

High Rise Construction Solutions

**Admixture Solutions for
World Record Breaking
Concrete Structures**



Master Builders Solutions®

Our comprehensive portfolio

Concrete Admixtures for:

- Low Clinker Concrete Solutions
- Precast Concrete Solutions
- Ready-Mixed Concrete Solutions
- Below Ground Waterproofing Solutions

Underground Construction Solutions for:

- Ground Engineering
- Mining Industry
- Rock Bolting
- Sprayed Concrete
- TBM systems
- Water Management

We provide value-added technology and market leading R&D capabilities to improve the performance of construction materials and to enable the reduction of CO₂ emissions in the production of concrete admixtures, cement additives, and solutions for underground construction.

We collaborate across areas of expertise and regions and draw on the experience gained from countless construction projects worldwide, leveraging global 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.

Founded in 1909, Master Builders Solutions® operates 35 production sites globally, supporting you in mastering your building challenges of today and tomorrow - for a decarbonised future.



High Rise Concrete Solutions

As towers continue to get higher, concrete plays an ever more vital role in their complex structural design. Building at height presents unique challenges both in terms of design and construction. The economic benefits of using high-performance, high-strength concrete for the structures of high-rise buildings are based on the straightforward premise of 'more for less'.

Using high-strength concrete means that the column size is reduced and therefore, the amount of concrete, reinforcement and formwork required is consequently reduced. The use of high-strength concrete provides one of the most economical ways to carry vertical loads to a building's foundation. It also provides performance benefits of early high-strength, volume stability and extended life cycle.

Master Builders Solutions range of Admixtures enables concrete to be pumped non-stop to a height of over several hundred meters in the construction of high-rise buildings and skyscrapers. They also stop the various components of the concrete mix from segregating due to the high pumping pressures involved, ensuring a faster construction process and longer building life expectancy.



Burj Khalifa

Dubai, United Arab Emirates

To reach this world record the structure of the building had to comply with strict design and durability criteria. One unique challenge was ensuring the concrete mix design for the structural core of the tower was capable of being pumped to formidable heights in extreme climatic conditions (temperatures of between 10°C and 50°C).

The structural core of the tower required nearly 170,000m³ of concrete designed with a compressive strength 80N/mm². MasterGlenium high range water reducing admixtures were able to meet this challenge making it possible to pump the concrete, without any interruption, to a height of up to 600 meters.

The Burj Khalifa has redefined what is possible in the design and engineering of supertall buildings. By combining cutting-edge technologies and cultural influences, the building serves as a global icon that is a model for future urban centres and the global movement towards compact, liveable urban areas.

At 828 metres high, the Burj Khalifa is the worlds tallest building.

World record for vertical pumping of concrete to heights of over 600 metres.

Master Builders Solutions admixtures made it possible to complete two stories per week, instead of the one storey per week, which is standard in Dubai.

The structural core of the tower required nearly 170,000m³ of concrete designed with a compressive strength of 80N/mm².

The structure also had to meet a 100-year design life requirement.

In total over 330,000m³ of concrete and 39,000 tonnes of steel reinforcement was used in the Burj Khalifa's construction.



Shanghai Tower

Shanghai, China

At 632 metres high, the Shanghai Tower was the world's 2nd tallest building when built. Master Builders Solutions admixtures were selected to control the workability of the self-consolidating concrete and to ensure that the concrete quality was maintained during the single, uninterrupted pour, whilst meeting a tight schedule.

The successful continuous pour of 61,000m³ was placed into the raft foundation over a period of 60 hours, a new world record at the time as the largest volume, continuous concrete pour of civil infrastructure.

Innovative concrete admixture technology was also featured in the construction of Shanghai Tower to meet the topping-out schedule, concrete containing Master Builders Solutions admixtures was pumped vertically to a height of over 560 meters at temperatures of up to 40°C.

Shanghai Tower is one of the most sustainably advanced tall buildings in the world. A central aspect of its design is the transparent second skin that wraps around the entire building. The ventilated atriums it encloses conserve energy by modulating the temperature within the void. The space acts as a buffer between the inside and outside, warming up the cool outside air in the winter and dissipating heat from the interior in the summer.

At 632 metres high on completion, the Shanghai Tower was the world's 2nd tallest building.

Building raft foundation required a total of 61,000m³ of concrete in one continuous pour.

Master Builders Solutions admixtures assisted in the global concrete placement record for the construction of the Shanghai Tower's foundation.

Concrete with Master Builders Solutions admixtures was pumped vertically to a height of over 560 metres at temperatures of up to 40°C.

The 125-storey Shanghai Tower is the tallest building in China.

The Shanghai Tower was designed to achieve both LEED Gold certification & China Green Building Three Star rating.



One World Trade Centre

New York, United States of America

At a height of 542 metres, the One World Trade Centre was the world's 3rd tallest building when built. Sustainable design was a central theme of the 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 concrete structural columns.

Master Builders Solutions Green Sense Concrete mix optimization service, was able to proportion a concrete mix with 71 % cementitious replacement. The mix replaced Portland cement with the recycled materials, non-cementitious fillers with specialized admixtures to exceed all performance targets specified by the One World Trade Centre project stakeholders.

The use of our Green Sense Concrete technology saved:

- 590,000 litres of water
- 1,835,494 gallons of petrol
- 25,402,200 kilowatt hours of energy
- 15,000,000 kilograms of CO₂
- 504,000 kilograms of fossil fuel equal to 29,872 barrels of oil

At 542 metres tall on completion, The One World Trade Centre was the world's 3rd tallest building.

Tallest building in the Western Hemisphere.

Master Builders Solutions optimized the concrete formulation to reduce the ecological footprint, and conserve resources whilst increasing the structural strength.

The concrete mix design had 71% cementitious replacement.

The concrete core is made of ultra-high-strength concrete, at 14,000psi the strongest ever poured in New York.

The One World Trade Centre was awarded LEED Gold certification by the U.S. Green Building Council (USGBC).



Petronas Towers

Kuala Lumpur, Malaysia

The 452 metre, 88-storey twin structure is Kuala Lumpur's crown jewel. The structure includes a 170 metre high sky bridge between the two towers and is the world's highest two storey bridge. The buildings are perhaps most noteworthy for their skybridge, which connects them on the 41st and 42nd floors. Although there is no structural benefit to the connection, it offers more than just an architectural flourish, linking the two buildings together, the facilities of each tower around that level can be shared.

Challenges during construction included the need to pump concrete vertically to the full height of 452 metres. This was successfully achieved using new concrete admixture technology developed for such demanding projects by Master Builders Solutions state of the art Research and Development facilities.

The buildings are also built on the world's deepest foundations, 104 concrete piles, ranging from 60 to 114 metres deep, were bored into the ground. The foundations, comprising of 13,200m³ of concrete, were poured continuously over a period of 54 hours for each tower.

At 452m high on completion, the Petronas Towers were the tallest buildings in the world.

The Petronas Towers remain the tallest twin towers in the world.

Master Builders Solutions admixtures were used in the concrete, which was pumped vertically 452 metres.

Each tower used over 80,000m³ of high-strength concrete.

The 88-floor towers are constructed largely of reinforced concrete, with a steel and glass facade designed to resemble motifs found in Islamic art.

The skybridge is 58 meters long, at 170 meters high from the ground, it is considered the highest two-story skybridge in the world.



International Finance Centre

Guangzhou, China

The International Finance Centre is an efficient, cost-effective composite structure comprising of a reinforced concrete core working in conjunction with the perimeter diagrid frame to provide overall stability. Master Builders Solutions admixtures were specified in the construction of the core to enable the concrete to be pumped vertically to a height of over 400 metres.

Following an international design competition, Wilkinson Eyre Architects was selected to design the 440 metre tower in Guangzhou, which is one of China's tallest buildings. With 103 storeys, the tower has a mixture of uses including office space, a luxury Four Seasons hotel with a top floor high-end restaurant and bar.

Guangzhou International Finance Centre won the Royal Institute of British Architects (RIBA) Lubetkin Prize for the best new international building.

At 438 metres high on completion, The Guangzhou International Finance Centre was the world's 9th tallest building.

The concrete, which included Master Builders Solutions admixtures, was pumped vertically to a height of over 400 metres.

The beauty of the diamond shaped grid is its inherent stiffness, which in turn gives it its strength.

Each diamond is 54 metres or twelve storeys high, reducing the amount of steel required for the construction by a remarkable 20%.

This diagrid structure, is formed from concrete filled steel tubes which provide both good stiffness and fire protection to the structure.

The shape was designed to reduce the effects of wind, thereby reducing the necessary size and weight of the structure.



432 Park Avenue

New York, United States of America

The pencil-thin 432 Park Avenue represents a new generation of supertall, superslim skyscrapers. Located in the ever-opulent Midtown neighborhood, the tower is placed in the heart of Manhattan overlooking Central Park. The narrow design of the building is intentional; as Manhattan increases in density, it is becoming ever more important to maximize building heights relative to site area.

Master Builders Solutions high range water reducing admixtures were used in the construction of 432 Park Avenue. As expected, the construction of a super-tower in midtown Manhattan was an incredible feat for the entire construction team. Standing at 426 metres tall, with only a 28.5 metre square footprint, the structure of the tower is composed of a 30 ft² square reinforced concrete core with 30-inch thick walls.

432 Park Avenue is the tallest residential building in the western hemisphere. A luxury condominium tower designed by famed architect Rafael Vinoly, 432 Park Avenue showcases cutting edge design through its square geometric footprint, white concrete facade, and repetitive checkerboard-style window pattern.

At 426 metres high on completion, 432 Park Avenue was the 3rd tallest building in the United States and the tallest residential building in the world.

The concrete, which included MasterGlenium admixtures, was pumped vertically over 400 metres.

The rapid construction schedule was a challenge, with a goal of one floor per week for a total of 90 floors.

Our Green Sense Concrete service also helped reduce CO₂ emissions via a sustainable concrete mix.

The concrete mix contained 70% cement replacement, contributing to the building achieving LEED status.

432 Park Avenue is 426 metres tall with only a small (28.5m²) footprint meaning the building has a height to width ratio of 15:1.



Trump International Hotel

Chicago, Illinois

The Trump International Hotel and Tower is a skyscraper condo-hotel in downtown Chicago. The building, named after businessman and the 45th President of the United States, Donald Trump. Amenities include the 339-room Trump International Hotel, 486 luxury condominium units, 9,300 square meters of riverfront retail space, 960 parking spaces, restaurant, banquet space, health club, spa, lounges and a ground floor beautified by a landscaped riverfront public plaza and a riverfront promenade.

The foundation for the Trump International Hotel and Tower in Chicago measured 60 meters in length, 18 meters in width and 3 metres in depth, requiring approximately 3,500m³ of concrete. The designers opted to use self-consolidating concrete following the successful use of this technology during construction of the Burj Khalifa building in Dubai. Over 30 ready-mixed concrete trucks were utilised making 600 trips to the site with the pour lasting 23 hours.

At 423 metres high on completion, the Trump International Hotel and Tower was the 7th tallest building in the world and 2nd tallest in the United States of America.

Over 30 ready ready-mixed concrete trucks were used making 600 trips to the site.

Placement lasted 23 hours and used 3,580m³ of concrete.

Overall, 137,620m³ of concrete containing Master Builders Solutions admixtures was used during construction.

The concrete temperature was limited to a maximum of 27°C at the time of placement and 77°C in-place.

A 56-day compressive strength of 10,000 psi (69 MPa) was specified for the SCC.



The Shard

London, United Kingdom

The Shard is a 95-storey skyscraper in London, that forms part of the London Bridge Quarter development. Standing 310 metres high, the Shard is the tallest building in the United Kingdom and the European Union. Delivering Europe's tallest tower in record time drove structural engineers to rethink the basic principles of construction and use new techniques in order to go higher and faster than had previously been achieved in the UK.

A massive continuous concrete pour was planned as part of the construction of the three-floor basement box, which had a depth of 13.3 metres and required 15,000m³ of concrete. A total of 16,000 litres of Master Builders Solutions admixtures were used in the record-breaking concrete pour.

This pour is the largest UK continuous concrete pour to date, lasting 35 hours and beating the schedule on both time and volume. The structure's core was slip-formed in reinforced concrete and progressed at an impressive rate of three metres per day, whilst the basement levels were built top down simultaneously.

At 310 metres high, the Shard is the tallest building in United Kingdom.

The concrete which included Master Builders Solutions MasterGlenium admixtures was pumped 250 meters high during construction of the central core.

A record-breaking concrete pour for the basement's construction, the largest UK continuous concrete pour at that time.

The actual placement time for 5480m³ was 35 hours, beating the schedule both on time and volume.

95% of the materials used to construct the building are recycled.

The Shard delivered some firsts: the first core to be built by top-down construction, the UK's largest concrete pour, and the first crane to be supported on a slipform.



Tour Odéon

Monaco, France

Soaring to a height of 170 metres in the heart of the Principality of Monaco, the Tour Odéon is the highest building in Monaco. Logistical considerations for the placement of the concrete were a major part of the challenge. Transporting, pumping and placing the concrete were to stringent timelines and workability control was a key issue.

Master Builders Solutions provided full support to the customer regarding the concrete laboratory trial mixes and played a major role in the technical communication with the end client at every step of the concrete mix design process. MasterGlenium, in conjunction with MasterPolyheed, provided the optimised admixture solution for this project.

Within the Tour Odéon there are a total of 259 residences, including 73 private luxury residences, 2 Sky Duplex apartments of 1,200m² each. Finally, there is 1 Sky Penthouse of 3,300m² over 5 floors which at the time was the most expensive penthouse in the world. Amenities include; retail shops, wellness centre including spa, a fitness centre and a swimming pool, offices and business centres.

At 170 metres high on completion, the Tour Odéon is the highest building in Monaco.

90% of the concrete was pumped – with a vertical pumping distance of 150 metres.

Optimizing the high-performance concrete mix design allowed a reduction of approximately 4,000 tons of CO₂ whilst maintaining the required durability criteria.

MasterGlenium, in conjunction with MasterPolyheed, provided the optimised admixtures solution.

Over 65,000m³ of concrete was used on the project.

Most expensive penthouse in the world (over \$400M).



Master Builders Solutions® for the Construction Industry

MasterAir

Complete solutions for air entrained concrete

MasterCast®

Solutions for the manufactured concrete product industry

MasterCem®

Solutions for cement manufacture

MasterCO₂re™

Solutions for low-clinker concrete

MasterEase®

Low viscosity for high performance concrete

MasterFinish®

Solutions for formwork treatment and surface improvement

MasterFiber®

Comprehensive solutions for fiber reinforced concrete

MasterGlenium®

Solutions for high performance concrete

MasterKure®

Solutions for concrete curing

MasterLife®

Solutions for enhanced durability

MasterMatrix®

Advanced rheology control for concrete

MasterPel®

Solutions for hydrophobization, anti-efflorescence and surface protection

MasterPolyheed®

Solutions for mid-range concrete

MasterPozzolith®

Solutions for water-reduced concrete

MasterRheobuild®

Solutions for high strength concrete

MasterRoc®

Solutions for underground construction and surface improvement

MasterSet®

Solutions for set control

MasterSphere®

Solutions for guaranteed freeze-thaw resistance

MasterSuna®

Solutions for sand and gravel in concrete

MasterSure®

Solutions for extraordinary workability retention

Master X-Seed®

Advanced accelerator solutions for concrete

Unveil the Power of MasterCO₂re™: Intelligent Cluster System for Low-clinker Concrete Production

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