



Fluid Concrete in the Precast Industry

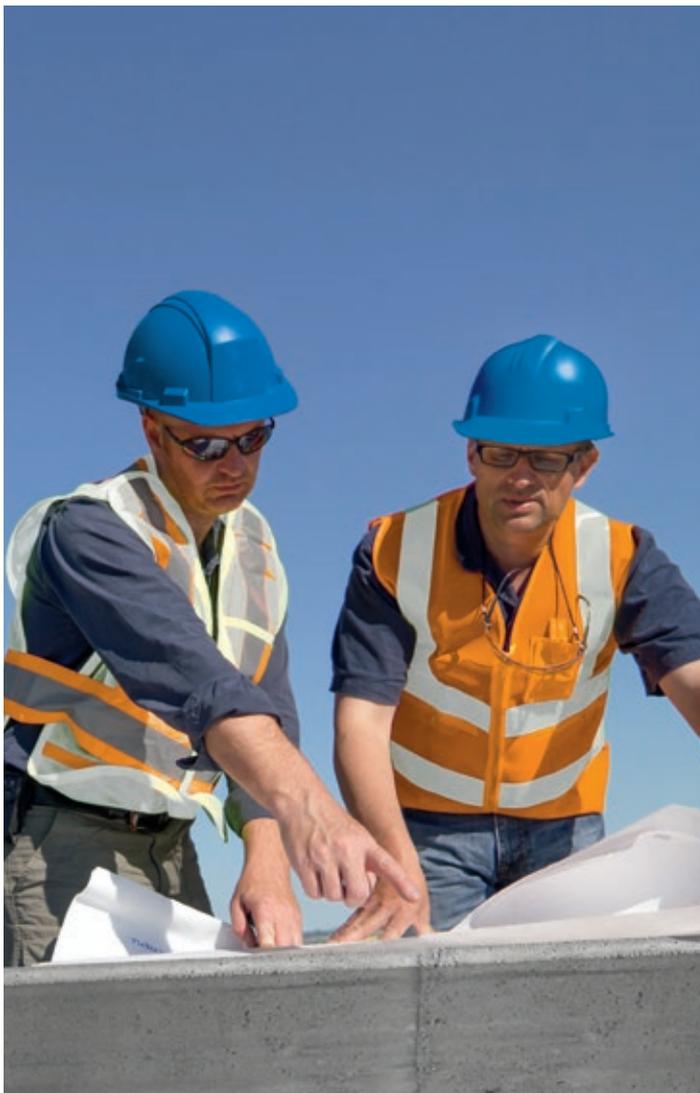
Advanced Admixture
Solutions





Master Builders Solutions from BASF

Building on partnership. Our Master Builders Solutions experts find innovative and sustainable solutions to meet your specific construction needs. Our global experience and network help you to be successful – today and tomorrow.



Master Builders Solutions

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 and protection solutions, performance grouts, performance flooring solutions.



Zero Energy System and Crystal Speed Hardening

The Industry Standard for Precast Production

Precasting is characterized by a great number and variety of types of components and production processes: unreinforced, non-prestressed and prestressed, post-tensioned – just about everything is possible.

Despite all this diversity, the precast industry consistently follows the same goal: manufacturing, addressing the four main challenges for a sustainable construction industry:

- efficient processes
- energy reduction
- material optimization
- high quality specs

In today's competitive environment, especially during periods of weak macroeconomics, the industry's major concern is to balance this commitment with the best possible cost effectiveness and maximum production flexibility. Therefore, accelerated concrete hardening at early ages is a target for saving time and money. Precast manufacturers must maintain their profitability in the face of rising material, labor and equipment costs during a period of falling prices, and quickly adapt, their activity to the challenging economic environment.

High early strength development is of key importance for precast producers. In a capital-intensive industrialized production process with high quality control, the critical economic factors are fast re-utilization of formworks and a high, continuous and adaptable output with the lowest possible production effort. The need for fast strength development makes the best suitable mix design a prerequisite. In precast, CEM I 52.5 R is most commonly used, while the European cement and concrete industry aims to use more and more binding material with reduced clinker content.

To meet all of these partially contradicting requirements, we offer two new solutions to the industry: the Zero Energy System and the Crystal Speed Hardening concepts, which are based on unique technologies.

In-depth understanding of the precast industry

Our team supports you with realistic solutions specifically catered to the precast industry. To complement our fluid concrete solutions, we also offer reinforcement solutions with MasterFiber, a wide range of release agents with

MasterFinish, and protective and repairing solutions with MasterKure, MasterLife, MasterProtect and MasterGrout. This complete product portfolio makes BASF the ideal solution provider for the precast industry.



Zero Energy System – MasterGlenium ACE

Our Zero Energy System from Master Builders Solutions takes into consideration all aspects for the production process for precast elements. Thanks to our Zero Energy System, vibrations are eliminated, energy consumption and labor are reduced and the durability of the concrete itself is also enhanced.

Its key element is MasterGlenium ACE, a latest generation high performance PCE superplasticizer, especially developed by experts for precast applications.

Energy in the sense of our Zero Energy System comprises the minimization of all the energy mobilized in precast production, i.e. stored in the final precast element; not only fossil fuels and electricity must be considered as forms of energy, but also aspects of direct labor, material consumption and productivity.

MasterGlenium ACE molecules are rapidly adsorbed on the surface of the cement grains and act to powerfully disperse the individual particles of cement. The molecular structure of polymers is essential early strength development. With conventional PCE superplasticizers, the molecules cover the entire surface of the cement grain and build a barrier against contact with water, significantly slowing down the hydration process.

The unique, proprietary molecular structure of MasterGlenium ACE exposes more of the surface of the cement grains to react with the water. As a result of this effect, it is possible to obtain earlier development of the heat of hydration, faster development of the hydration products and, as a consequence, higher strengths at a very early age. This advantage can even be utilized at low temperatures.





Crystal Speed Hardening – Master X-Seed

Our Crystal Speed Hardening concept enables more sustainable concrete production thanks to the unique technology of Master X-Seed, a new hardening accelerator. With it, the concrete industry will be able to save time and money while reducing CO₂ emissions at the same time.

Master X-Seed consists of synthetically produced nanoparticles suspended in a liquid and boosts the hardening properties of the concrete mix. While traditional acceleration methods such as heat application or common accelerators typically affect concrete's cost and durability, Master X-Seed brings a level of hardening acceleration to the mix that supports natural hydration and long-term performance properties by offering an attractive cost saving potential. A previously unattainable hardening boost at all temperature levels is achieved at an early age (6–12 hrs) due to the powerful

seeding of the mix design, which is also able to support the final performance of the specified concrete.

For instance, with Master X-Seed power, you will be able to manufacture a new concrete product needed for just one project without being forced to make an important investment in thermal treatment equipment. This means that the precast plan can adapt itself to the market demand in a much more flexible and economical way than before. New things are possible in the precast area.

The Crystal Speed Hardening concept exceeds and strengthens all existing solutions for key industry needs and is fully compatible with other Master Builders Solutions products, such as MasterGlenium and MasterFiber.



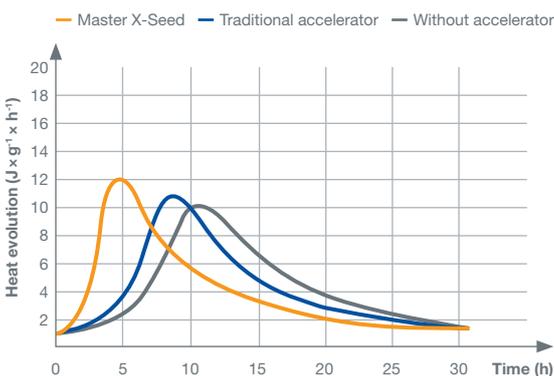
Our reference in the Czech Republic: Bridge over Rybný potok at D8 highway



Mechanism of Action – Master X-Seed

In standard cement hydration, the main clinker phases C_3S and C_2S react with water to form Calcium Silicate Hydrate (CSH) crystals and Calcium Hydroxide. The nucleation of the CSH crystals is an exothermic reaction, which occurs on the cement grain surface and requires overcoming some activation barriers for further growth.

Heat evolution – Accelerator effect (380 kg/m³ CEM I 52.5 R)

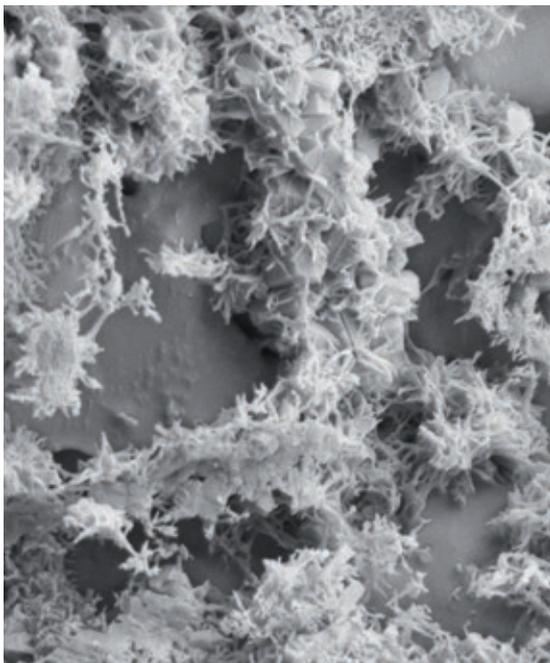


Crystal seeding

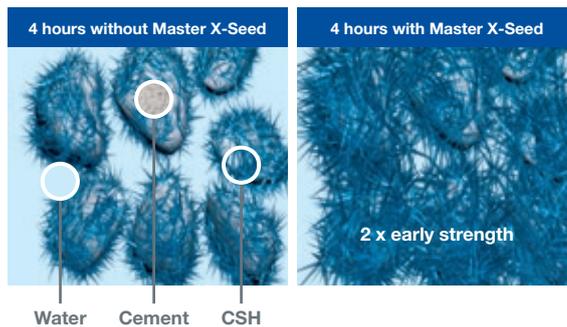
With Master X-Seed it is possible to suspend extra fine, synthetically produced CSH crystals in a ready-to-use admixture suspension and use them as seeding material in the pore solution between the cement grains. The active CSH crystals can virtually grow without an energy barrier. This method is known as crystal seeding.

It was found that the crystals show preferential growth behaviour in between and not on the surface of the cement grains. Therefore, the growth of the crystal structure is far quicker and earlier hardening as well as earlier strength development are observed.

The final, hydrated cement paste shows no microstructural changes compared to standard hydrated cement. In fact, the density of CSH crystals may actually improve the quality of the hardened cement paste and provide durability benefits.



CryoSEM of Master X-Seed: Active crystals growing in between the cement grains



Schematic view of CSH crystals in cement & water pore solution

The unique Master X-Seed technology provides an unmatched speeding up of the hydration process at early ages and as a result of many production processes. It is based on BASF proprietary technology which ensures a stable suspension of synthetically produced crystalline CSH nanoparticles. These particles act as active seeds in the concrete mix. Master X-Seed is active at all concrete temperatures, for example in winter, summer and under steam curing conditions.



Benefits

Productive, Economical, Vibrationless

Increased productivity

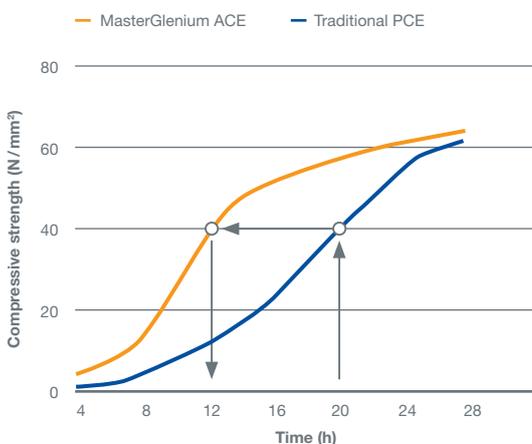
Productivity in the precast industry is directly dependent on the speed at which concrete cures, regardless of which manufacturing process is used.

Thanks to its unique principle of acting on the cement particles, MasterGlenium ACE significantly increases hydration kinetics without disturbing hydrate morphology. The natural exothermic heat produced in the first few hours is capable of speeding up the crystallization processes, developing faster material strength.

The substantial improvement in performance in comparison with traditional superplasticizers therefore optimizes the efficiency of the mix and reduces the production cycle, potentially doubling output!

Early strength development

(fluid concrete 350 kg CEM I 52.5 – 20 °C)



Minimized heat curing

The energy required for heat curing is one of the key parameters when calculating the cost of precast concrete elements. It is therefore an important economic factor. One of the objectives of the Zero Energy System is to optimize the amount of energy required in the production cycle to achieve specification requirements. The action of the unique MasterGlenium ACE polymer combined with Master X-Seed and the control of manufacturing and placing parameters allows optimum use of natural energy for hydration, making it happen sooner! External energy supplies can therefore be reduced or eliminated, removing the need for heat curing. This feature of the Zero Energy System not only saves you money; it also impacts on the durability of concrete by limiting any microcracks that may result from heat curing (thermal shock, temperature gradient, desiccation, etc.).

Elimination of vibration

The energy required to place concrete is a further key factor in calculating the cost of precast elements. However, vibration is also a recognized nuisance factor: noise for workers and nearby residents plus the physical stress for people involved in placing concrete.

One further advantage of the Zero Energy System is its ability to eliminate the energy required to place precast concrete.

The flow and water reduction action of MasterGlenium ACE enables the robust and direct formulation of self-compacting concretes, which can be placed without vibration when combined with a compatible manufacturing process.



Benefits

Cost Efficient, Energy Saving, Sustainable

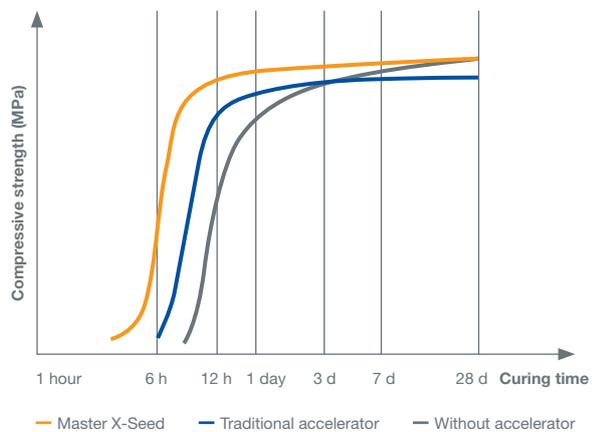
Speed and flexible process:

The essential performance benefit of this innovative concept is fast strength development at early ages of hydration at low, ambient and heat curing temperatures. Increased productivity has a direct impact on cost efficiency. The flexibility to increase capacity quickly is required, especially when unexpected high volume demands are faced. With Master X-Seed, no extra installations are needed to reach this target. In addition, in low demand or crisis times, the optimization of production capacity is essential. Master X-Seed offers you faster processes and increased production output within the regular production setup. Double rotation may lead to tailored formwork use, facilitating work with fewer forms or using existing forms more frequently.

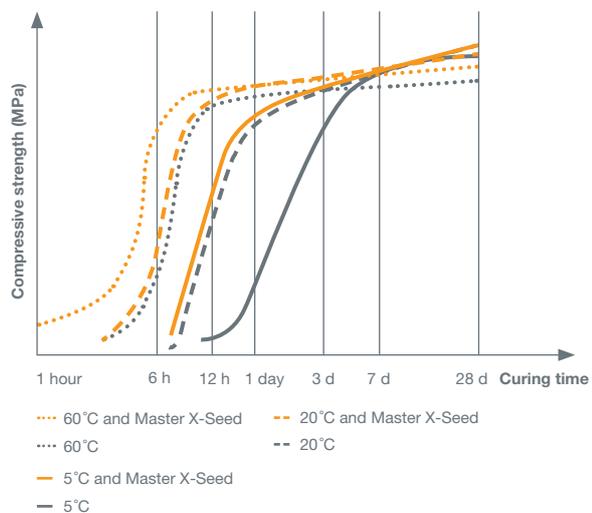
Hardening benefit – Energy reduction:

Heat curing is an energy and cost intensive method to achieve higher early strength development, mainly during winter periods or when more production cycles are required to satisfy high market demands. However, the application of direct or indirect heat to the concrete has to be well controlled in order to minimize durability risks (internal stresses, delayed ettringite formation). With Master X-Seed, you will be able to eliminate or reduce additional heat curing of concrete, thus saving the installation cost of heat curing equipment and reducing CO₂-related emissions.

Strength development – Accelerator effect (fluid concrete with 380 kg/m³ CEM I 52.5 R)



Strength development – Temperature effect (fluid concrete with 380 kg/m³ CEM I 52.5 R)



Hardening benefit – Material optimization:

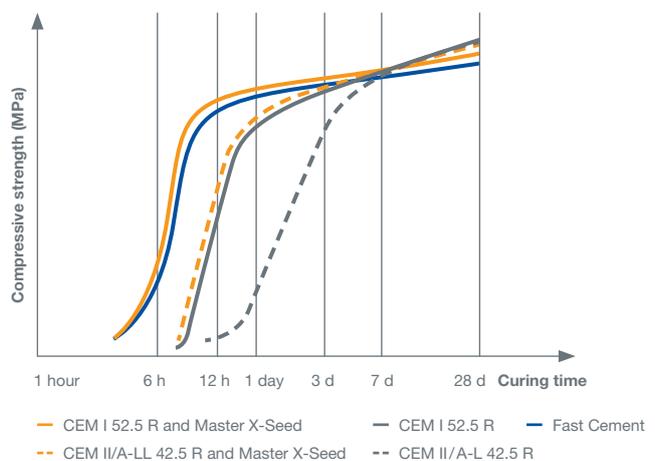
Composite cements and the use of Supplementary Cementitious Materials (SCMs) are important tools in optimizing mix designs to achieve specific performance requirements. However, this typically comes at the expense of the early strength development needed for precast operations and needs to be compensated for by higher amounts of binder material. Master X-Seed allows dedicated binder optimization without losing early strength behaviour or changing fresh concrete performances. This has a quantifiable, positive impact on final strength and contributes to lower CO₂ plant emissions. Optimal mix designs are achieved according to state-of-the-art concrete technology rules and the addition of Master X-Seed.

Hardening benefit – High quality specs:

Master X-Seed strengthens the interparticle bond because of the crystal formation power of the active CSH seeds. This has a positive impact on shrinkage and crack behaviour as well as on the property of reduced water absorption. Its combined use with SCMs strengthens durability characteristics and supports the overall life cycle of the concrete. More and more, high quality specifications for concrete include ecological aspects and require an optimized ECO-profile (balanced ecologic benefit versus economic cost over the full life cycle). With Master X-Seed, the concrete producer has all the means to contribute to a more sustainable concrete production as evidenced by the certified, in-depth Social-Eco-Efficiency Analysis, the BASF SEEBALANCE.

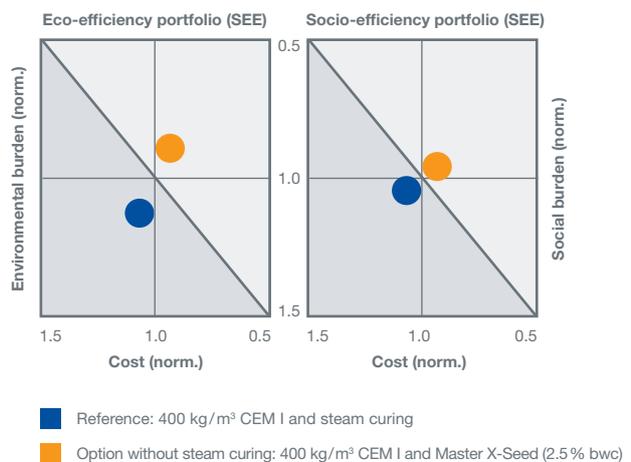
Strength development – Cement effect

(fluid concrete with 380 kg/m³ CEM I 52.5 R)



SEEBALANCE

Elimination of steam curing by use of Master X-Seed



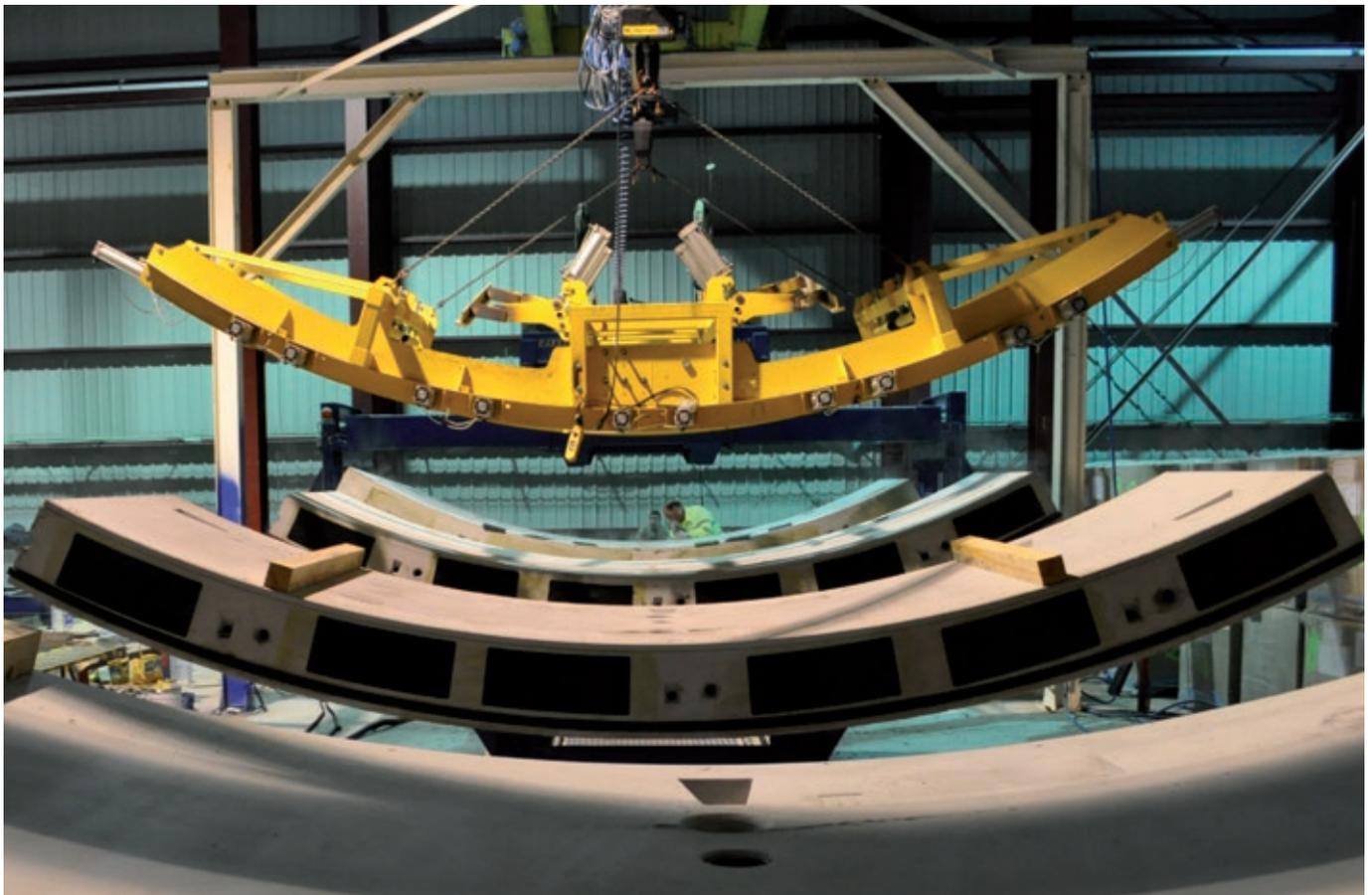


Connectedness at all Levels

Our mission

At BASF our mission is to engineer materials to match the needs of the end user. We add value to our customers through continuous targeted research and development. Our R&D teams are connected to partners who are globally recognized for their chemistry leadership, design insight and unsurpassed application abilities. Always focused on customer needs, the experts at Master Builders Solutions from BASF raised the benchmark for the performance of concrete through painstaking research from the molecular

level to the finished solution. In the precast sector, there is a constant need for overall process improvement to increase quality and productivity within tight production timeframes, while managing costs. Under the Master Builders Solutions brand, we have developed a comprehensive range of products and systems that address these challenges, redefining industry standards for the quality, safety and production efficiency of precast concrete.



Our reference in Barcelona (Spain): Arch bricks, La Sagrera metro station



Master Builders Solutions from BASF for the Construction Industry

MasterAir

Complete solutions for air entrained concrete

MasterBrace

Solutions for concrete strengthening

MasterCast

Solutions for the manufactured concrete product industry

MasterCem

Solutions for cement manufacture

MasterEase

Low viscosity for high performance concrete

MasterEmaco

Solutions for concrete repair

MasterFinish

Solutions for formwork treatment and surface improvement

MasterFlow

Solutions for precision grouting

MasterFiber

Comprehensive solutions for fiber reinforced concrete

MasterGlenium

Solutions for high performance concrete

MasterInject

Solutions for concrete injection

MasterKure

Solutions for concrete curing

MasterLife

Solutions for enhanced durability

MasterMatrix

Advanced rheology control for concrete

MasterPel

Solutions for water tight concrete

MasterPolyheed

Solutions for mid-range concrete

MasterPozzolith

Solutions for water-reduced concrete

MasterProtect

Solutions for concrete protection

MasterRheobuild

Solutions for high strength concrete

MasterRoc

Solutions for underground construction

MasterSeal

Solutions for waterproofing and sealing

MasterSet

Solutions for set control

MasterSuna

Solutions for sand and gravel in concrete

MasterSure

Solutions for extraordinary workability retention

MasterTop

Solutions for industrial and commercial floors

Master X-Seed

Advanced accelerator solutions for concrete

Ucrete

Flooring solutions for harsh environments

BASF plc

Construction Chemicals

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