



## **FRP COLUMN FORMS PROVIDE SMOOTH CONSTRUCTION SOLUTION FOR PERIMETER OF \$90 MILLION**

### **STANFORD STADIUM'S FAST-PACED RENOVATION**

#### **STADIUM PROJECT PROFILE:**

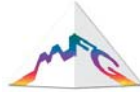
After eight-plus decades (Established: 1921) of fan-frenzied use, storied Stanford Stadium's infrastructure was crumbling and a major renovation was needed to ensure its fan base didn't do the same. The \$90 million renovation project, representing the single most significant capital project in the history of Stanford University Athletics, would bring the spectator's stadium experience into the new millennium and ensure the future of the facility as a viable source of revenue for all Cardinal varsity sports.

After evaluations were completed in 2002, building plans focused on improving sightlines, seating, circulation, ingress and egress, restrooms and concessions. To bring the spectators closer to the field for a more intimate experience, seating will be reduced from 85,500 seats to 50,000. With football season representing the highest revenue generating period of the fiscal year, the construction renovation timeline was a tight, one-phase target goal; beginning with the excavation of the existing stadium on November 28<sup>th</sup> 2005 and completion by the September 8<sup>th</sup> 2006 home opener.



#### **COLUMN FORM CHALLENGE: TIME / COST / AESTHETICS**

With a nine month completion schedule, General Contractor Vance Brown Builders (Palo Alto, CA) enlisted Peck and Hiller Company (East Palo Alto, CA) as the structural concrete formwork subcontractor to construct approximately 400 round columns that would adorn the entire perimeter of the stadium and support the steel field bleachers. Round column forms (RCF) would be filled with San Diego Buff-Beige colored concrete. The end result will produce an aesthetic and structural synergy to the architectural design (Hoover & Associates: Palo Alto, CA) for the state-of the art Stanford stadium.



In seeking the optimal RCF solution, Peck and Hiller's construction supply company (Level Construction Supply: San Francisco, CA) analyzed traditional disposable paper RCFs which can be cost-efficient. Given Northern California's inclement weather however, the possibility of the forms (tubes) getting wet became a factor because if the tubes get wet they could lose their structural properties; jeopardizing the form.

The forms, therefore, would have to be stored in a weather protected space; this would mean trucking in 360 12' forms in a dry container and finding at least 1440 square feet of space (x 12' high) to store them. Additionally, if using a light wall tube @ 5.4lb of paper per lf (linear foot) of tube; when the job was complete they would have had to dispose of 23,328 lbs. of paper.

### **FRP COLUMN FORM SOLUTION:**

Facing cost and performance deficiencies, Level contacted MFG Construction Products (Independence, KS) who manufactured a complete range of standard and custom one-piece fiber glass reinforced plastic (FRP) column forms.

MFG Construction Products (a division of Molded Fiber Glass Companies) offered a FRP/RCF solution whose composite properties made them corrosion resistant and reusable. The MFG single-seam design also provided the ability to nest/stack which reduced storage and shipping space costs. Vivaly, the MFG composite forms produced a smooth/clean finish (leaving no spiral rebar seams or bug holes) to the columns; an essential deliverable to the architectural vision and specifications.



According to Mike Baker, Owner of Level Construction Supply, "MFG's composite forms essentially took weather, storage and landfill out of the equation."

Given the projects' short deadline, MFG Construction Products responded quickly in providing 30, cut-to-length (12' x 24" diameter) forms so construction could begin two weeks ahead of schedule (January 2005). Approximately thirty concrete pours were completed every three days until completion in February 2006.



## **CUSTOM ANCHOR BOLT ASSEMBLY:**

Since the forms had to support the field steel bleachers, an anchor fastening system had to be customized to line up four bolts on each column to the bleacher bolts after the concrete pour. P&H engineers devised a custom solution involving a 2"x 6" wood material that they placed across the top of each column; hanging slightly past the column perimeter on each side. A Seimens L Grip was then used to bolt the material and hang the assembly to the outside of the form. Each assembly was set before the pour to align the bolts perfectly with the bleachers when installed.

## **REBAR AND CONCRETE:**

Five hundred (500) tons of number 9 concrete reinforcing bar (rebar) was used for the drilled pier and columns combined. The single-seam, flex-open spiral rebar cage came out of drilled piers set 30 feet below ground. Thirty columns were set, poured and reversed every three days; complete with the bleacher anchor bolt assembly.



Approximately three hundred yards of 4000/6000 psi color-mix concrete was poured for the forms (3 yards per). A PolyHeed mid-range water reducing admixture was used to provide better consolidation around the rebar; delivering less rock pockets and bubbles. The release agent also provided a higher slump; making it a more workable concrete. Additionally, because it was a color mix, they also had to be careful not to add water to the mix that would set off the formula; thus ruining its conformity.





## **CONCLUSION:**

According to Vance Brown's Project Manager, Tim Stitt, "It was an immense, fast-track project; starting the day after Stanford's' last football game. The aggressive schedule required two daily shifts plus Saturdays. MFG's composite forms were easy to strip and the end-result came out pretty slick as the finish looks just great."



## **CORPORATE PROFILE:**

MFG Construction Products Company, formed in 1962 and a charter member of the World of Concrete, manufactures a complete range of one-piece round column forms (RCFs), dome and pan forms for one-way and two-way joist slab floors, and customer forms for cast-in-place concrete construction applications. Made of fiberglass-reinforced thermo-set composites, MFG concrete forms can significantly reduce finishing costs and are fully re-usable.

Formed in 1948, Molded Fiber Glass Companies has been a pioneering force in optimizing resins and fiber reinforced polymer (FRP) materials and continues to build strength through focused diversity in providing superior composite material solutions worldwide.