AALBORG WHITE®

White Concrete Technology
- a world of possibilities

AALBORG WHITE® is white cement
– a product of nature's own raw materials,
refined with unparalleled technology,
for use in the creation of beauty and functionalism.

White concrete
is the foundation of beautiful results

White concrete is synonymous with light, clear colours and beautifully consistent surfaces – whether on large or small buildings, or in facilities of any size.
Constructions automatically look more elegant and slim when they are created using white concrete.

The light-reflecting property of white concrete is particularly useful as a practical function in the manufacture of kerbs, road markings, tunnel ramps and paving stones.

White concrete is used in the following areas:

- **Concrete elements**
- **Paving stones, tiles and blocks**
- **In-situ constructions**
- **Mortar and paints**
- **Terrazzo**

AALBORG WHITE® *is a good starting point for coloured plaster*

Light, friendly interior with AALBORG WHITE®, *used for ceilings, floors and other interior features.*

Clear marking with white concrete kerbstones.

Contents

AALBORG WHITE®

AALBORG WHITE®
combines functionality and aesthetics

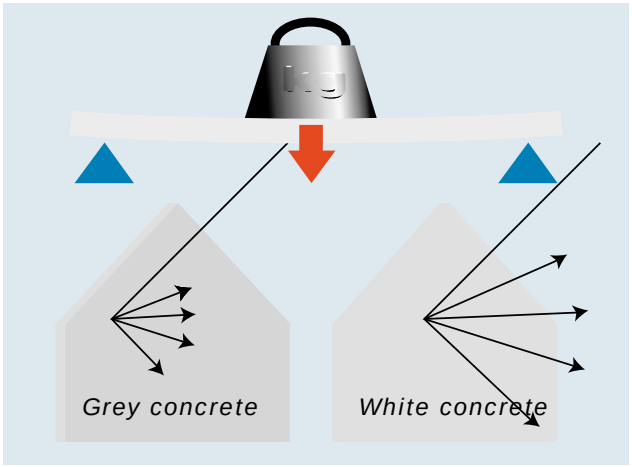
AALBORG WHITE®

AALBORG WHITE® is used as a binder in producing white or light-grey concrete. Used together with ordinary aggregates it gives a light-coloured and homogeneous concrete. Only with completely pure and light sand, and white aggregates can really white concrete be made.

Apart from the whiteness AALBORG WHITE® is characterised by:

- **Low chromate content**
  The chromate content is less than 2 mg per kg.
- **Extra low alkali content**
  AALBORG WHITE® is designated as low-alkali cement in Danish and international standards.
- **High sulphate resistance**
  AALBORG WHITE® is not affected by natural sulphated solutions.
- **Rapid hardening**
  AALBORG WHITE® hardens rapidly and quickly gains high strength.

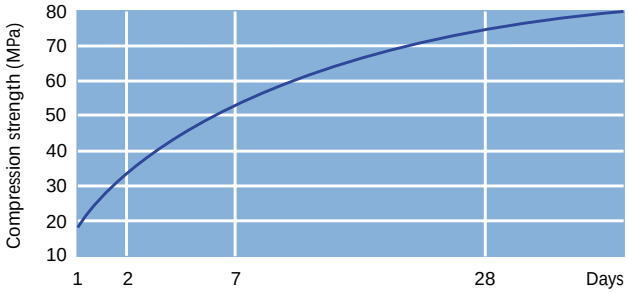
White concrete



High strength, high reflection.

High compressive strength

Concrete made with AALBORG WHITE® is significantly stronger than concrete made with other cements. AALBORG WHITE® is characterised by a compressive strength of min. 68 MPa, measured in accordance with EN 196-1 (standard mortar with water/cement ratio = 0.50). The typical strength development for AALBORG WHITE® is shown in the figure below.



Strength development for white concrete made using AALBORG WHITE®.

High reflection

White concrete has a higher reflection of light than grey concrete. Where grey concrete has a reflection corresponding to a Hunter L value of 40, white concrete has a reflection corresponding to a Hunter L value of up to 85. When the concrete surfaces are wet the difference is larger. With wet concrete the Hunter L value of grey concrete can fall to approx. 20 where the value for white concrete can fall to approx. 70.

Pure colours

Coloured concrete based on AALBORG WHITE® is particularly pure in colour when compared with coloured concrete made using grey cement. This property is also utilised when producing coloured mortars and facade paints based on AALBORG WHITE®. Since AALBORG WHITE® does not tone down colours, colour pigments indeed come into their own.

Raw materials
are the precondition for durable results

AALBORG WHITE®

AALBORG WHITE® meets the demands that most countries make on rapid-hardening cement and is made of particularly pure white chalk and finely-ground sand. The content of substances that might colour the cement is thus limited to a minimum. The small quantities of coloured substances that are always present in raw materials are bound and their colouring effect eliminated through the use of a special flame-cleaning technique.

AALBORG WHITE® has a very low alkali content and high sulphate resistance. It is therefore ideal for concrete used in passive as well as aggressive environments (e.g. bridges or structures in contact with sulphated ground water).

Concrete made with AALBORG WHITE® quickly gains relatively high compressive strength and its ultimate strength is far higher than that of concrete in which ordinary grey Portland cement is used.

AALBORG WHITE® carries a product certificate and fulfils the requirements of EN 197-1 and the American ASTM C 150.

Product characteristics for AALBORG WHITE®

Cement designation			To EN 197-1		ASTM C 150
Type			Portland cement		
Designation			CEM I 52.5		I II III V
Strength class			52.5		
Content of clinker minerals a.o. in %					
C_3S	C_2S	C_3A	C_4AF	Na_2O eqv.	$CaSO_4$
62	25	4	1	0.2	3-5
Density and setting					
Absolute density		kg/m³	3150		
Bulk density		kg/m³	1100 *)		
Setting time, initial			100 minutes		

*) Filling a silo pneumatically can increase cement bulk density by 20%.

Aggregate materials

Where white concrete is concerned, aggregates have a greater effect on the appearance of the finished concrete than when they are used in ordinary grey concrete.

Aggregates must therefore be selected in order to give finished concrete the desired appearance.

The aggregates for white concrete are often completely white such as white marble, white quartz, calcined flint, synthetic white stone materials or natural pale lake or beach pebbles.

Aggregates for white concrete must be frost-resistant and free of dust and sludge.

Untreated
With untreated surfaces, in addition to the cement it is mainly the colour of the sand, and especially of the filler content that determines the colour of the surface.

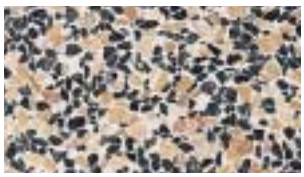
White marble
White marble is used as an aggregate when the requirement is for especially white concrete, which is also suitable where surfaces are exposed.

White quartz
White quartz is ideal as an aggregate for white concrete both for untreated and exposed surfaces.

Calcined flint
Burning flint at a high temperature gives calcined flint. This is a very white aggregate, which is suitable in concrete when light surfaces are required.

Light-coloured lake and beach materials
Natural light-coloured lake and beach materials are rounded pebbles especially suitable for exposed concrete surfaces.

Marble
Coloured marble is used as an aggregate for terrazzo floors, stairs, tiles, tabletops, etc. All colour combinations can be made up.



AALBORG WHITE®

Raw materials of significance for aesthetics and appearance

Pigments

Pure, clear colours result from the use of AALBORG WHITE® as the raw material in coloured concrete. The pigments used are normally synthetically produced inorganic substances that are alkali and weather-resistant, and which do not fade in sunlight.

By selecting aggregates with the same colour and reflection properties, coloured surfaces can be produced with a minimum of colour-fading during the life of the concrete.

Pigment is produced in all colours, e.g. in accordance with the colour notation system NCS (Natural Colour System) .

Admixtures

Admixtures are substances, which are added to concrete to give it a required property.

Air entrainment substances give greater frost resistance and plasticisers give higher strength for same cement content and workability. Calcium or zinc stearates reduce, among other things, the risk of efflorescence in coloured concrete. Admixtures that regulate setting and hardening can be different retarders and accelerators. Retarders are substances that delay setting and are used particularly with formwork where surfaces are to be exposed, while accelerators speed up setting and the early hardening stage.
Admixtures in concrete with white cement should be colourless.

White efflorescence can often be a big problem in coloured concrete. However, calcium or zinc stearates added in accordance with the supplier's instructions can significantly reduce the risk of efflorescence.

Trial batches of concrete containing the precise admixture(s) desired should always be made up to ensure that the efflorescence problem will not occur.

Lime and sand

The grain curve of aggregates must be maintained as constant as possible. Where the sand fraction is concerned, this is particularly important as even the smallest variations lead to colour-tone differences in the concrete surface.

Filler (0-0.25 mm) is frequently used to reduce the tendency to bleed in the soft, plastic concretes used in producing facade concrete.

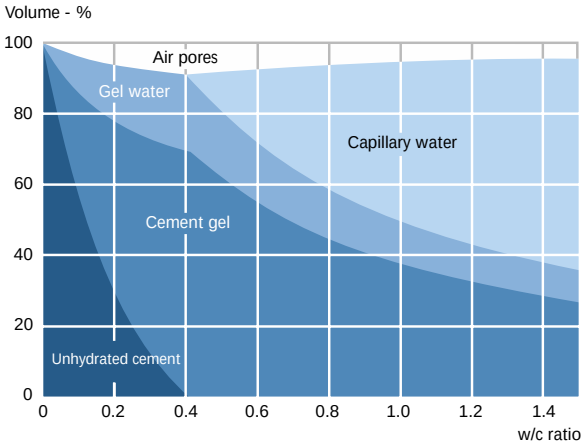
Lime is added in producing dry as well as wet mortars.

Proportioning

Proportioning of white concrete and mortar concerns the determination of mixing ratio between water and cement, aggregates and admixtures, consistency, etc. It is important that the composition be kept uniform since even small variations will produce different tones in the finished white concrete.

Water

The water used in mixing the concrete and the water applied to keep the concrete surface wet after casting must be completely clean – mains water for example.



W/C ratio

The cement paste (the mixture of cement and water) is the main deciding factor as regards the strength of the concrete. The binding power of the cement paste grows as it becomes more concentrated. Thus the strength of concrete also grows as the quantity of water used is reduced. The optimum ratio between water and cement (w/c ratio) for obtaining a specified concrete strength can be calculated beforehand.

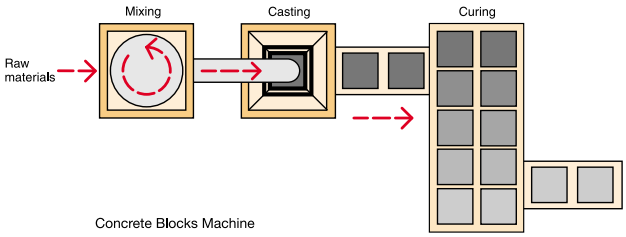
Production methods ensure strong structures

Concrete products

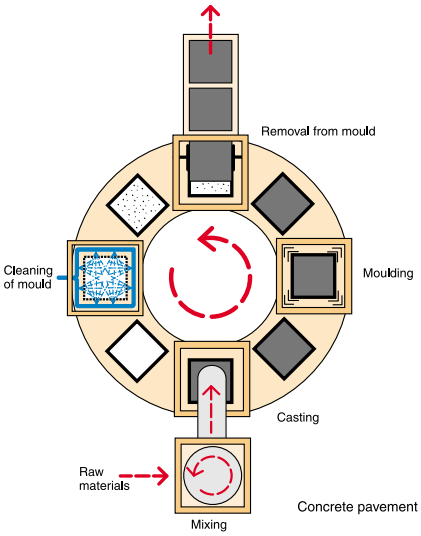
Concrete products are used everywhere - for paving, retaining walls, flower boxes, steps, pipes, etc.

Paving includes tiles and kerbstones, the latter with a white wearing course to mark parking bays, pavement edges, road lanes, traffic islands, etc.
In the manufacture of concrete products with AALBORG WHITE® the white concrete is often used for facings or for wearing courses. A layer of white concrete is poured into the mould first, followed by grey concrete. After casting, the product is turned out of its mould so that the white facing course is uppermost.

The method of production and the products themselves are closely controlled to ensure strong, uniform finished products of high quality.



Concrete Blocks Machine



Concrete pavement Slabs

Formwork oil

It must be possible to remove concrete products from moulds or formwork without either part becoming damaged. To ensure good release, the formwork surface must be brushed or sprayed with formwork oil (unless of course the formwork can be used without oil). Since in practice it is difficult to establish whether a surface defect can be attributed to the formwork oil or some other condition, trial castings using different form oils are advised.

Formwork oil application

Formwork oil must be applied in a very thin and even layer and must cover the formwork surface completely. The kind of formwork oil and the character of the surface are the determining factors in selecting the method of application. Formwork oils can be applied with a soft broom, clean cloth, cotton waste, paint roller, sprinkling or spraying. A thin and even application can be achieved by spraying and then drying off with clean cloth. No matter which method is used it is important always to ensure that surplus formwork oil is removed, with clean cloth or cotton waste.

Stripping and storing

When casting, the concrete is poured evenly throughout the form and then compacted with vibrators. The product is then dressed and finished. As far as storage is concerned, both underlay and shelving must be of materials that are non-absorbent or that do not lead to product discoloration. During transportation and installation, the surfaces of concrete products should be protected from dirt and contaminants such as plastic film.

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Production methods facilitate individual profiling

Wooden formwork

Wooden formwork can be used to impart a rough or a smooth surface to the finished concrete. Unplaned shuttering boards can be used to impart a rough, rustic surface, whereas planed boards or waterproof, plastic-lacquered plywood panels will produce a smooth surface.

Wooden formwork must be impregnated, with lacquer for example, to avoid colour changes in the finished concrete. The boards used in wooden formwork must be glued together or sealed in another way to prevent the creation of dark lines or edges on concrete elements.

Surface from wooden formwork

Steel formwork

Steel formwork is ideal for the production of large, smooth surfaces. Although expensive, it is very durable and the risk of formwork defects is less than with wooden formwork. On the other hand, the risk of permanent deformation is greater and steel formwork should be checked by measurement quite frequently.

Because of the density of steel formwork, it has a tendency to increase the number of air blisters in the concrete surface. Uniformly smooth concrete surfaces can also be difficult to achieve with steel formwork.

Surface from steel formwork

Plastic formwork

Plastic formwork is fairly reasonable in price; it is resistant to wear and comfortable to work with. Oiling is not usually necessary, but the formwork surface must be moistened with water before casting.

Formwork of fibreglass-reinforced polyester is just as wear-resistant as steel formwork. Plastic formwork is also dense and presents a risk of air blisters in the concrete surface.

Surface from plastic formwork

Profiling

If the concrete surface is to be profiled, formwork inlays can be used to create the desired pattern.

A rustic surface can be achieved using rough boards, perhaps steel-brushed, or treated with acid, singed or sandblasted to emphasise the grain of the boards.

Casting in

Concrete elements can be made up ready to accommodate wiring, i.e. with cast-in junction boxes, conduits or polystyrene blocks. They can also be cast with holes and recesses ready for piping and plumbing. Inserts and fittings can also be cast into elements as required.

Reliable methods for in-situ concrete construction

Concrete casting at the building site is known by several names including on-site concrete and in-situ concrete. In addition to foundations, many other concrete castings are made using formwork or shuttering, the purpose of which is to support and retain the concrete until it becomes self-supporting, and to give the finished concrete the appearance required by its position and function.

Shuttering material can be wood, wooden fibre board, steel, plastic or concrete. The making up of formwork or shuttering requires great care if the result is to be optimum, in that it is not possible to check the finished item before stripping. Shuttering can be temporary, sliding or permanent.

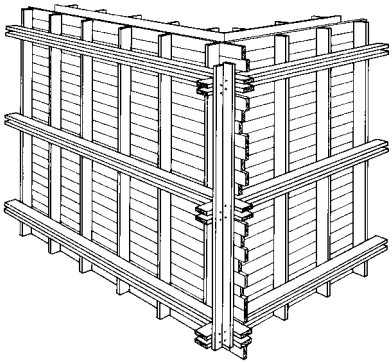
Board shuttering

Board shuttering is one of the simplest kinds of formwork and consists of loose boards nailed to planks. It is important to ensure that boards are fitted close together and that they are cleaned each time they are used. If this is not done, colour variations can result from the disappearance of water or cement slurry from the concrete.

If there are strict surface requirements, new boards become necessary. However, these must be treated because resin may act as a retarder on the setting properties of concrete. If the boards are not treated, light and dark areas will appear on the concrete because of the varying denseness of heartwood and sapwood. Boards can be treated with lacquer or lye, or they can be wetted with water before casting.

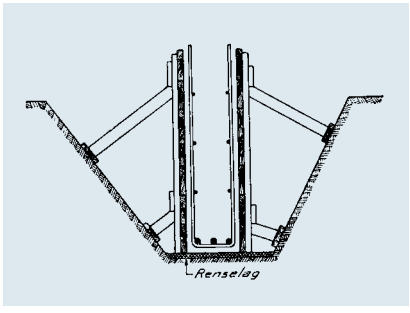
Because of the porosity of wood, air pores do not so readily form in the concrete surface, i.e. it is easy for the air to find its way from the formwork sides.

Shuttering for pedestrian and cycle bridge in white concrete.

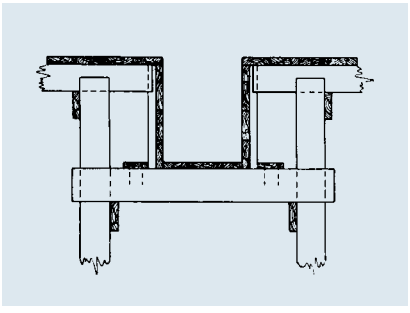


Shuttering for a plinth built up using rough shuttering boards.

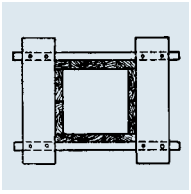
Concrete surface – from rough shuttering boards.



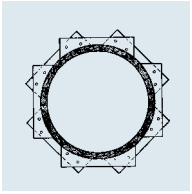
Foundation shuttering – rough boards and bracings.



Shuttering for a concrete beam.



Shuttering for a square column.



Shuttering for a round column.

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In-situ casting with different surfaces

Sheet shuttering

Waterproof plywood

Plastic-lacquered waterproof plywood panels last a long time and are the most common form of wooden shuttering. The panels give an even, uniform concrete surface.

The plastic lacquer prevents the wood from absorbing moisture from the concrete, but also usually creates more air pores in the concrete surface than rough wood shuttering.

Steel panels

Formwork made of steel panels is very durable and also provides an even, uniform concrete surface. The very dense surface of steel formwork means that it is necessary to vibrate the concrete more in order to avoid an excessive number of air pores in the concrete surface.

Steel formwork rusts if it is not oiled after use.

Plastic shuttering

Plastic formwork made of fibreglass-reinforced polyester is strong and durable. It is used particularly where special surfaces, i.e. patterns or profiling, are required. Plastic formwork must be supported, by a steel skeleton for example, because it is only a thin shuttering surface.

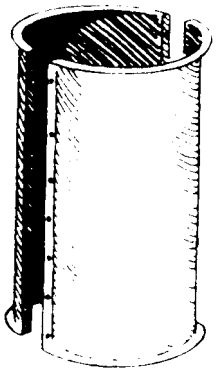
Sliding shuttering

Sliding shuttering can be used with advantage in casting silo walls,chimneys, stair turrets, etc. more than 10-15 m high and with a uniform or near-uniform cross-section over the whole height. Here, the formwork consists of a "belt" which with screw spindles is continuously moved upwards while reinforcement is inserted and concrete is poured.
A platform from which finishing work can be performed is located under the work deck.

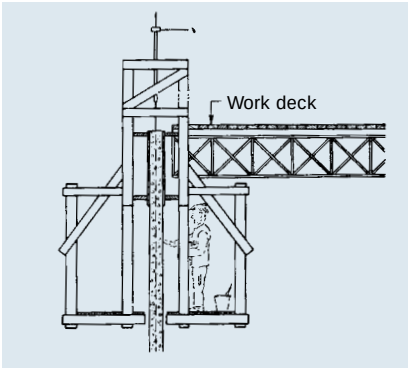
Permanent shuttering

Cornices, edge form sections, canopies, etc. made of fibre concrete for example, can be used as permanent shuttering. The formwork is mechanically fastened to the construction and thus remains in position when casting takes place.

Climbing shuttering



Steel mould for columns.



Sliding shuttering.

Sliding shuttering, Herlev Hospital.

Methods of surface treatment give structures their special characteristics

The purpose of concrete surface treatment is either to enhance the surface or to make it more durable. The simplest forms of surface treatment are screeding, rendering or trowelling.

The intrinsic colour of the aggregate can be exploited by using different exposure techniques that create various surface colours and structuring. An element made with AALBORG WHITE® and white marble aggregate will have a more uniform appearance when the surface is exposed.

Exposure removes the outer layer of the concrete surface to a desired depth. Depending on the surface effect desired, exposure can be performed with or without the use of retarder, or by sandblasting, acid etching, chiselling, or polishing.

White exposed coarse marble aggregate after grinding, with retarder.

Top photo: Applying and spreading retarder on the bottom of formwork. The retarder is applied with a broom and spread with a paint roller.

Above: Exposure by flushing and brushing the concrete surface. White exposed coarse marble aggregate after grinding, with retarder.

Exposure by retardation

This method of exposure is the most widespread. Retarding agents delay concrete surface hardening so that after formwork stripping, the surface layer can be removed by flushing or brushing. The retarder is applied to the formwork in an even layer and is allowed to dry before casting. The strength and thickness of the applied retarder determines exposure depth (which should not be more than a third of the largest size of stone/pebble).

Alternatively, retarding paper can be used. The supplier's recommendation must be followed when selecting and applying this material.

Cement slurry can be removed by acid etching preceded by thorough wetting and followed by flushing.

Exposure without retarder

Exposing the surface without the use of retarder involves brushing or flushing with water after the surface has stabilised. The surface is brushed and flushed until the desired exposure depth is reached. Cement slurry can be removed by acid etching preceded by thorough wetting and followed by flushing. Exposure without the use of a retarder is very rare.

Untreated surfaces

Untreated surfaces will bear the impression of the shuttering. Roughness and structure can be brought out by using rough shuttering boards of varying thickness. Special profiling can be produced by laying secondary materials in the shuttering, e.g. rubber, PVC, polystyrene, etc.

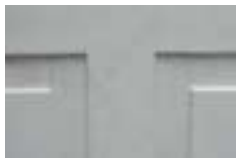
Sandblasting

Sandblasting is a widely used surface treatment of hardened concrete, e.g. in-situ concrete. The method removes the outer layer of cement paste so that the aggregate becomes visible. The surface is left rough, but quite uniform.

Sandblasting is normally performed with quartz sand. The treatment is often carried out in two stages. Coarse-grained sand is used first, the day after casting for example, followed some time later by fine-sand blasting to create an even and uniform finished surface.

Acid etching

Acid etching using thinned hydrochloric acid, acetic acid or phosphoric acid removes the outer layer of cement paste. Before treatment, the concrete must be thoroughly wetted with water. Normally, acid is applied with a broom or scrubbing brush, working from bottom to top. The treatment time must be as short as possible, followed immediately by thorough flushing with clean water.



Before acid etching

Acid-etched

Chiselling and polishing

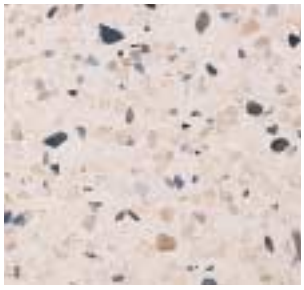
The surface of in-situ concrete is occasionally treated by chiselling. About 2 cm is removed in this way and therefore the concrete has to be quite strong to withstand the treatment, i.e. after it has been allowed to harden for 8-14 days. Chiselling is really work for stonemasons and skilled craftsmen should be engaged for the task.

Polishing or grinding the surface (customary with terrazzo) creates a strong and easy-to-clean surface.

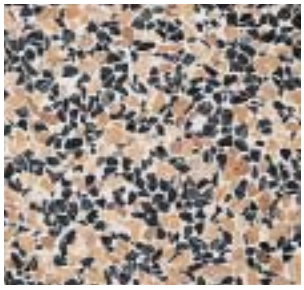
Part-exposure of coarse marble aggregate.

AALBORG WHITE®

Expert finishing creates elegance



Pink marble with black flecks



Red and black marble

Black and red marble

Patterned terrazzo tiles

Green plaster wash

Red plaster wash

Blue plaster wash

Yellow plaster wash

AALBORG WHITE®*-based diffusion-open facade paint*

Yellow cement-based, diffusion-open facade paint

Terrazzo

Terrazzo is most often used for floors and stairs, but can also been seen in the form of facade facing, tabletops, washbasins, artwork, fittings, etc.

AALBORG WHITE® is ideal for the production of terrazzo, a material consisting of aggregate such as coarse marble, onyx or glass fragments cast into concrete. Both the aggregate used and the concrete can be colour-matched and it is possible to produce surfaces in any colour shade.

Up to 70% aggregate is used for terrazzo, therefore it is mainly the aggregate that determines the choice of colour. If a coloured concrete base course is required, AALBORG WHITE® can be used to obtain clear, semi-transparent colours.

Terrazzo can be poured as a top layer on a concrete cover or in the form of tiles. If terrazzo is laid as a wearing course, extra aggregate can be added.

The terrazzo surface is kept moist until it is sufficiently hard (2-3 days). It is then coarse-ground and rendered with cement paste. After about 24 hours it is fine-ground until the surface is completely smooth and without cement slurry.

Terrazzo withstands hard daily use and is easy to maintain and clean.

Coloured mortars

Brickwork mortar, plaster mortar, plaster wash, hydraulic mortar and felt floating mortar can all be coloured. These mortars can be used for construction work, plastering, water and sack scouring or felt floating of brickwork or concrete. They are suitable for new building work and renovating, on outer and inner walls.

Coloured mortars made with AALBORG WHITE® give pure, clear colours. In principle, any colour can be mixed – right from semi-transparent to saturated. The colour fastness is quite good as a rule, but earth colours are the most durable.

Coloured mortar can be obtained as a dry or wet mortar mix.

Paints

Cement-based paints are mainly for facades, but can also be used for interior walls and basements.

AALBORG WHITE® is the natural raw material for cement-based paints and does not obscure the pure, clear colours of pigments.

Cement-based paints are water-repellent, but nevertheless allow the brickwork to breathe.

The appearance of coloured, plastered facades can be freshened by using silicate glaze or lime water in the same colour.

AALBORG WHITE®

A competent partner with comprehensive know-how

Aalborg Portland develops, produces and sells cement. The company ranks among the best in the cement world. The strength of the company builds upon more than 100 years' experience. The first cement was delivered in 1889 and now, more than a century later, Aalborg Portland stands as a modern cement factory with a strong profile on the international market.
Our force as a company lies in the supreme product quality we offer, a steady environmental profile, and an extensive range of service benefits for our customers.

Focus on the environment

Aalborg Portland has a clear policy on the general and working environments, on energy consumption, and on safety and health.
Every year Aalborg Portland publishes an Environment Report which pinpoints the improvements reached within the specific fields. From the middle of the 1980s to the present the company has invested more than DKK 1,000m in measures that have improved the environment. Internally as well as externally, these measures have been implemented to the optimum and always in close cooperation with the authorities.
Aalborg Portland's environmental management system is certified in accordance with ISO 14001 and the energy consumption of the company has thus been brought down to an absolute minimum.

Certified quality control

Aalborg Portland has always been known for its product quality. The reason is quality control. For more than 20 years, raw materials, processes and products have been the subject of systematic quality control. Today robot technology ensures 24-hour control and personnel constantly monitor the production processes by computer.
In 1989, Aalborg Portland's quality management system gained ISO 9002 certification by the BSI. AALBORG WHITE® cement made in Denmark is product certified by the Danish certification body Dansk Beton Certificering under an EC-certificate of conformity of cement to DS/EN 197-1:2000, certificate no. 1073-CPD-06209.

Benefit from our Know How

Choice of cement and concrete, concrete mix designs, casting techniques, curing, etc.

Education

Refresher courses for architects, consulting engineers, contractors, skilled bricklayers, and students.

Quality Control

Tests of gravel and other aggregates, suggestions for concrete mix design, trial mix, test of concrete properties.

Research and Development

Aalborg Portland is constantly working with further development of materials and techniques: New types of cement, alternative raw materials, new applications, high strength concrete, test methods, etc.

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