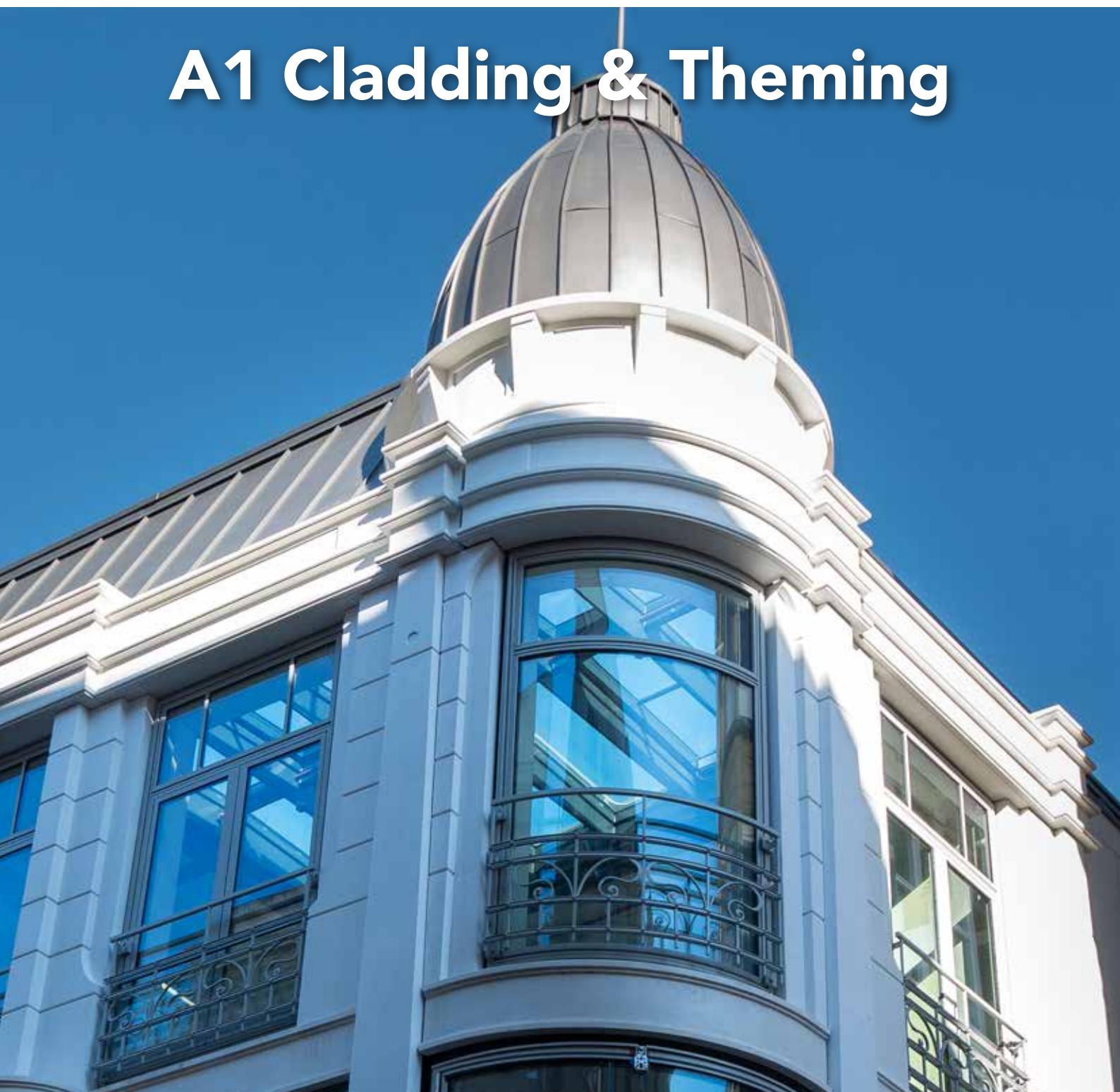




A1 Cladding & Theming



PREFACE

Active Composite Technologies (ACT) has developed Acrylic One (A1) composites. Since 20 years this material has been successfully applied in various products and applications. Besides the well-known benefits of composites (freedom of shape, light weight and strong), A1 has a superior fire resistance and absence of smoke generation during fire. This makes A1 unique for the creation of Cladding and Theming projects.



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1. A1 (ACRYLIC ONE)

A1, the abbreviation for Acrylic One, is a two-component material consisting of a mineral powder and a water-based acrylic resin. These bind in such a way that a strong material is created. A1 has many unique properties. These contribute to its strength, durability, weight to strength ratio, non-toxic, easy to manufacture and its ability to comply with many of the necessary test requirements of the construction industry, specifically those in regard to performance to fire and performance under impact.

A1's potential use is wide-ranging and could effectively replace much GRG, GRC and GRP in many of the situations where those materials are now used, both in- and outdoor. In comparison with GRC, A1 offers much greater versatility, as a panellised cladding system in that the manufacturing tolerance can be much tighter. A1 possesses a high resistance to ultraviolet degradation. It can, therefore, be used in the situation where other materials would suffer.

Main application areas

- Cladding & Façade panels
- Art & Sculpture
- Theming & Decoration

CLADDING & FAÇADE



Eksosiet

Properties

- Very high fire resistance properties
- UV stabilised
- Rainwater resistant (if sealed)
- Good mechanical properties
- Low heat generation during curing
- Shrink free
- Solvent-free
- Environmentally friendly
- Low peak exotherm

Surface finishes

A1 should be viewed as a matrix in which a variety of filler materials can be incorporated, either to enhance mechanical performance or for the sake of appearance. It is possible for A1 to include any non-reactive filler up to, and in some cases exceeding

200%. This allows a great deal of freedom when deciding upon encast and ex-mould finishes. An extensive and impressive range of finishes has been produced. These include a variety of metals (bronze, brass, copper and stainless steel), pigmented materials imitating terracotta, brick and pottery and encast stone finishes from white marble through to dark granite, Portland and Bath stone. It is thus possible to create a finish to meet the designer's specification rather than, as is usual, the designer having only two or three established finishes from which to make a choice.

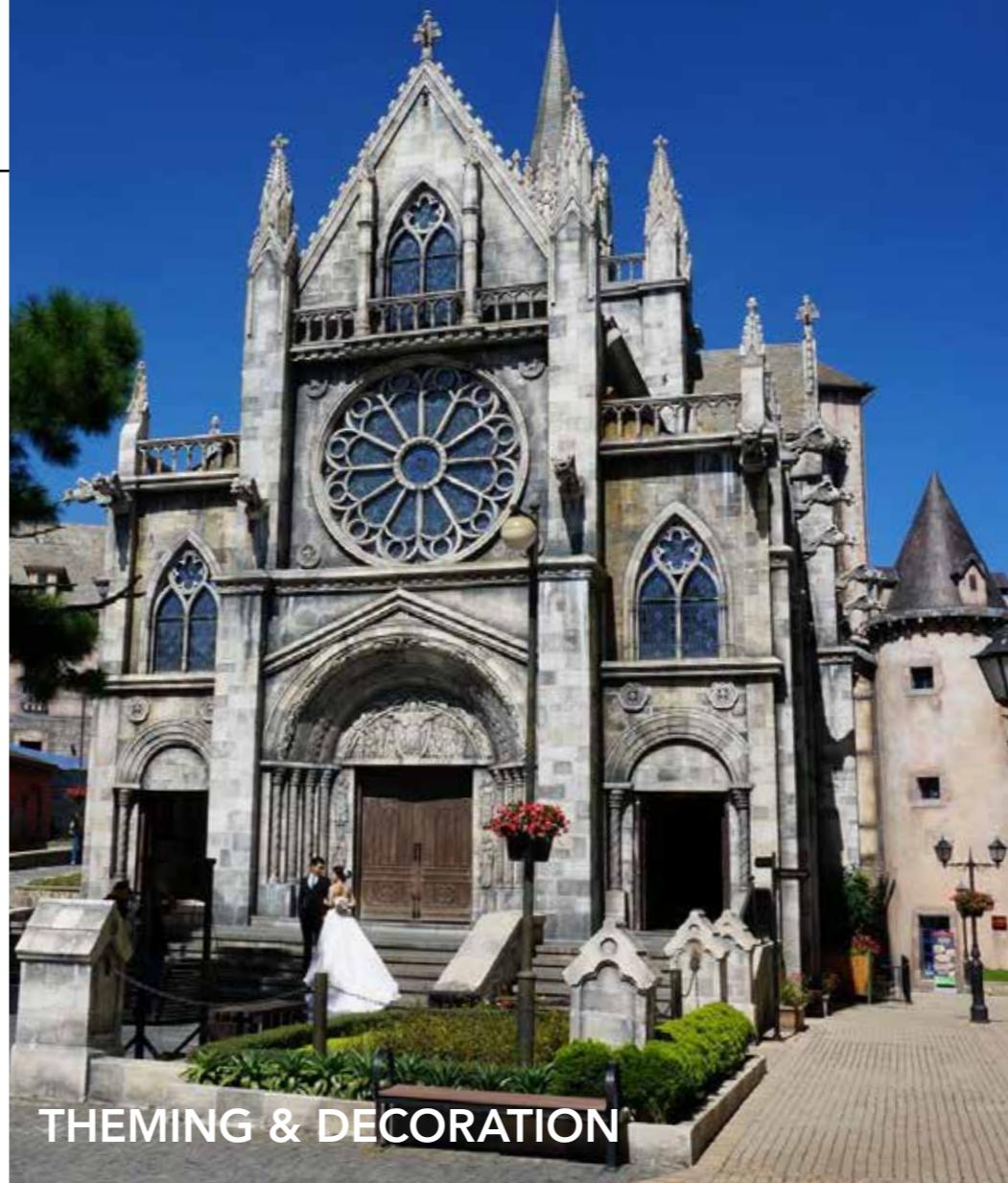
The standard finishes that can be produced are extremely high, both in their resemblance to the materials that they are imitating and in the quality of the surface finish.

A wide variety of finishes can either be incorporated into the material as a facing in the mould, where this is going to be backed up by a lamination or other composite foam material, or they can be included in the mix if the material is being used as solid cast. The method of manufacture obviously varies from situation to situation depending upon the design.

A range of fine textures and colours can be further produced. These include leather and cloth through this specialised process.

Design

A1's excellent weight-to-strength ratio means that when used as a lamination the designer is allowed greater freedom to produce large panels. Complex and fine details are possi-



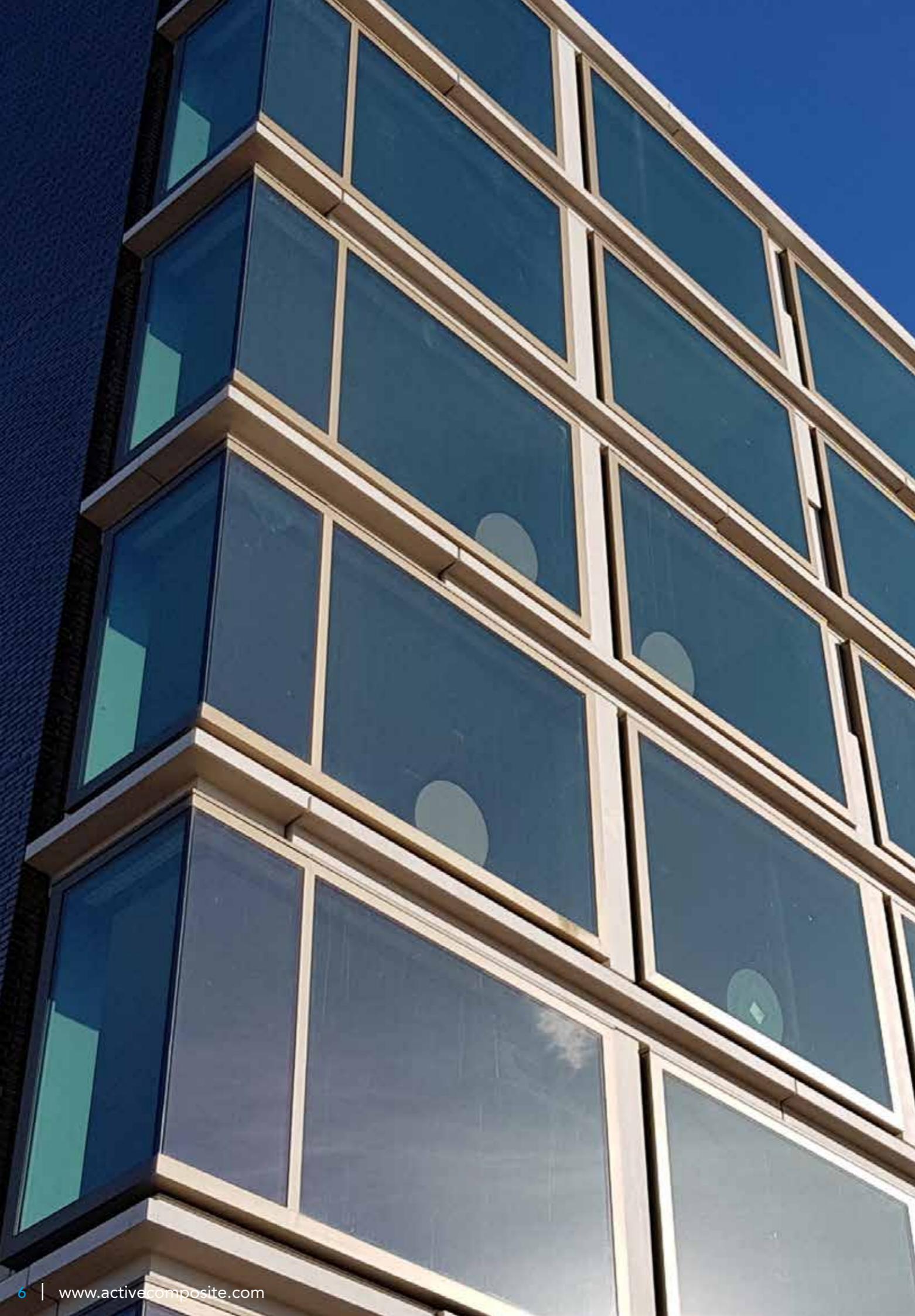
THEMING & DECORATION

anti-graffiti coating which allows for the removal of paint, crayons, etc. In normal maintenance conditions, the material can be simply washed with detergents and water or, if required, with stronger substances such as solvents, with no detriment to the surface finish.



ART & SCULPTURE

Lut van Dievel



2. FAÇADE PANELS - THE NETHERLANDS

In 2017 Rijnboutt architects has designed the Amsterdam Olympic Hotel. In the facade elements have been designed with a concrete look between the windows. These elements are oriented both horizontally and vertically.

The building company Van Wijnen Lelystad has investigated the possibility to use thin-walled profiles for these elements together with Poly Products. By using thin-walled profiles, a low weight can be realised that facilitates the mounting process and reduces the requirements on the anchoring of the elements to the building.

Project date: 2018

Where: IJsaanpad 12, 1076 CV Amsterdam
The Netherlands

By: Poly Products



2. FAÇADE PANELS - THE NETHERLANDS



A polyester mould with a release agent.



Cutting different sizes of A1 Triaxial fibre.



Within 2 hours the panel is demoulded for further curing.



On the inside panels are being reinforced with aluminum.



Weighing and mixing A1 Liquid, A1 Powder, Thix A and sand for the top layer.



Applying A1 with brush and roller.



L-shaped panels are sprayed with A1.



After complete curing, the panels are lightly sand blasted.



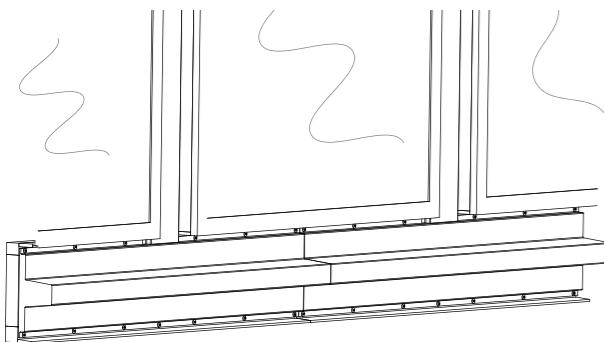
Several layers of A1 Sealer are applied to protect against weather influences.



Applying several layers of A1 with Triaxial fibre.



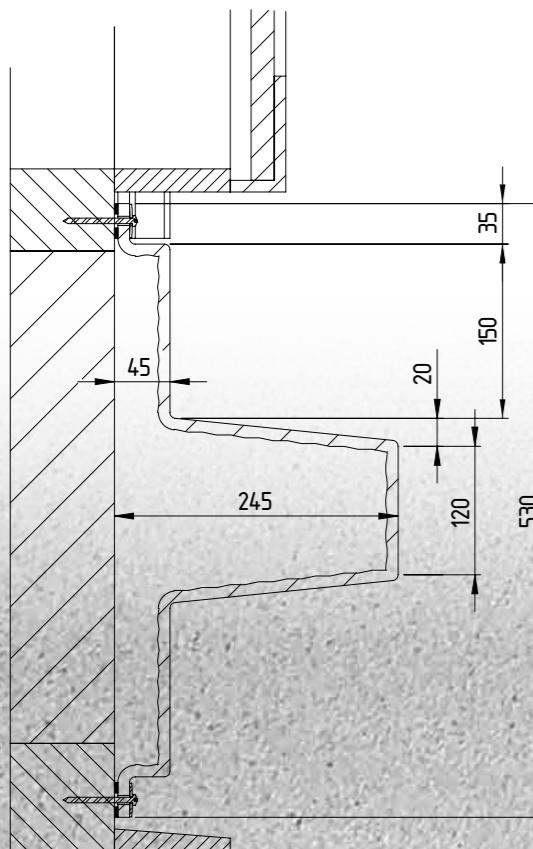
2. FAÇADE PANELS - THE NETHERLANDS



Location of the horizontal elements in de façade

Of the horizontal elements different types have been produced. The type that was most critical in wind loading will be considered in the following. The figure shows the cross-section of this element and relevant dimensions.

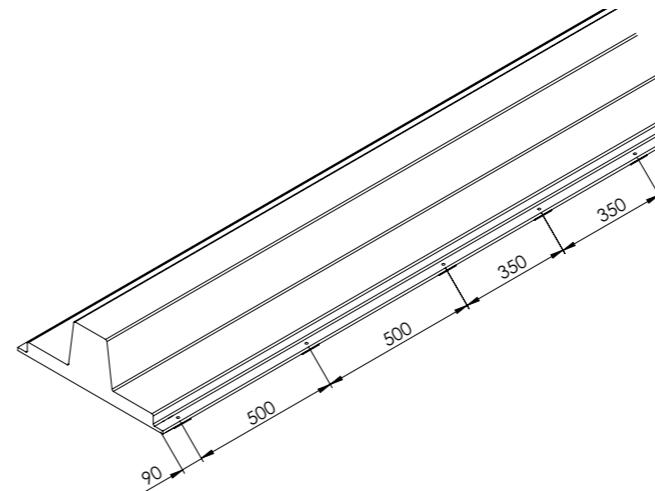
For the structural evaluation specially the wind forces are important to evaluate.



Strength of connection to the building

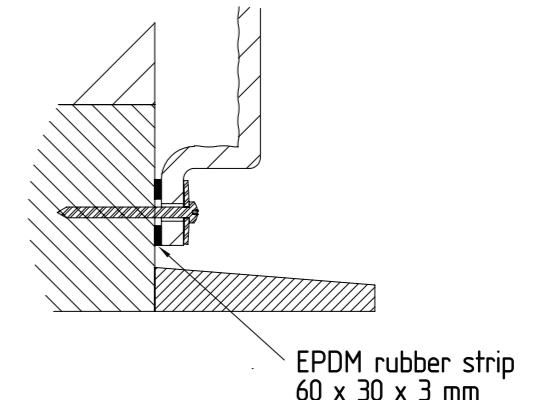
The strength of the connection of the profile to the building is determined by the method of connecting. A screw with a diameter of 5 mm and a shaft length of 60 mm is selected for this. For spreading the load, a washer is used with a diameter of 29 mm. Screw and washer are shown in the photo below.

In the project the maximum distance of the screws is selected to be 500 mm. Moreover, the maximum distance of screws near the end of the profile is selected to be 90 mm. Because the lengths of the elements vary, sometimes the distance between two screws is less than 500 mm. A typical screw pattern in the project is illustrated.



These ventilation openings are realized by placing 3 mm EPDM-rubber strips between the element and the building during mounting.

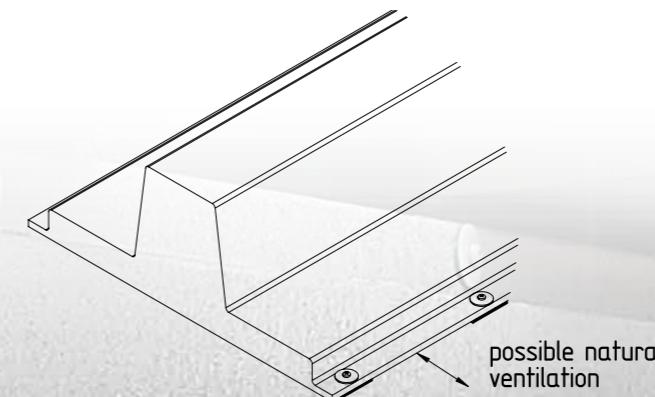
cross-section detail



EPDM rubber strip
60 x 30 x 3 mm



In order to avoid accumulation of moisture due to condensation, an opening is created between the element and the building structure.



The elements have been produced from polyester moulds using hand lay-up. For stiffening of the element in width direction aluminum profiles have been incorporated in the back-side of the elements. These aluminum profiles also have been used to release the product from the mould and for further handling and transportation.

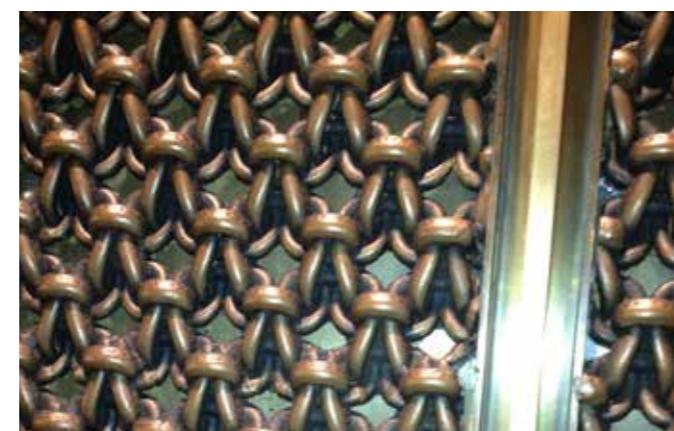
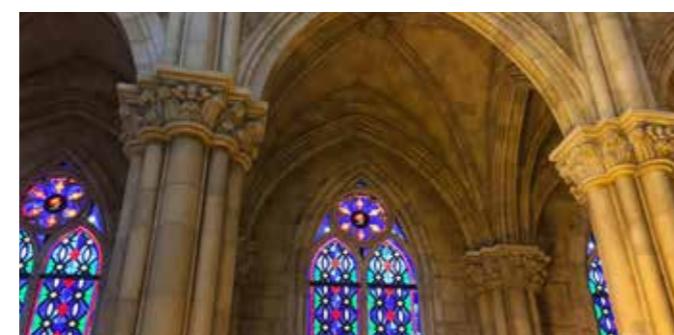


3. A1 FAÇADES

A1 has a number of important advantages in the manufacture of lightweight façades.

Appearance

A façade provides information about the function of the building and presents itself through its appearance. With A1 an almost infinite number of (natural) appearances and colours can be achieved by adding (natural) filling materials. By using (silicone) moulds almost every structure can be reproduced.



Processing

A1 is water-based and contains no harmful substances. This makes it a safe material to work with. Also, there are no expensive investments in equipment needed to be able to use A1. This means that A1 can be used in almost all types of production environments, provided that they have a proper heat and moisture balance.

Adhesion to EPS

A1 adheres excellently to EPS (Expanded Polystyrene) and is therefore a frequently used combination. Objects, for example made from modelling foam, can also be covered with A1.

Substitute for natural stone and brick

Natural stone and brick are traditionally the materials for load-bearing walls and columns. A1 can serve as a good alternative to these materials. Natural stone is precious, and its strength varies considerably. Brick as a load-bearing material has declined sharply in recent decades. With the introduction of the cavity wall, solid brick exterior walls can be replaced by thin A1 wall panels with a brick look.

Substitute for concrete

Decorative elements are often executed in a concrete appearance. By adding pigments and fillers it is possible to achieve a large number of different concrete radiations with A1, but in panels with enormous weight savings.

Substitute for wood

Wood is a widely used material for façades and decoration. Panels made of A1 not only have the appearance of wood but also meet the highest fire requirements.

Substitute for metal

Various metal powders are added to A1, allowing different metal radiations to be achieved, such as bronze, iron, copper and zinc. For A1 façades, we only add these metal powders in the top layer, so that we achieve the desired appearance with a little amount of metal.

4. PANELS IN WOOD STRUCTURE - THE NETHERLANDS



A1 reinforced with A1 Triaxial fibre, finished with a red/orange coating. Because of the fire retardant properties A1 was chosen, to replicate the fine wood structure of an original wooden panel.

Project date: 2011

Where: Ahoy (indoor event center), Ahoyweg 10, 3084 BA Rotterdam - The Netherlands

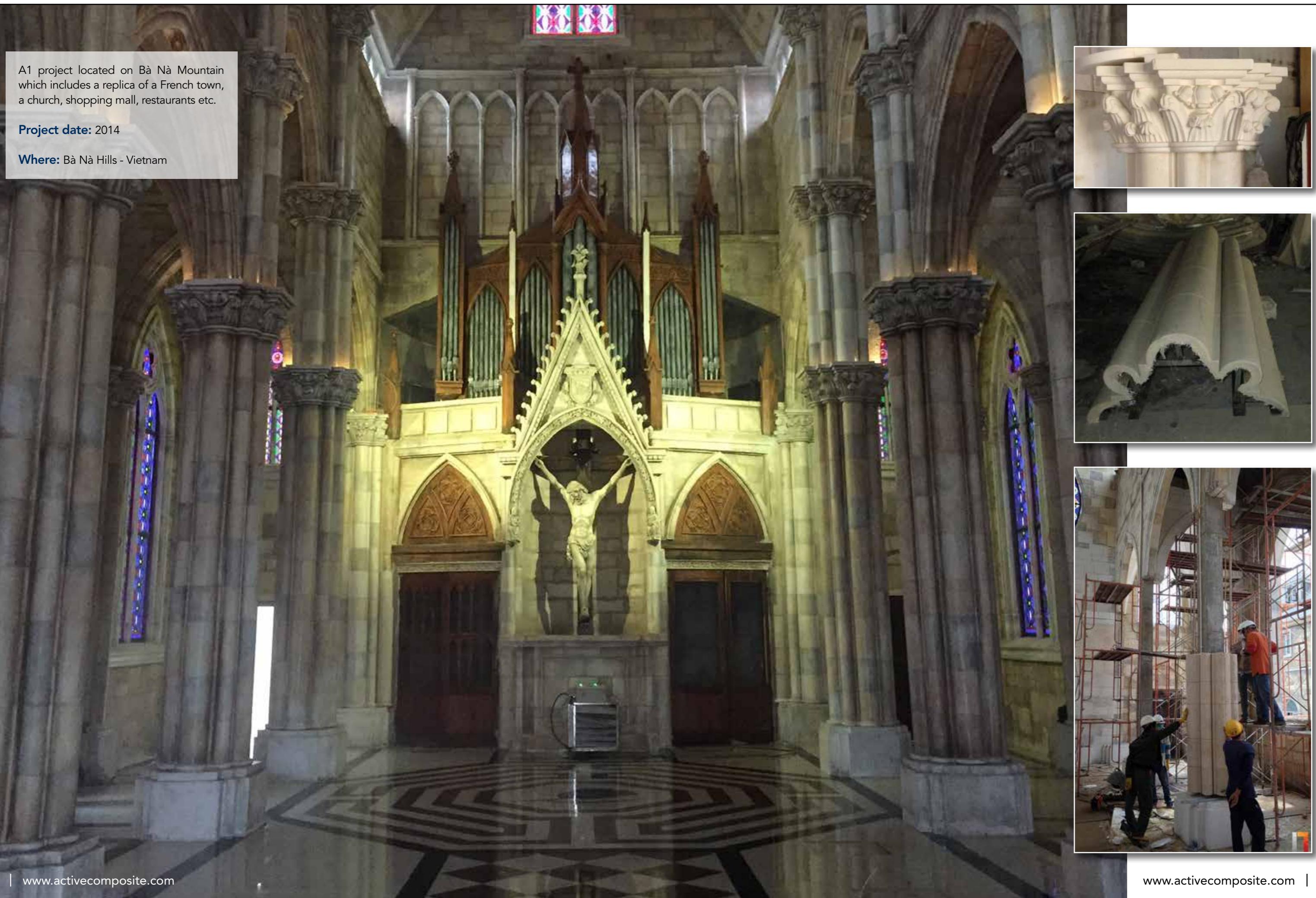
By: Kool Polyester

5. COLUMNS IN A CHURCH - VIETNAM

A1 project located on Bà Nà Mountain which includes a replica of a French town, a church, shopping mall, restaurants etc.

Project date: 2014

Where: Bà Nà Hills - Vietnam



6. A1 FIBRE REINFORCEMENT



A1 Triaxial glass fibre 160 gr/m²



A1 Triaxial basalt fibre 160 gr/m²



CSM 150 gr/m²

A1 Triaxial glass fibre 160 gr/m²

A1 Triaxial glass fibre is used in combination with A1. In this way, A1 objects can be created or covered in moulds with A1. Triaxial glass fibre strengthens the A1 objects.

- A1 Triaxial glass fibre has an open structure and has been specially developed for A1.
- It is flexible and easy drapable, even over round shapes.
- Lightweight (160 gr/m²) yet very strong.
- After use of 4 layers in combination with A1 vandalism proof.

A1 Triaxial basalt fibre 160 gr/m²

A1 Triaxial basalt fibre can be used as fibre reinforcement and has the same properties as our A1 Triaxial glass fibre. It is a good alternative for people who are sensitive to working with glass fibres. It's also alkaline resistant.

Use of natural fibres

Natural fibres are offered as an alternative to glass and basalt fabrics. A major disadvantage of these fibres is the tendency to absorb and retain moisture, which disturbs the moisture balance in the A1. This moisture absorption can also cause fungi to develop and eventually affect the A1 object. For outdoor applications, the use of natural fibres is therefore not recommended.

How do you process A1 Triaxial fibre?

A1, unlike polyester, does not absorb A1 Triaxial fibre but clamps it in between the different layers of A1. That's why our glass fabric has an open structure that allows the different layers of A1 to connect to each other and to clamp in the A1 Triaxial fibre.

The best time to start laminating over the top layer is when it is drying but

still feels slightly moist. immediately after the set time has expired.

The best result is achieved when the laminating layers are applied wet to wet. An advantage of A1 is that after a few days you can still apply A1 with A1 Triaxial fibre with a good adhesion. However, the substrate must first be coated with a wet layer of A1 before the A1 Triaxial fibre can be applied.

Even with larger surfaces it can happen that the A1 already reacts (is hard) before a new layer of A1 Triaxial fibre can be applied. This can be solved by applying a new thin layer of A1 or by slowing down the reaction time of the A1 using A1 Retarder.



To laminate, you have to work wet in wet. A quick way to apply A1 is with a brush or roller.



Examples laminate build up vs. thickness

Thickness	Protea building - SA	Tax office - NL	Apartments - NL	Olympic Hotel - NL
1st mm	gelcoat	gelcoat	gelcoat	gelcoat
2nd mm	triaxial	triaxial	triaxial	triaxial
3rd mm	triaxial	core	core	triaxial
4th mm	core	core	triaxial	triaxial
5th mm	core	triaxial	core	triaxial
6th mm	triaxial	top	triaxial	-
7th mm	triaxial	-	top	-
Coating system	A1 Sealer	PU 2K	A1 Sealer	A1 Sealer

Test values for mechanical properties

For the determination of the mechanical performance of A1 composite laminate panels have been made by hand lay-up of glass fibre reinforcement (Triaxial Fibre 300, 160 g/m²) with A1 mixture.

The laminate panels have been made without a gelcoat-layer (non-reinforced resin layer) and without any other additives. Laminate panels were built up on a flat, smooth panel as a mould.

Test (AM)	Property and unit	0° direction m _x / V _x (%)	90° direction m _x / V _x (%)
In-plane tension (n=8)	E-modulus (MPa)	2312 / 5.3	550 (*) / 8.2
	Tensile strength (MPa)	57 / 6.4	18 / 6.0
Bending (n = 16)	E-modulus (MPa)	3726 / 21.3	2984 / 35.5
	Flexural strength (MPa)	43 / 17.6	32 / 22.7
ILSS (n = 16)	Shear strength (MPa)	4.5 / 8.2	
Transverse tension (n = 20)	Tensile strength (MPa)	0.8 / 7.4	

All reinforcement layers have been stacked with the same orientation.



For more information
see our report:
**Design Guide
A1 structures.**

7. BRIDGE ELEMENTS FLY-OVER - THE NETHERLANDS



For a fly-over over the railway in Amersfoort the side elements have been designed as concrete elements. However, such elements would weigh 900 kg per meter bridge-edge. Because the total length of elements is 200 meter this would result in a weight of 180 tonnes. This was not acceptable. Therefore the elements have been made of A1 with a surface that has a concrete look. By using an integrated aluminum mounting structure the element made of A1 weighs only 150 kg per meter. This is more than 80% lighter than the concrete elements.

Additional advantages occurred as a result of the low weight of the A1-elements. Significant savings on the complete mounting system became possible because of the low weight. Moreover, the transportation to the building site and the mounting of the elements was significantly cheaper as a result of the low weight. The mounting time of the elements was 50% shorter than it would be the case when concrete elements would have been used.

Project date: 2015

Where: De Zonnecel 15, 3815 KN Amersfoort - The Netherlands

Designed by: Van Boekel Groep and Be Concrete



7. BRIDGE ELEMENTS FLY-OVER - THE NETHERLANDS

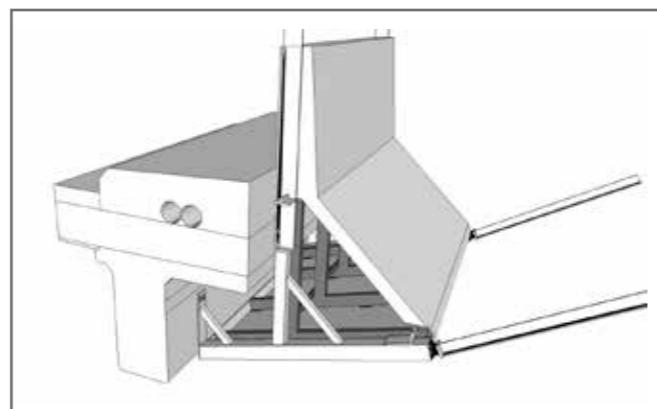
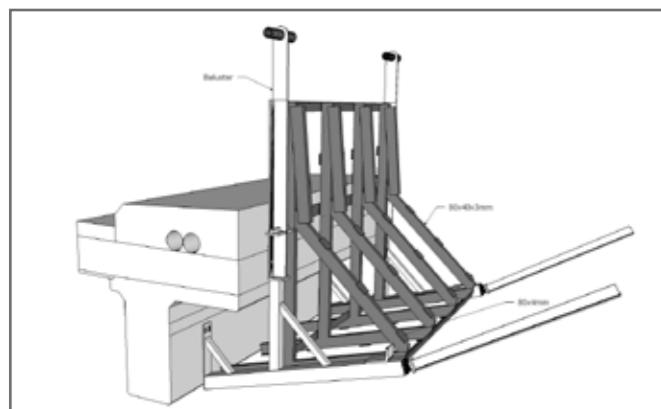
The A1 elements have been laminated in a mould, see photo below. Still in the mould, the aluminum mounting frame is connected to the A1 elements by laminating. In this manner the aluminum frame could be positioned accurately, which was important for the mounting of the assembly at the steel structure on the bridge edge.

The photos below show how this aluminum structure can be connected to the bridge edge.

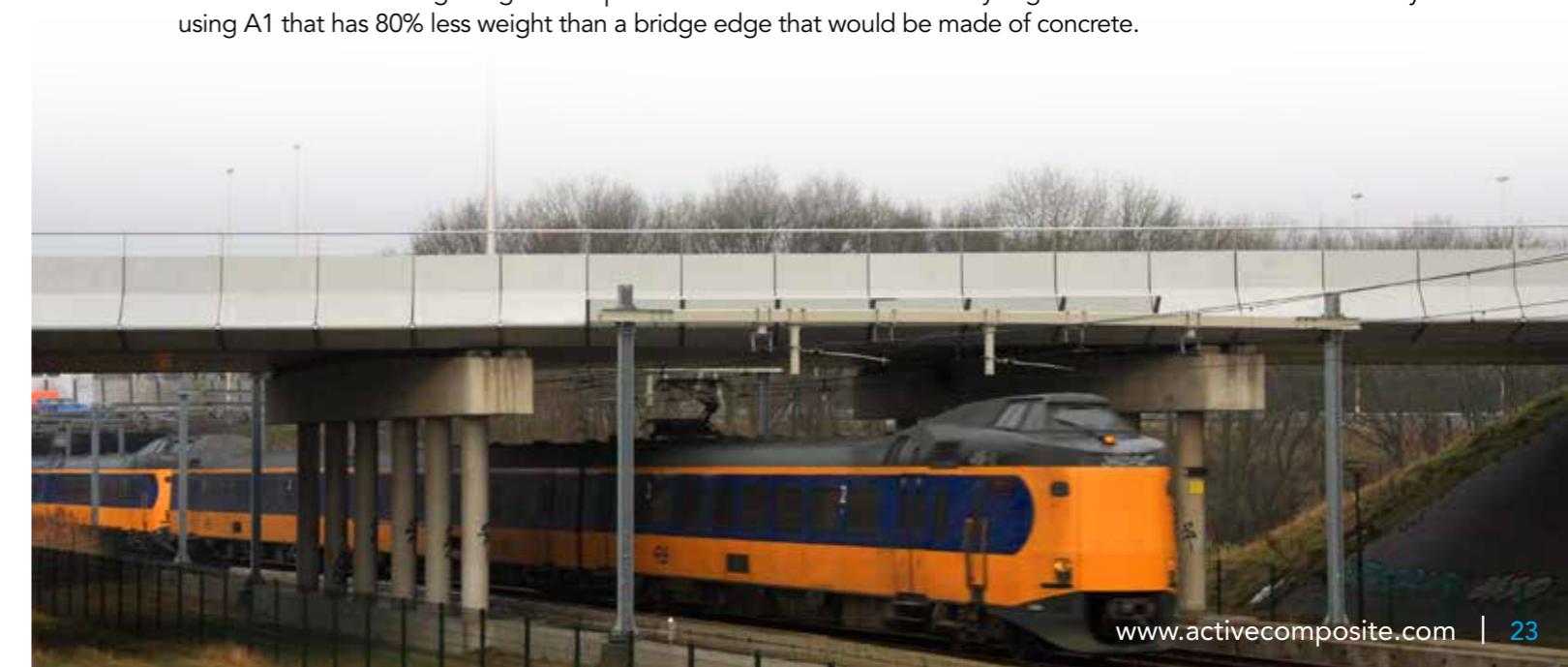
It was very important that the steel structure on the bridge edge was adjusted accurately. In this manner, the aluminum structure could be connected directly to it and resulted in a perfect alignment of the elements. The photo's below show the process of mounting of the elements at the bridge edge in Amersfoort.



A1 element laminated in the mould



Aluminum structure mounted to the steel structure (without A1 element)



The final result is a bridge edge built up from elements that are accurately aligned. A concrete look is realized by using A1 that has 80% less weight than a bridge edge that would be made of concrete.



8. TRAVERTIN PANELS - POLAND

The lightweight panels were made in a silicon mould and nicely connected on side.

Project date: 2015

Where: Church in Poland (Dobieszowice)

By: Jacek Kicinski



The panels are only 4 mm thick



Euroscop Amsterdam
Project date: 2019

Where: Buikslotermeerplein 3, 1025 ES Amsterdam - The Netherlands

By: Ascaro - Veghel

9. MOULDS

A1 is excellent to process in a mould so that exact copies of the original can be obtained. It is possible to use a mould of different materials such as: silicone rubber, concrete forming plywood, PU, polyester, etc.

It is important that no adhesion can take place between the mould and the A1. Silicone rubbers are excellently suited for this purpose and therefore we also recommend working with moulds made of silicone rubber.

A silicone mould has a number of other advantages, such as:

- flexibility of the mould is very useful when demoulding the A1 object.
- Because A1 does not shrink but has a small expansion during the reaction process between the A1 Liquid and the A1 Powder, an exact (detailed) impression of the silicone mould is created.
- A1 does not affect the silicone. This makes it possible to create an infinite number of A1 prints.

A silicone mould may be less suitable for dimensionally stable products. In addition, poor quality silicones (often cheap) with a high fat content can give off, which is sometimes visible on the A1 object.

Moulds made of sheet material such as epoxy plywood forms or polyester moulds work well in practice if provided with a suitable release agent. During hardening, A1 expands slightly. This can cause A1 to get stuck in the mould, especially when it is not self-discharging. Moulds made of

gypsum or other porous materials are not recommended unless they have a fully sealing coating or washing system that prevents moisture from the A1 from penetrating into the mould. There is a risk of a (strong) bond between the mould and the A1 and a weakening of the A1 object.

When using a release agent, (limited) release agent may remain on the A1 object after release. Often these release agents are based on fat/oil. This can affect the adhesion of even finishing coats such as A1 Sealer, paint system or an extra layer A1.

Therefore, we advise to limit the use of release agents as much as possible or to work with mould materials that do not bond with A1.



Silicone rubber



CNC



Plywood

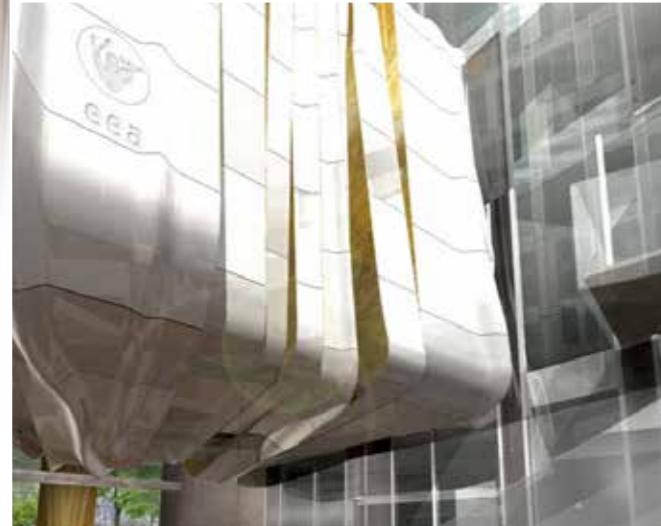


Glass fibre reinforced Polyester



Coated EPS/Polystyrol

10. AUDITORIUM - THE NETHERLANDS



Rendering of outside surface of auditorium by EEA

Project date: 2009

Where: De Brauw Blackstone Westbroek - Claude Debussystraat 80, 1082 MD Amsterdam - The Netherlands

By: Architect: Erick van Egeraat. **Production:** Poly Products

In 2007 Erick van Egeraat Architects (EEA) made a design for a covering of the auditorium inside the Mahler building that was built in Amsterdam. Again, because of the complex shape to be realised in combination with the requirements on fire behaviour the choice to use A1 was obvious.

In 2008 Poly Products has developed a method for realizing and mounting of the elements. Each element has been laminated with A1 in a mould. In the inner part of the element 36 mm plywood strips have been incorporated as mounting beams. While still in the mould, strips of 18 mm plywood strips were screwed to these beams. The plywood strips, 6 or 8 per element and extending from the back of the element were used later on for mounting the element in the building.

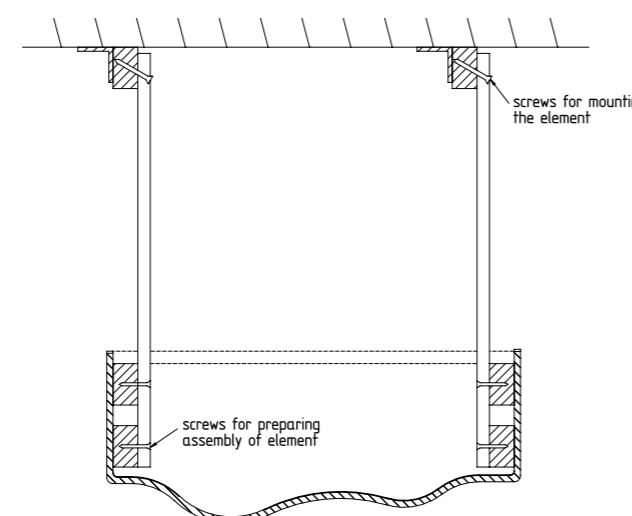


Element laminated and 36 mm plywood beams positioned to the sides



Further interior stiffening of laminate and 18 mm plywood strips connected

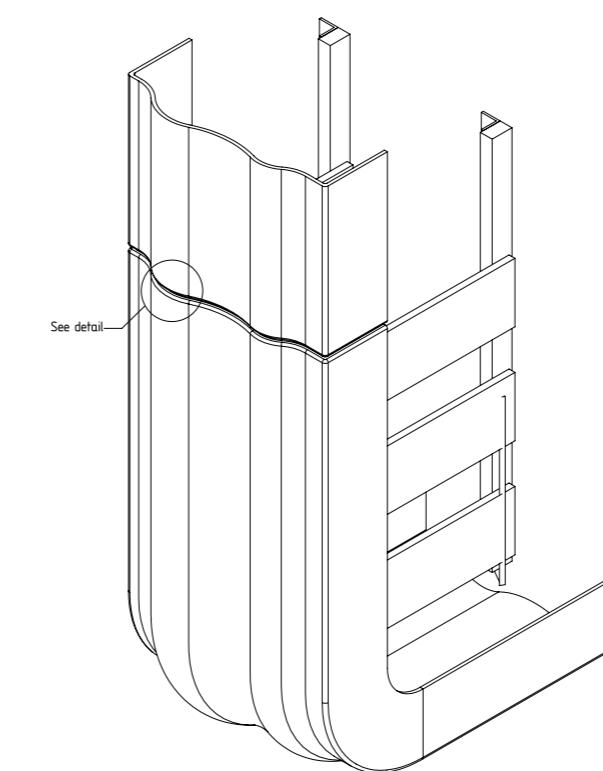
The principle of the mounting of an element to the building structure is based on the fixation of the protruding 18 mm plywood strips at the back of the element to wood beams that have been installed to the building structure, see figure below.



The 18 mm protruding plywood strips have a relatively high strength and stiffness in vertical direction in which direction they have to carry the weight of the element. In lateral direction these strips behave relatively flexible which makes the alignment with the adjacent elements relatively easy.

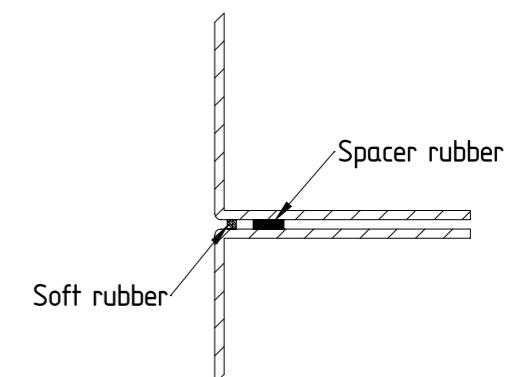


For the dilatation gap between two elements that are in line with each other in first instance it was designed to realize this by means of a joggle. However, this would involve additional inserts in each mould. Moreover, to obtain a situation that is nicely flush from one element to the other would become difficult. And there would be the risk of damaging the joggle during mounting of the element



when the joggle of one element had to be fitted into the internal space of the neighbouring element. With the connection of two elements as depicted below it is illustrated how this has been solved with another detailing.

Instead of a joggle, both elements were provided with a flat head plane. On one of the elements spacer rubbers were stuck to provide the desired dilatation distance. Near the visible edge, a white, compressible rubber strip has been stuck at a fixed distance of the outer edges. The principle is depicted in the figure below.



During mounting of an element it could be softly placed on the previous element that was provided with the spacer rubbers and the strip of white, soft rubber. This is shown in the photo below.



10. AUDITORIUM - THE NETHERLANDS



Unique moulds of milled EPS are smoothed, covered with a (red) coating system and boxed with the use of plates. After production of the A1 elements, the moulds are used for safe transportation of the A1 elements.

11. REINFORCEMENT & CONSTRUCTION

For projects in A1 it can be essential to provide the object with a reinforcement construction. This depends on the size, use and application of the object. It is possible to reinforce the object with numerous materials including EPS, wood, stainless steel and aluminium. The use of these materials should always be carefully considered. We do not recommend laminating wood into objects for outdoor use. This also applies to use in damp rooms. Aluminium has many advantages over wood and is therefore recommended in these situations.

To attach reinforcement materials, gluing can be done by laminating with A1 and Triaxial fibre. It is also possible to glue materials with bonding products. Observe the manufacturer's instructions. Excellent adhesives include MS polymer sealants.



Construction inside panel Mahler - The Netherlands



Panels Protea building - South Africa

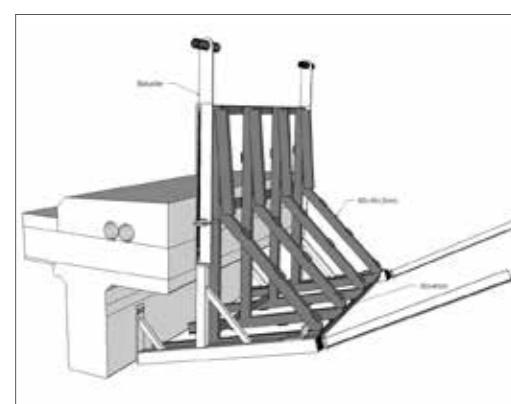
Other influences that should be taken into account are thermal and weather influences.

In addition, influences that may vary per location, such as wind load, are important to take into account.

For detailed construction methods of several A1 projects see our report:
Design Guide A1 structures.



V&D building Kalverstraat - The Netherlands



Construction inside panel fly-over - The Netherlands



A1 has good adhesion to materials such as wood and iron and is therefore an ideal combination in many situations. A major disadvantage of wood and iron is that both materials react to moisture. Wood will absorb moisture and expand. We see the same process with iron, which oxidises in contact with moisture.

A1 is a water-based material and a small amount of residual moisture will also be present in the A1 object after curing. In addition, A1 absorbs (to a limited extent) moisture in a humid environment, which can come into contact with the wood or iron. The reaction of the wood or iron to the moisture (expansion) can have consequences for the A1 in the form of markings and possible tearing of the A1.

A1 is often used as covering material for many different types of materials including EPS, plaster and many other foams/materials. In itself, this is perfectly applicable, but a number of factors must be taken into account. Especially when using A1 in combination with materials that are themselves very sensitive to moisture you should take into account reactions like blistering and drawing through of moisture spots. In outdoor applications, these materials are not recommended. In indoor applications, it is fine if triaxial fibre is also used, which reduces the risk of cracks

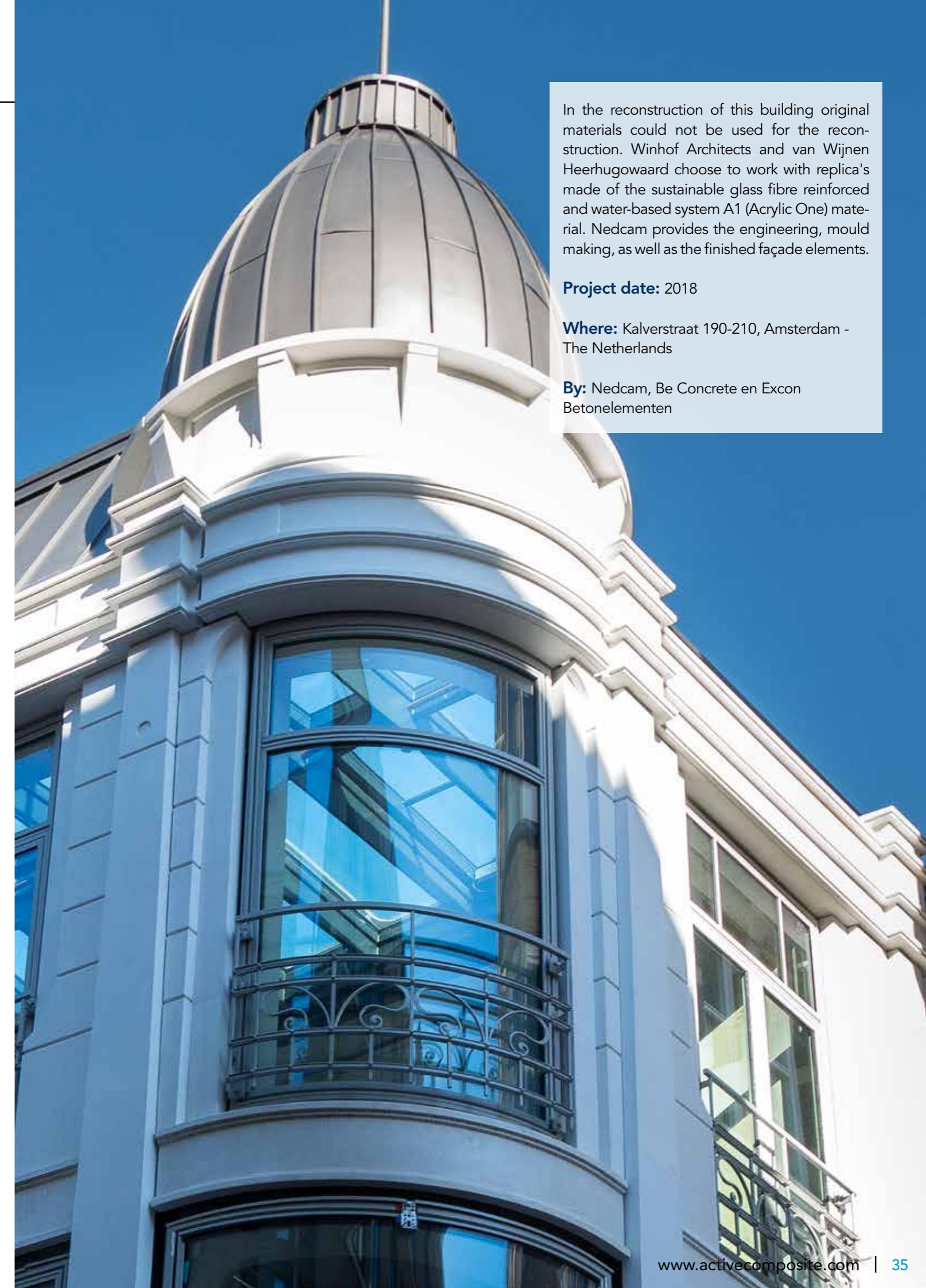
Material	Coefficient of thermal expansion (in 10^{-6} / °C)
A1 laminate	5
Glass (window plate glass)	8
Concrete	12
Steel	12
Aluminium	23
Polyester laminate (glass mat)	24
PVC	80
HDPE	200

drastically. It is advisable to use at least one layer of triaxial tissue in almost all applications. Due to the differences in thermal expansion of the materials, crack formation can easily occur without reinforcement. This is usually done by a greater thermal expansion of the materials compared to A1. A1 can absorb this but the thinner the A1 layer the greater the risk.

EPS, galvanised iron, stainless iron and aluminium will react not or less to the moisture present and are therefore better alternatives. However, we do recommend taking into account the differences in thermal expansion when changing temperatures of the different materials.

12. FAÇADE ELEMENTS LA PLACE - THE NETHERLANDS

Before renovation



In the reconstruction of this building original materials could not be used for the reconstruction. Winhof Architects and van Wijnen Heerhugowaard choose to work with replica's made of the sustainable glass fibre reinforced and water-based system A1 (Acrylic One) material. Nedcam provides the engineering, mould making, as well as the finished façade elements.

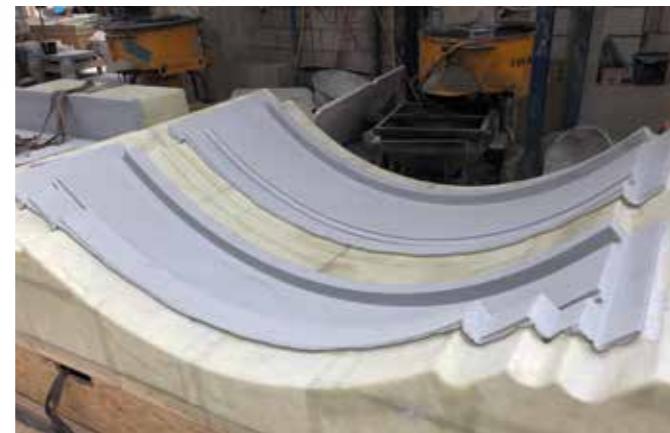
Project date: 2018

Where: Kalverstraat 190-210, Amsterdam - The Netherlands

By: Nedcam, Be Concrete en Excon Betonelementen

12. FAÇADE ELEMENTS LA PLACE - THE NETHERLANDS

The old façade of the building had to be replaced. First the old façade has been scanned by 3D-laserscanning. In this manner the façade could be rebuilt exactly in the same dimensions and with the same details.



From the scanned data, a 3D-model has been made with all 35 A1-elements to be made. For each element to be made a direct mould has been produced by Nedcam. The direct moulds were made of an EPS-base with a PU-paste layer that was milled to the exact dimensions.

In the moulds the elements have been produced using A1. These were built up by starting with a non-reinforced resin layer, followed by laminating 4 layers of A1 Triaxial glass fibre reinforcement of 160 g/m².



After curing an aluminum mounting structure is connected to the back of the panel by laminating. Including the mounting structure the elements have a surface weight of 20 kg/m².

Because of the low weight the elements were easy to install. In this manner the façade of La Place in Amsterdam has been built.



13. A1 IN AN OUTDOOR ENVIRONMENT

FIRE

A1 has good to excellent fire resistance properties and can be used for projects with high fire resistance requirements. We have tested A1 in accordance with EN 13501-1 and ASTM E84-15b.

European classification

Classification of reaction to fire performance in accordance with EN 13501-1:2002. A1 (Acrylic One) LP01 and A1 Tri-axial Fabric:

B-s1,d0

Its reaction to fire behavior is classified : B
The classification to smoke production is : s1
The classification to flaming droplets / particles is : d0

Class	Performance description	Fire scenario and heat attack	Examples of products
A1	No contribution to fire	Fully developed fire in a room	At least 60 kW/m ² Products of natural stone, concrete, bricks, ceramic, glass, steel and many metallic products
A2	"	"	Products similar to those of class A1, including small amounts of organic compounds
B	Very limited contribution to fire	Single burning item in a room	40 kW/m ² Gypsum boards with different (thin) surface linings Fire retardant wood products
C	Limited contribution to fire	"	" Phenolic foam, gypsum boards with different surface linings (thicker than in class B)
D	Acceptable contribution to fire	"	" Wood products with thickness ≥ about 10 mm and density ≥ about 400 kg/m ³ (depending on end use)
E	"	Small flame attack	Flame height of 20 mm Low density fibreboard, plastic based insulation products
F	No performance requirements	-	Products not tested (no requirements)

Classification of reaction to fire performance in accordance with EN 13501-1:2007+A1:2009. A1 LP01 and A1 Tri-axial Fabric + sand (25% of mass A1):

A2 - s1,d0

USA fire rating

Evaluation of the surface burning characteristics of a material identified as A1 in accordance with ASTM E84-15b, standard test method for surface burning characteristics of building materials.

Flame Spread Index (FSI) : 20
Smoke Development Index (SDI) : 15

Test Criteria.		
Classification	Flame Spread Index	Smoke Developed Index
A	0 – 25	0 – 450
B	26 – 75	0 – 450
C	76 – 200	0 – 450

In the following table a comparison is made of laminates based on A1 and several other materials. These materials include glass reinforced laminates based on a standard polyester resin and a polyester resin with the highest possible flame-retardancy (FR), polyester concrete and wood-based panels.

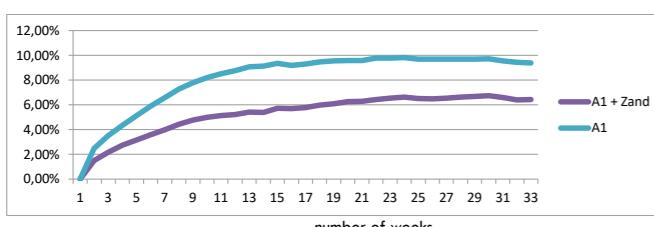
Fire performance (EN 13501)	Reaction to fire	Smoke	Droplets
A1 laminate (standard)	B	s1	d0
A1 laminate (25% sand filled)	A2	s1	d0
Polyester laminate (standard)	D	s3	d0
Polyester laminate (flame retarded)	B	s3	d0
PVC (wall cladding)	B	s2	d0
Plywood (600 kg/m ³)	D	s2	d0
Plywood (600 kg/m ³ , flame retarded)	B	s1	d0
OSB (600 kg/m ³)	D	s2	d2
MDF (600 kg/m ³)	D	s2	d0
Particle board (600 kg/m ³)	D	s2	d0
Cement-wood board (1000 kg/m ³)	B	s1	d0
High Pressure Laminate (1350 kg/m ³)	D	s2	d0
HPL (1350 kg/m ³ , flame retarded)	B	s1	d0
Mineral based panel (1100 kg/m ³)	A2	s1	d0
Mineral wool panel (100 kg/m ³)	A1	s1	d0
Concrete (2400 kg/m ³)	A1	s1	d0

13. A1 IN AN OUTDOOR ENVIRONMENT

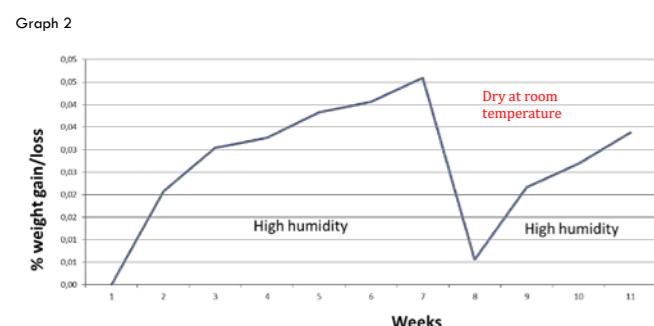
WATER

Similar to many other materials, A1 will attract moist/water at a humidity rate above 90%. As can be seen in graph 1 it will take several weeks at very high humidity level to reach the maximum levels of 10 to 11% water absorption. If we add sand to the A1 (1 part A1 Liquid, 2 parts A1 Powder and 2 parts Quartz Sand) the water absorption is significantly lower.

Graph 1: 90% to 95% humidity at room temperature



An A1 object will release its water when placed in an environment with a lower humidity (below 70%) at a high speed as can be seen in graph 2. It only takes a few days to reach the levels at starting point.



Exposure of an A1 object to very high humidity environment is possible for several months without affecting the A1 object. The use of an A1 Sealer or coating system will extent this period as it acts as a barrier between the humidity and the A1 object.

We have also tested A1 objects fully submerge under water and tested the quality of the top layer with the use of a Shore measurement (picture 1 and 2). Based on these tests an A1 object can be fully submerged under water for a period of 2 months without weakening the top layer. After this period the top layer weakens and the A1 will slowly dissolve in the water.



Picture 1



Picture 2

Equilibrium moisture content at different Relative Humidity levels

20°C	20% RH	0,06%
20°C	65% RH	0,50%
20°C	85% RH	1,20%
20°C	95% RH	11,00%



ULTRA VIOLET (UV)

UV has a strong influence on the durability of materials. 20+ year old A1 project in South Africa shows that (coated) A1 will withstand UV influence.

When an uncoated A1 object is exposed to (intensive) UV the very thin top layer of the A1 object will be affected (erosion) within a few months. This will mainly be noticeable by a change of the colour of the A1 object. After this initial period the erosion by UV will continue but at a very slow rate.

Adding sand to the A1 object (1 part A1 Liquid, 2 parts A1 Powder and 2 parts Quartz sand) will still result in an initial erosion of a very thin top layer but after this the added sand will almost stop the erosion process of the A1 object caused by UV.

For the best protection we advise applying layers of A1 Sealer (PLUS) to the A1 object as this layer will act as a barrier between the UV radiation and the A1. As the A1 Sealer (PLUS) will

now be affected by the UV we advise to apply a new layers of A1 Sealer every 3 years and of A1 Sealer PLUS every 6 years. Other coating systems can be used as well if they are damp open (KEIM Soldalan) or the A1 object can release its moist at the backside of the A1 objects (for ventilated Cladding systems).

Façade Nijmegen

The façade panels are placed close to ground level. This is possible as the A1 panels will release possible rainwater at a very high rate. Furthermore, these panels are coated with A1 Sealer which protects the A1 façade.



Bath Bunny

This A1 object with an polystyrene core is floating in the Rotterdam waters for several years now. The layer of A1 coated onto the polystyrene core is in good conditions excluding the layer of A1 which is fully submerged under water, which has dissolved in the water. The layer of A1 which is directly at the waterline is still fine as it does absorb water in rough conditions but has the opportunity to release this water when exposed to air.



Totem pole

This totem pole placed in a swimming pool is at the top made of A1 with a foam core. The lower part (50 cm) is made of polyester.



We would like to use A1 in an aqua parc and the A1 elements will frequently be exposed to water.

If the A1 object is constructed in such a way that the splash water can easily drain off and in combination with a good coating, we do not expect any problems. In places where the splash water can collect, we advise not to use A1.

A1
GRP

14. RENOVATION FAÇADE PANELS - THE NETHERLANDS

These panels are made of A1 mixed with yellow sand and reinforced with A1 Triaxial fibre.

Project date: 2016

Where: Rentmeesterhof, 6532 DB Nijmegen
- The Netherlands

By: Be Concrete



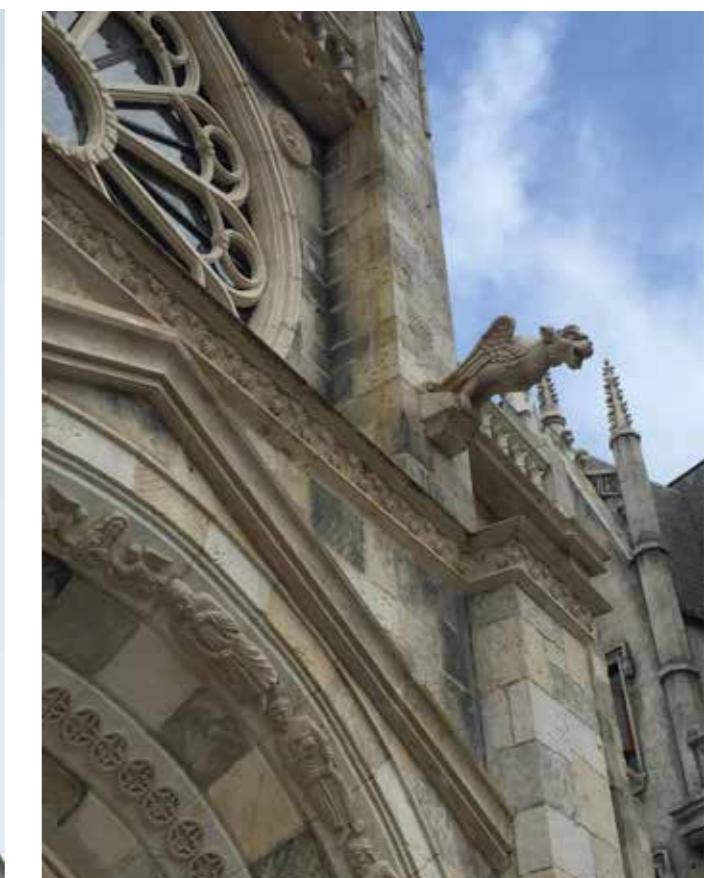
15. ELEMENTS OF A CHURCH - VIETNAM



A1 project located on Bà Nà Mountain which includes a replica of a French town, a church, shopping mall, restaurants etc.

Project date: 2014

Where: Bà Nà Hills - Vietnam



16. BENCHES CONCRETE LOOK - THE NETHERLANDS

Original designed in concrete, these hollow benches are made of glass fibre reinforced A1 to achieve the needed weight reduction because of the cellar underneath. An anti-graffiti coating is applied afterwards.

Project date: 2012

Where: Stedelijk Museum, Museumplein 10, Amsterdam - The Netherlands.

By: Be Concrete



17. COATINGS (FOR OUTDOOR USE)

For outdoor use you can choose several coating systems. Most common systems are:
A1 Sealer, 2K PU, Keim or other exterior wall paints.

A1 Sealer (PLUS)

A1 Sealer (PLUS) is the most common one-component sealer to protect A1 products for outside use. It is easy to apply in one or more layers. The more A1 Sealer (PLUS) you apply the more gloss will appear. It also can be used as a base resin for patina to decorate and give products a natural look. Advantages of the sealer: one component, solvent free, easy to apply, good UV resistant, protection against dirt pick up, quick drying, excellent adhesion and good humidity protection.

By our users also other coatings and sealers are used to enhance and/or protect the desired aesthetic properties (aesthetic and performance) of the A1 objects upon which they are applied. Below, you will find a list of several coatings/sealer's that (appears to) work well with A1. Information is based on projects from the past and achieved results after ageing in Weathering/UV cabinets. Depending on climate in different parts of the world, the lifespan and maintenance time of the different coating systems can vary.

Exterior wall paints

Exterior Wall Paints are available in a variety of brands and formulations, all with their specific features. Keim Soldalit is a Multi-purpose, silicate exterior paint on a sol silicate binder basis (combination of silica sol and water glass) for organic, mineral and mixed substrates. KEIM Soldalit is water-repellent, highly water vapour permeable, lightfast, UV-stable, extremely resistant to weathering with minimal soiling tendency.

2K Polyurethane coatings

2K Polyurethane coatings are available in a variety of brands, formulations and qualities. Baril 269 Poluran Clear Coat 75 is a high-quality coating with excellent adhesion on A1 composite products. This Semi-Gloss transparent coating is easy to apply and has high abrasion and chemical, high mechanical and impact resistance. The good flexibility and weathering/UV resistant results in a long-lasting protection of products made of A1. Be aware that 2K coatings are NOT vapour permeable, which could create water entrapment, if the A1 application is also closed on the back and not fully cured.

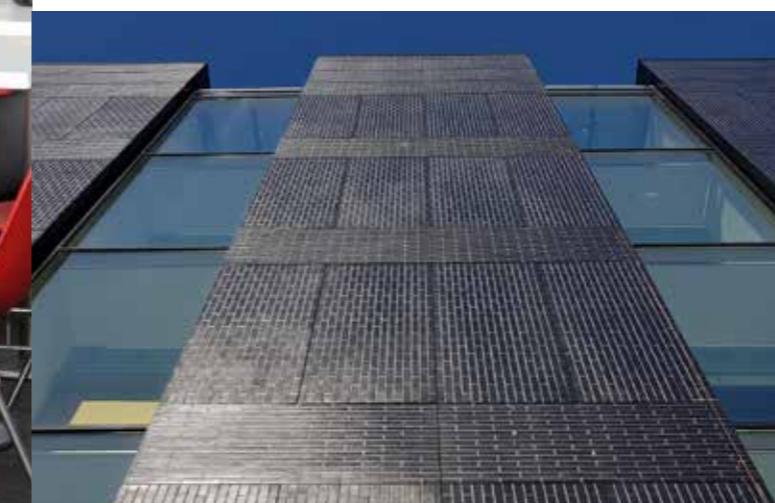
Acrylic paint, oil paint or lacquer

For indoor use, the A1 object can be finished with acrylic paint, oil paint or lacquer, provided that the adhesion of the paint has been tested beforehand.

If you choose such paint and final lacquer (matt or high gloss), we recommend, in addition to testing, to observe the following points:

- make the object inside,
- dry and cure the object completely,
- after about a week to paint (drying time on the advice of the paint supplier),
- then varnish (drying time on the advice of the supplier),
- an A1 Sealer is not necessary then.

For outdoor applications, such coating systems can interfere with the breathability of A1, which can lead to flaking of the coating layer.



Façade panels - Doetinchem, The Netherlands - Baril coating

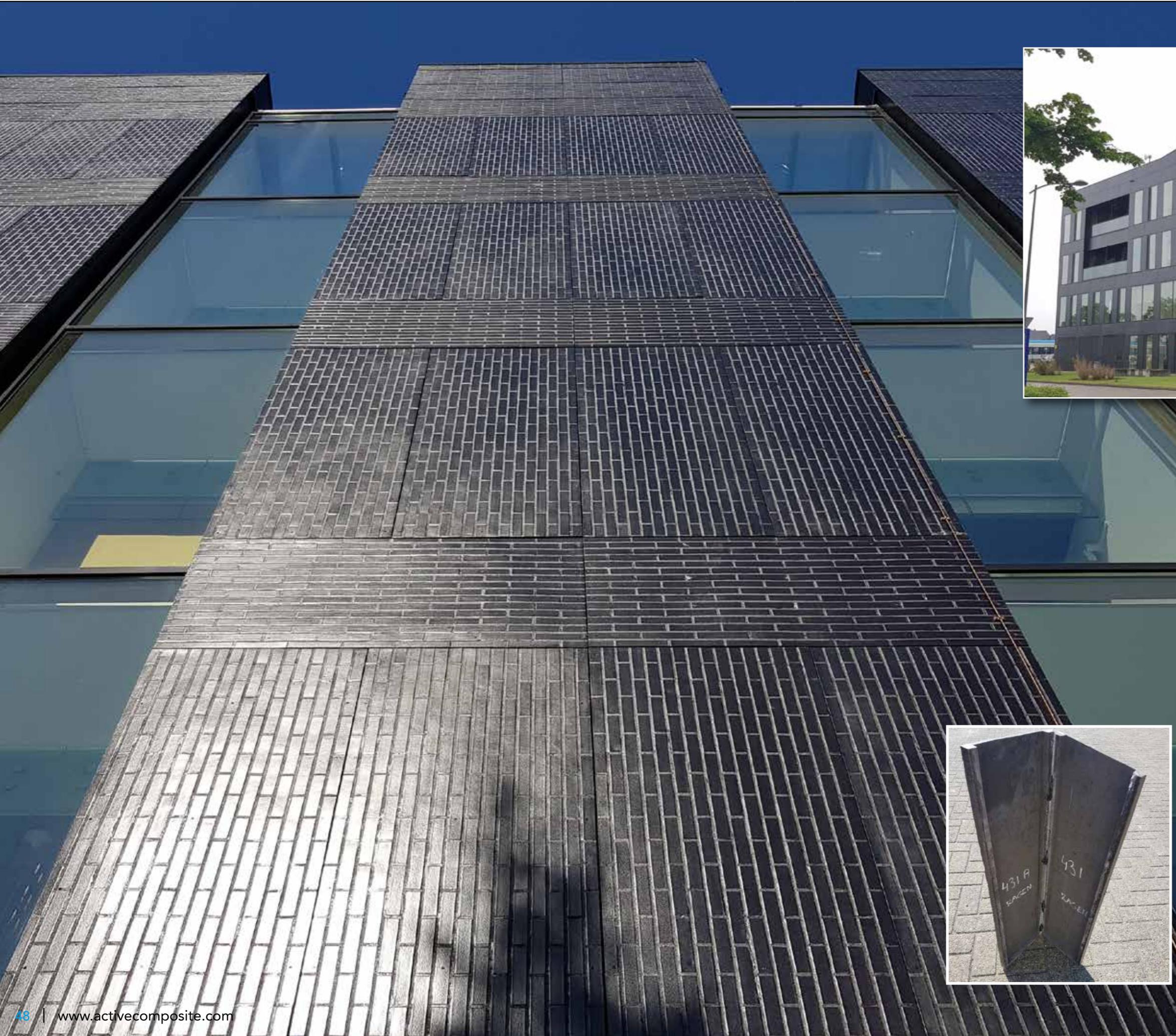


Kramer Kunstwerken - Anti-graffiti coating



Kool - Ahoy Rotterdam - 2K epoxy coating

18. PANELS - TAX OFFICE - THE NETHERLANDS



The original façade of this building was damaged badly by weather influence to such an extend that decided was to replace the whole façade. The original feel and look of the façade were to be maintained without the use of the original materials.

Silicone rubber was used to make a copy of the original façade, which acted as the moulds to make large A1 façade panels. The result are panels with the exact feel and look of the original façade.

A two-component coating was used to protect the panels against weather influences. This was possible as the back of the panels are not coated and well-ventilated resulting in a damp-open system.

Project date: 2014

Where: Hamburgerbroeklaan 12, 7005 AJ, Doetinchem - The Netherlands

By: Lensvelt en Ekosiet



19. PROJECT ASIA PARK - VIETNAM



20. FILLERS

It is possible to add many other products to the A1 base material in addition to pigment and metal powders. This allows you to give the A1 a different look, change its properties and possibly save costs.

Frequently used materials are dried sand, very fine stones, marble powder, etc. Particle size is up to the costumer's requirements but most common used is 0.1 - 2 mm. In addition to their aesthetic properties, these give the A1 a scratch-resistant and extra-hard top layer. By using sand of different colour and size, a granito or granite appearance can be obtained. In this case, after curing, the top layer can be sanded to bring the stone to the surface to obtain a greater contrast. Sand from the seaside is not suitable as it contains salts.

A special filler is expanded glass (Poraver), these are lightweight recycled glass balls. The main advantage is weight saving. For a good adhesion between the grains, it is possible to mix them beforehand with a limited quantity of A1.



A1 filled with iron powder



Sand



Marble dust



Metals



Granite



A1 ATP Powder



Graphite powder



Fillite



Poraver



Chopped fibres

Which fillers can I use to reduce costs?

Poraver (expanded glass) can be used as a filler for A1. This is a recycled lightweight glass ball that allows you to achieve a large volume gain. Add the grains little by little to the A1 base.

Another good and inexpensive filler medium for A1 is dried (silver) sand. (available in the cement department in your local hardware store).

The choice of filler depends on your preference in terms of weight, desired appearance and cost.

Adding fillers to the A1

First mix the A1 Liquid (1 part) with the A1 Powder (2 parts). Then gradually add the filler to the A1 (maximum 2 parts). Add A1 Diluent if desired.

We recommend adding a maximum of 0.67 kg fillers per kilogram of A1 created, whereby the ratio is 1 part A1 Liquid, 2 parts A1 Powder and 2 parts filler (all by weight).

A combination of fillers and/or pigments is also possible.



BeConcrete - yellow sand



Chopped fibres



Poraver

Examples materials mixed in A1

	Decorative	Light weight	Cost saving	Milling	Plaster	Putty
Sand	++	-	++	-	-	-
Marble dust	++	-	+	-	+	--
Metals	++	-	-	-	+	--
Granite	++	-	+	-	+	--
ATP Powder	--	-	+	+	++	++
Expancell	--	++	+	++	--	++
Fillite	++	+	+	+	+	+
Poraver	-	++	++	-	+	+
Chopped fibres	--	+	-	-	--	+

21. PROTEA BUILDING - JOHANNESBURG

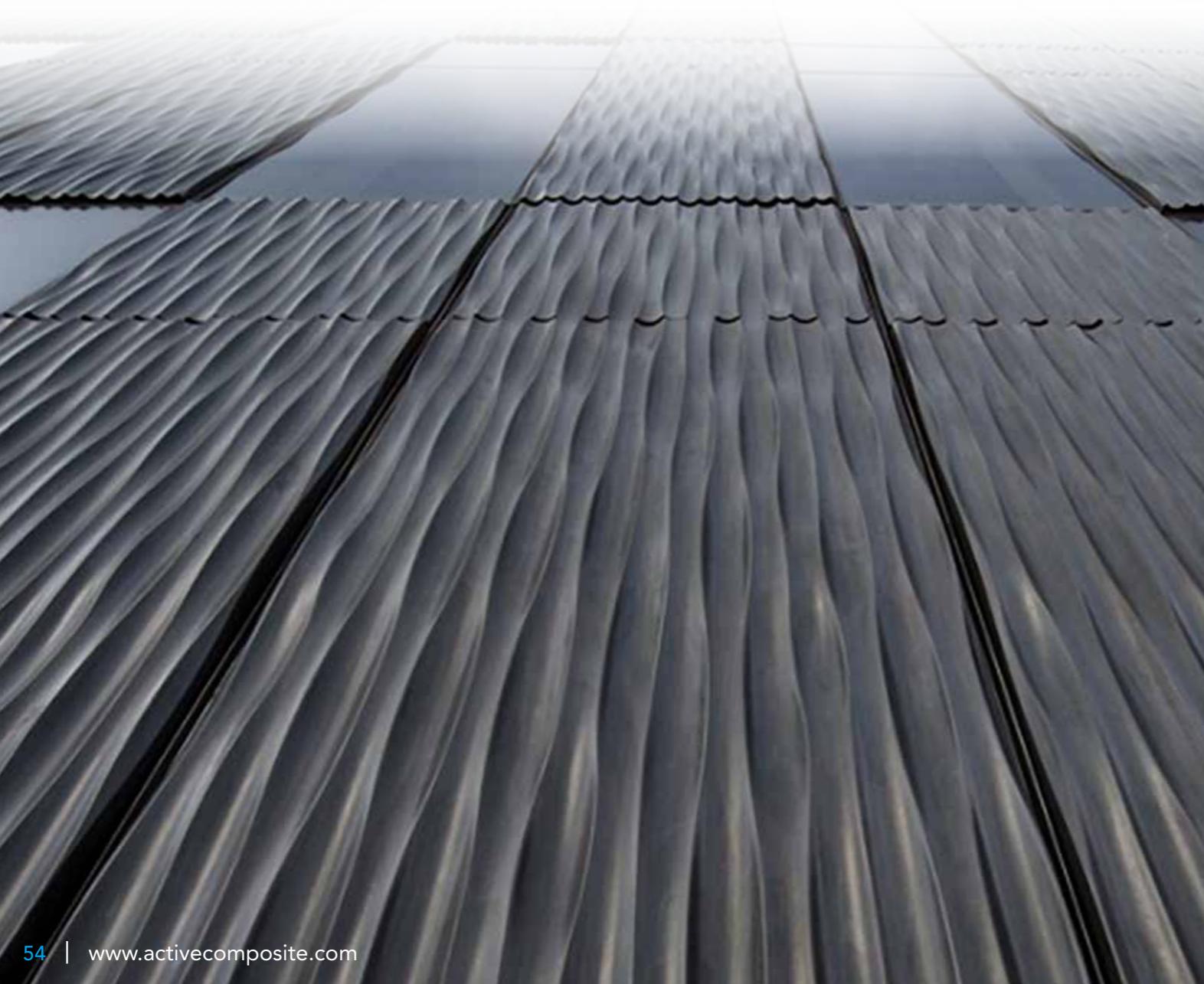
The panels are made out of A1 in a natural zinc look. Zinc powder has been added to the A1 in the first layer, to create a solid and smooth surface. After the first layer for reinforcement, several layers with glass fibre / chopped fibres were laminated. After demoulding the panels were sanded to get the zinc on the surface. To protect the zinc surface 3 layers of A1 Sealer were applied.

- The cladding system had to create movement and mood at different times of the day.
- A1 with zinc gelcoat with a wave type design was chosen.
- This was achieved by adding 80% zinc filler and slightly polished, then sealed with A1 sealer.

Project date: 2010

Where: Protea building - Johannesburg - South-Africa

By: Paragon Architects



Use a silicone or epoxy mould. The max. panel size is: 3800 x 1000 mm.



Use a release agent and apply this by brush. After applying wipe out with a cloth.



Mix the materials for the gelcoat layer: 50 parts zinc : 100 parts A1 (pbw).



Apply the first layer, this is called the gelcoat layer.



Wait until layer start to cure.



Apply the 1st laminate layer: A1 with 2 layers of A1 Triaxial fibre.



Apply the core layer; A1 met chopped fibers. The core layer has a total thickness of 3 mm.



Apply the 2nd layer: A1 with 2 layers of A1 triaxial fibre.



A frame is used to position the mounting brackets on the finished laminate.



Stainless steel brackets are mounted on the panel.



The stainless steel brackets were embedded with A1 with chopped glass fibres.



3 layers of A1 Triaxial fibre is laminated on the brackets to get a strong connection.



Backside of the panel.



Frontside of the panel.

22. COLUMNS IN A MALL - THE NETHERLANDS



Columns were made by using a mould. A1 was mixed with yellow sand reinforced with several layers of A1 Triaxial fibre.

Project date: 2009

Where: Promenade 12, 2711 AR Zoetermeer
The Netherlands

By: Vazupol



23. LAMINATING OF AN OBJECT

A1 adheres excellently to EPS (Expanded Polystyrene) and is therefore a frequently used combination. Objects, for example made from modelling foam, can also be covered with A1.

To finish the object smoothly, a layer A1 mixed with A1 Thix A or A1 ATP Powder can be applied. When the A1 is just dry, the surface can be rubbed flat with a slightly damp sponge. After complete curing, the object can be sanded.



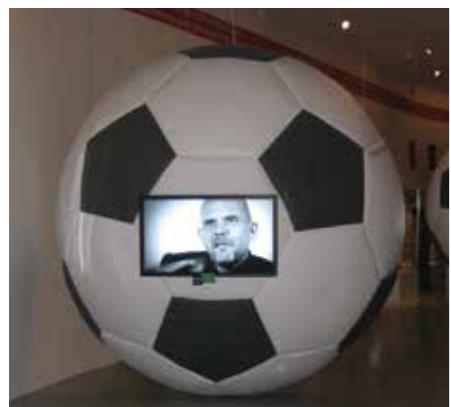
Studio Maky

EPS glued with A1

2 parts of EPS can be glued together using A1. A1 acts as an adhesive in this instance.

EPS coated with a layer of A1

You can easily apply a layer of A1 to the EPS by brushing, spraying, rolling or filling it. Sometimes, it is necessary to thicken the A1 with A1 Thix A or A1 ATP Powder.



Kim De Ruysscher

The strength of the A1 top layer also depends on the thickness of the A1 layer and the density of the EPS. To create a strong top layer, we recommend using 1 or more layers of A1 Triaxial fibre.

EPS coated with a layer of A1, reinforced with A1 Triaxial fibre

Brush EPS with A1. Secure the A1 Triaxial fibre in the still wet layer of A1. The A1 Triaxial fibre provides the strength to A1. The advice is to process at least 2 layers of A1 Triaxial fibre. From 4 layers of A1 Triaxial fibre onwards, it is proofed against vandalism.

Before applying the A1 Triaxial fibre, it is useful to cut it to size first, given the processing time of A1.

Because you work over an EPS form, the first layer will be the inner layer and will not be visible later. Very important

is that the A1 Triaxial fibre is completely soaked with A1 in each layer before you apply the next layer of A1 Triaxial fibre. This is because dry on dry provides air inclusion and consequently a vulnerable spot in the object.



Before applying the A1 Triaxial fibre, cut it to size first, given the processing time of A1.

FOAM PRODUCTS

Besides using EPS as a core, many other (lightweight) core materials are available in the market. Each of them with their own benefits and (dis)advantages. Well known are the PUR and PIR foam blocks and sheets. Although the adhesion of A1 on these foam blocks is perfect and quite often used, the risk of damage is higher compared to the use of EPS. Form stability is less, deformation is always possible mostly caused by moisture. Other core materials such as XPS and PE-foam are sometimes used as well. Always check the specifications and possibilities before use.

Examples amount material (mm/m²)

per mm/m ²	Top layer Thix	Top layer Sand	Laminate Standard	Laminate Sand
A1 Liquid	600	400	600	475
A1 Powder	1200	800	1200	950
Sand 0,2 - 2 mm		800		475
Thix A	36	-	-	-
Totaal	1,836 kg	2,000 kg	1,800 kg	1,900 kg



Jurriaan van Hall - Karel Goudsblom



Decolite - South Africa



Jurriaan van Hall - Karel Goudsblom



Decolite - South Africa



Asia Park - Vietnam



Asia Park - Vietnam



24. TOTEM POLES - DUINRELL - THE NETHERLANDS

The totem poles are made out of polyurethaan foam. This foam has a closed structure, therefore it almost doesn't absorb moisture. Also the foam can easily be shaped in any form. Then the totem poles are reinforced with a few layers of C-veil and later they have been painted in different colours.

Project date: 2018

Where: Tikibad Duinrell 1, 2242 JP Wassenaar
The Netherlands

By: Esthie Vormgeving



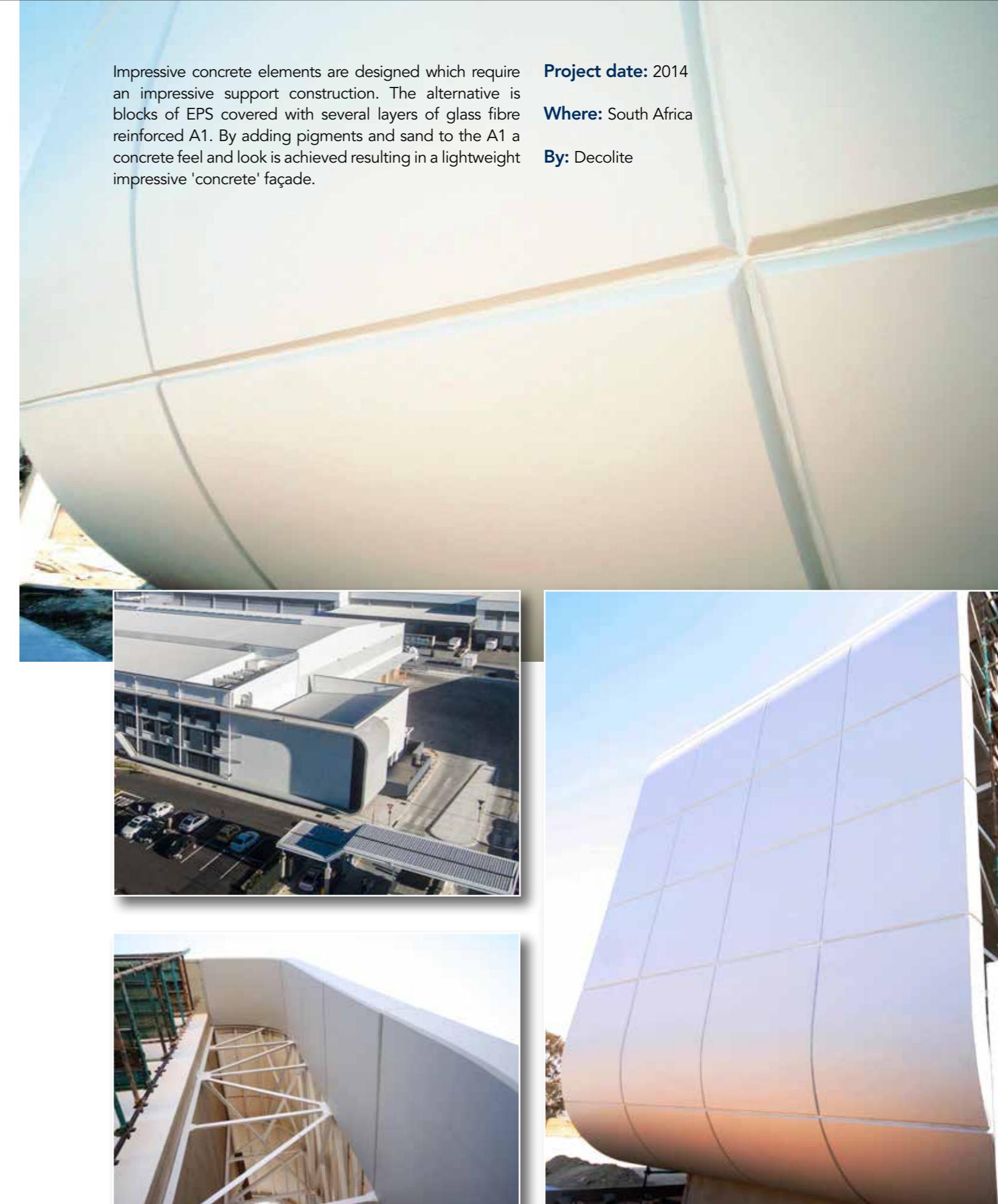
25. SASOL BUILDING - SOUTH AFRICA

Impressive concrete elements are designed which require an impressive support construction. The alternative is blocks of EPS covered with several layers of glass fibre reinforced A1. By adding pigments and sand to the A1 a concrete feel and look is achieved resulting in a lightweight impressive 'concrete' façade.

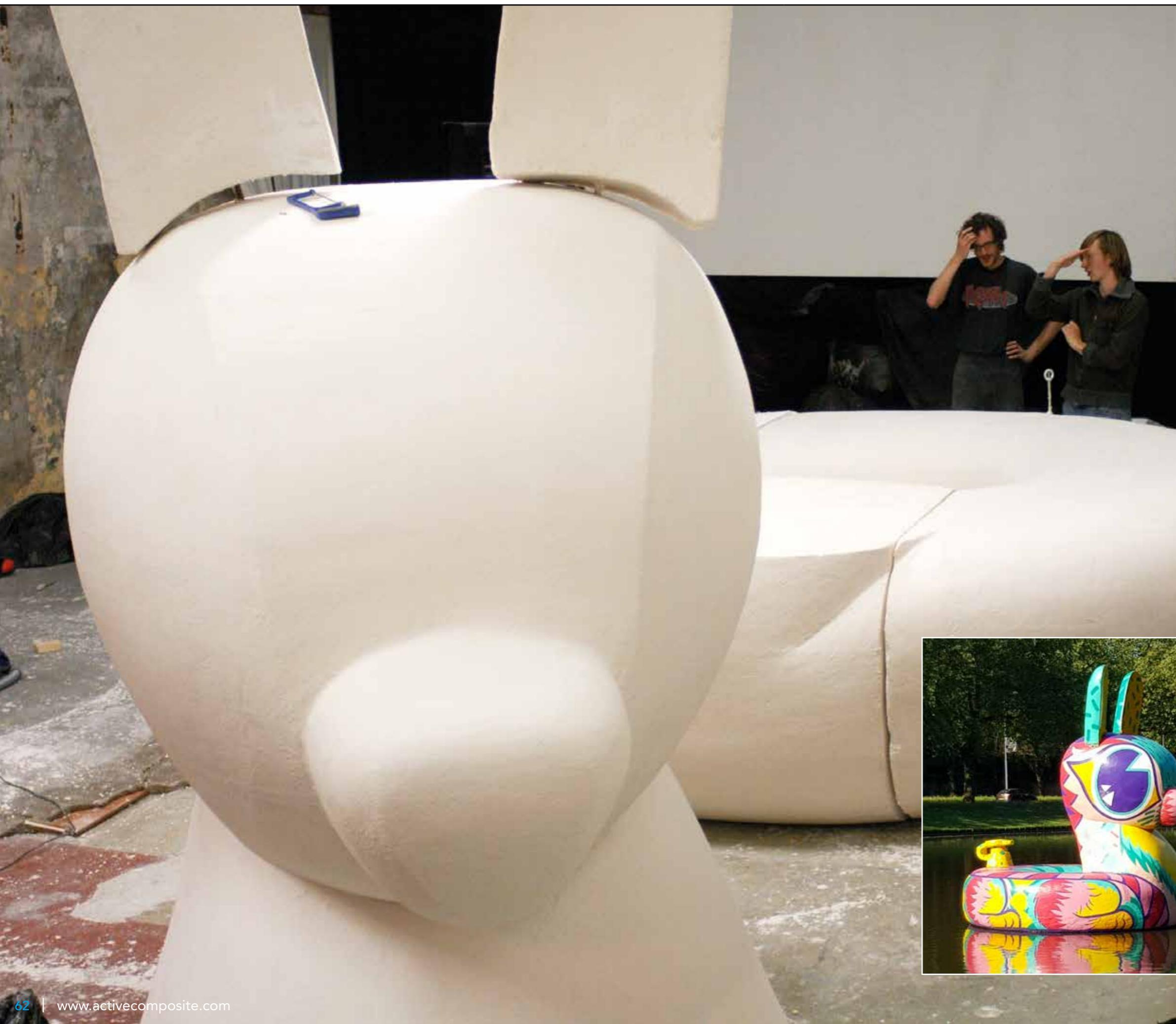
Project date: 2014

Where: South Africa

By: Decolite



26. BATH BUNNY - THE NETHERLANDS



This A1 Bath bunny is floating in the Rotterdam Vroesenpark lake since 2009. Each year it is repainted based on design competition between youngsters. The Bath bunny is carved out of EPS and covered with two layers of triaxial glass fibre reinforced A1.

Project date: 2009 - 2019

Where: Rotterdam - Vroesenpark - The Netherlands

By: Studio Maky

27. A1 IMO

IMO Resolution MSC 307(88) (2010 FTP Code): Annex 1: Part 5. A1 IMO is now also available for the production of lightweight glass fibre reinforced façades, panels and ceilings in ships.

IMO Resolution MSC 307(88) (2010 FTP Code) Annex 1: Part 5

Test Results

Test procedure: The test method involved mounting each conditioned specimen in a defined gradient of radiant flux and measuring the time to ignition, spread of flame and its final extinguishment distance together with a stack thermocouple signal as an indication of heat release by the specimen during burning.

Parameter	Units	Specimen Number	Average		
Heat for Ignition (Q_i)	MJm^{-2}	10.93	17.14	11.02	13.03
Heat for Sustained Burning (Q_{s0})	MJm^{-2}	12.43	17.98	10.86	13.76
Critical flux at Extinguishment (CFE)	kW/m^2	28.00	24.10	37.80	30.0
Peak Heat Release Rate (q_p)	kW	0.63	0.85	0.96	0.82
Total Heat Release (Q_t)	MJ	0.28	0.35	0.30	0.31
Burning drops	N/A	No	No	No	N/A

Other test observations required by standard

Number of specimens tested	3
Type of pilot flame	Propane / air

The test results relating to the spread of flame parameters for the individual specimens encountered during the test and comments on any difficulties during each of the tests is given in Appendix 1. The heat release data generated

Classification

Materials giving values for all the surface flammability criteria not exceeding those listed below are considered to meet the requirement for low flame spread in compliance with the regulations II - 2/3.29 and II-2/5.3.2.4 of the International Convention for the Safety of Life at Sea (SOLAS), 1974, and related Articles of Protocol 1998, as amended and consolidated in the 2004 publication of SOLAS.

Parameter	Requirement for bulkhead, wall & ceiling linings	Requirement for floor coverings	Requirements for primary deck coverings
Heat for Sustained Burning	$\geq 1.5 \text{ MJm}^{-2}$	$\geq 0.25 \text{ MJm}^{-2}$	$\geq 0.25 \text{ MJm}^{-2}$
Critical flux at Extinguishment	$\geq 20 \text{ kW/m}^2$	$\geq 7.0 \text{ kW/m}^2$	$\geq 7.0 \text{ kW/m}^2$
Peak Heat Release Rate	$\leq 4.0 \text{ kW}$	$\leq 10.0 \text{ kW}$	$\leq 10.0 \text{ kW}$
Total Heat Release	$\leq 0.7 \text{ MJ}$	$\leq 2.0 \text{ MJ}$	$\leq 2.0 \text{ MJ}$
Burning drops	Zero	≤ 10	Zero

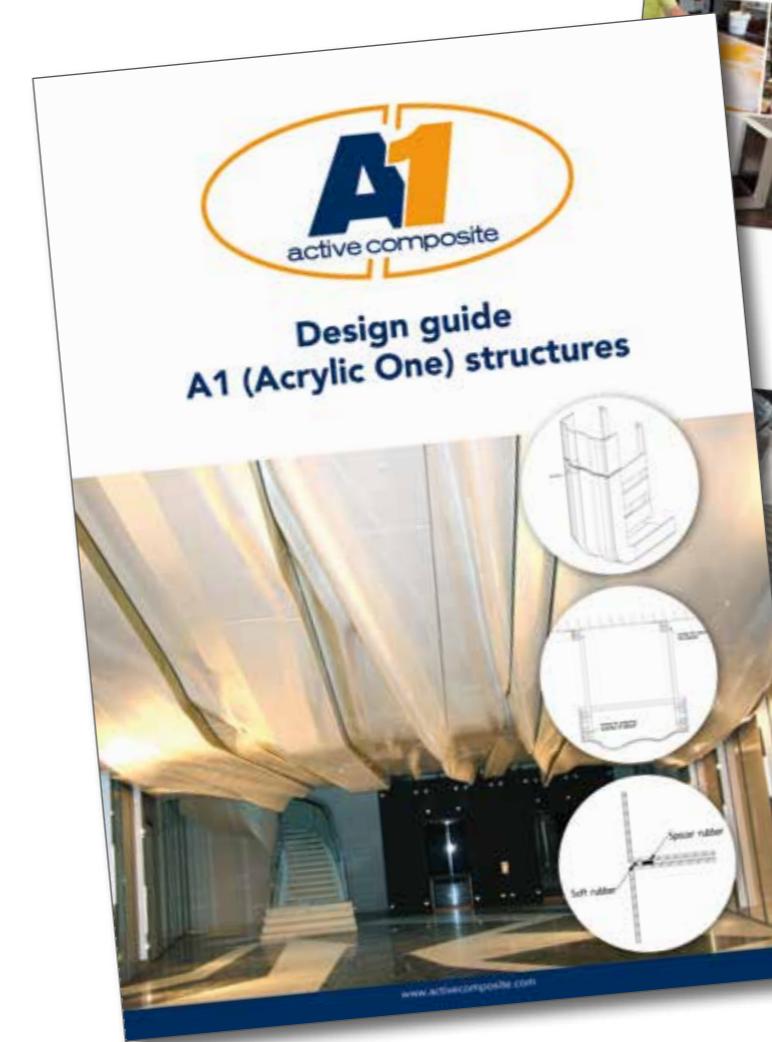
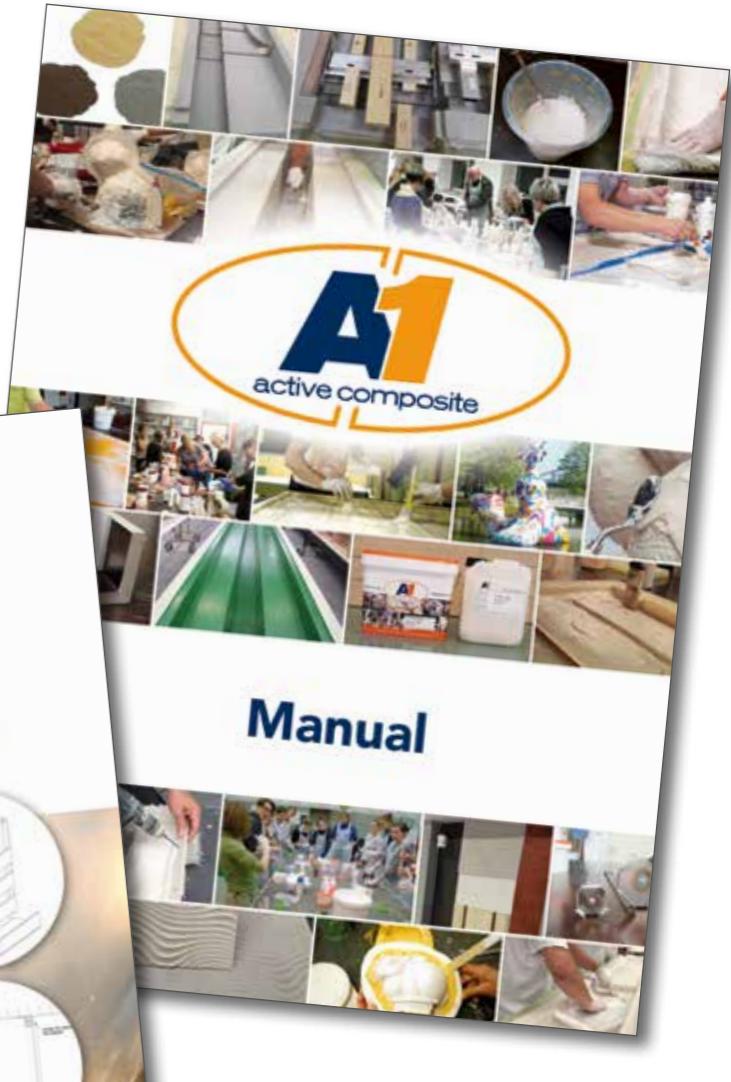
Document No.: 412943
Author: T. Kinder
Client: Active Composite Technologies
Page No.: 6 of 10
Issue Date: 23rd May 2019
Issue No.: 1

28. A1 MANUAL & DESIGN GUIDE A1 STRUCTURES

A1 Manual

This manual is full of examples, processing methods, how to use additives, fillers (like metal powders), working methods and much more.

This manual can also be downloaded at:
www.activecomposite.com > downloads



Design Guide A1 (Acrylic One) structures

ACT commissioned Dr. Ir. Albert ten Busschen, technical director of Poly Products to write a design guide to have a clear methodology for designing products and verify structural behaviour such as strength and stiffness. Poly Products has over 10 years of experience in the use of A1 in several products. Moreover, this firm has an extensive knowledge of product design, composite mechanics, production and installation.

For a critical review this report has been pre-screened by Ir. P.A. Joosse. He is an expert in composite design and the use of design methodology according to the Eurocodes. Moreover, he has been one of the authors of the recently reviewed CUR-recommendation 96 (2017) for the structural design of fibre reinforced polymer composites.

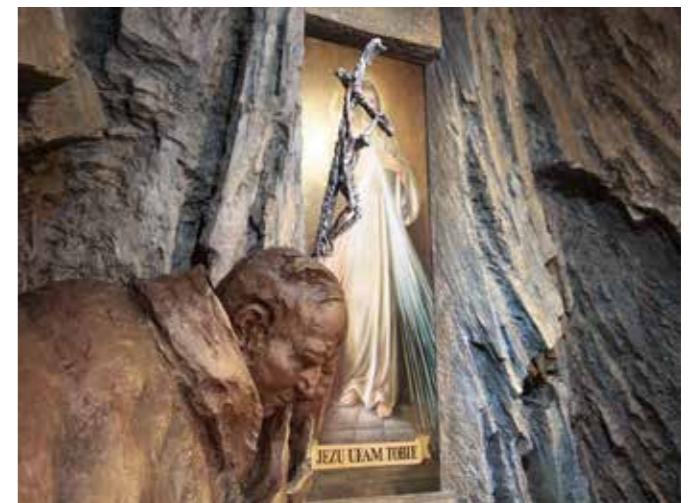
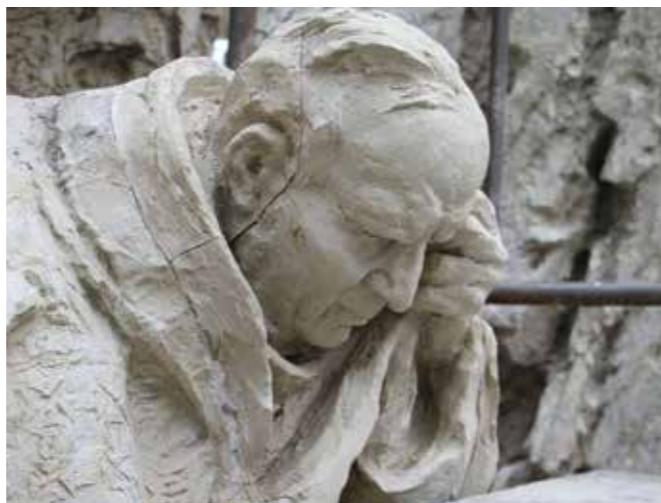
29. ALTAR IN A CHAPEL - POLAND



Project date:
2017

Where:
Church in Poland

By:
Jacek Kicinski



The information in this user manual is considered accurate. The user needs to ascertain the suitability of the product for the application the user wishes to apply.

When in doubt, the user needs to carry out tests to ascertain the suitability of the product.



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