



AALBORG
EXCEL®
HIGH PERFORMANCE CONCRETE

HIGH-PERFORMANCE CONCRETE

In the 1980ies, the laboratories of AALBORG PORTLAND A/S, in Denmark, conducted pioneering research to develop very dense cement-based binder-matrices, in order to fully exploit the performance of concrete. These efforts resulted in the first ever patented ultra-high performance steel fiber reinforced concrete – bearing the name Compact Reinforced Composite, CRC®. This technology was, and is still today, based on the AALBORG WHITE® white cement, which offers perfectly suited chemistry and purity, as well as superior mechanical performance.

Cementir Holding's Innovation Team within AALBORG INWHITE SOLUTION®, synergizing expertise from the Research & Quality Centre in Aalborg, Denmark and market/customer driven trends and insights from the global Sales Team, is again taking the lead in further developing the

very complex binder technology behind high and ultra-high performance concrete.

AALBORG EXCEL® is based on a further refinement of Aalborg Portland's recently patented binder technology, FUTURECEM™, which still offers highly advantageous pozzolanic reactions, but without being constrained by the availability and quality of waste materials from other industries.

The performance of AALBORG EXCEL® in fresh and hardened state has been designed to accurately suit the production flows and requirements of our industrial customers.

AALBORG EXCEL®

is a shrinkage reduced, ready-to-use, self-compacting High-Performance Concrete for the manufacturing of thin/slim concrete products with high aesthetic, mechanical and durability performance. Binder, admixtures and aggregates are included, and only water should be added during mixing.

The product offers enhanced flow for high surface detailing requirements, in complex mould geometries. After mixing with water, the product results in a white base coloured High-Performance Concrete for personal tailorization in terms of pigments. Due to its high flowability, fibres can be added to adjust mechanical properties, whilst still maintaining self-compacting properties.

AALBORG WHITE® is the cement used in AALBORG EXCEL®. This cement is neutral in terms of meeting the EU requirements for a maximum soluble chromium (VI) in cement of 2 mg/kg with no time limits on storage time.



MAIN APPLICATIONS

- Thin/slim and high compressive and flexural strength
aesthetical / architectural panels:
facades, cladding, sun-screens,
ornamental elements
- Artistic and ornamental elements made in concrete.
- Gardening / street architectural elements.

BENEFITS

WORKABILITY
Self-compacting properties and long flow retention.

STRENGTH
High early and final strength.

PREDICTABLE & RELIABLE PERFORMANCE
Balanced chemistry for controlled workability and hydration

SHRINKAGE REDUCED
Minimizes the risk of cracks.

HIGHLY DURABLE
Even when exposed to harsh environment.

COLOR PERFORMANCE
High whiteness ideal for architectural and ornamental elements.

QUALITY STATEMENT

AALBORG EXCEL® is produced under the strict quality control procedures defined and audited by Cementir Holding. Samples of AALBORG EXCEL® are frequently cross-checked and fully tested at Cementir Holdings Research and Quality Centre in Denmark.

TRIAL CASTING

AALBORG EXCEL™ turns into a high-flowable mix with excellent mould filling properties. It is, however, always recommended to carry out a trial casting replicating the intended use of the product (representative moulding, release agents if applicable, casting procedure, ...) before production is initiated, to evaluate the achieved surface properties of the finished concrete product.

The above is particularly relevant if fibers are added to the concrete, leading to progressive reduction in flow and increase in viscosity. The trial casting should hence reveal, if vibration must be applied to the mould in order to reach the targeted surface detailing and finishing.

AUTO-CONTROL

The user of AALBORG EXCEL™ is expected to implement a quality control testing for monitoring the quality of the mixed concrete against the performance parameters listed in the table of the "Product Information Sheet", and the project specific requirements, and should at least include:

- Control of water dosage
- Flow and density
- 1 day and 28 days compressive strength



SUSTAINABILITY

In our effort to limit the use of scarce materials, AALBORG EXCEL® is manufactured with raw materials from sources vastly available in nature. Therefore, it is not constrained by the availability and quality of waste materials from other industries.



FRESH STATE PROPERTIES

AALBORG EXCEL® is a self-compacting mortar with long opening time. Its flowability makes it suitable for addition of fibers.

The fresh mix of AALBORG EXCEL® is stable when the recommended water dosage is used, Under these conditions, no segregation or bleeding will occur.

The flowability of the material has been measured according to ASTM C230 as a quality routinely test. Also, periodic measurements according to the EN-206 are made to correlate with concrete standards.

Table 1. Flow measurements of AALBORG EXCEL®

Method	Flow after mixing (mm)	Flow after 45min (mm)
ASTM C230	300 ± 20	300 ± 20
EN-206	>900	>900



MECHANICAL PROPERTIES

COMPRESSIVE STRENGTH

The compressive strength of AALBORG EXCEL® was determined at 1 and 28 days, on both prisms 40x40x160 mm (in accordance to EN 196-1) and cylinders Ø150x300 mm (in accordance to EN 12390-3). The results are found in table 2.

Table 2. Compressive strength at 1 and 28 days of AALBORG EXCEL®

Dimensions of specimens (mm)	Compressive strength 1d (MPa)	Compressive strength 28d (MPa)
Prisms (40x40x160)	> 75	> 140
Cylinders (150x300)	> 75	> 140

FLEXURAL STRENGTH

Flexural strength was determined at 28 days on 50x50x500mm beams, according to EN 12390-5. Results are shown in Table 3.

Table 3. Flexural strength of AALBORG EXCEL®

Curing time	Flexural strength (MPa)
28 days	> 14 MPa

ELASTIC MODULUS

Elastic modulus was determined at 28 days on Ø100/200 mm cylinder, according to EN 12390-13. Results are shown in Table 4.

Table 4. Modulus of elasticity of AALBORG EXCEL®

Curing time	Modulus of elasticity (GPa)
28 days	50

SHRINKAGE

Volume changes of concrete are the main reason for crack formation, especially in high and ultra-high performance concrete formulations. Hence, it is very important to quantify and control shrinkage and/or expansion of concrete at early and late hydration stages.

A further development of the FUTURECEM™ binder technology applied to the mix design of AALBORG EXCEL® translates into a shrinkage reduced material.

HYDRAULIC SHRINKAGE

Hydraulic shrinkage was measured on prisms 40x40x160mm after 28 and 90 days of casting, according to EN 12617-4. Results are shown in table 5.

Table 5. Hydraulic Shrinkage

Time	Hydraulic shrinkage
28 days	< 600 µm/m
90 days	< 700 µm/m

PIGMENTS

AALBORG EXCEL® is a practical and affordable material suitable for colored concrete to achieve the high architectural aesthetics. High purity and stable Aalborg White® cement is the key to all colored precast concrete elements.

Preliminary tests are always recommended to adjust the dosage of pigment and the fresh state properties of the material. Extra water can be added, up to the maximum amount of water stated in the Product Information Sheet.

RECOMMENDED MIX PROCEDURE WITH PIGMENTS:

1. Mix the dry mix together with the pigment (powder) for 30s.
2. Add the water and mix for 6 minutes.
3. Add the fibers and mix until total mixing time equal to 8 minutes

DURABILITY INDICATORS

AALBORG EXCEL® is based on a technology recently patented by Aalborg Portland, FUTURECEM™, developed at Group Research and Quality Center in Aalborg.

Due to the low water content and complex chemical reactions undergoing during the hydration of the cement and the pozzolanic constituents of the binder, the microstructure of the final material is very dense. This translates into outstanding properties in terms of durability.

Table 6 shows the main durability indicators measured on AALBORG EXCEL®.

Property	Standard	Unit	Value
Chloride content		Wt. % to cement	< 0.09% to cement
Water soluble equivalent alkali content (Na ₂ O+0,658xK ₂ O)		Kg/m ³	< 3.4 Kg/m ³
Chloride migration	28 days 90 days	NT Build 492	x 10 ⁻¹² m ² /s 0.40 0.17
Freeze-thaw resistance - Scaling	EN 12390-9	Kg/m ³	0.01
Water absorption	EN 1015-18	Kg/ (m ² • min ^{0.5})	< 0.02 (W _{c2})

Table 6 Durability indicators.



Cementir Group established a global innovation engine for white cement, InWhite, with the purpose of generating a prioritized and actionable pipeline of high potential customer value proposition global initiatives, bringing new solutions for well-known applications, or completely new applications for white cement-based products, aligned to megatrends detected in the society, such as customization, circular economy and high-energy efficient solutions.

The InWhite process benefits from the Group's global knowledge on both well-established and emerging applications for white cement and technical knowhow of its internationally acclaimed R&D center located at Aalborg, Denmark.

AALBORG INWHITE SOLUTION® has become the umbrella brand for commercialized high value adding and high-performing products, identified and developed under InWhite initiatives, that Cementir Holding will serve to the building industry.

For technical matters related to the product,
please address your request to:

Inwhitesolution@cementirholding.it

For commercial inquiries,
please find your nearest sales office of AALBORG WHITE® at

www.aalborgwhite.com

MADE IN POLAND

Aalborg Portland Polska Sp. z o.o.

Ul. Targowa 24

03-733 Warszawa,

Poland

(part of the Cementir Group)