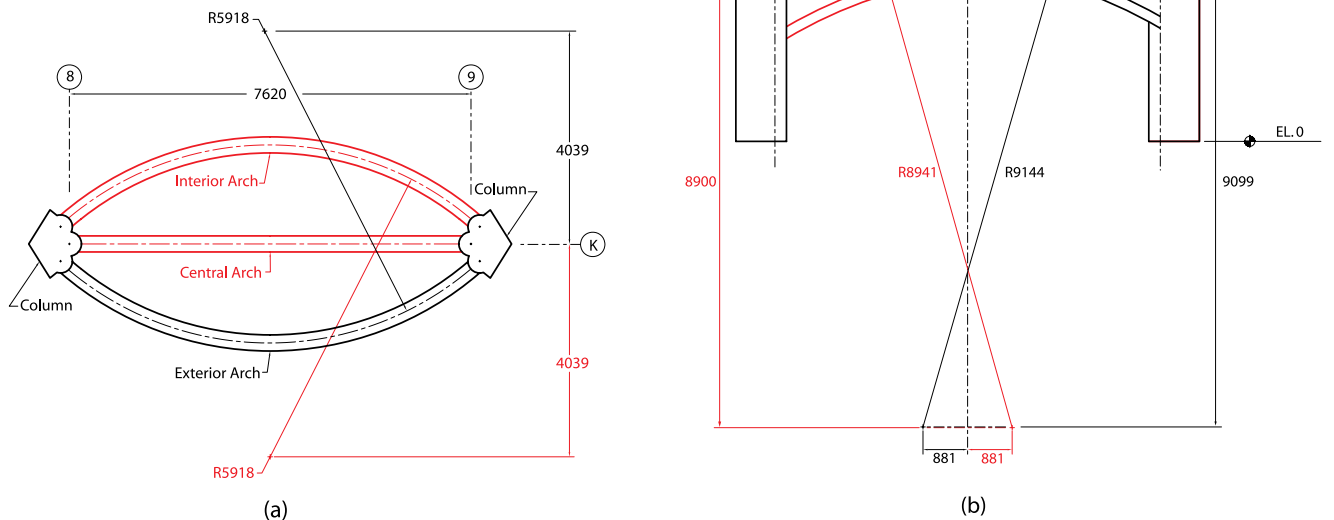


Fig. 1: Work point layout for arches: (a) plan; and (b) elevations (all dimensions in mm; 1 in. = 25.4 mm)

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inboard side, with each shaft corresponding to the springing point for an arch.

## CUSTOM FRP FORMWORK SYSTEM

The unique configuration required for the arches and columns at the entryway lead to the decision to use a custom fiber-reinforced polymer (FRP) formwork system. Molded Fiberglass (MFG) Construction Products, located in Independence, KS, was selected to produce it.

The FRP formwork pieces were produced using the hand layup method using molds fabricated by means of a computer numerical control (CNC) machine. The design aesthetic mandated smooth concrete surfaces, so the machined surfaces of the molds were filled, sanded, and buffed before they were put to use. After applying a bond breaker to the mold surfaces, the flanges and sheathing surfaces for the forms were produced by applying a gel coat, glass fiber reinforcement, and resin matrix to the molds. Dimension lumber and plywood stiffeners were then bonded to the exterior side of the sheathing. Once cured, the individual formwork pieces were assembled at the plant (Fig. 2) to ensure the components would fit accurately and meet the dimensional requirements. The pieces were then disassembled and shipped to the West Point job site.

## IMPLEMENTATION

On site, the size and weight of the formwork required the use of forklifts and scissor lifts for assembly. After the forms were assembled (Fig. 3) and the reinforcement was placed, self-consolidating concrete was used to produce the required smooth, uniform finish. The entryway is shown from below in Fig. 4, shortly



**Fig. 2:** Prior to shipping to the job site, workers assembled formwork for the entryway to check fit and dimensions. Note dimension lumber and plywood studs bonded to the fiberglass sheathing



**Fig. 3:** Formwork for the entryway was reassembled on site and integrated with the soffit formwork for the floor slab for the level above

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**Fig. 4:** View looking up into the arches at the entryway

after the forms had been unbolted and removed using lifts, and the form ties had been cut.

The entryway is shown from outside the building in Fig. 5. The arched corbels visible in the rooms above and adjacent to the entryway are additional design elements that link the library to the surrounding historic architecture. While not as complex as the entryway arches, the aesthetic demands for these corbels lead to the decision to cast them in custom FRP forms as well.

### PROJECT CREDITS

**General Contractor:** J. Kokolakakis Contracting, Inc., Rocky Point, NY

**Concrete Subcontractor:** Roger & Sons Concrete Inc., LaGrangeville, NY

**Formwork Subcontractor:** Ceco Concrete Construction, Gladstone, MO

**Custom Formwork Subcontractor:** MFG Construction Products, Independence, KS



**Fig. 5:** View looking into the building, showing the gothic arches at the entryway as well as arched corbels featured in the rooms beyond and above

Selected for reader interest by the editors.

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**CIRCLE**



**Eric Brace** is the Engineering Manager of Molded Fiberglass (MFG) Construction Products in Independence, KS. He holds an advanced degree in architecture and structural design and is listed as a Certified Composite Technician by the American Composites Manufacturers Association. With more than 20 years of service working with MFG, Brace oversees the structural design of FRP concrete forms for major national projects.