INNOVATIONS FOR LIVING

TECHNICAL EVALUATION: **Concrete reinforced with Anti-Crak® HP 67/36**

PRODUCT DESCRIPTION

Anti-Crak® HP 67/36 is a high-performance Alkali-Resistant glass macrofiber, engineered to provide pot-cracking strength to concrete. Such performance adds toughness (energy absorption capacity during failure) to the material, and increases its impact and fatigue resistance. Given the total affinity between glass fibers and the cementitious matrix, this fiber also increases the flexure strength of the material.

Anti-Crak® HP 67/36 provides a three-dimensional reinforcement of high effectiveness to control cracking from hygrothermal effects, and can be used to replace traditional steel reinforcement in slabs-on-grade and specific precast concrete elements.

For more information on product applications, benefits, dosages and utilization please refer to the product data sheet.

PERFORMANCE IN FRESH CONCRETE

Even if introducing more than 45000 fibers/kg, due to their density (similar to concrete), flexibility, and high dispersability, glass macrofibers have a very low influence on the material workability.

The following laboratory example presents a typical C25/30 mix for pavement applications, reinforced with 5, 10, and 15 kg/m^3 of Anti-Crak® HP 67/36. As it can be seen, the addition of up to 15 kg/m^3 of glass macrofibers has very little effect on the workability of the mix, measured through the slump test (EN 12390-2) using the Abrams Cone.

Anti-Crak® HP 67/36 fibers introduce no processing issues, present no incompatibility with common supplementary cementitious materials and pigments, and can be mixed in traditional concrete mixers or ready-mix trucks.

Anti-Crak® HP 67/36 fiber reinforced concrete can be poured, placed, compacted, and finished by any conventional means. Importantly, no fibers are expected to appear on the concrete surface.

Concrete mix design and characteristics:

MATERIALS (kg/m3)	**Plain concrete**	**Anti-Crak® HP 67/36** 5 kg/m^3	**Anti-Crak® HP 67/36** 10 kg/m^3	**Anti-Crak® HP 67/36** 15 kg/m^3
Gravel 12.5-20 mm	842			
Gravel 8-12 mm	135			
Sand 0-4 mm	888			
CEM II 42.5 R	320			
Total Water	192			
Superplasticizer* (%)	0.9			
AR glass macrofibers	0	5	10	15
Concrete temperature (ºC)	*17.5*	*17.7*	*18.0*	*18.2*
Air content (%)	*1.2*	*1.2*	*1.9*	*2.1*
Slump (cm)	***19***	***18***	***17***	***17***

(*) *% of cement weight*

Air content measured according to EN 12350-7.

Note that the effect of fiber reinforcement on workability depends on the characteristics of all concrete component materials, mix proportions, and workability class. Hence, specific evaluations should be conducted to validate the specific fiber reinforced concrete mix design to be used.

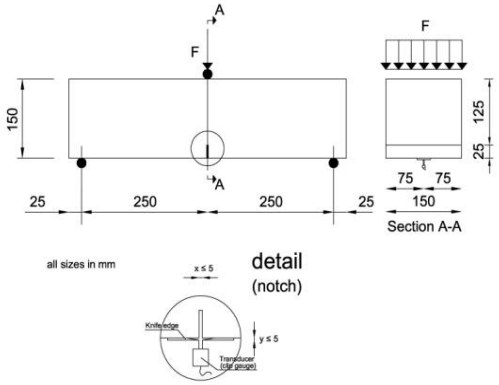
Anti-Crak® HP 67/36

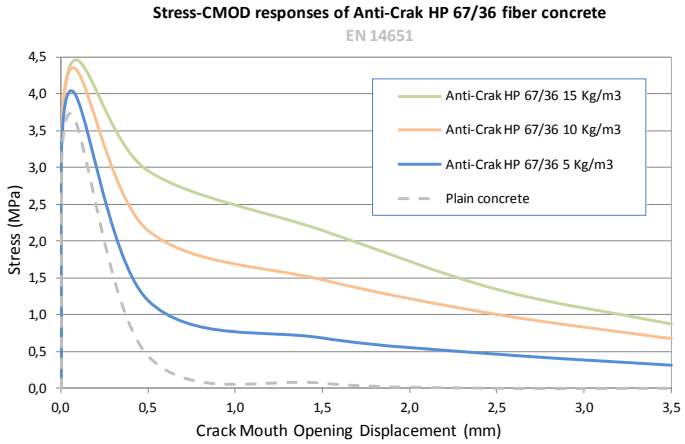
AR glass macrofiber for concrete reinforcement

MECHANICAL PERFORMANCE

Flexural tensile strength. EN 14651.

The fundamental mechanical performance of fiber reinforced concrete can be obtained from a three point bending test performed on a prismatic beam of 150 x 150 x 550 mm including a notch at mid-span. The displacement-controlled testing system introduces a specific deflection or CMOD (Crack Mouth Opening Displacement) rate, and records load and displacement up to a CMOD limit of 4 mm. The fiber reinforced concrete performance is evaluated by means of residual flexural strength values at 0.5, 1.5, 2.5, and 3.5 mm of CMOD, namely f_{R1}, f_{R2}, f_{R3} and f_{R4}, respectively. According to the ***fib* Model Code 2010**[1] , the constitutive law of the material in tension is defined by means of the tensile stresses f_{Fts} and f_{Ftu}, calculated from f_{R1} and f_{R3} for service and ultimate limit state, respectively. The sketch below shows the basic configuration of the test and stress formula. The following data shows the general performance of a C25/30 concrete reinforced with 5, 10, and 15 kg/m3 of Anti-Crak HP 67/36 alkali-resistant glass macrofibers in terms of mean values, it's stress stress-CMOD response, mechanical properties, and specific residual strength values (from 12 specimens in each case).





C25/30, S2 concrete mix design and characteristics:
Lab conditions: Temperature: 23 ºC, Humidity: 40%

MATERIALS (kg/m3)	**Plain concrete**	**Anti-Crak® HP 67/36** 5 kg/m^3	**Anti-Crak® HP 67/36** 10 kg/m^3	**Anti-Crak® HP 67/36** 15 kg/m^3
Gravel 4-20 mm	1177			
Sand 0-4 mm	668			
CEM I 42.5 R	350			
Total Water	191			
Superplasticizer* (%)	1.1			
AR glass macrofibers	0	5	10	15
Properties (MPa)				
f_c (150mm cube)	37	-	41	42
f_{Lm} (increase with respect to plain concrete)	3.73	4.03 (+8%)	4.31 (+16%)	4.36 (+17%)
f_{R1m}	-	1.19	2.14	2.95
f_{R2m}	-	0.68	1.47	2.14
f_{R3m}	-	0.46	1.00	1.34
f_{R4m}	-	0.31	0.67	0.87

(*) *Percentage of cement weight*

[1] *The International Federation for Structural Concrete **fib** Model Code 2010 is a revision of the 1978 and 1990 CEB-FIP Model Codes. The 2010 Model Code gives an extensive state-of-the-art design approach regarding material properties for structural concrete.*