

**Project:**

One World Trade Centre

**Location:**

New York, USA

**Owners:**

Port Authority of New York/New Jersey

**Contractor:**

Collavino Construction Company

**Concrete Producer:**

Eastern Concrete Materials,  
a U.S. Concrete Company

**Market sector:**

Ready-mixed concrete

**Products used:**

MasterSure Z 60 workability-  
retaining admixture  
MasterGlenium7500 high-range  
water-reducing admixture  
MasterSet DELVO  
hydrationcontrolling admixture  
MasterLife SF 100 silica fume

## One World Trade Centre New York, USA



One World Trade Centre, New York, USA.

### The background

Soaring to a height of 1,776 feet (540-metres), the 2.6-million-square-foot (242,000-square-metre) skyscraper known as One World Trade Centre in the lower Manhattan district of New York City is a marvel of design and engineering. Construction of the building, previously called the Freedom Tower, began in April 2006 and it is now the tallest building in the United States.

### The challenge

Sustainable design was a central theme to One World Trade Centre's development, with the Port Authority of New York/New Jersey imposing a strict requirement for the replacement of Portland cement with recycled materials. In addition, extremely high-performance concrete was necessary to meet the compressive strength requirements of the steel and concrete structural columns, which ranged from 14,000 psi (97 MPa) to 12,000 psi (83 MPa) for the lower 40 floors and 10,000 psi (69 MPa) to 8,600 psi (59 MPa) for the upper floors. The 12,000 psi (83 MPa) concrete phase of the project was the most challenging, with the engineers, owners and contractors all having their own requirements and specifications.

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# One World Trade Centre

## New York, USA



### Engineering requirements:

- 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

### Port Authority of New York/New Jersey requirements:

- Quantity of Portland cement in the mixture: Less than 400 lb/yd<sup>3</sup> (240 kg/m<sup>3</sup>)

### Contractor requirements:

- 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

To achieve these concrete properties which, combined, would be a ground-breaking feat, concrete producer Eastern Concrete Materials, Elmwood Park, NJ partnered with admixture supplier BASF Construction Chemicals, Beachwood, OH.

### The results

Through BASF's Green Sense Concrete mixture optimization service, Eastern Concrete Materials was able to proportion an EF Technology® concrete mixture with 71% cement replacement. The mixture replaced Portland cement with the recycled materials, non-cementitious fillers and specialized admixtures to exceed all the performance targets specified by the One World Trade Centre project stakeholders. This EF Technology mixture was used for the 38,000 yd<sup>3</sup> (29,000 m<sup>3</sup>) of concrete needed for the columns through the first 40 floors.

To quantify the environmental impact of sustainable concrete for the structure, an Eco-Efficiency Analysis was conducted, using a methodology validated by NSF International, to compare the specialized EF Technology mixture to a reference mixture. The results of this cradle-to-gate analysis are included in Table 1. Some practical equivalents for these savings are:

- Water savings equal to 1,177,329 half-litre bottles of water
- Reduced carbon footprint equal to 1,835,494 gallons of gasoline
- Fossil fuel savings equal to 29,872 barrels of oil

**Table 1. Environmental impact of sustainable concrete for One World Trade Centre**

Environmental Impacts	Environmental Savings
Energy (kWh)	25,402,200 kWh savings
Resource consumption (lb) savings	2,774,650 lb (1,259,691 kg)
Fossil fuel consumption (lb)	1,110,050 lb (503,963 kg) savings
Greenhouse gas (lb CO <sub>2</sub> eq)	34,886,050 lb (15,838,267 kg) CO <sub>2</sub> reduction
Photochemical ozone creation potential	2,837 lb (1,288 kg) ethene reduction [summer smog] (lb ethene eq)
Acidification potential [acid rain] (lb SO <sub>2</sub> eq)	221,820 lb (100,706 kg) SO <sub>2</sub> reduction
Water production (gal)	155,466 gal (588,437 L) water production savings
Water emissions (gal)	5,247,050 gal (19,860,084 L) water emissions savings
Solid waste (lb)	1,720,100 lb (780,925 kg) solid waste savings
Land use (ft <sup>2</sup> )	2,221,400 ft <sup>2</sup> (2,063,681 m <sup>2</sup> ) land savings

### Master Builders Solutions from BASF

The Master Builders Solutions brand brings all of BASF's expertise together to create chemical solutions for new construction, maintenance, repair and renovation of structures. Master Builders Solutions is built on the experience gained from more than a century in the construction industry.

The know-how and experience of a global community of BASF construction experts form the core of Master Builders Solutions. We combine the right elements from our portfolio to solve your specific construction challenges. We collaborate across areas of expertise and regions and draw on the experience gained from countless construction projects worldwide. We leverage global BASF technologies, as well as our in-depth knowledge of local building needs, to develop innovations that help make you more successful and drive sustainable construction.

The comprehensive portfolio under the Master Builders Solutions brand encompasses concrete admixtures, cement additives, chemical solutions for underground construction, waterproofing solutions, sealants, concrete repair & protection solutions, performance grouts, performance flooring solutions.

Further information is available at [www.master-builders-solutions.basf.co.uk](http://www.master-builders-solutions.basf.co.uk)