



CONCRETE SIKA WET PRECAST TECHNOLOGY

BUILDING TRUST





BENEFIT OF OUR SOLUTION

HIGH QUALITY, INCREASED DURABILITY AND HIGHLY EFFICIENT PRODUCTION

In precast concrete industry concrete elements are produced with high requirements on quality and durability. The production needs to be highly efficient and the producers aim to increase the output with constant quality. Especially the surface requirements are high as this is the calling card of the producer.

With Sika® ViscoCrete® Technology the water can be reduced and higher strength and improved durability can be achieved. The efficiency of the production process can be optimized with SikaRapid® Technology as the hardening process of the concrete is accelerated. Next to admixtures which are dosed directly into the concrete Sika offers a large variety of products improving the quality and the efficiency of the production process, like products for formwork preparation, products for repair and protection as well as sealing and bonding products.

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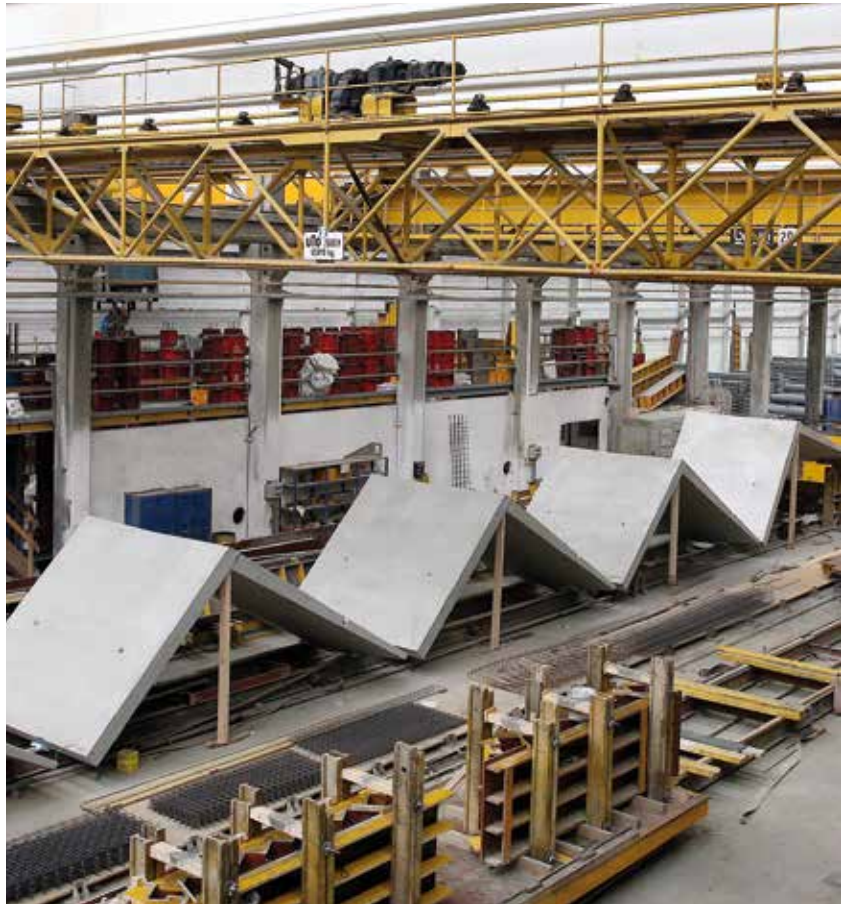


WET PRECAST CONCRETE

IN THE PRECAST CONCRETE INDUSTRY, a concrete element producer sells a finished technical product, though its quality and surface appearance are the producer's calling card. The precast concrete element producer bears responsibility for technical performance, compliance to standards and durability of products. The production process for precast concrete elements is increasingly industrialized, and efficiency is essential.

Because they execute the entire production process, precast concrete element manufacturers encounter myriad requirements. In addition to being efficient the production process should be sustainable and environmentally friendly, holding the CO₂ footprint of the product to a minimum. Besides ecological concerns, health and safety of workers also continue to grow in importance. Structural design and construction with precast concrete elements requires versatile chemical products, from wet precast production to erection on site. Sika, a full range supplier, meets the diverse complexity of the entire precast concrete element production and construction process with solutions for all requirements.

SIKA, A FULL RANGE SUPPLIER, MEETS THE DIVERSE COMPLEXITY OF THE ENTIRE PRECAST CONCRETE ELEMENT PRODUCTION.



Concrete Structure	Surface Appearance	Repair and Protection	Sealing and Bonding
Sikament®	Sika® Separol®	Antisol®	Sikaflex®
Sika® ViscoCrete®	Sika® PerFin	Sikagard®	Sikadur®
SikaRapid®	Sika® Rugasol®	Sika MonoTop®	Sika® AnchorFix®
Sika® Stabilizer	SikaColor®	SikaGrout®	
SikaFume®			

THE INNOVATIVE CONCRETE CONCEPT

THE CONCRETE CONCEPT drives a precast concrete element production process and has essential impact on process timing. Concrete production, installation and curing must therefore be kept as short as possible.

This has consequences regarding concrete technology. Requirements influencing precast concrete production are excellence of concrete surface appearance, high compressive strength and high durability. The production steps of batching and mixing, transport, compaction and finishing must also be considered within a concrete concept.

With advanced concrete technology and suitable admixture application, adequate workability, rapid installation and subsequent fast strength development of the concrete can be ensured whereas fast strength development is critical for swift production. Application of innovative concrete mix designs such as Self Compacting Concrete (SCC) offer further advantages. Besides rapid installation, vibration work can be eliminated, substantially improving the working environment in a precast concrete factory.

The latest concrete admixture technology can improve concrete production and achieve the following advantages:

- Cost efficient concrete mix designs
- Production of high strength, highly durable concrete
- Application of Self Compacting Concrete
- Reduction or elimination of heat or steam curing
- Sustainable and environmentally friendly production

INNOVATIONS LIKE SELF COMPACTING CONCRETE OFFER AMAZING ADVANTAGES.



SUPERPLASTICIZER TECHNOLOGY

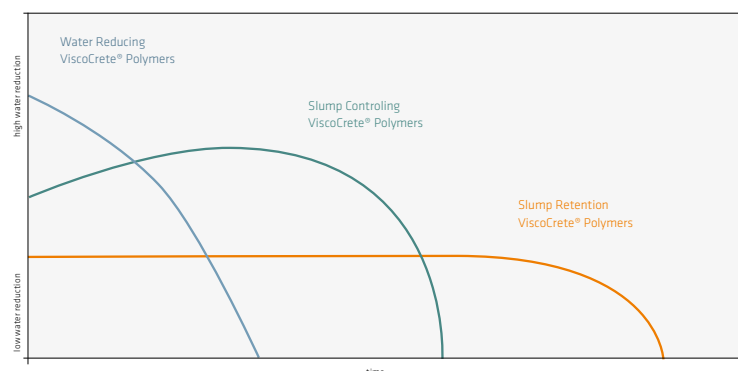


HIGH STRENGTH CONCRETE types are used increasingly in the precast concrete business. The quality of the final element, and thus the quality of the concrete, play central roles. Concrete quality and durability are therefore constantly improved.

Precast concrete plant processes are evermore industrialized. Timing is more and more important. Concerns regarding factory working environments are rising. Innovative technologies and concrete types such as Self Compacting Concrete are being utilized, which result in improved working conditions, since vibration work is eliminated and noise thereby significantly reduced. Superplasticizers based on polycarboxylate ether (PCE) technology contribute to these developments and factors. Their application is becoming indispensable.

The Sika® ViscoCrete® product range is an innovative PCE based admixture technology capable of offering solutions to all precast concrete production challenges. The application of Sika® ViscoCrete® can ensure substantial water reduction with adequate workability and slump life in combination with fast early strength development. Sika® ViscoCrete® technology enables the design of polymers in direct regard to fresh and hardened concrete performance. Furthermore, technologies can be combined, allowing easy adaptation of solutions to changing production circumstances.

SIKA'S LATEST SUPERPLASTICIZER TECHNOLOGY OFFERS SOLUTIONS TO ALL PRECAST PRODUCTION CHALLENGES.



ACCELERATION

THE CONCRETE HARDENING PROCESS is a time-consuming step within precast concrete production. On one hand it is important to reduce the hardening time, which is almost always carried out with the application of heat or steam curing – both highly energy-consumptive measures.

ACCELERATED HARDENING IN COMBINATION WITH RESOURCE-FRIENDLY PRODUCTION.

On the other hand energy efficient and environmentally friendly production processes are gaining importance. Production must be both cost effective and have a small CO₂ footprint. With sound concrete mix design, innovative superplasticizer technology and powerful accelerator technology, the whole production process can be significantly optimized and the energy consumption for heat or steam curing respectively can be either reduced or even eliminated.

The SikaRapid® technology offers accelerated hardening with no loss of slump life. As a result this technology provides solutions for accelerating performance of all concrete types according to different production conditions. Optimized hardening performance of concrete can reduce or eliminate heat or steam curing, speed the turnaround of formwork, making it more efficient and ultimately increasing productivity.



EXAMPLE TUNNEL SEGMENT PRODUCTION

In tunnel segment production there are two key parameters. On one hand it is extremely important to realize a specified early strength, while on the other tunnels as complex constructions must fulfill the highest requirements with regard to durability. The concrete performance regarding these two demands can be enhanced with SikaRapid® technology.

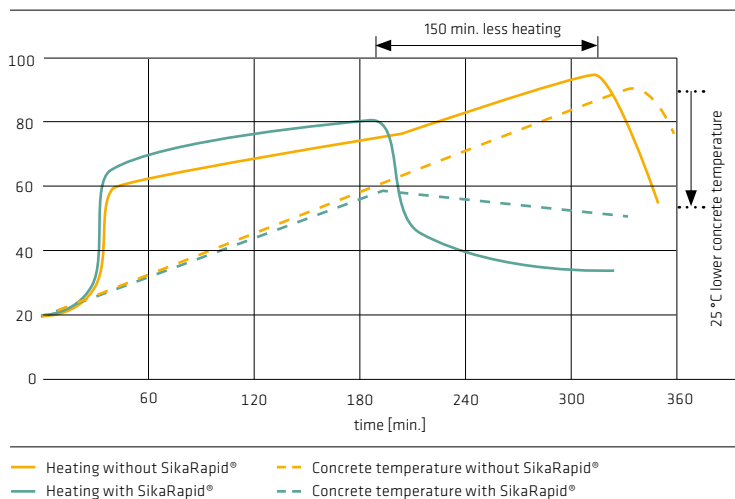
The fulfillment of the first target could be achieved by incorporating heat curing in the tunnel segment production concept. In order to reach an early strength of more than 25 MPa it was necessary to apply a heating sequence of more than 5 hours. With the application of SikaRapid® the hardening process of concrete was optimized, with the result that approximately 150 minutes of heating could be eliminated.

At the same time the early and final strength requirements were attained. Moreover the durability of the tunnel segments was improved as the concrete peak temperature was limited

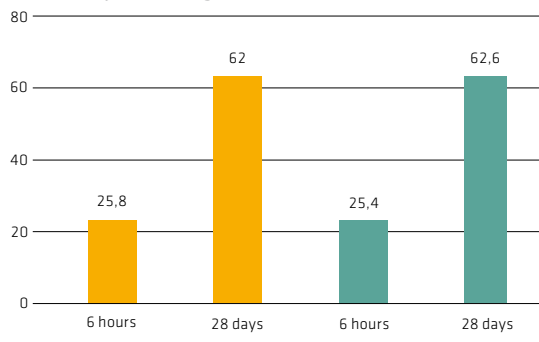
to less than 60 °C. Thereby a significant reduction of more than 25 °C concrete temperature could be realized. Overall the energy consumption of the tunnel segment production process could be substantially reduced. This approach demonstrates a high degree of sustainability.



Concrete temperature development in [°C]



Concrete compressive strength [MPa]



DESIGN AND PROTECTION OF CONCRETE SURFACES

FAIR-FACED CONCRETE SURFACES are looked on as aesthetical only if their appearance is pleasing. Thus the design of a desired surface appearance extends beyond basic design criteria to the curing of concrete surfaces within precast concrete production.

During the hardening process, unprotected concrete surfaces dry out prematurely. In order to avoid this effect concrete surfaces can be protected with Sika® Antisol®.

Regarding the design of concrete surfaces different requirements can be of interest, which are almost always diverse and individual. The fulfillment of individual expectations with regard to concrete surface appearance can be attained through the following measures or a combination thereof:

- Finishing of surfaces instantly after concrete installation
- Deliberate selection of formwork surface
- Subsequent treatment of concrete surfaces
- Composition in terms of color

Sika supports diversity with selective application of products and technologies. While Sika® ColorFlo® opens opportunity for concrete color design with different tones, it is possible to realize fascinating exposed aggregate concrete surfaces with the application of Sika® Rugasol®. Mechanically treated or handcrafted, structured concrete surfaces are often underestimated and characterized by a high degree of surface appearance quality. This appearance can be reached with a broom finish or special trowel treatment on a concrete matrix which is prepared with SikaFilm®.

To bring the design of molded concrete surfaces to perfection the interaction of concrete mix design, installation technique, formwork type as well as concrete compaction has to be considered with highest priority. High quality concrete surfaces can be achieved with the correct application of the suitable Sika® Separol® technology or with Sika® PerFin® already in the concrete mix design. Based on Sika® ViscoCrete® technology it is possible to realize complex architectural shapes as well as slender, aesthetic concrete elements with a dense reinforcement.

**FLEXIBLE PROCESSING
OF CONCRETE
SURFACES FULFILLS
INNUMERABLE
CUSTOMER
REQUIREMENTS.**

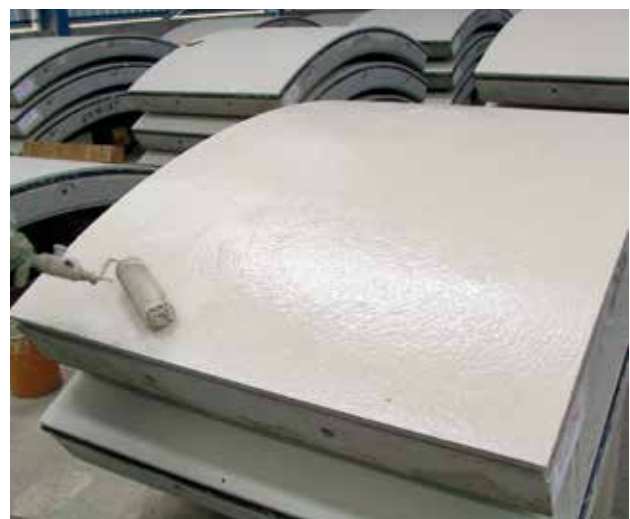


REPAIR AND PROTECTION

THE PRECAST CONCRETE ELEMENT SURFACE appearance is the calling card of a precast producer. This places high quality requirements on the precast concrete production process. Nevertheless surface defects and broken or spalled edges are unavoidable in production.

The repair of defects requires a repair mortar that is easily and quickly applied as well as being highly durable. Moreover, defects should not be detectable following repair; the mortar must present a crack-free and adequate concrete surface appearance. These requirements can be fulfilled with Sika MonoTop® repair mortar range. In order to prolong the durability, ensure the brightness of colored concrete elements and avoid the formation of dirt and moss, a protective system should be applied. The Sikagard® range of protective systems, easily and rapidly applied, ensures the longevity of precast concrete elements, and the surface appearance can be significantly improved for an extended period of time. With the cement based grout injection SikaGrout®-300 PT Sika provides a durable, well-proved solution to fill post-tensioning ducts to protect steel tendon against corrosion.

**FAST AND EASY
REPAIR OF DEFECTS
AND EXTENDED
LONGEVITY WITH
SIKA PRODUCTS.**



DURABLE SEALING OF PRECAST ELEMENTS

The building blocks of a structure or building, like precast concrete elements or windows, generally do not let water enter into the building. It is at the joints where a building is weakest to leakage.

Therefore Sika has a dedicated range of sealants with excellent adhesion on concrete, high movement capability and outstanding weatherability for precast construction.

The assembly of structures and buildings from precast concrete elements leads to joints which have to be sealed to ensure water and air tightness. These joints are under con-

stant movement due to thermal expansion of the elements, mechanical loads, vibrations or environmental impacts. Only a high quality elastic sealant will be able to durably compensate this. With Sikaflex® and SikaHyflex® quality sealants you are on the safe side.

Sika sealants have a long history and countless references in joining precast elements in many applications and comprises solutions for facade, interior sealing and floor joints. Sika products cover different movement classes, chemical resistances, fire resistances and price levels.



PRECAST – RIGID BONDING

The erection of structures and buildings out of precast concrete elements requires also structural connection joints, which must be glued to ensure function with respect to load transfer, water tightness and filling of voids. This combination of several elements with non-moving, stiff joints is important in various projects.

Sikadur® epoxy adhesives are applied between the hardened precast units as they are assembled to seal the joints, provide a uniform surface bearing area for assembly without damage and to help distribute the stresses uniformly.

The Sikadur® product range fulfills all the challenges of these requirements; it offers various technologies for long lasting rigid bonding of precast elements, e.g. segmental bridge elements.

In the Precast Industry, the Sikadur® can furthermore be used to rebuild broken edges and effectively repair defects.

Other applications for bonding concrete elements with Sikadur® adhesives are important in many further areas such as fixing of different concrete elements to one unit, concrete pipes, retaining walls, tanks etc.

They also have excellent adhesion to many other construction materials and can be used to bond different substrates.

Additional to adhesives for structural bonding of various substrates, Sika also offers bonding bridges for the connection of old and new concrete, as well as epoxy based mortars for fast repairs.



FORMWORK PREPARATION

THE USE OF MOLD RELEASE AGENTS is imperative for production of long-lasting, high quality concrete products. Agent application must be fast, safe and easy.

Only mold release agent technology adapted to the production process offers safe, thin-film application and ensures high quality concrete surfaces. Ease of thin-film application is crucial, because film thickness is decisive for achievement of high quality concrete surfaces.

The Sika® Separol® product range offers technologies for fast, safe and easy thin-film application of oils. Based on various technologies, the product range can fulfill the comprehensive and specific needs of differing production conditions. Optimal results in release performance and high quality surface appearance can be achieved with Sika's water-based emulsion technology Sika® Separol® W.

HIGH QUALITY CONCRETE SURFACES WITH INNOVATIVE MOLD RELEASE AGENT TECHNOLOGY.



REQUIREMENTS AND APPLICATION

REQUIREMENTS

The wet precast concrete industry is characterized by the production of high quality concrete elements in an industrialized production process. Quality demands focus on both, the technical performance as well as the surface appearance of finished concrete products, including the application of colored concrete. Continuous improvement of the production process leads to innovative solutions in manufacturing, placement and finishing, as well as property advances in strength development or treatment steps such as curing.

High quality concrete element production in an industrialized process demands:

- Excellent fair-faced concrete surface appearance of the finished element
- Fast installation of the fresh concrete
- Early and fast finishing
- Rapid early strength development
- Swift and easy application of any repair mortar and protection agents

The need for efficiency in the production process raises additional requirements:

- Safe and easy application of mold release agents
- Cost efficient concrete mix design with optimized utilization of all constituent materials
- Early strength gain with reduced or eliminated heat and steam curing

The overall sustainability of the entire production and construction process is gaining importance; demands on the process and improvements thereof must respond adequately.

APPLICATIONS

The innovation and development of superplasticizers based on polycarboxylate ether (PCE) play a major role in enhancing both – technical performance of concrete and the production process. The application of PCE-based superplasticizers such as Sika® ViscoCrete® technology enables production of high performance concrete types like Self Compacting Concrete, High Strength Concrete and Ultra High Performance Concrete. High quality concrete surface appearance is strongly dependent on the type and application of a mold release agent. Sika® Separol® product range offers solutions for all precast concrete production needs.

Challenging requirements with regard to early strength development of the concrete can be fulfilled with a suitable concrete mix design in conjunction with powerful superplasticizer and hardening accelerator technologies, Sika® ViscoCrete® and SikaRapid®.

The building industry recognizes the growing importance of sustainability for the whole production and construction process. Within the wet precast concrete industry, several opportunities are at hand to reduce the CO₂ footprint of construction overall and improve the working environment.

Opportunities for sustainable wet precast concrete production include:

- Application of a resource-friendly mold release agent: Sika® Separol® W technology
- Mix design adaptation regarding optimized binder usage, facilitated by Sika® ViscoCrete® technology
- Elimination of steam and heat curing with the application of Sika® ViscoCrete® technology and SikaRapid® technology
- Elimination of vibration with the application of Self Compacting Concrete
- Sealing and bonding of the precast concrete elements with sustainable, long-lasting sealing and bonding technologies like Sikaflex® and Sikadur®



SUSTAINABILITY AND COST OPTIMIZATION

SUSTAINABLE PRODUCTION, ENERGY SAVINGS and reduction of CO₂ emissions are ever-present topics – also gaining importance in the concrete industry, including the wet precast sector. Several measures are possible in precast concrete plants to save resources, thereby conserving energy and enhancing the sustainability of the production process.

Heat and steam curing are used in concrete element production to attain a required early strength within a short period of time. The implementation of optimized concrete mix designs in combination with innovative admixture technologies enable reduction or elimination of heat and steam curing.

INNOVATIVE ADMIXTURE TECHNOLOGIES ALLOW THE REDUCTION OR ELIMINATION OF HEAT AND STEAM CURING.



EXAMPLE – ENERGY SAVINGS FACILITATED BY SIKA ADMIXTURES

A wet precast concrete element manufacturer was producing various wet precast concrete elements such as columns, prestressed beams, precast panels as well as special parts.

The production of several elements required steam curing. The volume of steam cured concrete amounted to 40,000 m³ per year. Steam curing was necessary for release of formwork after 3 hours and cutting of tendons after 14 hours.

In addition to energy costs for steam curing, the process generated expenses for maintenance of steam distribution, water desalination and maintenance of four steamers.

The cost structure of the production process was as follows:

Total energy cost for steam curing	260,000 €	per year
Steam cured concrete	40,000 m³	per year
Energy cost	6.5 €	per m ³
Raw material cost of concrete	52 €	per m ³
Total concrete cost	58.5 €	per m³

The customer sought a solution that offered elimination of the steam curing process. The Sika solution was a concrete concept based on Sika® ViscoCrete® as well as SikaRapid® technology. With the application of Sika® ViscoCrete® technology it was possible to reduce the water-/cement ratio at ensured workability performance, resulting in a slump of 240 mm. In addition, SikaRapid® offered significant early strength development that eliminated the need for steam curing.

Characteristics after the introduction of Sika® ViscoCrete® and SikaRapid® as well as omitted steam curing:

	W/C	Sika® ViscoCrete®	SikaRapid®	Cost per m ³
Initial mix	0.4	0.46% b.w.o.c.	–	58.5 €
SikaRapid® mix	0.37	0.70% b.w.o.c.	1.0% b.w.o.c.	55.5 €
Net savings per m³				3.0 €

The total savings amounted up to **120,000 € per year.**

REFERENCES

BONNA SABLA, FRANCE – A FULL RANGE SOLUTION

PRODUCER

Bonna Sabla is a major wet and semi-dry precast concrete element producer in France belonging to the Consolis group. This company offers all kinds of precast concrete solutions from planning, over production of precast elements to erection of the precast parts on site.

PROJECT AND REQUIREMENTS

This challenging project was the planning and production of shower cabins for prisons. Due to the special exposition of these elements they had to be strongly resistant to vandalism and should be maintenance-free. The total project included the production of over 650 double modules and 130 single modules, each weighing 4.5 tons. Built-in parts had to be installed with highest degree of safety as well as durability, because any removal of these parts needed to be avoided.

SIKA SOLUTION

The shower cabins were produced with high strength Self Compacting Concrete (SCC). With the application of an innovative admixture combination it was possible to produce an early strength SCC with significant fresh concrete stability, facilitated by Sika® ViscoCrete® KRONO-20 HE, Sika® SET-2 as well as Sika® Stabilizer -300. The hardened concrete characteristics were realized with the application of Micro Silica in combination with Sika® Fibre CERACEM PVA RF1000, which led to compressive strength of more than 70 MPa after 28 days, with flexural strength of 6 MPa.

The installation of the built-in parts was carried out with SikaBond® T2 and AnchorFix®-3+. These two products offer the fast and easy installation of any built-in parts. Moreover a high degree of safety and durability is ensured.



CASE STUDIES

DUBAI METRO



PROJECT

The Dubai Metro is a 2.7 billion € infrastructure project, which once in full service is projected to carry approximately 1.2 million passengers per day. It will consist of four lines whereby the red and green lines are under construction and started operation in September 2009 and March 2010 respectively. The elevated sections will have a total length of 58.7 km and the two lines will provide an underground system of 12.6 km. The tunnels of both lines are constructed with Tunnel Boring Machines (TBM) and subsequently lined with precast concrete segments. The volume of concrete for the precast concrete tunnel segments of the Dubai Metro project amounts to a total of more than 130,000 m³, corresponding to an impressive number of more than 53,000 units.

The elevated sections of the Metro Dubai are designed as a trough bridge construction consisting of pre-stressed, precast concrete segments. The required 17,000 viaduct elements representing 700,000 m³ of concrete have a width of 10.18 meters and can reach a maximum weight of over 80 tons.

REQUIREMENTS

The production of precast concrete tunnel segments is an automated industrialized process that must meet the highest specifications regarding concrete quality and surface appearance. The precast concrete must gain a compressive strength of more than 10 MPa within 12 hours including steam curing. The precast concrete for the viaduct segments must also fulfill high specifications regarding surface appearance. Within

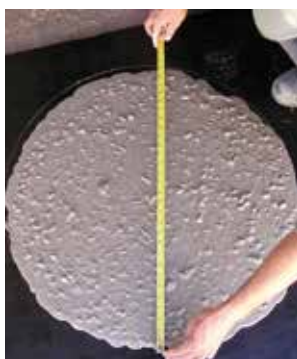
the production of these huge elements the two driving factors sufficient slump-life and early strength development play a major role.

SIKA SOLUTION

The overall quality of the precast tunnel segments was significantly improved and variations of the fresh concrete properties were minimized by executing an extensive testing program and adjusting the concrete mix design. Early strength development was enhanced to meet the specified requirements. Sikament® NN technology facilitated a high slump of approximately 150 mm for over one hour and early strength improvement helped to double the production.

Within the production of the pre-stressed precast bridge elements, the variation in fresh concrete performance was greatly improved. With the application of Sikament® NN and Sikament® NNS during the summer, the slump-life as well as the strength requirements could be fulfilled. Test results show that the Sika technologies ensure the required slump-life of one hour, maintaining a slump of 215 mm at very low water-/cement ratio of 0.29. Compressive strength tests resulted in cube strength of over 70 MPa, which complies with the specifications. Finally a high quality surface appearance is assured to minimize undesired additional cost for repairs.

SUBSTANTIALLY IMPROVED PRECAST PRODUCTION WITH Sika® ViscoCrete®, BRAZIL



CUSTOMER

Munte is a wet precast concrete element producer located in the vicinity of Sao Paulo, Brazil. Munte has been producing beams and columns as well as concrete slabs and tiles in two precast factories for 32 years and is known for high quality concrete products. The plant with column and beam production achieves an output of 30,000 m³ per year.

REQUIREMENTS

The customer was looking for a solution to change the production of structural elements such as columns and beams from conventionally vibrated concrete to Self Compacting Concrete (SCC). Due to the fact that these concrete elements are characterized by congested steel reinforcement, the application of Self Compacting Concrete offered a high potential for improvements within the production. The Self Compacting Concrete should reach a slump flow of 660 – 750 mm and 760 – 850 mm respectively with low viscosity of the fresh concrete. Further, a compressive strength of 50 MPa after 28 days was necessary, with early strength development of more than 21 MPa after 10 hours.

Sika® ViscoCrete® SOLUTION

Sika offered a high degree of support for the development of different types of Self Compacting Concrete (SCC) mix designs, which included the selection of suitable superplasticizers and development of new superplasticizer systems. After 6 months of intensive investigation work the required solutions

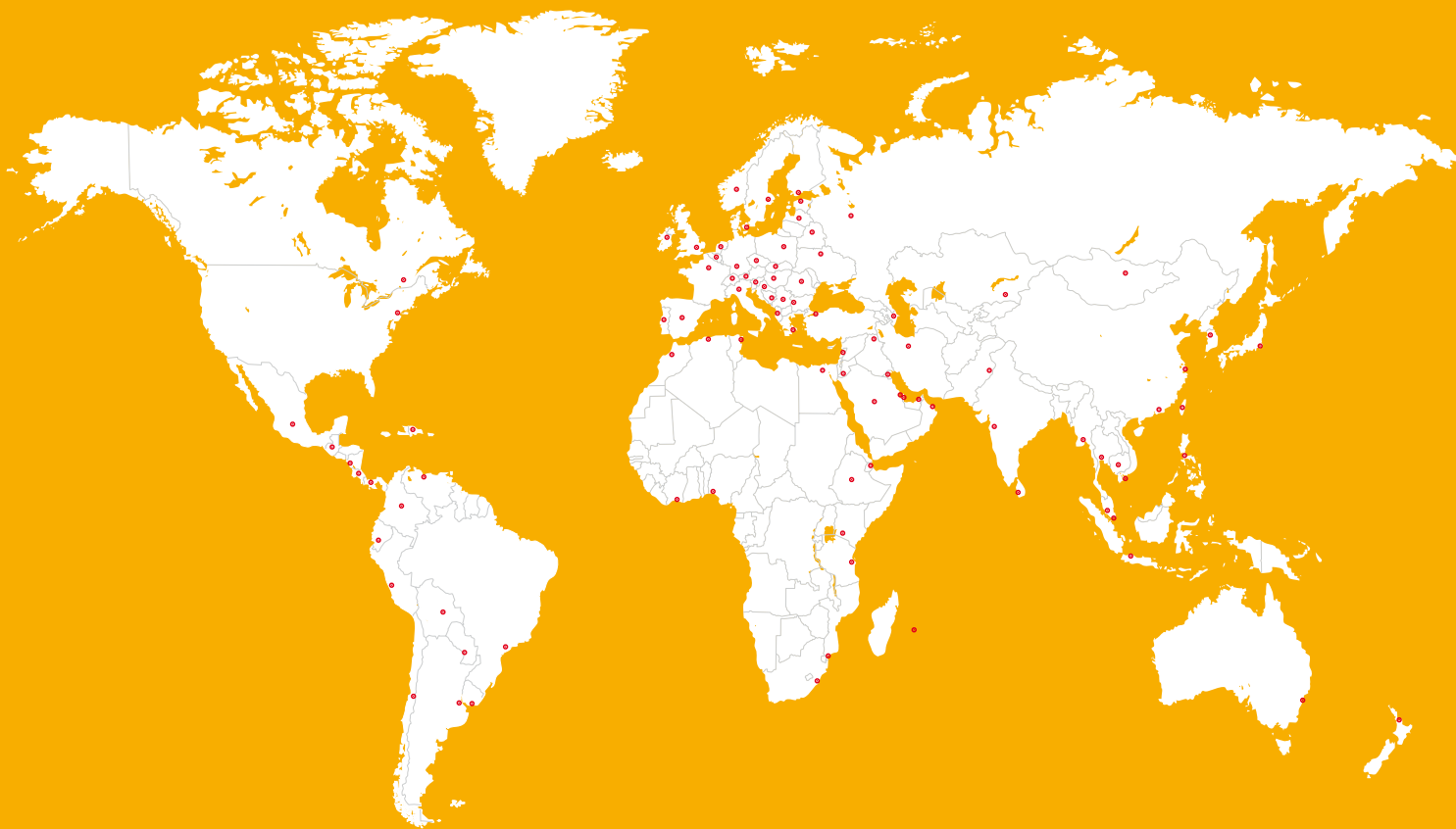
were developed including beneficial procedures for placement and finishing of the fresh concrete.

The range of SCC mix designs used today fulfills the above-mentioned fresh and hardened concrete requirements. The lighter reinforced elements are produced with an SCC at a slump flow of approximately 710 mm using Sika® ViscoCrete® 3535 CB. The heavily reinforced pre-stressed elements are produced with a Self Compacting Concrete, which reaches a slump flow of approximately 800 mm enabled by the powerful liquefying performance of Sika® ViscoCrete®-20 HE.

All mixes are characterized by low viscosity, demonstrated by a t500 time of less than 2 seconds and a V-funnel time of not more than 8 seconds respectively.

With the application of Self Compacting Concrete several improvements of the production process could be achieved. First of all the SCC solution represents a significant enhancement of the overall quality of the precast elements. The use of this innovative concrete also enabled elimination of vibration of the fresh concrete and minimized labor in finishing, which resulted in a labor cost reduction of 30%. In addition, the production capacity of pre-stressed beams could be doubled from 500 m³/month to 1,000 m³/month at constant production time and manpower. Last but not least the application of Sika® ViscoCrete® technology offered the above mentioned improvements and advantages at equal final cost per m³ of concrete due to the potential labor savings for production.

GLOBAL BUT LOCAL PARTNERSHIP



FOR MORE CONCRETE INFORMATION:



WE ARE SIKA

Sika is a specialty chemicals company with a leading position in the development and production of systems and products for bonding, sealing, damping, reinforcing and protecting in the building sector and the motor vehicle industry. Sika's product lines feature concrete admixtures, mortars, sealants and adhesives, structural strengthening systems, flooring as well as roofing and waterproofing systems.

Our most current General Sales Conditions shall apply. Please consult the most current local Product Data Sheet prior to any use.



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