Beneficial Use Case Study

1144 Fifteenth Street

Coal Combustion Product Type
Fly Ash

Project Location
Denver, Colorado

Project Participants
Hines Interests Limited Partnership, Martin/Martin Consulting Engineers, CTL|Thompson, Kendall/Heaton Associates, Pickard Chilton, Hensel Phelps Construction Company, Martin Marietta

Project Completion Date
January 2018

Project Summary
1144 Fifteenth is the first class-A office tower constructed in Denver in over 30 years. The 42-story, 603-foot-high building, the city's fifth-tallest, is a LEED Gold-certified glass tower providing 640,000 square feet of office space. It consists of two levels of below-grade parking, twelve levels of podium parking above grade, twenty-seven levels of office space, and two penthouse levels for mechanical equipment.

Project Description
Construction of 1144 Fifteenth, in Denver's LoDo neighborhood, involved solving a number of design challenges—not the least of which was how to safely anchor a heavy skyscraper on a comparatively small footprint in the sedimentary bedrock that sits beneath the city. Local firm CTL|Thompson—which operates one of a handful of laboratories in the U.S. with deep expertise in the use of fly ash in concrete—was enlisted to provide the geotechnical investigation and environmental site assessment for the project.

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Site analysis by CTL|Thompson and Martin/Martin Consulting Engineers revealed that the site's bedrock was relatively shallow—at the same elevation as the building's lower level. So, rather than digging down into the bedrock to build a platform supporting a drilled pier and reinforced concrete mat core, the engineers instead opted to put in place a tie-beam connecting and supported by drilled concrete piers sunk over 100 feet into the bedrock.

The system comprises eight drilled piers measuring 10 feet in diameter and capable of supporting seven-foot-wide, seven-foot-deep tie-beams. Beams running along the longitudinal axis of the building are pulled together by shorter perpendicular beams in a system designed to rest against bedrock three stories below street level and reduce lateral loads on the piers that support the foundation. The drilled piers provide lateral resistance.

Due to the massive volumes of concrete required for the foundation—2400 cubic yards across eight piers—engineers developed a custom mix to reduce the heat generated when water and portland cement react, slow the initial curing process, and preserve the strength and quality of the concrete. Martin/Martin and CTL|Thompson developed a mix for concrete supplier Martin Marietta that incorporated up to 40% fly ash for the job.

During the filling process, concrete temperatures were continuously monitored to ensure that they stayed within the desired range. With the strength gain slowed, the allowable minimum compressive strength requirement at 28 days was eased to 56 days.

According to CTL|Thompson, use of fly ash in the design solution helped minimize the volumes of cement and concrete required for the core foundation, while reducing costs and boosting its strength.