

CASE STUDY: ONE WORLD TRADE CENTER

NEW YORK CITY, NEW YORK, USA

Towering over the lower Manhattan skyline, the One World Trade Center is known for its innovative design and engineering. The imposing 2.6-million-square-foot (242,000-square-meter) skyscraper, formerly known as the Freedom Tower, began construction in April 2006 and was the tallest building in the United States at the time.

Environmental sustainability was a top priority in the design and construction of One World Trade Center. The Port Authority of New York/New Jersey required that recycled materials be used in place of portland cement.

One World Trade Center used a revolutionary EF Technology® concrete mixture that replaced 71% of the portland cement with recycled materials including fly ash, slag cement, silica fume, non-cementitious fillers, and specialized admixtures. This mixture exceeded all performance targets and was used for the 38,000 yd³ (29,000 m³) of concrete needed for the columns through the first 40 floors.

To quantify the environmental impact of this sustainable concrete, an Eco-Efficiency Analysis was conducted, comparing the EF Technology mixture to a reference mixture. The results, validated by NSF International, are shown in the Project Details.



PHOTO BY PIXABAY

REQUIREMENTS

- Quantity of portland cement in the mixture: Less than 400 lb/yd³ (240 kg/m³)
- Compressive strength: 12,000 psi (83 [MPa] @ 56 days
- Over-design for safety: 1,900 psi (13 MPa)
- Modulus of elasticity: 7.0 million psi (48 GPa)
- Heat of hydration: Not to exceed 160 °F (70 °C)
- Non-air-entrained
- Slump flow: 24 -28 inches (610 -710 mm)

- Ability to pump to at least 40 floors
- No loss in concrete workability during transit and placement
- Aesthetically pleasing

PRODUCTS USED

- MasterGlenium® 7500 high-range water-reducing admixture
- MasterSure® Z 60 workability-retaining admixture
- MasterSet® DELVO hydration-controlling admixture
- MasterLife® SF 100 silica fume
- Market Sector: Ready-mixed concrete

PROJECT DETAILS

Environmental impact of sustainable concrete for One World Trade Center, as compared to a standard reference mixture.

Energy usage (savings)	25,400,000 kWh (91,440,000 MJ)
Greenhouse gas emissions (savings)	34,800,000 lb CO ₂ eq (15,785,000 kg CO ₂ eq)

PROJECT TEAM

Owners: Port Authority of New York/New Jersey

Concrete Contractor: Collavino Construction Co.

Concrete Producer: Ferrara Bros. Building Materials Corp.

Project information provided courtesy of Master Builders Solutions.