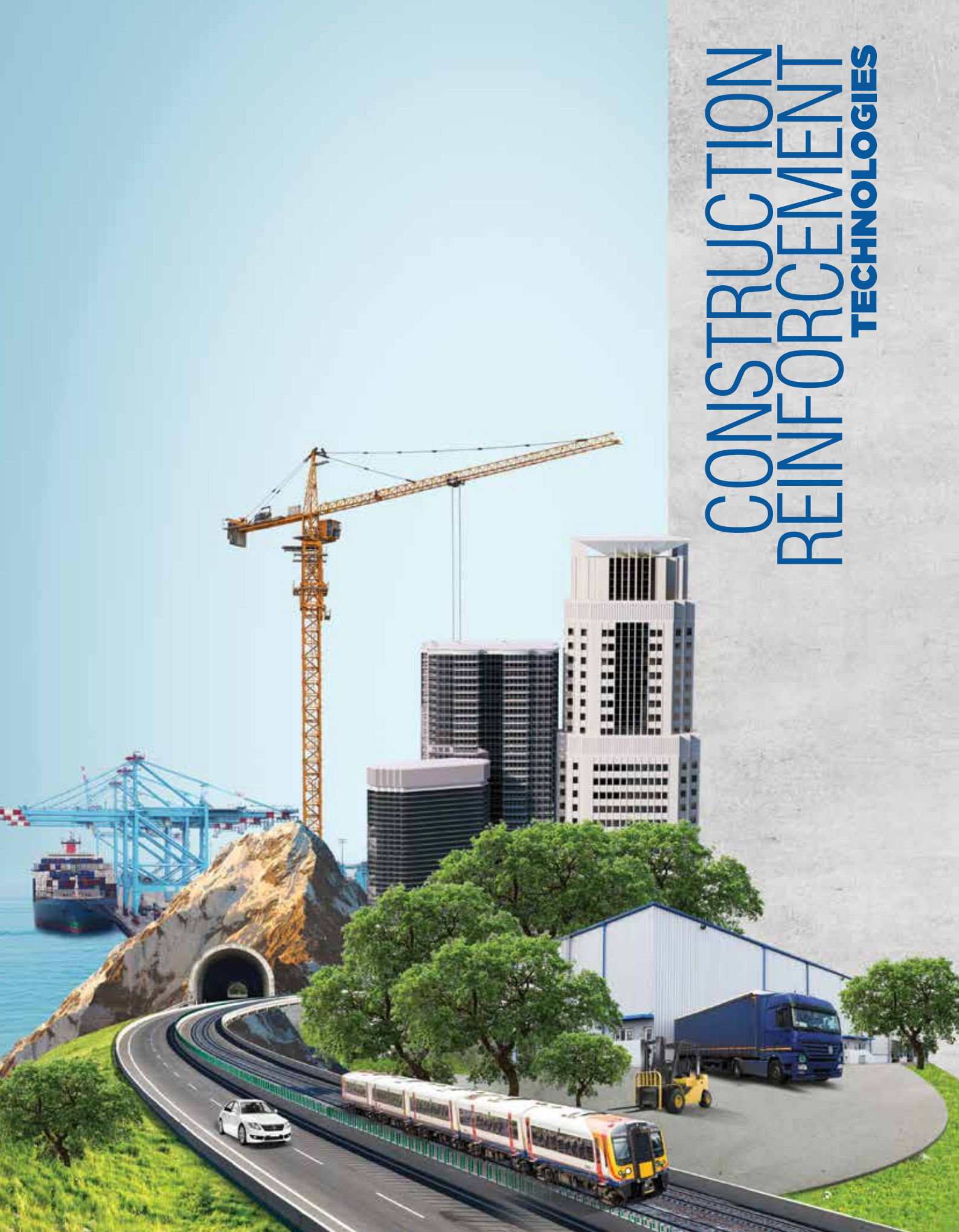


# CONSTRUCTION REINFORCEMENT TECHNOLOGIES





Established in 1973 as a subsidiary of Sabancı Holding, Kordsa is positioned as the global leader of its sector, providing reinforcement materials to the leading tire companies of the world for more than 40 years. Over the years, Kordsa has enlarged its reinforcement areas to composite and construction market as well.

“Today, Kordsa, reinforces every 1 in 2 automobile tires and every 2 in 3 aircraft tires in the world.”

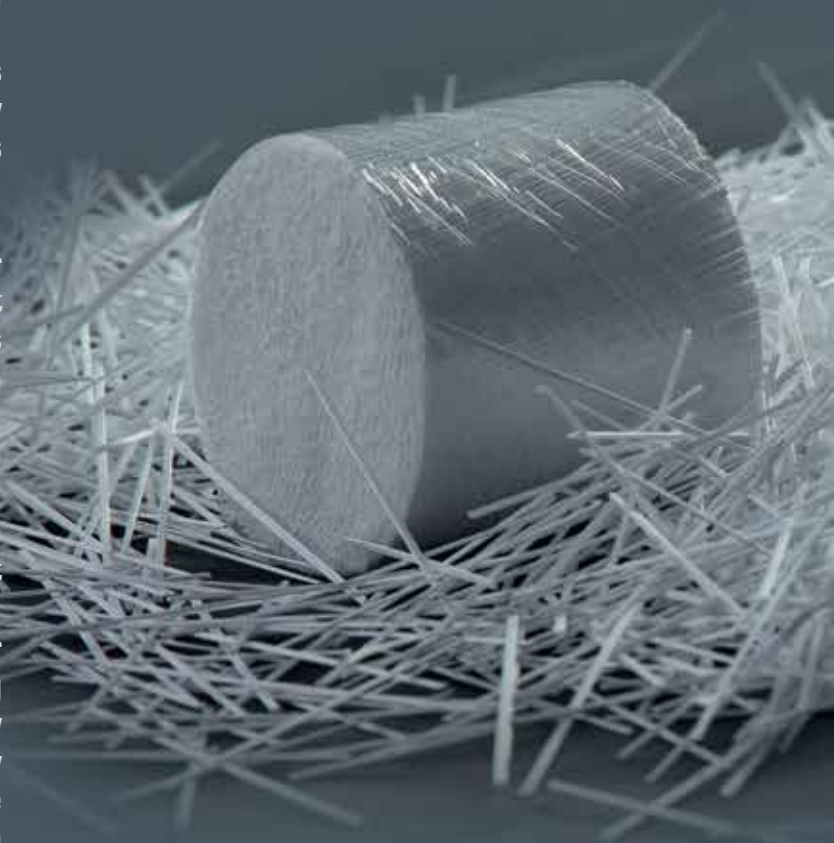
Kordsa provides high quality service and end to end solutions with a high level of technical competency. The main objective of the company is to “progress with innovative value added technologies” by continuously investing in its customers, its shareholders and its employees.

Worldwide the company is the acclaimed holder of “The Reinforcer” title, thanks to its market leader position, its strong global footprint, its technological leadership and its experience on reinforcement technologies.

Kordsa has combined its experience in industrial fiber technologies with its reinforcement mission to introduce its brand KraTos, the first product of the Construction Reinforcement Business Unit, and continues now with its R&D activities for other innovative reinforcement materials. Offering speed, labor cost savings, equipment and energy efficiency, as well as long-lasting durability and low carbon emission for successful and sustainable construction projects, KraTos stands out as a new concrete reinforcement synthetic fiber for the construction industry.

Together with Akçansa and Çimsa, KraTos was awarded the First Prize in the Corporate Synergy subcategory of the Golden Collar Awards of the Sabancı Group in April 2013, and also became the first Turkish product in the global fiber reinforcement market. Increasing growth and awareness in the construction market has resulted in a preference for synthetic fiber reinforcement products as one of the most innovative solutions.

CE-certified KraTos Synthetic Fiber Reinforcement products not only provide labor cost savings and reinforcement of the concrete in terms of resistance and long-lasting durability by increasing its load-bearing capacity, but also prevent cracks, which makes KraTos Macro the material of choice in infrastructure and superstructure projects instead of wire mesh or anchoring. Thanks to its easy handling and internal curing properties, KraTos Micro differentiates itself from the competition in the market, and provides effective solutions. KraTos Macro and Micro products are now preferred in major projects in the domestic market for their easy handling advantages and performance. Our activities in markets where we have a global footprint are well under way.





# Special Solutions to Construction Projects

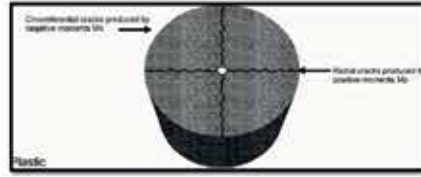
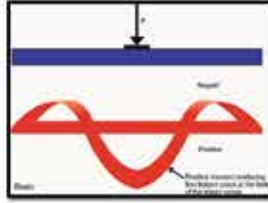
Kordsa provides special solutions for projects by performing ASTM C 1609 – third-point bending test, EN 14651 – CMOD (Crack Mouth Opening Displacement) center-point bending test in its concrete laboratory built specifically according to the needs of the construction projects.

Static design reports with KraTos Macro Synthetic Fiber Reinforcements, which are created by special design programs based on international standards and specifications on which static calculations of global infrastructure and superstructure projects are based, are prepared specifically for the details and needs of projects.

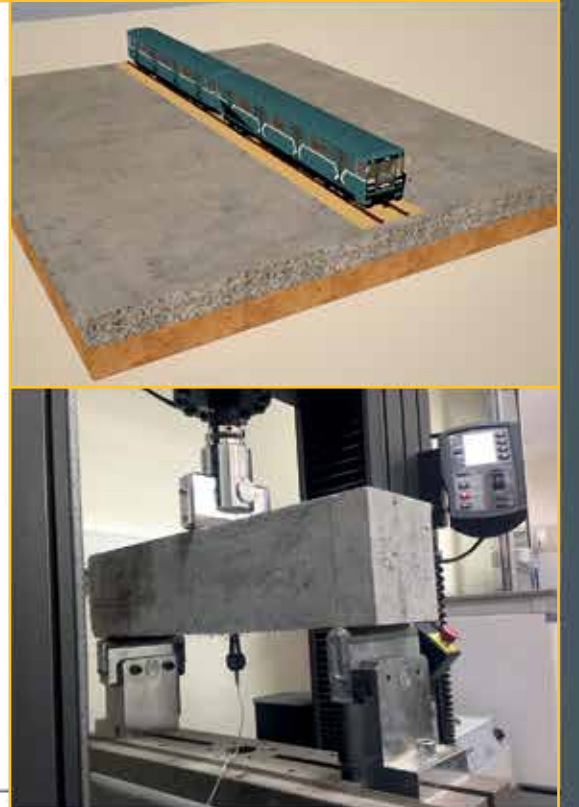


KORDSA

## YIELD LINE THEORY



Elastik ve Plastik bölgedeki Moment dağılımı, çevresel ve radyal çatlak bölgeleri



KORDSA

## YÜKLEME DURUMU: TEKERLEK AĞIR (Ezerken Single Point)



### PLAK MERKEZ

#### SINGLE POINT LOADS (Aksa Yükleme Kontrolü)

Single point load P (kN) = 34.00

$w = 126.16$  mm  $a/b = 0.43$  (800 mm xan yan çap, Bağı / 1900 mm çap)

güçlüf = 1.6 (Malzeme Ölümlük katsayısı)

Kanardan Üstük Yükleme Kontrolü

Internal load  $P_u$  (kN) = 125.65

Internal load  $P_u = 125.65 > 0.87 < \text{güçlüf} < P_u = 54.400$  OK

$P_u = 1$  Flağın Kanardan Üstük Yükleme Durumunda Tezyetici Max Yük Kapasitesi

### YÜKLEME DURUMU: PLAK KENAR

Kenardan Yükleme Kontrolü

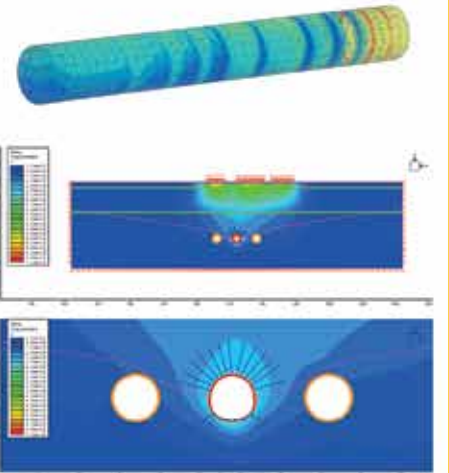
Edge load  $P_u$  (kN) = 71.42

Free edge load  $P_u = 71.42 < 0.87 < \text{güçlüf} < P_u = 43.530$  OK

$P_u = 1$  Flağın Kenardan Max Tezyetici Yük Kapasitesi



KORDSA



# Global Footprint

Anaheim, CA



Quakertown, PA



Laurel Hill, NC



San Marcos, CA

Chattanooga, TN

Brazil



Composite Reinforcement  
Business Unit



Tire Reinforcement  
Business Unit



R&D Center



Construction  
Reinforcement





Istanbul

Izmit

Thailand

Indonesia

# KraTos Micro



KraTos Micro Synthetic Fiber Reinforcement is being produced from the raw material Polyamide 6.6 according to the EN 14889-2 Class I standard and provides superior results in terms of preventing early age plastic and long-term drying shrinkage cracks when compared to polypropylene and basalt fibers.

In contrast to other synthetic fibers, KraTos Micro is capable of absorbing up to 5% of the moisture. Moisture that is retained by the fibers when the concrete is freshly poured is reintroduced to the concrete as it sets, resulting in an internal curing effect. This minimizes the formation of cracks due to heat and shrinkage and improves structural integrity.

## Areas of Use

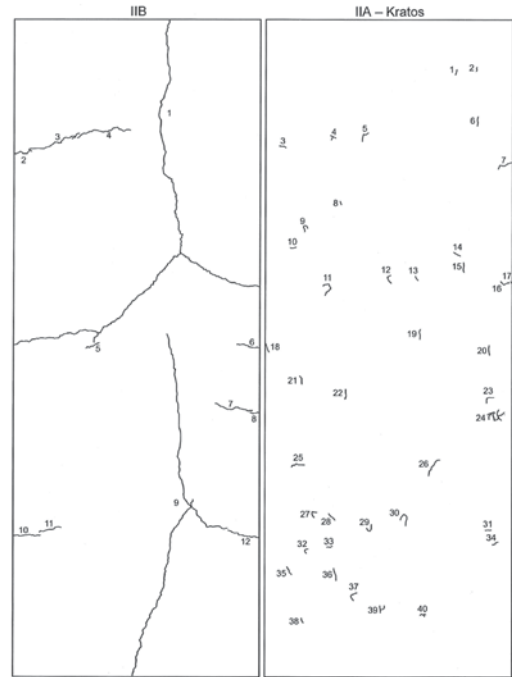
Apart from its application in ready-mixed concrete and shotcrete, KraTos Micro can be used in all cement-based composite materials, including semi-dry floor screed applications, interior and exterior plaster

applications, construction chemicals manufacturing, repair mortars and similar technical mortar applications.

## Dosing

As a result of accredited tests conducted at Aachen University in Germany, it has been proved that the use of 600 gr/m<sup>3</sup> (1.0 lb/yd<sup>3</sup>) dosage prevents 98.3% of the shrinkage cracks.

KraTos Micro	Characteristic Properties
Fiber Class	EN 14889-2 Class I
Raw Material	Polyamide 6.6
Specific Gravity gr/cm <sup>3</sup> (lb/yd <sup>3</sup> )	1.14 (71.17)
Length mm (in)	6, 12 (0.24, 0.48)
Tensile Strength MPa (ksi)	900 (130)
Alkali Resistance	Excellent
Resistance to Corrosion	Excellent
Melting Temperature °C (°F)	260 (500)
Number of Fibers (#/kg)	222 Million (6 mm) 111 Million (12 mm)
Number of Fibers (#/lb)	100 Million (0.24 in) 50 Million (0.47 in)



Picture B5: Cracked patterns of the different concretes

## Packaging

KraTos Micro Synthetic Fiber Reinforcement is available in 450 gr (1lb) water-soluble bags that can be dosed or supplied in big-bags, which are scaled according to project requirements.







## KraTos Macro



KraTos Structural Macro Synthetic Fiber Reinforcement is being produced from the highly resistant raw material Polypropylene according to EN 14889-2 Class II and ASTM C 1116 standards. Highly engineered optimized fiber design ensures a homogeneous 3-dimensional distribution in concrete and KraTos Macro provides allaround crack control by increasing load bearing capacity of concrete under service and design loads of the structure.

### Areas of Use

KraTos Macro offers the most effective solution against crack formation which is considered to be the weakness of any concrete application. In addition to its superior toughness properties, easy mixing and applicability enables its use in a variety of construction applications including industrial slab-on-ground concretes, screed and topping concretes, specific track slabs, tunnel linings, shotcretes, airport and dock slab-on-ground concretes and precast concrete components.

### Packaging

KraTos structural Macro Synthetic Fiber Reinforcement is available in 3 kg (5 lb) water-soluble bags that can be dosed or supplied in big-bags, which are scaled according to project requirements.

### Dosing

The optimum dosing of KraTos Macro depends on the requirements of the specific project. The usual range lies between 2 to 10 kg/m<sup>3</sup> (3 to 16 lb/yd<sup>3</sup>).

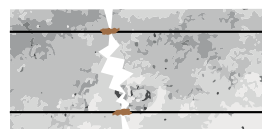
KraTos Macro	Characteristic Properties
Fiber Class	EN 14889-2 Class II
Raw Material	Polypropylene
Specific Gravity g/cm <sup>3</sup> (lb/ft <sup>3</sup> )	0.91 (56.81)
Length mm (in)	54-48-40 (2.12-1.88-1.57)
Diameter mm (in)	0.72 (0.03)
Tensile Strength MPa (ksi)	550 (80)
Melting Temperature °C (°F)	160 (320)
Alkali Resistance	Excellent
Resistance to Corrosion	Excellent
Number of Fibers #/ kg (#/lb)	~50.000 (~22.500)

### Working Principle of KraTos Macro



#### KraTos Macro

- With its unique fiber design that can homogeneously disperse within concrete, KraTos Macro provides effective 3D crack control at all points by increasing the load carrying capacity of concrete under service and design loads.
- Provides excellent and long term durability by its anchoring ability with its unique embossed surface.
- Highly resistant to alkali, acid and salt effects.
- With its non-conductive structure, provides safety in magnetic fields



#### Steel Mesh

- Risk of crack formation and expansion under design loads.
- Risk of corrosion and strength loss in exposed rebars.
- Risk of exposure and strength loss in areas with severe weather conditions and in underground areas in contact with acid, salt, chemicals etc.

## Effective Packaging Solutions for All Project Applications

1. For concrete mixer and RMC plant applications, KraTos Macro fibers are supplied in water-soluble packages in pallets. Package sizes can be adjusted according to project specifications.
2. For dosing machine applications in RMC plant mixes, KraTos Macro fibers are supplied in big-bags.
3. Whether in individual packages or big-bags, KraTos Macro is supplied in water-soluble PVA bundles for homogeneous mixing and easy applicability.

## Mixing and Application



KraTos Macro in water-soluble packages are added into the concrete mixer. After adding all packages into the mixer, the concrete mixer should be mixed at top speed for minimum 7 minutes and maximum 10 minutes.



The high-speed mixing made on the worksite enables KraTos Macro the three-dimensional homogeneous distribution.



KraTos Macro, which is supplied in big-bags to the RMC plant, is added to the mix at a constant rate with the help of a dosing machine.



According to the project and worksite conditions, KraTos Macro can be poured by concrete mixer or concrete pump and applied to the surface by hand or laser screed. KraTos Macro fibers do not harm concrete pump or equipments.



Following the couple hours from concrete casting, surface finishing and power trowel operations are started. KraTos Macro guarantees a perfect surface finish in applications.



KraTos Macro increases the adherence of shotcrete and minimizes rebound.





**LABOR**  
+  
**COST**  
+  
**TIME**  
**ADVANTAGE**

KraTos Macro offers ease of application and is compatible with any class or slump of concrete. KraTos Macro is designed to minimize the slump loss in the concrete and to ensure rapid and homogeneous distribution in the mix.

KraTos Macro completely eliminates steel mesh placing and anchoring applications to reinforce the concrete. The direct application of reinforced concrete offers up to 40% savings in time and reduces the total cost of ownership. It prevents handling errors, improving the quality of the application and increases work safety by preventing occupational accidents associated with the application of steel mesh.

The fact that KraTos Macro is easier to pump or spray, compared to the competition, results in a high-quality execution and prevents errors such as adding excessive water to the concrete mix. Easy passage through the concrete pump or the grate of machine ensures an effective application. KraTos Macro does not remain on the surface, thereby saving labor costs related to surface finishing and adding a time benefit.

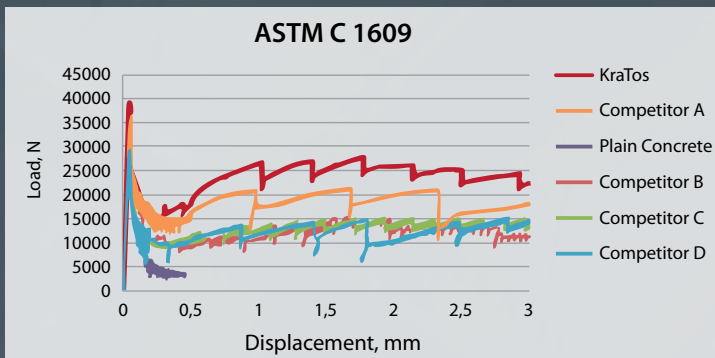


# Meeting The Expectations: KraTos Macro

## High Quality, High Performance

KraTos Macro increases the load-bearing capacity and toughness of concrete, effectively controls cracks and raises the ductility of concrete under repeated loads. The residual behaviour in beam loading test is shown in the following chart:

### ASTM C 1609: Third-Point Bending Test Laboratory Tests Done With C 30/37 Concrete Class



## Strong and Durable Structures

Corrosion, also known as the cancer of concrete, is the worst enemy of any structure. Corrosion affects the durability and long-term performance of concrete. Thanks to its polymeric structure, KraTos Macro is resistant to corrosion, which contributes to the long-term durability of concrete.

In addition to its corrosion resistant structure, KraTos Macro provides long term safety and high durability in the structures where it is desired to ensure the continuity of electromagnetic systems with its non-conductive structure.



Concrete Reinforcement Type	Reduces					Provides			
	Plastic Shrinkage	Long-Term Drying Shrinkage Cracks	Corrosion Risk	Magnetic Fields Affect Risk	Risk of Damage to Machinery and Equipment	Fast Labor	Easy Applicability	Post-Crack Load Carrying Capacity	Logistics Advantages
Steel Mesh	-	+(1)	-	-	0	-	-	+(2)	-
Steel Fibers	-	+	-	-	-	+	-	+	+
KraTos Macro Synthetic Fiber Reinforcement	+	+	+	+	+	+	+	+	+

+ = Positive Effect, 0 = No Effect, - = Negative Effect, (1) Only if Positioned in Top Third Of Floor Slab, (2) Only if Positioned in Bottom Third Of Floor Slab.





## SAFE, STRONG AND SUSTAINABLE STRUCTURES

### High Quality, Durability, Safety

- Provides long-term durability, is resistant to corrosion.
- Effectively controls cracks.
- Is non-conductive and safe for use with electricity.
- Causes no damage to machine or equipment.
- High energy absorption capacity provides toughness.

### Increased Efficiency, Resource Economy

- Provides structural efficiency resulting in cost savings for the project.
- Time-saving up to 40%.
- Eliminates steel mesh labor costs.
- Lighter and safer than steel.
- Saves 60% in storage, transportation and inventory costs.

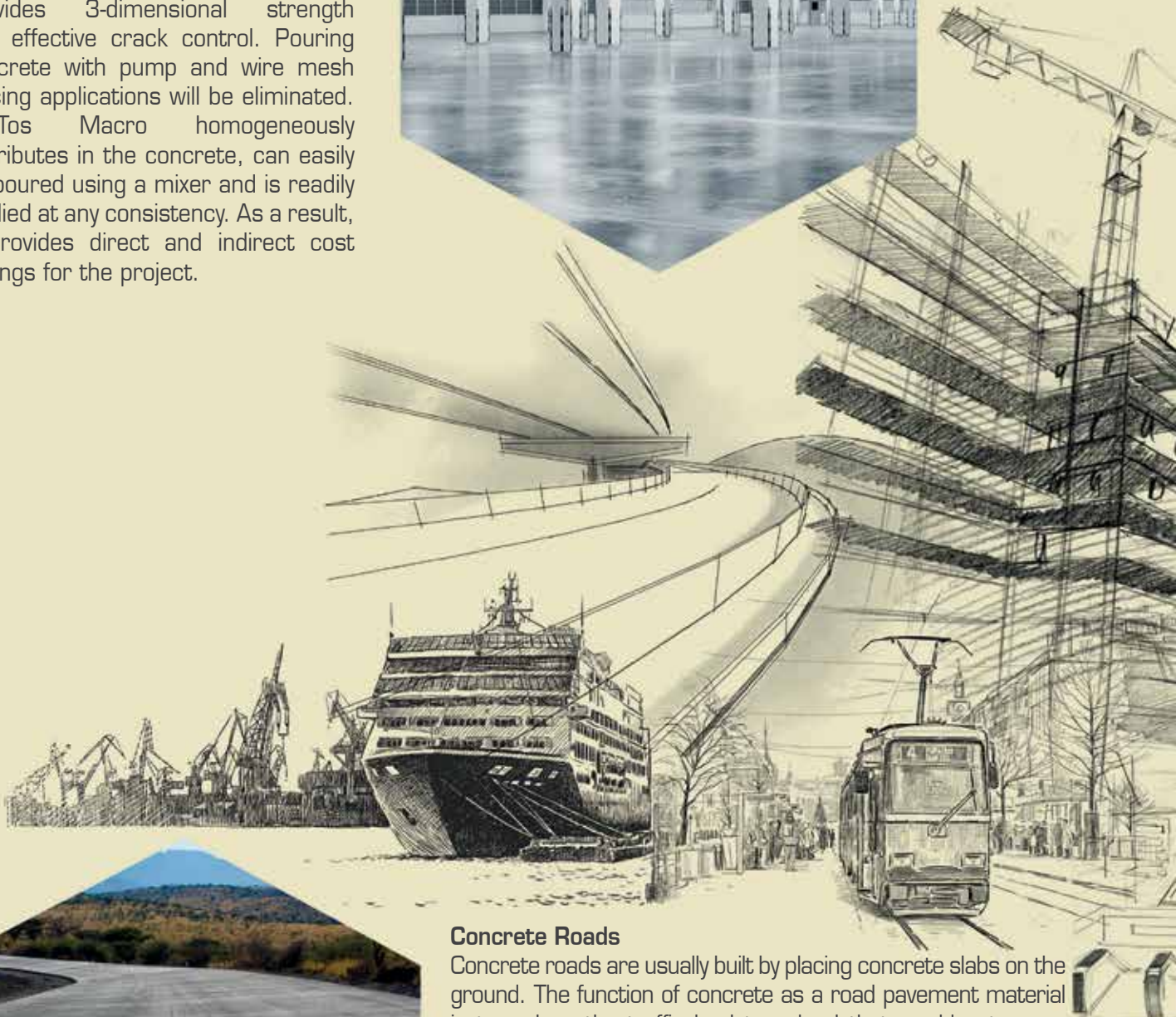
### Energy Efficiency, Climate Protection

- Requires less processing, can be applied without modifying the dosing of cement.
- 40% less carbon emission than steel.
- Ease of application, pumping and spraying results in energy savings.

# APPLICATIONS

## Industrial Flooring

Industrial flooring is a concrete floor system that aims to prevent wear using special protection or coating solutions and is designed to meet the end user's needs with special consideration given to esthetics (such as surface color, tining, curing, etc.). The use of KraTos Macro in industrial flooring applications provides 3-dimensional strength and effective crack control. Pouring concrete with pump and wire mesh placing applications will be eliminated. KraTos Macro homogeneously distributes in the concrete, can easily be poured using a mixer and is readily applied at any consistency. As a result, it provides direct and indirect cost savings for the project.



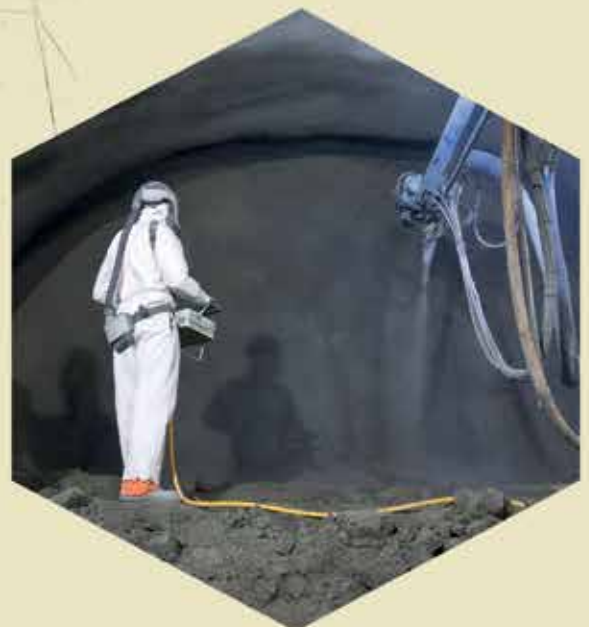
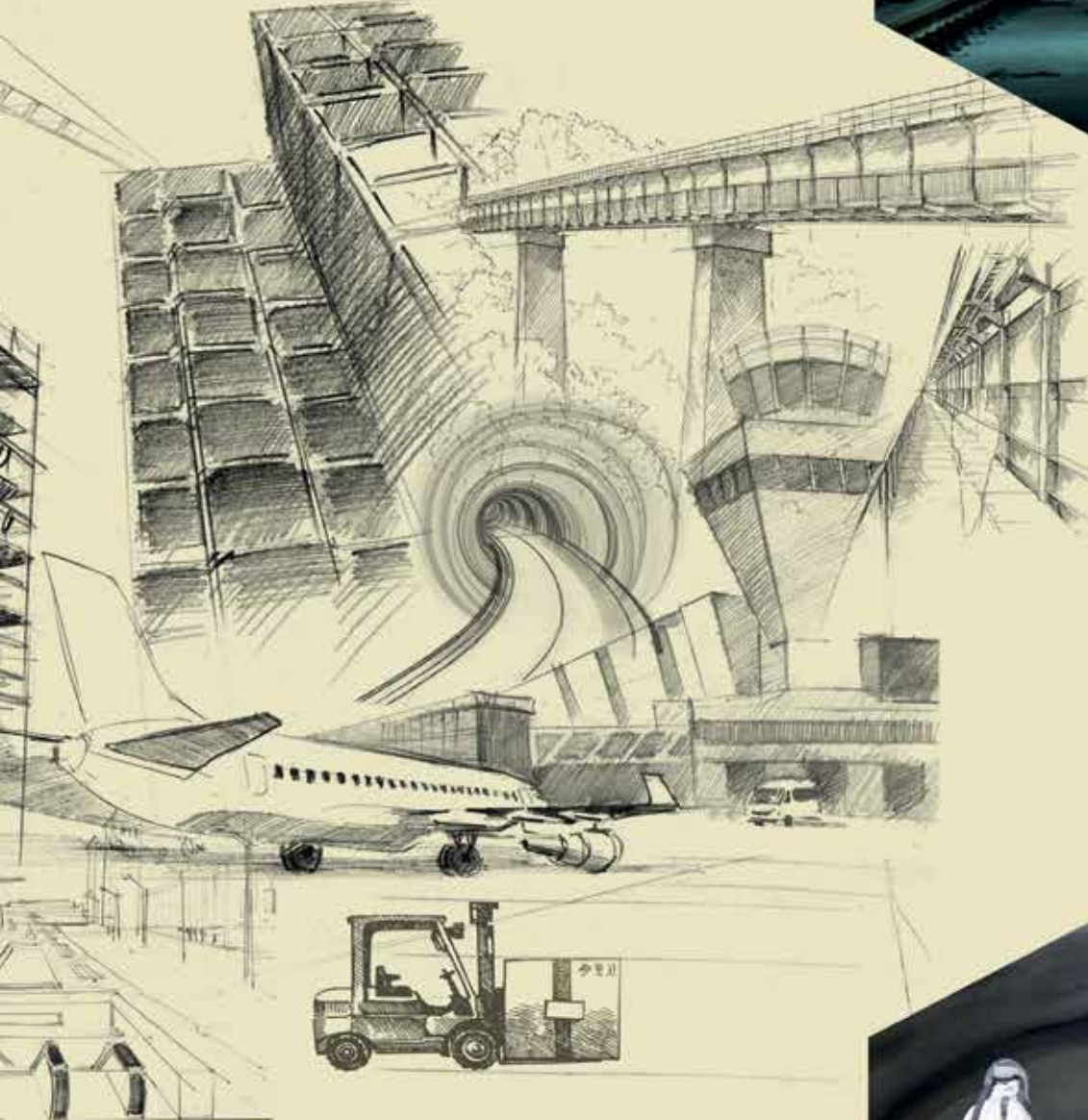
## Concrete Roads

Concrete roads are usually built by placing concrete slabs on the ground. The function of concrete as a road pavement material is to reduce the traffic load to a level that would not cause deformation before transferring it to the ground. Project-related factors that are considered when designing a concrete road include traffic, weather conditions, the load-bearing capacity of the ground, mechanical properties of the concrete slabs, economic service life and expected service quality of the road. The use of KraTos Macro in concrete roads improves the fatigue resistance of concrete under repeated loads, prevents the formation of longitudinal cracks and faulting and extends the service life of concrete by adding chemical resistance. The homogeneous distribution of the material in concrete makes it resistant against the effects of freezing and thawing.



## Tunnel Lining

In tunnel lining, time and safety are the two most important parameters. The use of KraTos Macro reinforced concrete lining provides ductility and prevents sudden collapse. KraTos Macro eliminates steel reinforcement application and saves time to the tunnel construction project. Exposed to groundwater, steel reinforcement might incur sectional loss due to several reactions. Therefore, reinforcement that is resistant to corrosion extends the service life of concrete. Fire resistance is the most important safety concern in any tunnel construction. As KraTos Macro synthetic fibers have no thermal conductivity, they do not contribute to the heating of cement as steel wires or other reinforcements would do in case of fire. Similar to other polypropylene fibers, KraTos Macro has a high melting temperature, which helps to preserve the structural integrity of the tunnel lining after a fire.



## Shotcrete Lining

Using KraTos Macro synthetic fiber reinforcement in shotcrete instead of wire mesh may help to shorten the project time by up to 40% depending on the surface class. Placing wire mesh in a tunnel is a challenging work that may lead to accidents. As the surface gaps are heterogeneous, the wire mesh may not be laid out so as to cover the concrete evenly, which results in 50% more shotcrete use and faulty applications. Using shotcrete reinforcement with non-corrosive KraTos Macro fibers improves work safety, extends durability and saves time and money for the project.

# APPLICATIONS

## Port Projects

Port structures are highly susceptible to the effects of humidity, wind and salt water. Replacing conventional reinforcement with KraTos Macro helps to avoid corrosion, provides effective crack control by 3-dimensional fiber reinforcement and thus extends the service life of the structure and improves its impact resistance. Compared to conventional methods, pouring KraTos concrete reinforced with saves up to 40% time, which, together with the elimination of reinforcement work, translates into cost advantages for the project.



## Track Slabs

The use of KraTos Macro fiber reinforcement in the construction of railway systems eliminates reinforcement applications, ensuring the most convenient application and saving at least 30% of time. The most important safety concern related to railway systems and track slabs in particular is electrical conductivity.

Non-conductive KraTos Macro synthetic fibers provide maximum safety. Its 3-dimensional strength and resistance translate into high performance after crack formation by holding the concrete together.

## Hydraulic Structures

Hydraulic structures are expected to have a long service life. Concrete reinforced with conventional means is subject to early degradation and corrosion due to the impact of ground and surface waters. This type of concrete structures reinforced with KraTos Macro is not exposed to the detrimental effect of corrosion and offers a long service life as planned. Its effective and easy use during construction expedites the project.

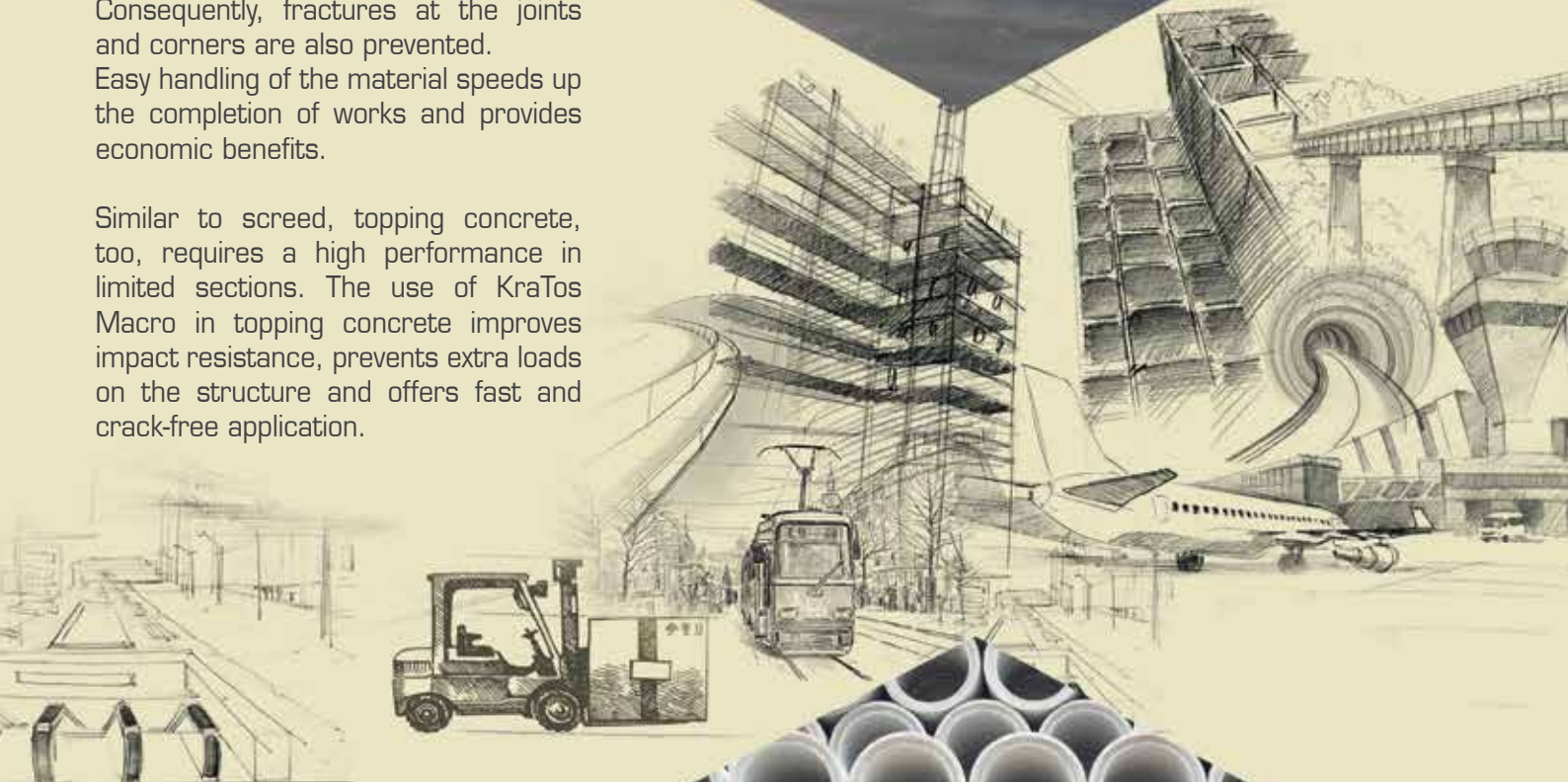




### **Screed, Topping and Slab on Ground Concrete**

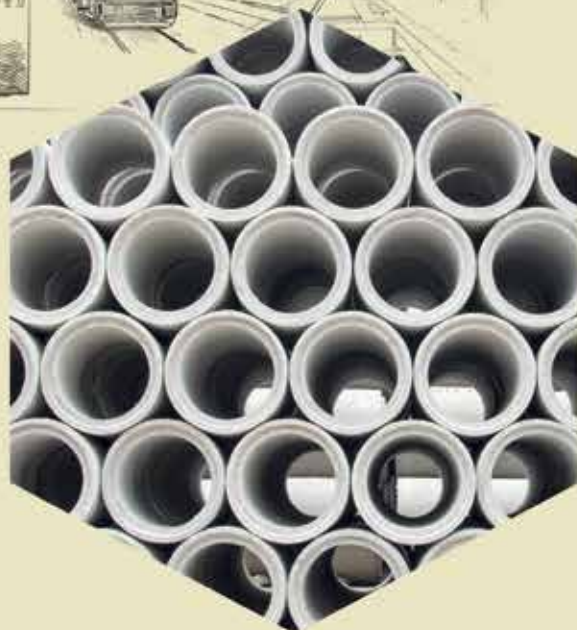
Screed must perform well in limited sections considering the level of the building. Insufficient concrete thickness or early dehydration may cause curling of the screed. This curling may lead to crack formation over time. The 3-dimensional distribution of KraTos Macro in the concrete minimizes curling and thus prevents crack formation. Consequently, fractures at the joints and corners are also prevented. Easy handling of the material speeds up the completion of works and provides economic benefits.

Similar to screed, topping concrete, too, requires a high performance in limited sections. The use of KraTos Macro in topping concrete improves impact resistance, prevents extra loads on the structure and offers fast and crack-free application.



### **Precast Concrete**

The use of fiber reinforcement in precast concrete imparts a high durability to the application. Compared to steel mesh, its easy application saves both time and labor costs. Its corrosion resistance protects the structure in the long-term against unfavorable external factors such as groundwater.





# For Safe, Strong and Sustainable Structures!

With KraTos new generation macro and micro synthetic fiber reinforcements, we bring Kordsa quality into construction sector and provide effective solutions.



- With easy and fast application, eliminates steel mesh labour and provides time-saving up to 40%.
- Provides effective crack control with homogeneous distribution in concrete with optimum packaging system.
- Provides toughness in concrete with high energy absorption capacity.
- Corrosion resistant and stainless. Provides long-term durability in concrete.
- No electrical conductivity. Ensures efficient operation of electromagnetic systems.
- KraTos Micro Synthetic Fiber Reinforcements prevent plastic and long-term drying shrinkage cracks by 99%.

For further information:  
[kratos@kordsa.com](mailto:kratos@kordsa.com)  
[www.kordsa.com](http://www.kordsa.com)  
[www.kordsa.com/kratos/](http://www.kordsa.com/kratos/)

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