

Pre-Cast Arched Wall Panels for Underground Library

Faced with the task of constructing 90,000 sq. ft. of one-sided, curved, cast-in-place concrete walls for an underground library at the University of Minnesota, designers and contractors worked together to devise an alternate method of construction. Two caverns, each 600 feet long, 25 feet high, and 70 ft wide, were mined in St. Peter Sandstone just below a limestone formation that acted as a roof. Geological conditions required that concrete walls closely follow the excavation of the cavern face to support the sandstone. Casting the walls in place would have required the use of heavy steel forms, and the low overhead clearance would have complicated formwork, handling of reinforcing steel, and concrete placement. Form ties could not be secured due to the nature of the sandstone, and horizontal shoring to resist concrete pressures would obstruct cavern excavation and rock bolting operations. Also, cool cavern temperatures would retard concrete placement rates and formwork cycle times.

The solution was to use 400 curved, precast concrete panels. Each panel was 8 inches thick, 10 feet wide, and varied in height from 15 to 25 feet. A unique panel handling machine was built to transport the panels horizontally through the cavern entrance, and then tilt them up and set them in place. The top and bottom edges of the panel were dry packed at the footing and against the limestone ceiling. The ability to set fully-cured concrete panels near the cavern face allowed the excavation to proceed at a fast pace. After the wall panels were in place, a 4 inch thick, high-slump, pea rock grout was placed behind them to provide full contact support to the sandstone. With the top and bottom ends of the panel restrained, the concave panel functioned like an arch and withstood hydrostatic grouting pressures without ties or bracing. The pressure-grouted, arched, pre-cast panels resulted in a smaller on-site crew and produced a quality structure

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