An ACI Center of Excellence for Carbon Neutral Concrete

CASE STUDY: 432 PARK AVENUE

NEW YORK CITY, NEW YORK, USA

Towering over midtown Manhattan is 432 Park Avenue, considered one of the tallest buildings in the Western Hemisphere. The luxury condominium building features a square geometric footprint, white facade, and a repetitive checkerboard-style window pattern. The construction of this 1,396 ft (426 m) tall building with a 93.5 ft (28.5 m) square footprint in midst of a busy city area was an incredible feat for the construction team.

To achieve the desired white exterior color, a white cement was used in place of the usual gray cement which is typically much more forgiving in terms of mixing, pumping and placing. White cement, on the other hand, reacts more quickly and can be temperamental, which meant it needed careful attention to the quality control process. Also, an important requirement was the use of a sustainable mixture to supply a **70% replacement of portland cement**. The project also had a rapid construction schedule, with a goal of one floor per week for a total of 90 floors.

To meet all these needs, a self-consolidating concrete mixture was developed that addressed the challenges of the fast-reacting white cement, using high-performance concrete admixtures to control slump and set time. **The CO_2 emissions were lowered through a reduction in portland cement content and the addition of fly ash, slag cement and metakaolin, which also contributed to the LEED status of the project.**

PROJECT DETAILS

Environmental impact of sustainable concrete for 432 Park Ave. as compared to standard reference mixture based on 90,000 yd^3 (69,000 m^3) of concrete developed for four compressive strengths.

Energy usage (savings)	822,000 kWh (2,959,200 MJ)
Greenhouse gas emissions (savings)	21,120,000 lb CO_2 eq (9,579,000 kg CO_2 eq)

REQUIREMENTS

- Architectural surface finish
- Pumpable, flowable self-consolidating concrete
- Slump flow spread: 30 in. (760 mm)
- Heat of hydration: max 160 ºF (71 ºC)
- 56-day modulus of elasticity (MoE): 7.25 million psi (50 GPa)
- **Sustainable mixture with 70% replacement of portland cement, using fly ash, slag cement and metakaolin**
- 56-day compressive strength: 14,000 psi (96 MPa) for the lower floors, and 10,000 psi (69 MPa) for the upper floors

PRODUCTS USED

- MasterGlenium® 7500 high-range water-reducing admixture
- MasterSure® Z 60 workability-retaining admixture
- MasterSet® DELVO hydration-controlling admixture
- MasterLife® MK 828 high-reactivity metakaolin was used in place of silica fume (which is gray in color) to meet high MoE requirements

PROJECT ACHIEVEMENTS

- Architectural surface finish
- MoE: 7.67 million psi (52.9 GPa) at 56 days
- Compressive strength: 20,500 psi (141 MPa) at 56 days
- Heat of hydration: 147 ºF (64 ºC)
- LEED requirements

PROJECT TEAM

Developer: CIM Group/Macklowe Properties

Construction Manager: Lend Lease

Architects: Rafael Vinoly Architects, SLCE Architects

Structural Engineer: WSP Cantor Seinuk

Concrete Contractor: Roger & Sons Concrete, Inc.

Concrete Producer: Ferrara Bros. Building Materials Corp.

Concrete Admixture Supplier: Master Builders Solutions

Project information provided courtesy of Master Builders Solutions