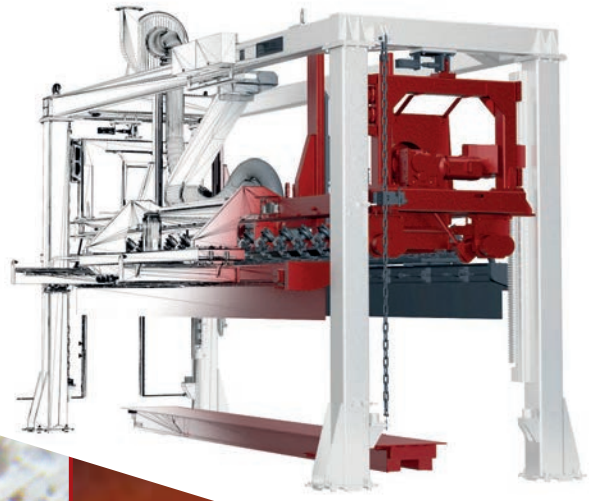
2 | 2020

AAC Autoclaved Aerated Concrete WORLDWIDE

www.aac-worldwide.com

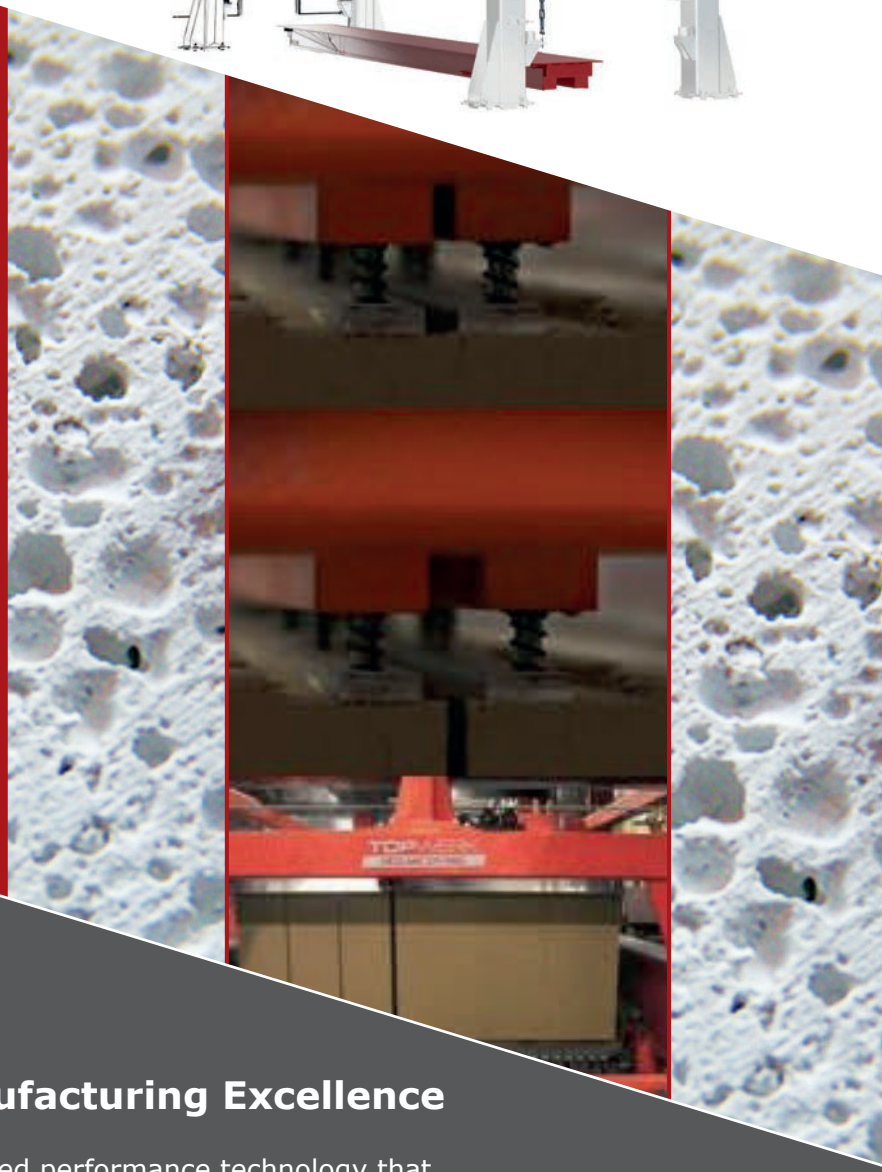
HESS AAC SYSTEMS



## State-of-art AAC technology

- Green separation and horizontal autoclaving, Sticking – What is that?
- Modular system, can simply be extended to meet growing demand
- Block only or panel is no question, because start with blocks and on demand simply add panel production
- Turnkey or partial delivery, our service is from A to Z

Do you need structural design for panels and bearing system or training for AAC application on site? We deliver comprehensive service!



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World-class know-how. Every Cycle.

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EDITORIAL

*Editor-in-Chief*
*Dipl.-Ing. (FH) Michael von Ahlen*

# Dynamic readership – an indicator of a good economy

The development of our readership is not only an economic consideration for us as a publisher of trade journals. Most importantly, we see it as an indicator for the technical development in regions in which the building material autoclaved aerated concrete is on the upswing.

The steady increase in subscriptions of AAC worldwide – particularly in India – shows that the appreciation of this trade journal in the autoclaved aerated concrete industry is gratifyingly high and indicates which markets are currently developing most dynamically. Experience has shown that the markets where information is in demand are also the ones where the most movement occurs in the medium- and long run.

This impression is also confirmed by the reader feedback. We receive many inquiries from India, often related to technical questions which can in most cases be answered by referring to selected published articles from industry suppliers. In return, if you have knowledge to share to the AAC professionals all around the world, feel free to send us your proposal.

We hope to continue to have such an active readership and look forward to any feedback from the international autoclaved aerated concrete industry and to personal meetings at trade fairs and conferences. You will find a separate reader survey (loose sheet) in this issue. You are more than welcome to give us your personnel feedback. Every single feedback form will be included in a draw for one of three exclusive high-value Samsonite trolleys or 25 one-year subscriptions of AAC worldwide (print and e-paper).

Due to the current situation, I wish you and your families above all health and strength. Only together we can overcome this crisis and ensure that we will emerge from it with a strengthened community.

Yours sincerely,
Michael von Ahlen

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## News & Markets

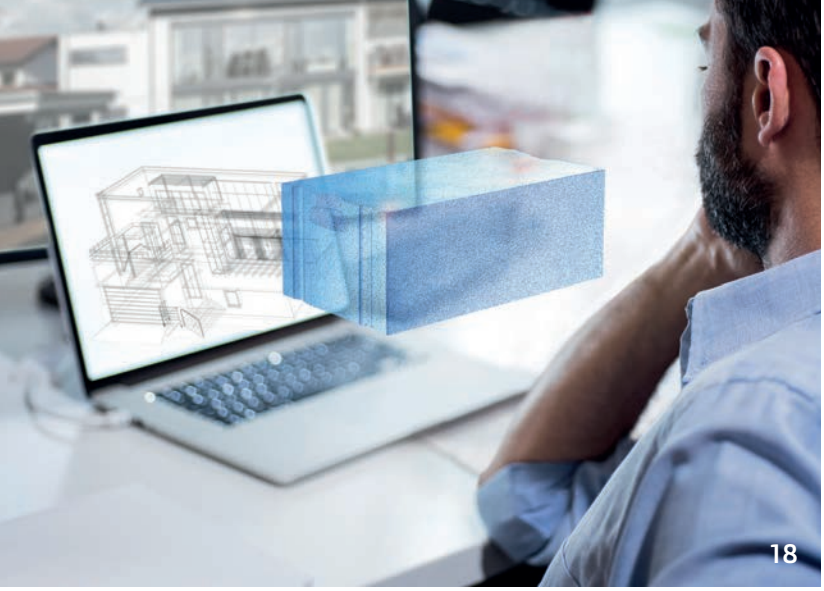




## Science & Innovation



## Production Technology







## Application & Construction



## Projects

# Missing Yogender Varma

**On February 18 in the early morning, our well respected colleague and dear friend Yogender Varma passed away because of cardiac arrest. We still cannot believe that such an energetic life had to end so suddenly and unexpectedly. His absence is painfully noted and we miss him very much.**

*Yogender Varma (59),*
*† February 18, 2020*

Yogender Varma started working with ad-media in 2012. Well experienced in trade show organization and customer acquisition, and also with experience in the publication of trade journals, he was an excellent fit to our family.

He started working for us in India where he established excellent relations to AAC worldwide readers and potential advertisement customers. As country head India he later he extended his work to Nepal, Bangladesh, Bhutan, Myanmar and Sri Lanka.

Everyone in the Indian AAC industry knew and respected Yogender. He was a person of honor and integrity, and at trade shows he ever so often appeared not only with a box of journals, but also with a box of gifts which he distributed to his many friends.

Yogender travelled with us to Russia and Germany. During his trip to Germany last April, after bauma, he visited an Indian temple in Frankfurt. Visiting temples, typically in India, was very important and ritualistic for Yogender and while he had seen countless temples in India, the one in Frankfurt was very special to him. Nobody would believe Yogender's skills as an artist and painter! Over the years, he had already donated several of his paintings to this particular temple in Frankfurt. And last year, finally, during his trip to Germany he could see his paintings displayed in this temple, which gave him a lot of satisfaction.

Yogender Varma was a very proud and loving father. He worked hard for years to provide his children with the opportunity to study abroad. His son Nikhil finished his degree in the UK and he now works in an excellent position in Bangalore, while his daughter Shraddha is about to finish her studies in Canada very soon. Yogender's wife Shakuntla frequently joined him at trade shows, and often the presents he gave to his friends at the shows were in fact produced by herself – typical Indian cuisine and sweets.

Nikhil, Shraddha and Shakuntla will miss their beloved father and husband very much. Our thoughts are with them now.
Rest in peace, Yogender!

**Your ad-media family**

*The industry will miss Yogender – picture taken in December 2019 at Excon, Bangalore*


*Yogender had a passion for painting. He put a video about his paintings on Youtube: https://bit.ly/39JPViW*

*Gorai Beach, Mumbai., where he spent his last trip with his wife. Rest in peace, Yogender!*

# EAACA launched new website

**The European Autoclaved Aerated Concrete Association (EAACA) recently launched its new website: eaaca.org. Not only the website's content was updated, but also its structure, navigation and design in view of state-of-the-art usability. The new design is user-friendly and optimized for all devices.**

From the initial brainstorming to the final launch, the EAACA board took into consideration important key-facts as user-friendliness, content strategy, design and content transfer. It was also necessary to define EAACA´s objectives for the redesign.

The new website offers information about the product AAC itself and its applications, the Urban Transformation Campaign, trends in the AAC industry and many more. Users can download brochures, position papers and other different useful content.
Furthermore, EAACA members, coming from 18 different European countries and operating in more than 100 production sites, are now able to benefit from a special members account.

www.eaaca.org

*EAACA launched a new website.*
*It´s user-friendly and focuses content transfer to the user.*

19 - 21 May 2020

# 11th International Conference on AAC Production and Application in Minsk

**It will be for the 11th time on 19 to 21 May 2020 that the International Scientific and Industrial Conference on the topic of AAC is going to take place in the Belarus capital of Minsk. The event's agenda will comprise a comprehensive and state-of-the-art sequence of speeches and a visit to an AAC production facility.**

The growth potential for standard AAC masonry blocks is increasingly reaching its level of saturation on the Russian, Belarus, and Ukrainian markets. Accordingly, there exists a lot of competitive pressure on manufacturers.
Taking this into consideration, it is optimization and an increase in efficiency in terms of production processes that are gaining importance just the same as the need for enlarging one's range of products by, for instance, AAC reinforced elements. The organizers of the 11th International Scientific and Industrial Conference on the topic of AAC production and application have therefore drawn up a program of speeches that perfectly corresponds to the information needs of manufacturers as it precisely addresses these issues.

*The International Scientific Conference on AAC Manufacture and Application is taking place every two years in the Belarus capital of Minsk*

The agenda of this get-together comprises, amongst other things, the modernization of production plant, new control software, fibers and additives, thermal insulation, and energy-efficient buildings.

Apart from speeches, a visit to a production facility will also be forming part of the program in Minsk. This year, the participants are going to visit OAO „Beresovskiy KCI“ in Beresa, about 300 km southwest of Minsk, a facility where plant and equipment technology of Masa-Henke is doing a fine job.

## Tremendous support by industrial associations

The chief sponsor of the 3-day event will be machine and equipment manufacturer Masa GmbH. Partners, amongst others, are the national AAC associations of Russia and Ukraine and the Russian Lightweight Concrete Association.

The conference is supported by the Ministry of Architecture and Construction of the Republic of Belarus; the Association of Construction Entrepreneurs; the Institutes of Residential Construction, NIPTIS im. Atayeva S. S., NIISM and BelNIIS; and TNKA-Arkhitek, Institute of Planning and Development.

Even though Belarus is not as badly affected by the crisis caused by the coronavirus as many Western European countries, the organizational committee of the conference stated in an email to AAC Worldwide that it will monitor the situation and take a final decision in the beginning of April whether to postpone the conference to September.

Further information can be found at the conference website: www.architec.by.

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www.architec.by

# A Platform for AAC

**Poland as a country is the most important AAC manufacturer in Europe. A good reason for co-organizer AAC Worldwide to provide a platform for this highly demanded building material during ICCX Central Europe, the conference and tradeshow held in Warsaw on 12 and 13 February 2020. Amongst other topics, experts also spoke on the strategies of the European Autoclaved Aerated Concrete Association, EAACA.**


*Han den Hartog, Marketing Manager of EAACA (European Autoclaved Aerated Concrete Association) intends to position AAC against the backdrop of current discussions on urbanization issues.*

*Łukasz Drobiec, PhD Eng. at the Silesian University of Technology (Politechnika Śląska) in Gliwice, Poland, demonstrated in his speech the differences in connections between various wall types and systems.*

The ICCX Central Europe as a conference and tradeshow event took place on 12 and 13 February this year for the seventh time already and has meanwhile developed into the leading annual get-together for the concrete and precast industries in Central Europe. This year, too, the ICCX was able to attract an even greater number of participants (>750, +10 % compared to the previous year) and more exhibitors (110, +7 % compared to the previous year) to join in at Warsaw's Double Tree by Hilton hotel.

*Speeches on the topic of AAC attracted a lot of attention.*

ICCX Central Europe provided participants with a well-balanced and solidly designed program of speeches that this year, for the first time, also covered issues pertaining to AAC production.

Han den Hartog, Marketing Manager of the European Autoclaved Aerated Concrete Association, EAACA, informed attendees in a well frequented conference room about the Association's strategy focussing on further development of the European AAC industry. The starting point of this strategy is the so-called "Green Deal" initiated by the European Commission which is supposed to include climate legislation with the aim of turning Europe into a "climate neutral" continent by the year 2050. Central measures to this end are, amongst others, the promotion of recyclable building materials and circular economies plus comprehensive renovation efforts targeted at already

existing buildings and structures with the aim of reducing energy consumption. With the help of its "Urban Transformation Campaign", the EAACA intends to further direct public attention to the advantages of AAC as a building material to firmly address climate goals as announced by the European Union.

## Next ICCX Central Europe scheduled for March 2021

In one AAC speech, Łukasz Drobiec from the Silesian University of Technology in Gliwice, Poland, reported on connections between walls and other neighbouring structures. In doing so, he especially presented and compared connections between masonry walls and reinforced in situ concrete, between masonry walls and steel, and between masonry walls in general, load-bearing and non-load-bearing walls of each variation.
Result: Selecting the appropriate connection between a wall and another structure is a decisive aspect for planning and has indeed substantial effects on loads and deformations that buildings and walls may be exposed to. Inappropriate consideration of corresponding specific individual connection solutions during planning activities may result in damage to interconnected wall systems.

The ICCX Central Europe and the AAC program were supported this year by machine and equipment manufacturers for AAC producers, namely Keda Suremaker (gold sponsor), Topwerk Group-Hess AAC Systems (gold sponsor) and Masa (silver sponsor).

The next ICCX Central Europe will be taking place on 3 and 4 March 2021 at the Double Tree by Hilton hotel in the Polish capital of Warsaw. Already now, 80 % of available stands have been positively booked again. Anyone wishing to participate is invited to book a stand or purchase a ticket online.

ICCX CENTRAL EUROPE 2021
03. - 04.03.2021
Warsaw, Poland

www.iccx.org

# Aircrete China: Local office to optimally capture China's large growth potential

Andre Antonow, General Manager, Aircrete China, P.R. China

**The growing demand and the global shift to an AAC panel-based building solution has been never more evident than in China today. As already discussed in the article published in AAC worldwide, Vol. 1, 2019 [1], this has increased the requirements for the unique Aircrete flat-cake AAC panel technology to be locally presented in China. Therefore, Aircrete Europe has made a sound and solid entry in the world`s highest potential market by opening its own office in Shanghai, China. In order to hit the ground running, Aircrete Europe appointed Andre Antonow, an experienced AAC industry heavyweight, as the General Manager of Aircrete China.**

The impressive opening ceremony was successfully held at the Grand Hyatt Hotel located at the Lu Jia Zui Finance Centre in Shanghai, on December 13th, 2019. Leaders from the Ministry of Commerce of China, the official representative of the Dutch Embassy in China, leading members from Keqiao District Committee and Shaoxing Municipal Housing & Construction Bureau, as well as the Secretary General of the China AAC Association and other representatives of domestic and foreign cooperative clients, banks and media representatives attended the Aircrete China opening ceremony.


*Andre Antonow, the General Manager of Aircrete China, has more than 15 years of experience in the AAC industry.*

*The impressive Aircrete China office looks over the Putuo District of Shanghai City from the 17th floor.*

*A memorable moment from the opening ceremony, the push-button declaring the official opening of the Aircrete China office.*

Speaking at the opening session, Ralf Beier, Managing Director of Aircrete Europe and the Chairman of Aircrete China, expressed his deep appreciation to the government officials, leaders of federal institutions and commercial executives who's presence at the ceremony confirmed their great interest in

*Mr. Beier`s speech during the opening ceremony emphasized the importance of this milestone to further grow the business in China with a local presence.*

supporting Aircrete with its growth ambitions in China. “Aircrete`s strength, in any given market, is to understand the local market conditions and adapt our solution to fit the requirements of that market. The Aircrete Hybrid model, which offers a combination of key technology supplied from Europe, with locally-produced equipment from Aircrete China, provides an affordable solution to produce high-quality AAC panels on the world’s leading AAC panel production technology.” Mr. Beier mentioned in his speech during the opening ceremony.


*Mr. Antonow introducing Aircrete flat-cake cutting technology, that results in products with Super Smooth surfaces and ultra-thin AAC panels, to the members of the Keqiao Chamber of Commerce at the Aircrete China office*

## Strategical steps towards a strong positioning in China

The establishment of Aircrete China closely follows the trend of the Chinese vigorous development of green prefabricated concrete buildings and promotes sustainable development. AAC products, particularly AAC panels, can minimize the adverse environmental impact of the construction process while at the same time meet the requirements of Chinese green prefabricated buildings, an ambition also high on the agenda of China's State Council [2].

Aircrete China has become an official member of the China Aerated Concrete Association (CACA) and participated in the 39th Annual Meeting of CACA and the 2019 AAC International Forum in December 2019 with its own booth. In addition, Andre Antonow has become the Vice President of the Keqiao Chamber of Commerce in Shanghai, which is a remarkable achievement and an important recognition for Aircrete China.


[1] "Engine-Only model supplies the "heart" of an AAC panel plant for the South East Asia Markets" AAC worldwide, Vol. 1, 2019.

[2] The State Council People Republic of China targets a 30% adoption rate of prefabricated solutions in construction before 2020.



AIRCRETE CHINA

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*Actual example of a warehouse in the city of Xi'an being built with AAC panels.*

Activity Report of the China Aerated Concrete Association

# Modernise production, increase product quality, reduce energy consumption



**In its recently published "Activity Report", the China Aerated Concrete Association (CACA) discusses the market situation in China and points out development perspectives and challenges: Modernization of production technology, improvement of product quality and reduction of energy consumption are at the top of the agenda for 2020 and subsequent years.**

In its recently published "Activity Report for 2019", the China Aerated Concrete Association underlines the outstanding importance of the autoclaved aerated concrete sector (AAC sector) within the Chinese construction industry. Over the last decades, an industry has developed that encompasses the entire value-added chain – starting with research and development, through the production of supplier materials, machines and plant technology, to the finished autoclaved aerated concrete products.
The AAC industry also plays a leading role in the development of wall construction materials that make a positive contribution to energy saving in buildings. With increased state construction activity and rising requirements for sustainability and energy saving, the share of AAC in the market for wall building materials is showing a positive growth trend.

## Development goals and obstacles

Despite this welcome development, it appears that urgent reforms in the industry are now needed – in its "Activity Report", the association identifies three main objectives for the near future: the structure of the industry must be reformed to improve both the efficiency of production and the quality of the finished products; working conditions in manufacturing and sustainability of production must also be improved.
The report also identifies the main obstacles to the further development of the industry, which have been decisive to date: production capacities in China are only utilised to 60% of the industry average. There are overcapacities (currently approx. 1,900 plants exist in China with a total capacity of 250 million $m^3$) with a simultaneous shortage of high-end AAC products. In other words, many plants pro-

duce products with relatively low technical properties, such as AAC wall-building blocks; at the same time, only a few plants produce the technically more sophisticated flat components which are currently in increasing demand, such as wall and ceiling panels.
A further obstacle to the development of the industry is its low capacity for innovation. Research and development structures are only weakly developed. There is a lack of a clear strategy, financing and innovative talent within the industry.

*Inside view of a hospital in the city of Xi'an being built with AAC panels.*

## Modernisation measures

As a first measure to modernise production and increase product quality, backlogged production capacities are to be gradually reduced. The Chinese AAC association names plants with a single production line and an annual capacity of 150,000 m³ as obsolete assets to be dismantled, upgraded or modernized (Catalogue of Structural Adjustment of Autoclaved Aerated Concrete Industry).
The association also wants to formulate higher requirements for the plants in the medium term in order to limit the development of further capacities.
Conversely, a catalogue of alternative autoclaved aerated concrete products should offer plant operators an incentive to restructure their production facilities, change production methods and product composition.
In order to push ahead with the above-mentioned modernisation measures, remove obstacles to the further development of the industry and promote the exchange of information, China Aerated Concrete Association together with China's Brick-and-Tile Industry Association and China Building Block Association have set up a sub-committee for wall building materials within the Party Committee of the Chinese Building Materials Federation.

China Aerated Concrete Association
www.cacajq.cn

# Digital planning from the manufacturer's viewpoint

Xella International GmbH, 47259 Duisburg, Xella

**The building industry is in upheaval: high land and raw material prices, shortages of skilled labor and scarcity of housing in urban areas call for more efficiency from all participants. Digitalization is making progress, although rather slowly in comparison to other industries. As manufacturers we are aware of our responsibility and have developed the blue.sprint digital planning service to have an optimal effect in the area of structure and building shell in collaboration with our customers. Our planning service provides all services that make a building project simpler, faster and more cost effective from the outset.**

In an initial discussion with our customers, we take their requirements and in the best case we receive a 3D model from them. We optimize this model with respect to material selection and material alternatives as well as structure, building physics and cost-effectiveness. This enable us to provide an individual pre-commissioning on a project-specific basis, thus ensuring a seamless order and delivery chain through track & trace and just-in-time delivery. As a result, we achieve maximum cost and time savings through optimized material selection and management.

From experience we can verify how the collaboration between manufacturers, planners and trades can be improved based on numerous already implemented building projects. From planning to production, logistics, construction and all the way to future processing.

According to studies, planning errors in construction result in extra work averaging 14 percent. And even though the actual savings are different from project to project, based on prior experience the additional expense due to errors can be reduced by approximately 30 percent, depending on the building project. This is confirmed by our first digitally planned reference projects that have been completed in the meantime.

*Our customers do not need to be BIM experts to make use of our service. A 3D model, a project and an affinity for digital collaboration is enough.*

### 1.Transmission of the BIM model

Check of the usability of the 3D model by Xella's Technical Service department via BCF (BIM Collaboration Format). First feedback on the wall/ceiling/roof model by Xella. Update of the wall model by partners and transmission to Xella.

### 2. Model optimization and wall planning

Xella checks the progressive model optimizations and changes. Feedback is communicated digitally via BCF in a timely manner. Xella then unitizes all wall elements and executes the clash detections.

### 3. Digital production

The approval of the 3D model is followed by the digital production. The BIM modell is used for automated production.

### 4. Transmission to the customer

Now, the 3D data model including all important parameters (such as compressive strength, etc.) is transmitted to the customer. All information on the construction project is stored in the 3D-model and can be accessed on a long-term basis.

### 5. Production of the building materials, logistics

Xella produces all building materials individually and adapted to the respective project and picks and packages the goods. Finally, Xella delivers the wall materials just-in-time to the construction site.

### 6. Construction phase

Improved construction site logistics, shorter construction time, lower construction costs due to fewer errors in the 3D model and thus minimum waste.

*Step-by-step to more project transparency and greater cost effectiveness: every company participating in the construction benefits from the interactive collaboration.*

For example, on our reference project "Variowohnen in Kassel", 20 percent of the building shell cost and 30 percent of the construction time could be saved with the aid of digital technologies such as BIM planning with blue.sprint, the use of Hololens technology on the building site and the delivery of individually prefabricated materials.

## About Xella

Sales revenues of EUR 1.5 billion Euro and over 7,100 employees make Xella Group one of the leading internationally operating solution providers to the building and insulating materials industry. Xella is the parent company of renowned brands such as Ytong, Silka, Hebel, Multipor or Ursa and is one of the pioneers in digitally supported building processes.

Xella is headquartered in Duisburg (Germany) and operates 99 plants in 20 countries and sales organizations in more than 30 countries.

Andreas Radischewski, Digital Building Solution & Transformation Manager Xella International, has been responsible within the Xella Group for harmonizing existing planning processes and technologies since August 2017. In addition, he is establishing the blue.sprint digital service throughout the Group. As an architect, he has many years of professional experience in applying and introducing digital planning processes.

Sebastian Kulle, Digital Building Solution & Transformation Manager Xella International, supports Andreas Radischewski in the international expansion of the blue.sprint digital planning service. In addition, he develops concepts and application scenarios for the use of Hololens on the construction site. The graduate architect and media technologist joined Xella last year. Before that he was a BIM consultant and project manager in various companies, most recently as BIM 5D specialist at AECOM Deutschland GmbH.

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Benda-Lutz Skawina Sp. z o.o., 32-050 Skawina, Poland

# Wettability, dispersion and demand for surfactants and their influence on the preparation of aluminium powder suspension in water



**The preparation of a homogeneous and stable in time aluminium suspension is important for the production of AAC. The suspension should be homogeneous in its entire volume, no uncontrolled layer of foam/scum of aluminium should be created on its surface, and the suspension should be stable over time while maintaining certain storage parameters (such as temperature and pH). That is why the use of very well-dispersing aluminium powders and pastes as well as the use of appropriate amounts of surfactants is very important for repeatable and stable production of AAC. The purpose of the article is to provide users of aluminium powders with information allowing them to use them correctly.**

The aluminium powders offered by Benda-Lutz Skawina and Benda-Lutz Volshsky (members of SunChemical) exist in the form of 5-63XX series powders spontaneously dispersing in water without any additives (the so-called wettable powders) and in the form of non-wettable powders, 5-73XX and 5-74XX series. Non-wettable powders need a surfactant to form a homogeneous suspension in water. Aluminium pastes, by definition, are always dispersible in water without the need to use any additional surfactants. Seeing the problems AAC manufacturers face in their everyday production practice, in this article the differences between both types of aluminium powders and the method of assessing the amount of surfactant necessary to obtain sufficient dispersion of non-wettable aluminium powders are presented.

Different AAC production technologies use various types of aluminium as a blowing agent, adapted to different types of AAC plant equipment. In dry aluminium dosage systems, referred to as "single batch systems", most frequently wettable aluminium powders are used. Due to very good dispersion, the aluminium suspension preparation time is very short and allows to reproduce the cycle every few minutes with very high repeatability. These types of alumin-

*Fig. 1: Dispersion achieved by 3 different powders, 10 seconds after being poured into the water.*

*Beaker no.1* *Beaker no. 2* *Beaker no. 3*

*Table 1: Quantities of surfactant used in the sinkability test.*
*Values are given in grams of surfactant per 560 g of water and 40 g of powder (suspension 1:14)*

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Surfactant A [g] (concentration 50%) | | | 0,60 | | 0,67 | | 0,70 | 0,80 | | | | | | 1,00 | | 1,60 |
| Surfactant B [g] (concentration 20%) | | 1,50 | | 1,75 | | 2,00 | | | | | 3,00 | 4,30 | | | | |
| Surfactant C [g] (concentration 18%) | 1,75 | | | | | 1,90 | | | 2,50 | 2,00 | | | 3,00 | | 4,00 | |
| Scum thickness [mm]: | 82 | 75 | 60 | 28 | 20 | 18 | 16 | 16 | 15,5 | 15 | 13 | 11 | 9 | 8 | 6 | 4 |

ium powders, however, are usually less stable in the suspension over time. They are generally not suitable for systems in which the suspension is prepared for a longer period of time, usually for one production shift. In such systems, commonly referred to as "wet" or "tank systems", non-wettable aluminium powders are used together with surfactant which makes it possible to create an aluminium suspension. Such a suspension is stable even for several dozen hours and can be safely used without increasing dosage at the end of the shift. Aluminium pastes are dedicated to wet dosage systems also. Various combinations of both systems of suspension preparation are available, therefore the selection of the appropriate aluminium should always be treated individually.

## Wettable powders, with very good dispersion

These powders are characterized by very good sinkability and dispersion. The ability to form a suspension is characterized as the time needed for a sample weight of powder to sink and be dispersed. Usually this time should not be longer than 20 seconds. Examples of powders with very good, average and poor sinkability and dispersion are presented in Fig. 1.
The test consisted in pouring a specific sample weight of the powder into a beaker. For beaker no. 1 the powder dispersed itself spontaneously. For beaker no. 2, the powder dispersed after 20 seconds, but additional 5-second mixing was necessary. Both powders were classified as well dispersible. In beaker no. 3 there is a powder which reached full dispersion after longer intensive mixing. That sort of powders should not be used as they may result in preparation of suspension which is non-repeatable for subsequent castings.

## Non-wettable powders

Non-wettable powders form a suspension in water only when a sufficient amount of surfactant is added. Number of tests were conducted to determine the amount of different types of surfactants needed to obtain correct aluminium suspension.
Test description: The test was conducted in accordance with LHB/519/BLS. The sample weight of the surfactant was mixed with a certain amount of water in the backer with magnetic stirrer. Then the weighed amount of non-wettable aluminium powder was dosed and mixing continued until the suspension was obtained. Then the beaker was left in an isolated place for 5 minutes. After that time the thickness of the layer of powder which was pushed out of the suspension (named as "scum") was measured on the surface of the suspension. Table 1 presents actual quantities dosed into the suspension. Surfactants containing active substances of different chemical compounds were used.

The measurement results converted into 100 % of active substance are shown in Fig. 2.

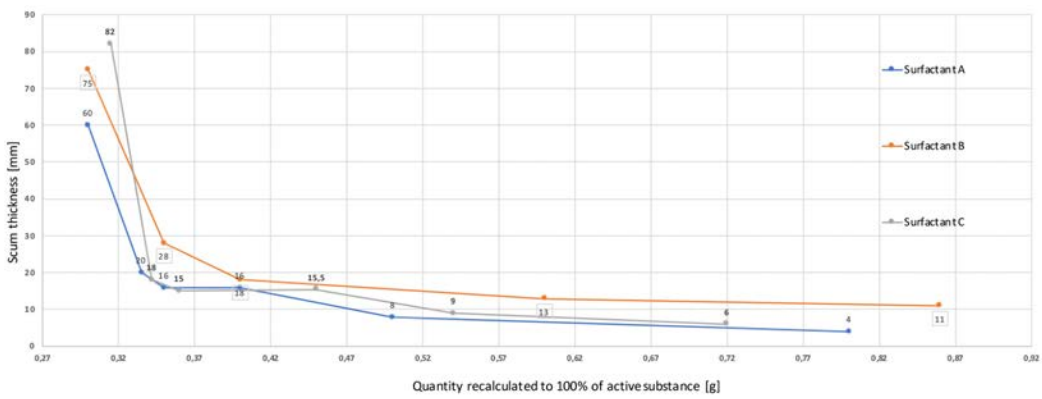


*Fig. 2: Dependence of the aluminium scum height on the dose and type of the surfactant.*

Paweł Wolski, AGH University of Science and Technology graduate, Faculty of Ceramics. With more than 20 years in Benda-Lutz as a Head of Sales, well experienced in aluminium powders and paste application support as well as in technological consultations.

pawel.wolski@sunchemical.com

As it is evident from the test, the scum thickness decreases rapidly after exceeding a certain concentration of the surfactant. The graph takes a hyperbolic shape with two asymptotes (vertical and horizontal). Interestingly, this relation is very similar for all applied surfactants. The effect of surfactant overdosing on AAC properties was not studied. However, it was found out that below a certain limit value (approaching the vertical asymptote), very small changes in the surfactant concentration may cause a very rapid increase in the scum thickness. That is why it is recommended to keep the surfactant concentration above this limit value. The use of an excessive quantity of surfactant has, as it seems, only economic consequences.
In order to illustrate the influence of changes of surfactant on the thickness of the aluminium scum, the differences obtained during the tests are presented in Fig. 3.

Thanks to cooperation with AAC manufacturers, it was established that the optimum thickness of scum for proper preparation of the aluminium suspension is not higher than 0.7 - 0.8 mm. However, the maximum thickness of the scum, at which no problems appear yet, is 1.0 - 1.5 mm. For these values, with temporary changes in the parameters of aluminium (content of organic compounds, specific surface area), water (pH, hardness) or the quality of the surfactant, an unfavourable increase in the scum thickness can be expected.

## The influence of specific surface area of aluminium powder on the demand for surfactants

Information on the impact of the specific surface area of the aluminium powder on the demand for surfactant is also important. According to the conducted research it turned out that the demand for surfactants increases with the increase in surface area. The specific surface area for non-wettable powders is referred to as water coverage.

Test description: The test was carried out according to an internal lab instruction. The surfactant was systematically added to the beaker in which aluminium powder was continuously mixed with water (aluminium to water ratio: 1:20) until the required sinkability and dispersion was achieved. Surfactants of various concentrations were added. A selection of results is given in table 2.

As a result of this test is was found, that demand for surfactant increases with the increase of powders specific surface area. Surface area is usually linked with D50 value, but not always. It was found, that at the same D50 but increasing surface area, increased demand for surfactant was also noted. Taking the above results into account, it should be remembered that once determined, the demand for surfactants should be corrected when changing the aluminium powder surface area, or it should consider the full range of products used, from the thickest to the finest ones.

*Fig. 3: Dependence of the aluminium scum thickness on the surfactant amount (Surfactant A)*

*Beaker no. 1: 2,8 g, scum 4 mm*

*Beaker no. 2 0,9 g, scum 10 mm*

*Beaker no. 3 0,7 g, scum 15 mm*

*Beaker no. 4 0,6 g, scum 40 mm.*

*Table 2: Demand of aluminium powder for surfactants, depending on specific surface area.*

| Water coverage [cm²/g] | 12,600 | 9,200 | 7,000 | 4,900 |
|---|---|---|---|---|
| Particle size, D50 [µm] | 18-20 | 42-50 | 50-54 | 67-77 |
| Surfactant B [g] (20% concentration) | 1.40 | 1.30 | 1.00 | 0.750 |
| Surfactant D [g] (52% concentration) | 0.153 | 0.130 | 0.119 | 0.092 |

## Consequences of mistakes in selecting the quantity of surfactants

As a result of incorrect selection of the amount of surfactants, problems appear with preparation of the aluminium suspension. They are manifested by excessive scum in the aluminium mixer or even by pushing the non-wetted aluminium powder out of the mixer. This effect may even cause an explosion hazard within the suspension preparation station as well as disturb the production fluidity (incomplete growth or boiling of castings caused by the change of aluminium concentration in the suspension together with emptying the mixer).
The quality of water used for suspension preparation also has an impact on wettability of powders and operation of surfactants. Therefore, the selection of surfactant amount or optimization of its consumption should be done individually for each plant.

*Fig. 4: Pushing out the non-wetted aluminium powder from the mixer in the event of insufficient amount of surfactant.*

## Summary

For the correct operation of aluminium as a blowing agent in the production of AAC, in addition to the standard parameters responsible for activity of aluminium such as the grain size, specific surface area or bulk density, an important parameter determining its quality is its ability to form a suspension in water (especially in the case of wettable powders). It is also very important to use optimal amounts of surfactants when using non-wettable powders. The obtained suspensions should be homogeneous, without agglomerates, without uncontrolled scum, stable over time. Tests of powders as well as selection of surfactants can be performed in the laboratory, however, they should be confirmed in each of the plants individually on an industrial scale before the final determination of formulas. At the customer's request, such service can be performed in cooperation with the supplier of aluminium powders.

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# Influence of cement quality in the production of AAC in Azerbaijan

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**Autoclaved Aerated Concrete (AAC) was introduced to construction sector of Azerbaijan since 2011 and during a short time period, it has been widely used with economic and technical advantages in construction market. As well known, the cement and its technical properties are very important factors to be considered in the production of AAC. In this paper, the possible usage of Portland-pozzolanic cement with low C3A content and its certain advantages will be pointed in the production of AAC. Apart from this, the initial compressive strength, fineness (residue over 40 µm and Blaine) and several chemical parameters of Portland-pozzolanic cement were also considered as positive advantages. Consequently, the final product meets both technical and economical requirements of the producing company. The data used in this research was taken from industrial test performed in AAC plant situated in Azerbaijan.**

Concrete is one of the most popular and well-known used construction material in the world. Having featured with its chemical and physical advantages it has been widely consumed by people for strength and durability. To say in other words, by giving higher compressive and tensile strength concrete is sometimes called as bone system of construction building that is resistant to earthquakes and other environmental changes. In this case, concrete density plays an important role as the weight of the building contributes the earthquake force. Taking into the consideration of these reasons, modern material production technology is making structures with a strong and more durable concrete based material by decreasing the weight of non-structural materials with lightweight concrete. One of the most common sample of nonstructural member is wall system, made from lightweight concrete [1].

AAC is one of common types of lightweight concrete made mainly with silica fume, fly ash, quartz sand, lime, Portland cement and other materials categorized as constituents for lightweight concrete. In addition, aluminum powder generally applied in making lightweight concrete to accelerate the foaming process in order to decrease the density of concrete generally below 1000 kg/m3. This process causes a chemical reaction, which releases gas. After the mixture hardens, porous concrete is formed. Usually, after setting the lightweight concrete were cured in an autoclave at a temperature of 120-250°C and a pressure of 5-20 bars for 8-20 hours. Autoclaving significantly increases the compressive strength with its high temperature and pressure to produce a stable form of voids. Final strength obtained depending on the pressure and duration of autoclaving process. The process increases the strength and reduces the density of lightweight concrete [1].

Since the first invention of AAC during the early 20th century, it has been only presented to the Azerbaijan construction materials market at the beginning of 2000's. Meanwhile, this building material has been constantly developed in order to enhance its technical and physical parameters. Today's production technologies are able to control the amount and size of pores precisely so that AAC-blocks with a density from $\rho$ = 400 kg/m³ to $\rho$ = 600 kg/m³ and a compressive strength from 2.0 MPa to 6.0 MPa are available for the construction of residential buildings.

In this study, the influence of different cement types on the physical and mechanical properties of AAC is investigated. Moreover, the effect of lime and aluminum powder additions to the mixture are investigated as well.

## History of AAC in the world and Azerbaijan

AAC as a construction material has been industrially produced since the beginning of 20th century. AAC is also known as Aerated Cellular Concrete or

Aircrete. Early history of autoclaved aerated concrete is based on a series of process patents. In 1880, a German researcher Michaelis was granted a patent on his steam curing processes. Czech Hoffman successfully tested and patented in 1889 the method of "aerating" the concrete by carbon dioxide. Americans Aylsworth and Dyer used aluminum powder and calcium hydroxide to attain porous cementitious mixture for which they also received a patent in 1914. Sweden Axel Eriksson made a serious next step towards developing modern AAC when in 1920 he patented the methods of making aerated mix of limestone and ground slate (a so-called "lime formula") [2].

Eriksson's success immediately attracted a much needed commercial interest and in 1929 the first large scale manufacturing facility of these artificially-made crystalized stone blocks was launched in a factory "Yxhults Stenhuggeri Aktibolag", Sweden under the name Yxhult. In 1940, the "Yxhult" name was changed to YTONG as this name was easier to pronounce [2].

AAC manufacturing went international in 1937 with introduction of technology licensing and know-how transfer. After WWII, there existed only few leading AAC technology suppliers: Siporex and Ytong (both belonging to the Swedes), Durox (bought by the Dutch) and Hebel (German). Throughout the 20th century, all of them successfully sold AAC technology licenses around the world while at the same time annual conventions contributed to further developments in AAC production, product quality and its applications. Given different manufacturing technologies, production of AAC blocks became associated with Ytong (tilt-cake system) while production of both AAC blocks and reinforced elements was led by Durox, Siporex and late Hebel (flat-cake systems) [2].

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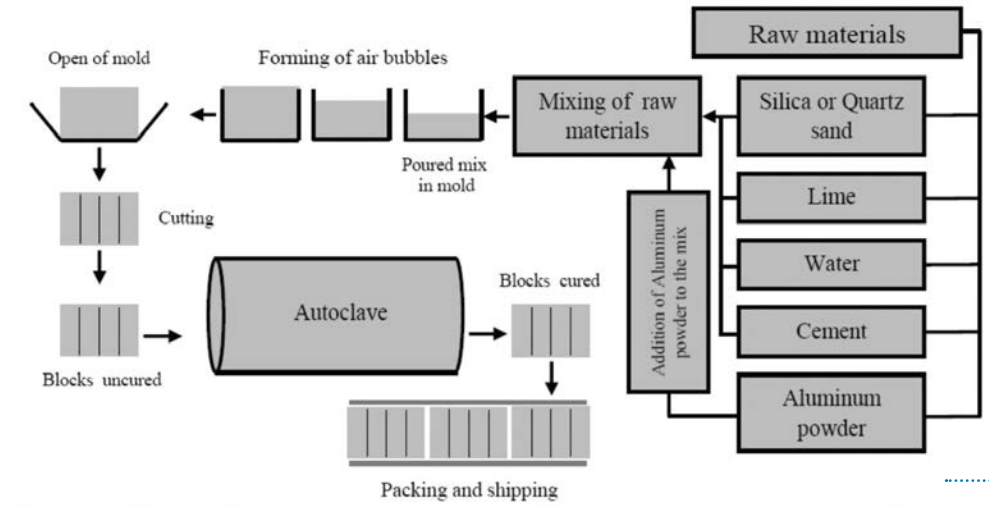



*Fig. 1: Process phases of AAC production*

AAC manufacturing started industrially produced in Azerbaijan since 2011 under the brand of "Gobustone" and became known wall material in the construction sector in a short time period. Aerated concrete blocks, which were new for the country's construction sector, have found their application in many areas and a number of successful projects, have increased their popularity and mainly replaced the natural Baku limestone stones and bricks. Currently, "Gobustone" aerated concrete blocks is one of the leading construction brands in the country's construction market and widely used by construction companies and individuals due to its advantages.

"Gobustone" aerated concrete blocks are manufactured at the plant equipped with Wehrhahn that is a high - quality German technology. All products meet the requirements of local and international standards. At the same time, the product quality is controlled at modern laboratories on an ongoing basis. The annual production capacity is 180,000 cubic meters of aerated concrete blocks and 30,000 tons of lime.

## Materials and production methodology

AAC is produced with fine aggregates (quartz sand, lime), cement, and an expansion agent (such as Aluminum powder) that causes the fresh mixture to rise like cake dough. In fact, this type of concrete contains 80% air. The material is moulded and cut into precisely dimensioned units in the factory. Quartz sand's percentage (as a source of silica) is higher than the other aggregates in aerated concrete mix. Both lime and quartz sand are mineral-based aggregates, which can be obtained from broken rocks or granites [3].

Cement, as main part of the raw materials used in AAC production is also the key parameter, that should be considered while preparation of fresh mix. In most cases, production people prefer the cement with higher specific surface (Blaine) and $C_3A$ content (≥ 6.0%). One of the best suitable products for these parameters is OPC, which is quite easy to handle and technically meets the requirements of AAC production.

*Fig. 2: Testing Process of Portland Pozzolana Cement in AAC Production*

*Table 1: Properties of different cement types used in AAC production vs reference requirements*

| List of Products | Sieve Residue over 40 µm, % | Blaine (cm²/gr) | Setting Time (min.) | | Compressive Strength of Cement (MPa) | | | CaO, % | $Na_2Oeq$, % | $C_3A$ content in clinker, % | $C_3S$ content in clinker, % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Initial | Final | 2 Days | 7 Days | 28 Days | | | | |
| Cement No1 | 10,8 | 4320 | 230 | 320 | 24,2 | 35,9 | 49,6 | 48,9 | 2,1 | 3,2 | 56,4 |
| Cement No2 | 5,5 | 3759 | 195 | 320 | 33,0 | 46,5 | 60,1 | 59,8 | 0,97 | 4,3 | 63,6 |
| Reference | – | ≥ 3700 | – | – | ≥ 28,0 | ≥ 40,0 | ≥ 55,0 | ≥ 60,0 | ≤ 1,0 | ≥ 5,0 | ≥ 60,0 |

As a start of the process, all main materials such as silica sand or quartz sand and lime are mixed with cement. Then water is added to this mix and hydration starts with cement forming bond between fine aggregates and cement paste. After mixing process, expansion agent is added to the mix for increasing its volume and this increase can be from 2 to 5 times more than original volume of the paste. Finally, expansion agent, which is used for this process, is aluminum powder; this material reacts with calcium hydroxide, which is the product of reaction between cement and water. This reaction between aluminum powder and calcium hydroxide causes forming of microscopic air bubbles which results in increasing of pastes volume as shown in fig. 1 [3].

The volume increase during the process is dependent upon the amount of aluminum powder/paste that is introduced to react with the calcium hydroxide in the mixture. This reaction is shown in following equations:

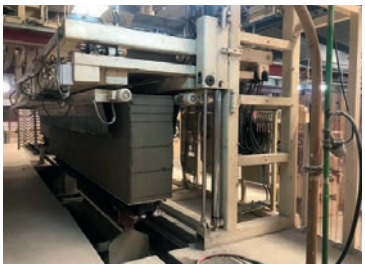
$$2Al + 3Ca(OH)_2 + 6H_2O = 3CaO * Al_2O_3 * 6H_2O + 3H_2 \quad (1)$$

Aluminum powder + Hydrated Lime = Tricalcium Hydrate + Hydrogen (2)

The less expansion that is induced will produce a higher strength material (more dense) versus the maximum amount of expansion induced, which produces a lower strength material (less dense) [3].

## Production requirements and testing process of Portland Pozzolana Cement in AAC production

In the production of AAC, certain physical and chemical parameters of raw materials considered as having key effects on the quality, especially compressive strength of final product. In fact, the compressive strength of an AAC product is a function of a number of parameters such as density, grain size of sand and amount of binder.



Cutting on certain sizes

Autoclaving process

Storage & packing

By using the optimal relationship between grain size of sand and amount of binder and autoclaving the product in an optimal way, will produce AAC blocks in an outstanding performance [5].

Mixing of raw materials carried out accordingly to the optimum recipes, whose ingredients modified according to the AAC parameters specified and operational cycle times required. In most cases AAC producers stand on cement quality that plays as binding agent role in the production of AAC. The effect of cement in slurry production and temperature is always subject of discussions, whereas the grinded lime is the main factor of temperature increase in the fresh mix. Alternatively, the used cement type has also great importance in optimizing the density and water/solid ratio in the suspension. Both parameters are critical control variables in managing the subsequent maturing, stiffening and setting processes.

The cement's fineness and particle size distribution have to be adjusted in such a way that its reduced water demand guarantees a greatest possible solid content while keeping the suspension thixotropy controlled and providing the planned setting characteristics of the fresh cake during the final phase of the maturing process [4].

One of the most important factors is the quality parameters of materials used in the production of AAC production. According to the existing regulations, the standard procedure requires using an Ordinary Portland Cement having specific gravity of 3.1 g/cm³. A lime containing 98% of hydrated lime is added to accelerate the hydration process. The specific gravity of the lime is 2.3 g/cm³. The aluminum powder is applied as a foaming agent [1].

In the testing process of Portland Pozzolana Cement, the main aim was about to study advantages of blended cement products in the production and their main effects on compressive strength of autoclaved aerated concretes. In addition to this, content of lime & aluminum powder as well as effect of pressures and curing duration have also been considered as key factors. As technical specifications, certain physical & chemical figures required by Producer Company in order to produce the AAC products with compressive strength around 3.0 MPa. Moreover, homogenous mixing of slurry, fermentation process, cake growth and elimination of possible cracks also have been taken into the consideration in the testing process described in fig. 2.

The main requirements on the cement was about to have definite quality figures mentioned in tab. 1, in order to have stable manufacturing process of AAC products in desired quality. So, according to the table, Producer Company used to handle the Cement No1, just because of having higher specific surface results. Nevertheless, having lower figures in CaO, $C_3A$ and $C_3S$ contents as well as higher alkaline content brought significant technical issues to them in the quality, which ultimately affected to their productivity and production costs.

After making the comprehensive investigation, the more suitable cement (Cement No2) was offered to the producing company and has been tested in AAC production. At the end of the day, having met almost all technical requirements, the final product (AAC blocks) was produced and tested in anticipated better quality by meeting both technical and economical requirements of the producing company. This testing process was a subject of Win-Win situation of all interested parties concentrating on real customer needs [4].

## Conclusion

In this work, the authors tried to present the advantages of Portland Pozzolana Cement with high early and final compressive strength (Cement no2) in the production of AAC blocks that meets all the needs of end users in appropriate quality (min. 3.0 MPa strength). The testing methodology of preparation and some preliminary data on properties of the materials were used from the same sources of daily production. The changes on raw materials, reduction in the processing time, increase in the compressive strength of the materials and reduction in the production costs were the main points of this project [5].

Due to the growing demand of AAC in Azerbaijan, the authors are looking forward this work will draw significant interests from different construction companies, consultants and other AAC producing companies.

## Acknowledgement

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# Part 2: Dealing with slurry components in AAC dosing procedures

**This is a sequel to "Establishing the suitable mass values for dosing of raw material components", which was part one of a series of articles concerning "Recipe calculation for autoclaved aerated concrete" [1]. The first part of this series didn't factor in detail the slurry components in AAC production. But every AAC plant has to deal with return slurry and most of them also with sand slurry. So, the correct calculation of solids and water parts in these slurries is an essential for dosing process in industrial scale.**

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## Slurry components in AAC recipes

There are some components in AAC formulations, which are dosed in form of dispersions. These are return slurry, and in most of the AAC plants also sand slurry and aluminium suspension. When the AAC production is based on fly ash this component also may be processed as a slurry component.

### Return slurry

Residuals from cutting the pre-cured block are stirred with additional water to form a suspension, which is named return slurry in most factories. This slurry is a standard component in AAC formulations because the cutting residuals are as valuable as original raw materials. The proportion of return slurry is varying in AAC recipes due to the amount of cutting residuals to be recycled. The amount is considerably changing daily because in AAC production in almost every plant there are manufactured different density grades and different unit sizes. So, mass and volume proportion as well of cutting residuals per block may change during a processing period. The return slurry is stored in big tanks or silos with continuous stirring to homogenize it. Slurry properties of interest for dosing are slurry density and temperature.
Another important property of return slurry is the content of CaO, which may be available for chemical reaction during steam curing; this problem is not addressed in this article.

### Sand slurry

Quartz sand is ground in most of the AAC plants on site; this can be done dry or wet. In the case of wet grinding with water the sand component in the AAC formulation is a suspension, the sand slurry. Sand slurry is stored in big tanks or silos before dosing. Continuous stirring is necessary to prevent sedimentation. The important properties of this slurry concerning dosing process are again slurry density and temperature.

### Fly ash slurry

For fly ash slurry the situation is very similar to sand. So, there will be no extra explanation in the following text concerning the fly ash on most topics.

### Aluminium suspension

Aluminium, the blowing agent, is often prepared as slurry to dose this component. The situation with aluminium suspension is somewhat different from return and sand slurry, as aluminium is only a minor component in the total amount of solids in an AAC recipe. In most cases it is below 0.1 % mass percent of dry material in the mixture.
The preparation of the aluminium suspension is under strict control with pre defined amount of water and aluminium component, may it be paste or powder, so there is no need to check the aluminium suspension again before it is used in dosing process. The amount of water contributed by aluminium suspension dosing is known already and has a fixed value, which is used in the recipe calculation.

In AAC plants return and sand slurries are produced daily in continuous processes on site. This causes variations in slurry quality to a more or less extent. With return slurry such variations are unavoidable when different grades and size of units of AAC are produced in the same plant. Without compensatory measures in the formulation of the recipe, these variations would strongly affect the product quality. So, checking the slurry properties at a high frequency is necessary, first of all the determination of slurry densities. Only with actual slurry density values can the dosage calculations be carried out correctly. The density measurement may be done automatically with mechanical scales (U-pipe scale) or based

on radiometric sensors, which are fixed to the slurry pipe, or simply by hand sampling using a container of one litre, which is placed on a scale.

## A calculation procedure for slurries

For recipe formulation it is necessary to know the amount of water and solids in slurries. By measuring the slurry density and with the knowledge of the pure density values of water and the solid components, it is possible to calculate the desired quantities of water and solids in a distinct slurry mass or volume. One solution is listed here:

| | | |
|---|---|---|
| slurry density | $\rho_{sl}$ | |
| water density | $\rho_w$ | |
| solids true density | $\rho_{sol}$ | |
| dry solids mass in slurry | $m_{sol}$ | |
| solids mass proportion | $f_{sol}$ | $(= m_{sol} \div m_{sl})$ |
| water mass proportion | $f_{w,sl}$ | $(= m_{wat} \div m_{sl})$ |
| total mass slurry | $m_{sl}$ | |
| water mass in slurry | $m_{wat}$ | |

$$f_{sol} = \rho_{sol} \times (\rho_w - \rho_{sl}) \div (\rho_{sl} \times \rho_w \times (1 - \rho_{sol} \div \rho_w)) \quad (1)$$

$$f_{w,sl} = 1 - f_{sol} \quad (2)$$

$$m_{sl} = m_{sol} \div f_{sol} \quad (3)$$

$$m_{wat} = m_{sl} \times f_{w,sl} \quad (4)$$

These formulations hold for both, sand slurry and return slurry. In the case of return slurry $m_{sol}$ is equal to $m_{rs}$, in the case of sand slurry $m_{sol}$ is equal to $m_{mix} \times p_{qua}$, see [1].
The solids density values for quartz sand are in the range of 2.55 to 2.65 g/cm³, and for the return dry material between 2.45 to 2.52 g/cm³. For pure quartz sand the value would be 2.63 g/cm³. Fly ashes, as mostly composed of vitreous material, show a true density of around 2.30 g/cm³. These density values always are averages for the minerals composition present in sand or flay ash raw materials and in return dry solids respectively.
It is recommended to use correct values, which are determined on the real material in use in the different production sites. An appropriate method to determine true density of powders would be pycnometry. With estimated true density values there can occur errors in mass determination of water proportion in the recipe mixture, which gives miss-information concerning the water solid ratio.
Typical values for true densities of return mass in dry state and for dry sand are 2.50 g/cm³ and 2.60 g/cm³ respectively. These values are used subsequently when explaining the use of slurry-tables for recipe calculation and some other issues.

## Including the slurry calculation into the recipe calculation for AAC

To complete the recipe calculation with respect to using of slurries the following changes to calculation procedure, which was presented in part one of this article series [1], have to be made:

| | | |
|---|---|---|
| proportion of water in return slurry | $f_{w,rs}$ | (to calculate by (1) and (2) with appropriate density values) |
| total mass of return slurry | $m_{sl,rs}$ | (to calculate by (3) with $m_{sol} = m_{rs}$) |
| mass of water in return slurry | $m_{wat,rs}$ | (to calculate by (4)) |

This procedure for calculating $m_{wat,rs}$ is replacing equation (7) in part one of the article series [1]. And following, the section concerning production of return slurry in lab scale, on page 37 in [1], can be omitted.

For sand slurry the calculation procedure is the same as with return slurry:

| | | |
|---|---|---|
| proportion of water in sand slurry | $f_{w,ss}$ | (to calculate by (1) and (2) with appropriate density values) |
| total mass of sand slurry | $m_{sl,ss}$ | (to calculate by (3) $m_{sol} = m_{mix} \times p_{qua}$) |
| mass of water in sand slurry | $m_{wat,ss}$ | (to calculate by (4)) |

The final step now to evaluate the mixture components in mass units for dosing looks as follows:

| | |
|---|---|
| return slurry$_{mix}$ | $m_{sl,rs}$ |
| sand slurry$_{mix}$ | $m_{sl,ss}$ |
| cement$_{mix}$ | $m_{mix} \times p_{cem}$ |
| lime$_{mix}$ | $m_{mix} \times p_{lim}$ |
| gypsum$_{mix}$ | $m_{mix} \times$ psul |
| or anhydrite$_{mix}$ | |
| (AAC powder | $m_{mix} \times p_{AAC}$) |
| (additive | $m_{mix} \times p_{add}$) |
| water$_{mix}$ | $m_{wat,to} - m_{wat,rs} - m_{wat,ss} - m_{wat,Al}$ |
| aluminium suspension | $m_{Al} + m_{wat,Al}$ |

Here, compared to the final calculation step given in [1], only the lines for return slurry$_{mix}$, sand slurry$_{mix}$ and water$_{mix}$ have changed.

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*Table 1: Slurry-tables for sand and return slurries as used in AAC production.*

**Per cent of water and solids for different densities of slurries (mass-%)**

| sand slurry | | | return slurry | | |
|---|---|---|---|---|---|
| density of slurry | water | solid | density of slurry | water | solid |
| g/cm³ | mass-% | mass-% | g/cm³ | mass-% | mass-% |
| 1.50 | 45.8 | 54.2 | 1.25 | 66.7 | 33.3 |
| 1.51 | 45.1 | 54.9 | 1.26 | 65.6 | 34.4 |
| 1.52 | 44.4 | 55.6 | 1.27 | 64.6 | 35.4 |
| 1.53 | 43.7 | 56.3 | 1.28 | 63.5 | 36.5 |
| 1.54 | 43.0 | 57.0 | 1.29 | 62.5 | 37.5 |
| 1.55 | 42.3 | 57.7 | 1.30 | 61.5 | 38.5 |
| 1.56 | 41.7 | 58.3 | 1.31 | 60.6 | 39.4 |
| 1.57 | 41.0 | 59.0 | 1.32 | 59.6 | 40.4 |
| 1.58 | 40.3 | 59.7 | 1.33 | 58.6 | 41.4 |
| 1.59 | 39.7 | 60.3 | 1.34 | 57.7 | 42.3 |
| 1.60 | 39.1 | 60.9 | 1.35 | 56.8 | 43.2 |
| 1.61 | 38.4 | 61.6 | 1.36 | 55.9 | 44.1 |
| 1.62 | 37.8 | 62.2 | 1.37 | 55.0 | 45.0 |
| 1.63 | 37.2 | 62.8 | 1.38 | 54.1 | 45.9 |
| 1.64 | 36.6 | 63.4 | 1.39 | 53.2 | 46.8 |
| 1.65 | 36.0 | 64.0 | 1.40 | 52.4 | 47.6 |
| 1.66 | 35.4 | 64.6 | 1.41 | 51.5 | 48.5 |
| 1.67 | 34.8 | 65.2 | 1.42 | 50.7 | 49.3 |
| 1.68 | 34.2 | 65.8 | 1.43 | 49.9 | 50.1 |
| 1.69 | 33.7 | 66.3 | 1.44 | 49.1 | 50.9 |
| 1.70 | 33.1 | 66.9 | 1.45 | 48.3 | 51.7 |
| 1.71 | 32.5 | 67.5 | 1.46 | 47.5 | 52.5 |
| 1.72 | 32.0 | 68.0 | 1.47 | 46.7 | 53.3 |
| 1.73 | 31.4 | 68.6 | 1.48 | 45.9 | 54.1 |
| 1.74 | 30.9 | 69.1 | 1.49 | 45.2 | 54.8 |
| 1.75 | 30.4 | 69.6 | 1.50 | 44.4 | 55.6 |
| 1.76 | 29.8 | 70.2 | 1.51 | 43.7 | 56.3 |
| 1.77 | 29.3 | 70.7 | 1.52 | 43.0 | 57.0 |
| 1.78 | 28.8 | 71.2 | 1.53 | 42.3 | 57.7 |
| 1.79 | 28.3 | 71.7 | 1.54 | 41.6 | 58.4 |
| 1.80 | 27.8 | 72.2 | 1.55 | 40.9 | 59.1 |

The basis calculation procedure with implementation of slurry components for AAC recipe calculation is completed with these explanations above as far as concerning the mass values.

### Slurry-tables

In some older AAC plants there are still so-called slurry-tables in use; Table 1 gives an example. Mixing towers which less sophisticated control software may lack an automatized density recording of slurries and recipe adjusting. Then there is the necessity to do some calculation for recipe adjustment by hand, and slurry-tables are a tool very helpful. Also for understanding of slurry properties and issues related to them the tables are of advantage.

The slurry-tables give the solids and water proportions in per cent for every density value listed, so complex calculation steps are replaced by a simple look up. Calculation of per cent values is based on 2.60 g/cm$_3$ and 2.50 g/cm$^3$ true density values for sand and return dry solids respectively in Table 1. The ranges for typical density values are shown with the light blue background.

A rule of thumb on slurries in AAC production is that there are about equal amounts of solids and water in the return slurry and for sand slurries this proportion is near 2 to 1. According to Table 1 the related slurry densities are 1.43 g/cm$^3$ and 1.70 g/cm$^3$. This is on the upper end of the ranges given for the typical slurry density values observed in AAC plants.

## Production issues related to slurry properties

The slurry density for sand slurry and return slurry as well should be as high as possible, because less water in slurries gives great advantage in adjusting mixing temperature. There is more mixing water left, which is composed of a cold and a hot component to meet the desired pouring temperature of the mixture. Such problems with mixing temperature are more likely to occur during summer season and in regions with hot climate.

The upper limits for slurry densities are imposed by viscosity and capability of slurry pumps. High slurry viscosities may cause a high viscosity too high in the mixture, so the mould wouldn't get filled evenly or the mixing vessel and pipes wont empty completely. Also the expanding process can negatively be affected by high viscosity of the mixture.

A common reason for high viscosity of slurries is the fineness of raw materials involved; with sand there may be a certain amount of clay materials, with return slurry there may cement with very high fineness be in use. In the end the suitable slurry density values will reside near the lower end of the light blue marked density ranges in the slurry-tables. In such cases to lower the water amount in slurries and mixtures it may be suitable to use liquifiers.

The calculation procedures presented in this article and in the corresponding part one [1] are a basic necessity in AAC production. If they are not implemented properly, with frequent slurry density measurements and short-time recipe adjustments, the product quality will fluctuate to an inadmissible extent. Modern plant equipment should have included all this in their mixing tower control software and in the raw materials and mixing tower section, where the necessary sensors have to be installed.

## References


[1] Schober, G.: Recipe calculation for AAC, Part 1: Establishing the suitable mass values for dosing of raw material components, AAC WORLDWIDE, 3, 2019, pp. 34-37


*Slurry tanks in AAC plant*


*Stirring sand slurry*

# Complex upgrades made easy: A holistic approach for enhanced capacity

**When choosing the right technology and the right technology partner, an investment in an AAC factory is quite a long-term investment. There are many real-life examples of successfully operating factories for more than 50 years that are still producing today. Of course, the right level and frequency of maintenance and cleaning are important to ensure the plant keeps on running well.**

Wouter Ros, Technical Sales Manager, Aircrete Europe, The Netherlands

However, given the smooth characteristics of the AAC production process, the equipment has a very long lifetime with relatively very limited wear (as opposed to the production of for example traditional concrete, where vibrating in the production process demands a lot from the equipment). Over time, a change in market demand may require a shift in product portfolio (e.g. the global trend visible today,




*Fig. 1: Aircrete Europe was also engaged as SYC's technology partner in 2013 for the upgrade project from a Hebel to a Durox flat-cake cutting system.*

*Fig. 2: The new fully automated end crust removal system.*


*Fig. 3: The vacuum crane is repositioned and attached to a new vacuum hood crane for efficient top waste collection.*

with a shift from AAC blocks to AAC panels) or simply could require an increase in the production capacity. Often, in order to adapt to these opportunities, a more fundamental change in the equipment and operations is required. This change results in with the upgrade or modernization of equipment, level of automation, control systems and even full production areas. This article shows how one of the leading AAC producers in South Korea recently realized a successful upgrade of their factory with a well-designed and well-executed upgrade project to increase the capacity of their plant.

## Expansion opportunity

Started production in 1993, SYC ALC Co. (SYC) is a leading AAC producer located in the city of Asansi, South Korea. The factory is based on a flat-cake Durox line, which was upgraded from a Hebel cutting line by Aircrete Europe in 2013 (fig. 1). As a result of that upgrade project, SYC is currently the only producer in Korea that is able to produce AAC elements with a Super Smooth surface as a result of to the double-oscillating wire cutting technology from Aircrete Europe.

South Korean residential construction accounts for about 40% of the total construction market in Korea. As a result of the government incentive plans that focus on affordable public housing and increasing the supply of rental public housing in the country, this market has a prosperous outlook in terms of growth figures [1].

Anticipating the future demand increase within the light of these developments, SYC decided to execute an upgrade of their existing factory to increase the production capacity, together with the automation of several existing machines. As for every large modernization project, a customized solution was required, and the installation had to be executed flawlessly in a very short time frame in order to minimize the production down time. Looking for a technology partner that was associated with the flat-cake technology and that, besides supplying the equipment, understands the production process of its customer, SYC engaged Aircrete Europe as their technology partner to execute this challenging project.

The project started with detailed discussions between all stakeholders, to understand the exact objectives of the customer and translate into an innovative design that spanned several areas of the production process, starting from mould handling to all the way to the packing area, including an automation upgrade of the autoclave traverser. In addition, three new autoclaves were added to the factory to also increase the autoclaving capacity. The entire project resulted in a capacity increase of nearly 60% and installation was executed in a very short time frame of two weeks only.

## The SYC upgrade project

To significantly reduce the cycle time in the cutting area, the cutting machine has been extended to have the possibility to have several cakes at the same time in the cutting line. Also, the side, end and top- waste removal (fig. 2) as well as the stacking of maximal three cakes on an autoclave trolley has been fully automated within the process. Previously, only one cake at a time could be handled in the cutting line and the green waste was being removed manually.

*Fig. 4: The new frame stacking crane picks the cake automatically and stacks it two or three high as per the autoclave height.*

In the new cutting process, the cake is put on a retractable table where the Aircrete Inclined Cross Cutter cuts the length of the panels (or the height of the blocks). After the cross-cut, the cake is put on the first section of the cutting line by the existing crane, which is since this project now operational in automatic mode. Once placed on the first section, the cake is pushed through the Aircrete High Speed Cutting Frame, where a horizontal cut is made. Double oscillating wires provide a vertical cut at the same


*Fig. 5: A close-up view from the new outfeed conveyor.*

time, creating AAC products with a Super Smooth surface that reduces finishing requirements when applied in construction projects. After the cutting, a vacuum hood that is repositioned and attached to a new wagon, removes the end and top crusts efficiently (fig. 3). The new frame stacking crane picks up the cake and stacks it two or three high (depending on the diameter of the autoclaves) on trolleys that are standing on buffer tracks towards the autoclaves (fig. 4).

Additionally, the entire process of loading and unloading of the autoclaves has been automated, resulting in significant cycle-time and labor cost reductions. SYC originally started production in 1993 with six smaller autoclaves, each with a capacity of ten cakes at once (stacked 2-high). In 2010 and 2013, additional autoclaves were added, with 15-cake capacity per autoclave (stacked 3-high). With this recent modernization project, three additional autoclaves are added, each with a capacity of 18 cakes. As a result of the various dimensions of the autoclaves, the upgrade project required some flexibility in the stacking of the cakes before autoclaving. The traverser car is reinforced to handle the higher loads for the additional cakes per autoclave. In addition, the horizontal movement and the push-pull mechanism of the traverser are also upgraded to become fully automated.

Another important area of the upgrade project was the replacement of the packing line. The newly installed equipment and significant modifications to the existing packing crane resulted in significant cycle time and labour cost reductions. The new tilting table is now able to tilt two cakes concurrently on the pallets, which are automatically fed in by a new automated pallet insert system. From the tilting table, the packs are automatically transported along a strapping and foiling machine before they are buffered outside the building on a large conveyor (fig. 5). This new design results in less dependency on the availability of the forklift driver. A semi-automatic crane is also installed to enable operators to efficiently remove products that do not meet the quality standards.

## Mission accomplished

With a careful and intensive design and engineering phase, the installation of all the upgrades are completed in just two weeks onsite. This required very strong cooperation and excellent planning capabilities between all project stakeholders involved. Both SYC and Aircrete Europe teams worked together in multiple shifts with extraordinary dedication, which was a major contributor to a successful project.

Mr. Yoo, proud owner of SYC, commented "Aircrete Europe's role as a partner, not just a machine supplier, was tremendously important in this project. They truly understood the challenges and objectives of us as an AAC producer and have managed to translate this very well into an innovative design and very efficient installation."

As a global leader in AAC panel applications, Aircrete Europe possesses the right technology and process know-how to execute complex upgrades and modernization projects. Whether it is to increase capacity, upgrade plant automation, optimize the unloading logistics or even upgrade from an existing tilt-cake cutting line to a flat-cake cutting line in order to make AAC panels, Aircrete Europe is a reliable technology partner throughout every modernization project.

[1] South Korea Construction Market Trends, Shraddha Sarvankar, July 23, 2019, Medium.com

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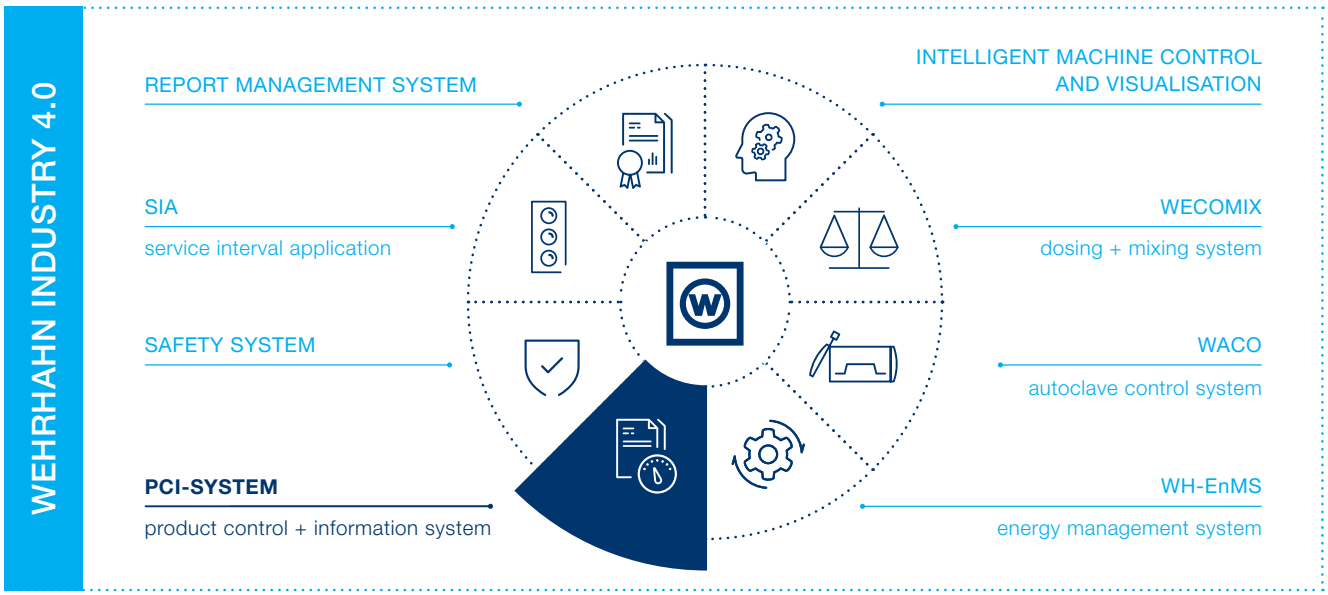
# Intelligent automation modules in AAC production plants – part 3: Product Control and Information (PCI)-system

**A state-of-the-art factory has to save and store all relevant product data to ensure product traceability (especially in case of claims). Furthermore, it should continuously increase product quality and plant efficiency by a "continuous improvement process" according to the four steps "Plan - Do - Check - Act". Consequently, the production process should be automatically monitored and analysed. This part of the series of articles describes the automatic control of machine and process parameters as part of the entire PCI-system.**

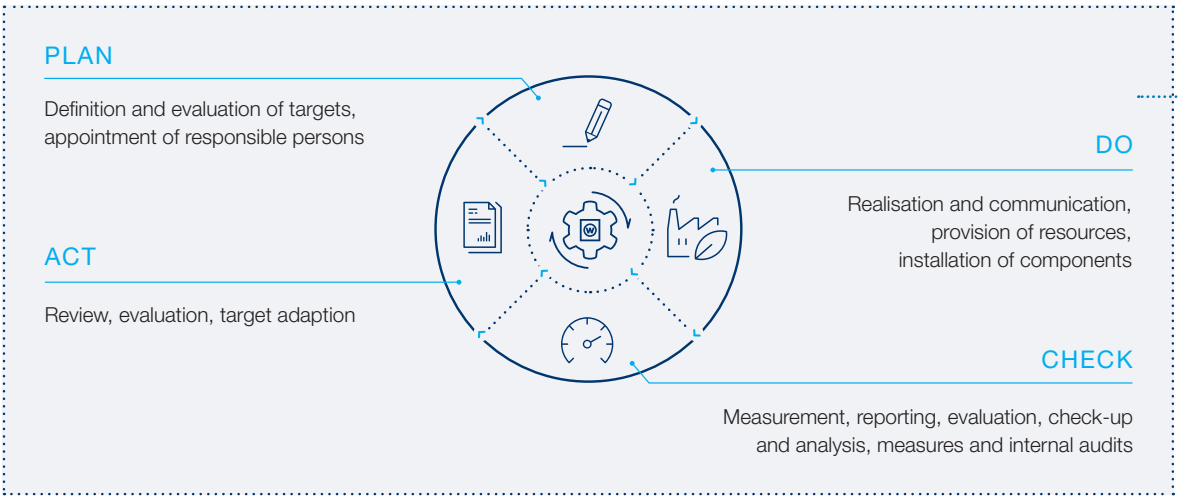
An efficient production plant provides a large number of measured values, product data and machine data which are of interest for the operators (for required machine adjustments), the ERP-system (information about the productivity and amount of products on stock), the management (product quality, output, plant performance) and the laboratory department (information about raw material consumption, production process and product quality) etc.

## Data collection in the past

For decades, data handling in many plants was primarily manually done by taking notes. Information and notes were handwritten on paper by every single operator. Handling over paper notes from one division to the next, however, causes problems and it is rather difficult to follow up the production process.




*AAC - automation modules for a precisely coordinated Automation Control System.*




*Plan-Do-Check-Act cycle for continuous improvement process.*

Therefore, following up each individual cake was formerly almost impossible. It was common that the operators marked up numbers on the cake at the end of the cutting process to help operators in the packing area to identify the cake. But it is essential to track the AAC cake throughout the whole process and it is not possible to use the old style of paper notes collection and distribution.

## How to evaluate the data economically?

The manually written product data are usually only partly evaluated and unfortunately mostly too late. Data are entered into an Excel file by somebody, a practice not only costly and time-consuming but also fault-prone. As a result, the causes of possible malfunctions and optimization potentials cannot be found quickly enough which negatively reflects in quality and quantity of production.

Moreover, online data evaluation in real time is not possible. Many plant managers may feel overloaded by the amount of data and wide data diversity. Therefore, it is hardly possible to profitably use the provided data.

## The solution to improve

An automatic electronic measuring, recording, processing and analysis of the production data in real time would provide the management with all the important information quickly and reliably.

If this control system is used to track each individual cake in every position continuously, it would facilitate to adjust the machine parameters exactly to the requirements for a smoothly running plant and to gain maximum plant availability and reliability - and finally profit!


*Handwritten notes on cakes were customary in former times.*

Mandatory features of such a system are

- Identification of the cake in each position of the production process
- Machine parameters of the different product types
- Self-adjustment of the machine parameters automatically
- Storage and analysis of all product data
- Provision of comprehensible information for operators, laboratory engineers and management in real time
- Transfer of data to connected analysing software and for evaluation.

## The solution is the Wehrhahn Product Control and Information system (PCI-system)

### Product

... pursues the product through the whole process and saves all relevant production data automatically in a secured SQL-database, e.g. for merchandise or quality management systems.

### Control

... adjusts machine parameters automatically depending on the individual product type preventing operator errors in the machine settings and reducing product damages (cutting speed, separating pressure, etc.)

### Information

... includes an analysis software where data can be selected to evaluate productivity and detect or locate production disturbances.

### PCI helps to improve production in all areas

„Our Wehrhahn plant is operating with Wecomix, the basic level of the Wehrhahn PCI-system in the 'dosing and mixing' section. All data for both areas have always been saved and could be used for retracing the process. However, for the areas 'precuring', 'cutting' and 'packing' we had only handwritten records. A long way for the evaluation. After installing the PCI we are now able to evaluate all required production data and to analyse quality directly.

Today we have very reliable production data. This helps us to optimise our production process. So we can provide consistent good quality to our customers.

When changing the block dimensions or density then PCI automatically adjusts the machine parameters. The required type of AAC block parameters are set once at the 'dosing and mixing' control. All subsequent production sections adjust their plant parameters automatically. The operator only has to supervise the process on the monitor. Operator errors are minimised close to zero."

*Stefan Wolf,*
*Production Manager of Rodgauer Baustoffwerke, Germany*

## The cake is "born"

In the dosing and mixing process the precise amount of raw materials is dosed into a high speed mixer. The different recipes define the properties of the AAC to be produced, e.g. strength classes, raw densities, thermal conductivity, etc. The physical characteristic of the final product is determined and significantly influenced in this section.

Each cake automatically gets an individual identification number (cake-ID) from the dosing and mixing control system Wecomix. This cake-ID will be tracked during the whole process. When the cake is "born" (the mix is filled into the mould) all data from the mixing process like raw material amounts, temperatures, densities, mixing times, correction values, CaO, water/solid-ratio as well as process values like operator name, automatic mode, cycle time, fault messages, etc. and mould number will be stored in the database under the unique cake-ID.

## How can the cake-ID be tracked throughout the process?

Two different identification steps are required:

1. The cake-ID is created after the mixture is poured into the mould. The cake tracking process is started.

2. The cake leaves the mould and is placed onto a cutting pallet before it is cut and finally, after cutting, onto an autoclave grid/pallet.

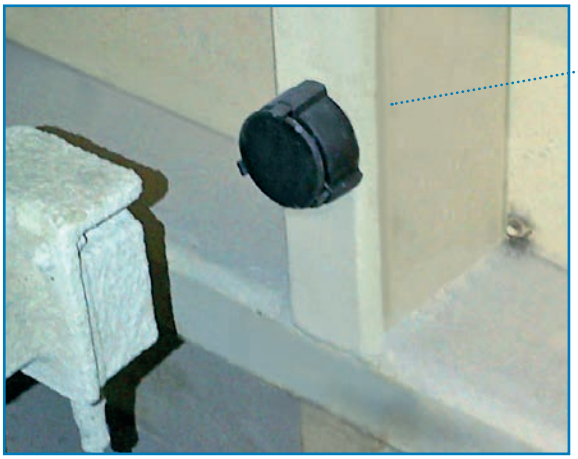
## Mould identification in the dosing and precuring area

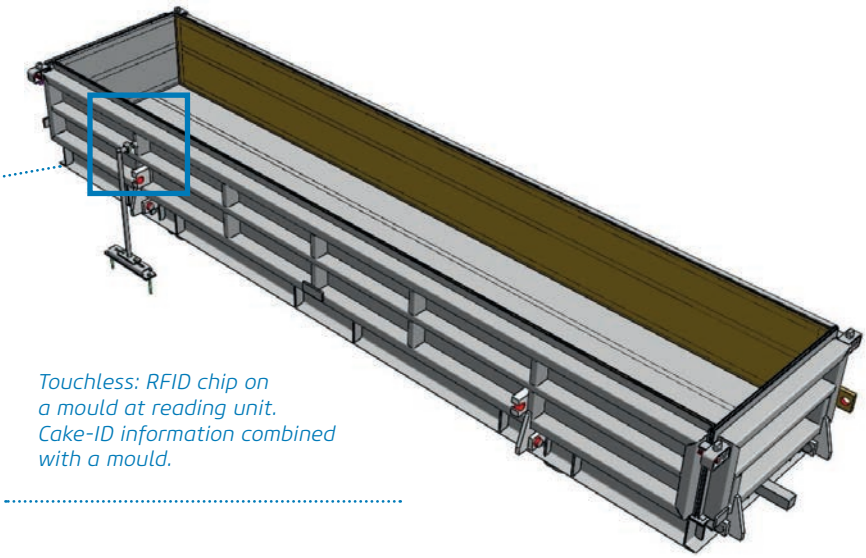
The optimum result can be reached with RFID-chips (Radio-frequency identification). The RFID tag is a very thin radio transponder which transmits digital data to a RFID reader when triggered by an electromagnetic interrogation pulse. There are two types of transponders (passive and active tags). While passive tags will be energized by interrogating radio waves of the RFID reader, the active tags are powered by a battery which allows a distance to the reader of up to hundred meters. Usually the passive tags are sufficient since they need less maintenance.

Although the climatic conditions in the precuring area are quite demanding (the system needs to overcome and resist high temperatures, humidity, dust and soiling), the identification is working absolutely reliable.

## The optimal precuring process

In the precuring section the machines are automatically adjusted to the requirements of the product inside the mould. Transportation speeds are precisely adjusted to transport in the shortest possible time without stressing the cake too much. The precuring time is adjusted to the recipe to cut the cake in the





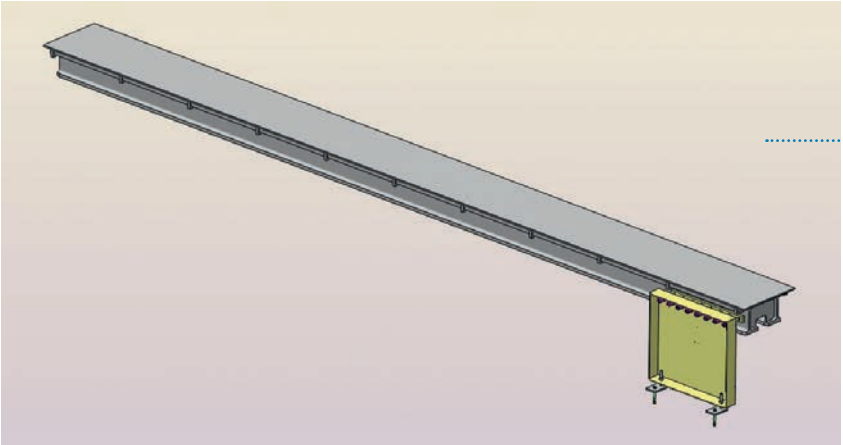
*Touchless: RFID chip on a mould at reading unit. Cake-ID information combined with a mould.*

best moment. Additional measuring devices like cake tester (cake hardness, temperature and height) just before the cutting line as well as a sensor unit in the precuring chamber (cake height and temperature rising measuring, chamber temperature and humidity) help to find the optimal cutting time. All these data are stored in the cake database under the cake-ID.

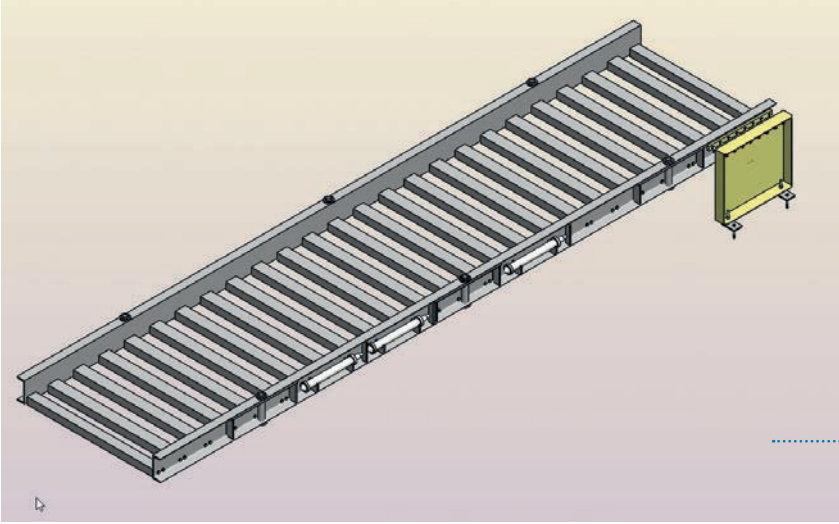
## Precise cutting at the right time ensures the high quality

When the cake is ready to be cut it leaves the mould and it is transferred onto a cutting pallet and finally onto an autoclave pallet/grid after cutting. The cake on the autoclave pallet is placed onto an autoclave trolley to be transported into the autoclave.

Before the cutting process starts, the machine parameters are automatically adjusted, i.e. cutting speeds, handholds, cutting wire positions, etc. and are stored in the database together with cycle time, fault messages, etc.
In case of irregularities the operator can prepare comments which are stored in the database, too. This supports the finding of reasons for any disturbances in the production process during data evaluation.



*Cake data transfer and identification of an autoclave pallet.*



*Cake data transfer and identification of an autoclave grid.*

## Autoclave pallet identification

The steel pallet or grid stays in an autoclave with 12 bar at around 190 °C for 12 hours which makes it difficult to use electronic identification tags like RFID for cake detection. Even there are some RFID-chips available on the market which resist temperatures over 250 °C, but lifetime is limited to less than six months. The exchange of RFID-chips of around 200 pallets every six months is unacceptable.

The solution is the combination of special inductive proximity switches or camera systems and a precise evaluation algorithm in the control system to reliably detect the pallets/grids.
Wehrhahn has developed pallet detection systems with inductive sensors and special QR-code similar tags for AAC plants as well as for sand lime brick plants.

## Automatic autoclaving process

As soon as a complete set of autoclave trolleys is ready to be loaded into an autoclave the applicable autoclave curve has to be chosen. Here the automatic data transfer, read from the autoclave pallet / grid, can enable an autoclave control system like WACO to automatically select the required autoclave curve and to autonomously carry out all autoclaving process steps.

When the autoclaving process is finished successfully, the autoclave trolleys with the white cakes are transported automatically to the packing section.

## Blocks or panels will be sorted and packed automatically

The autoclave pallet detection helps to identify the product in the packing line via the cake-ID. Also here all machine parameters are automatically adjusted, without any manual actions taken by the operator. The freshly produced AAC blocks or panels are placed onto wooden pallets. The background communication from the packing control system to the label printer guarantees the correct labelling of the packed product, including QR-code or barcode.
Daily reports provide all information of product types, productivity and reject rates to the ERP-system and/or to the quality management system.

## Benefits with Wehrhahn PCI-system

To identify optimisation potential and to implement it precisely it is necessary to combine all production databases and to bring the individual data in

correlation to each other. Therefore, all production data from the different kind of control systems are stored in a Wehrhahn created SQL-database which is part of the Wehrhahn Master Control Server system (MCS-system).

## PCI helps to:

- Increase productivity by shorter set-up times
- Increase product quality by less errors and faults due to automatic set-up
- Reduce production costs by optimising raw material consumption

The MCS-system will be described in one of the next issues of the Industry 4.0 series in AAC wordwide.

See here a video about Wehrhahn automation. Scan the QR-code with your smartphone.

Frank Pottin studied automation engineering in Bremen. Immediately after completing his studies, he began with the electrical design, programming and commissioning of Wehrhahn AAC production plants. Today he has over 27 years' experience in AAC production. As Director Electric and Automation, with his team of more than 30 automation specialists, he continually develops new innovations for AAC production.
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Klaus Boderke studied process engineering in Clausthal-Zellerfeld. After being plant manager in several plants and meanwhile having 30 years experience in AAC plants he now supports plants worldwide for quality and output increase, cost reduction, change and project management, safety and environmental assessments with profound skillness in staff training and leadership. boderke@wehrhahn.de

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# "Safety First" – tailor-made plant safety concepts

**Since years, the plant safety developed to one of the central spotlights in the plant environment. The demand of a most efficient and safe production becomes increasingly apparent for both, plant manufacturers and plant owners. Especially in Germany, but also throughout Europe, the demand for effective safety concepts as well as the option to retrofit of new safety technologies in existing plants, which consider the current standards and norms, is increasing. The health of people and environment, in addition to minimizing of downtimes, have a particularly high significance.**

Masa GmbH with its two locations in Andernach and Porta Westfalica has been sensitized for plant safety for decades. During the planning phase of production plants, Masa employees are always on hand to provide advice and support with various safety concepts. These concepts are perfectly adapted to the individual product groups of Masa GmbH – plants to manufacture autoclaved aerated concrete products, sand-lime bricks or all kind of concrete blocks and pavers. Appropriate and comprehensive training activities for Masa specialists and the investment in its own safety consultants are a matter of course for the German company. Masa also maintains an intensive partnership with its suppliers and benefits from

*Fig.1: View of the plant in Ulyanovsk of the ZAO "Prominvest" group of companies.*

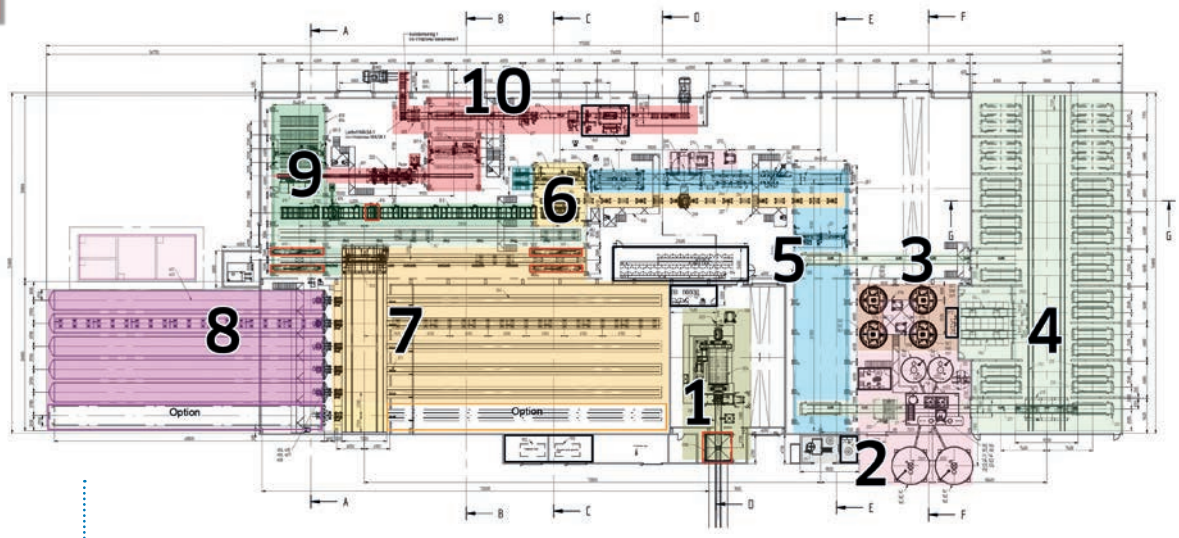


*Fig. 2: In this example the AAC plant is divided into 10 safety areas.*
*Zone 1: Wet ball mill*
*Zone 2: Dosing, mixing and dispensing, high-security area Binder storage, especially in the storage area of aluminium powder/paste*
*Zone 3: Slurry silos and return slurry silos*
*Zone 4: Fermentation area*
*Zone 5: Transport to the cutting line and removal of the mould*
*Zone 6: Cutting line and Tilting table*
*Zone 6: Autoclave loading and intermediate storage*
*Zone 7: Hardening plant*
*Zone 8: Autoclave*
*Zone 8: Steam boiler plant*
*Zone 9: Re-tilting table, hardening grid transport, and hardening car return*
*Zone 10: Separating machine, Block transfer device and Packaging*

their respective wealth of experience. In this way, the latest safety technology finds its way into Masa plants.

## Security is always a mix of actions

The extensiveness of the Masa safety concept can be considered in a Russian plant to produce AAC blocks and elements, which was commissioned in 2019: The ZAO "Prominvest" group of companies has been very successfully operating a sand-lime brick production plant for over 45 years and is one of the leading manufacturers in Russia in this field. Due to the new Masa AAC plant, the expansion of the product portfolio could be advanced promisingly. The fully automatic Masa production plant produces AAC products of the brand "Novoblock" according to the latest quality standards. The capacity reserves of the supplied plant allow an expansion of the daily production capacity by further 20 %.
The Masa safety concept, installed in this factory, combines both output demands and the needed technology to avoid risks for plant operators within the plant. The individual measures and the technology used were designed true to the principle "safe and uncomplicated at once". Each production plant requires individual solutions, only the appropriate mix of measures ultimately led to effective results.

## Organize in safety areas

To ensure safe and effective production, Prominvest's new production plant was divided into independent safety areas and set up accordingly. If certain plant components in one safety area must be shut down as scheduled, the production can continue in any other unaffected safety area. The number of safety areas varies and depends on the plant concept.
The biggest advantage is obvious: The plant basically continues to produce. Minor maintenance or cleaning work can be carried out during operation. For example, packaging materials can be refilled in the area of the packaging line without affecting the fermentation area.

## Access to safety areas

During inspections, maintenance or troubleshooting a safe access to the individual areas is essential. Depending to the characteristics of the area or the required work, a precisely defined procedure must be followed (A-B-C access). The individual security zones have security boxes which control the opening of the security doors. The access to the corresponding area can be requested by means of illuminated buttons. All moving plant components within the area are stopped. As soon as a safe condition is present, a second illuminated button signals the possibility of releasing the area. When the release button is pressed, all necessary safety light barriers are automatically activated, the safety door can be unlocked with a key switch and the safety area can be entered (A access). Potential faults on the light barriers are displayed. After completion of the work and leaving the danger area, the correct closing of the safety door is visualized by with LED door switches. The activation of the safety door takes place through the key switch.


*Fig. 3: The Fortress safety system has recently been implemented in the safety concept of a sand lime brick sawing plant.*

The procedure for a B-access also includes the setting of a locking pliers on the relevant safety component. The locking pliers must be secured with a personal padlock to prevent the unlocking by another person. In comparison to the other accesses, the C-access requires also the disconnection of the energy supply in the security area. The corresponding switches can be secured with personal padlocks as well.

A comfortable alternative to the A-B-C access to safety areas is provided by the British company Fortress Interlocks. The intelligent locking system is currently successfully and reliably used in Masa sand lime brick and concrete block production plants. The implementation in Masa AAC plants is already being considered.

## Technical innovations: 3D Safety Radar

Masa currently uses light barriers in the take-off area at the end of the production process. The most effective design of this area has already been the greatest challenge in the past – regardless of the current safety level.

The initial situation: In general, the pickup of the final products takes place by forklifts. As soon as the forklift driver passes the safety light barrier, the entire area including the pickup belt is stopped until the forklift has left the safety area again. The reactivation of the area is done manually, only subsequently the packaging line starts again. The reset as well as the necessary activation of the light barrier sensors is usually carried out via a wire rope hoist near the pickup belt or by actuating via remote control.

However, optical systems such as light barriers are sensitive to external influences (e.g. snow, heavy rain or leaves). If the light barrier is interrupted as a result of these influences, an unintentional standstill is inevitable the consequence. A manual reset is unavoidable.

In order to optimize this safety area, Masa is currently testing a promisingly more effective solution called "3D Safety Radar" at the factory in Porta Westfalica, a LBK system designed by Inxpect. This system enables the replacement of any optical systems in the outdoor area of the factory.

*Fig. 4: The removal area is secured by optical systems.*

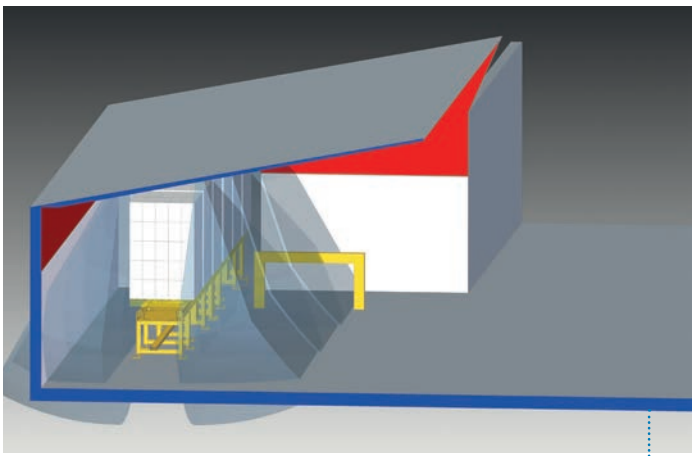

*Fig. 5: The LBK system is less sensitive compared to optical systems.*

According to Inxpect, the 3D Safety Radar is the first certified volumetric safety system with radar technology in the world and is suitable for industrial safety applications to protect plant operator.
The LBK system detects as soon as operating personnel are within the safety area. A restart of the system components is prevented by an integrated restart lock and is no longer dependent on the care of the forklift driver.
But why is 3D Safety Radar superior to optical systems? In contrast to optical systems, the LBK system proves to be resistant to external influences such as smoke, dust, chips, water splashes/drops and other production waste. Inxpect has developed a system which is able to filter external interferences by using the 24-GHz frequency band and thus increase the efficiency of the production plant.
If the 3D Safety Radar meets all requirements after the inhouse test runs, the LBK system can also be used in Masa plants in the future.
This advantage will also be intended for existing plants. A replacement of the optical system or retrofitting with the new LBK system is possible without major effort and costs.

*Fig. 6: With Safety Simplify the wiring effort is reduced (Source: SSP).*


In addition, the 3D Safety Radar offers easy handling and operation. Although a Masa safety engineer must be present during the initial set-up, if the system needs to be reconfigured, the set-up procedure can be carried out remotely.

## Outlook: Wireless Safety

The products manufactured by the company SSP Safety Systems Products GmbH & Co. KG is another safety technology which is currently being examined and tested by Masa. Safety Simplify is particularly suitable as a retrofit option.

The local conditions within an existing plant are often complex, especially in the case of a retrofit or upgrade of the safety technology. Simply laying or pulling cables in narrow and tight cable shafts or trays later is always challenging. The wiring effort is considerably reduced by the wireless safety system. This saves additional space in the control cabinet. The "Plug & Play safety solution", user-friendly safety concepts and systems are easier to implement and is especially interesting in retrofit projects.
Safety technologies such as 3D Safety Radar or Safety Simplify are just two examples that Masa focuses always on new safety concepts which increases the plant safety and effectiveness significantly.

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# Enhancing competitiveness through modernization of manufacturing equipment

**Autoclaved Aerated Concrete with all its unique advantages has over the last years had a breathtaking revival and its demand is increasing worldwide. Since AAC has been used over decades already, many production facilities are outdated today, both in terms of technology updates and material & equipment fatigue. Because of growing demand in all relevant markets, these old facilities find it hard to compete with their modern counterparts. The latter, of course, come along in new highly appropriate designs in terms of the technologies used, energy savings, maintenance cost, needed manpower and product quality. That is to say, times are truly getting harder for the operators of outdated production sites.**

At a first glance, it might appear wise to follow the philosophies of competitors and decide on the purchase of new plant and equipment. However, before embarking on any such route, it could be wiser to examine other options.

Hess AAC Systems is a world leader in the field of AAC technology, offering its services of integrating state-of-the-art technologies into already existing production lines. Some equipment for AAC production has been made to last "forever" and only needs

*Hess engineers do not believe in the sole use of old drawings because a physical check on site will show the real-life situation to form the true basics needed to build new machinery quickly and with highest accuracy.*

replacement of specific parts in the event of wear and tear. Other parts of the plant however, need to be taken care of for reasons of performance, product quality and/or product portfolio because customers and the market in general demand so. Key in assuring top quality and product accuracy is the performance of the cutting line and this is where Hess AAC comes in to ensure state-of-the-art solutions.

Successful implementation of modern technology requires exact planning in terms of preparation and engineering. These efforts will certainly reduce costs and elevate production and revenues to higher levels. What is of utmost importance in this context, is very close and strong teamwork between owners/operators of plant and their suppliers. Hess AAC has a very experienced team of engineers. The company boasts over 40 years' experience, dating back from Stork offering cutting systems and handling equipment for a wide range of different production technologies. Modifications of plants ranging from flat cake systems as Durox, Siporex and Hebel to tilt cake systems like Ytong. But also new plants in which the best of both worlds was combined since 2000 by Hess AAC's KeenCrete concept, based on a tilt and tilt-back technology with green separation for zero-waste production. This type of experience on the part of this supplier has proven to be a reliable basis for solutions incorporable to existing plant technology.

*After getting the go-ahead, Hess AAC engineers will start the manufacture and shop-assembly of new machinery at the Hess AAC facility in Enschede.*


*The new cutting line ready to produce supreme quality products with highest precision*



The very first step is to make an analysis of prevailing conditions on site. Hess engineers do not believe in old and possibly outdated drawings, as it is only real-life physical checks on site that give a realistic picture of the status quo, a fundamental prerequisite for designing and assembling new machines quickly and with highest accuracy. In coordination with the client's local team, the interfaces between existing and new equipment are determined, and a road map considering product range, production volumes, cost and the desire to achieve the best quality possible for the AAC products after autoclaving. In this context, it is irrelevant whether AAC blocks only or blocks and panels are produced – Hess AAC offers solutions for any product type.

As a second step, machinery drawings are developed and discussed with the client's engineering department. After getting the go-ahead, Hess AAC starts with manufacture and shop-assembly of the new machinery at the Hess AAC facility in Enschede (The Netherlands). It is Hess AAC's claim to offer state-of-the-art technology, which of course also includes the implementation of all commonly used machine parts at highest possible quality levels, from leading manufacturers and brands.

The mechanical equipment will be connected to a (PLC-based) control system for a no-load shop test covering all equipment components in their entirety, hence leaving nothing to chance.

The client is invited to visit and witness the machinery in operation. Hess AAC always recommends that an engineer from the client checks the assembly, to study the range of functions provided by the new equipment.
Becoming familiar with the PLC is another important undertaking. Such modifications from old to new production systems, sometimes include a leap forward skipping generations in technical development, like for instance with a change from good old-fashioned relay controls to a Siemens S7 TIA portal PLC system with fail-safe operation features.

Pre-wiring and equipment testing already at the supplier's workshop will reduce risks and time consuming (superfluous) work on site.

Under normal conditions, Hess AAC equipment also reduces the necessity of additional civil engineering jobs by cutting down on hydraulic or tilting systems underground. It is a Hess AAC standard to design machinery that can be installed on a flat floor, thus making erection easier, later maintenance faster, and the cost for clients lower because the Hess AAC machinery requires merely a concrete foundation slab. The Hess AAC foundation design is very easy to implement and only needs minor amounts of concrete.

The integration of new machinery on site can be carried out quickly, because of an accurately prepared time schedule, pre-assembled and pre-tested equipment and the experience of Hess AAC engineers during installation and commissioning supervision on-site.

With this new cutting line, the client will be in a position to produce supreme quality products with utmost precision. If there is a possibility to integrate the Hess AAC back-tilting technology in combination with green separation, the daily quality of final products will be outstanding in all aspects and, most importantly, the sticking of AAC after autoclaving will no longer be an issue, dropping waste levels and costs to virtually zero.

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# "Renovation wave" – a chance for autoclaved aerated concrete

**In December 2019, the European Commission under the leadership of President Ursula von der Leyen and Vice-President Frans Timmermans presented its new agenda for climate and environmental action: The European Green Deal. Our organization, the European Autoclaved Aerated Concrete Association (EAACA), is committed to supporting the ambitions of the Green Deal and help mitigate climate risks in every way we can. Our members, from 18 different European countries, operating in more than 100 production sites, produce around 16 million cubic meters of autoclaved aerated concrete (AAC) – a product that, with its strong and lightweight, multi-usable and fully recyclable characteristics, is perfectly in line with Europe's new environmental ambitions.**

In partnership with AAC worldwide we will show in several articles over the following months how the policy initiatives proposed by the Commission in its Communication on the Green Deal can be realised with the help of AAC in times of increasing urbanisation and need for affordable housing. To begin with, we will showcase how AAC can be efficiently and intelligently used in renovation processes. Within the Green Deal, the Commission promised to put forward an initiative for a so-called "Renovation wave" in

*The modernization of the historic complex without changing the outer façades, energy performance improvement and an enlargement with additional walls and floors was the task at the renovation of the Résidence Palace in Brussels Belgium.*

Summer 2020, aiming to set incentives that shall lead to a doubling or even tripling of the annual renovation rate across Europe.

This initiative is urgently needed considering the current low rate (around 1.3%) and the amount of old post-war building stock that is unfit in terms of energy-efficiency, air quality and security levels.

## The renovation process of the famous "Europa building"

A very recent case of AAC usage in renovation processes – at the very heart of Europe - is one of the most extraordinary and impressive buildings in Brussels: the "Europa building". After the European Union's expansion in 2004, the Council of the EU as well as the European Council had to find a new and larger meeting location for their headquarters in Brussels. Ministerial meetings and quarterly summits of the heads of State of the EU member countries used to be held in the Justus Lipsius building, which did not meet their needs anymore. The decision was made to integrate parts of the "Résidence Palace", a historic but outdated building into the neighbouring Justus Lipsius complex.

The task however was a difficult one, as the building parts that were to be connected needed to be renovated and expanded to fit the high requirements of European decision-makers, while simultaneously complying with new regulations in the field of energy consumption and air quality. To add to the complexity, the historic Art déco façades of the Résidence Palace were protected and had to be preserved. Originally constructed between 1922 and 1927, the building used to be a luxury apartment building for the rich Brussels bourgeoisie, including a hotel, swimming pool and theatre, as well as tennis courts on the roof. After 1945, the complex became an office building for the Belgian government.

The delicate project found its perfect candidate: the Belgian architect Philippe Samyn with his company Samyn & Partners. An architect who during his career has always looked for challenging projects and uses his knowledge as an engineer to produce buildings as lean and efficiently as possible. Over 12 years, Samyn and his team carefully designed the building, resulting in 13,000 drawings, and two comprehensive and detailed books that Samyn released in 2013 and 2016.

The goal was to make this place explicit, symbolic beyond purely functional, as well as visible from the public space, even in the evening through well-placed lighting. All floors of the building are designed in an elliptical shape, showing differences in dimension but having the same center. The visual result is an opal-shaped "lantern" mounted with glass panels that maintain daylight in all corridors, rooms and halls, creating a symmetrical structure with a high atrium inside an outer double-walled glass façade. The building provides a large amount of conference rooms surrounded by a daylight circulation zone as well as comfortable cafeterias, restaurants and dining halls. By centrally positioning the lantern surrounded by offices in the carefully renovated Résidence Palace, Samyn achieved a split between pragmatic and serving functions as well as modern design.

*The Xella-multipor products were in this case especially important as they were used inside insulation through a "vapor-open insulation" approach, which was crucial for such a heritage building.*

*Detail of the insulation at a window opening.*

*Fully insulated walls.*

*The new building in the whole complex is designed in an elliptical shape, showing differences in dimension but having the same center. The visual result is an opal-shaped "lantern" mounted with glass panels that maintain daylight in all corridors, rooms and halls.*

Samyn showed his architectural and engineering skills not only in the construction of the façade, where he chose to use thirty percent less steel than firstly planned. He also had to overcome problems such as limited foundation possibilities due to the underground railway that bordered the building, high security requirements for the top-level diplomatic meetings, the modernization of the historic complex without changing the outer façades, energy performance improvement and an enlargement with additional walls and floors. Luckily, Samyn had contacts to AAC producer Xella from Germany, one of the largest members of EAACA. He first discovered Xella products at a construction exhibition in Munich and was keen on using the material to solve some of his problems with the Résidence Palace. AAC was again able to prove its strength as a complementary building material for difficult and large renovation processes.

## AAC as the key ingredient for the complex renovation of a high-security heritage

AAC products that was especially useful during the renovation were the mineral insulation boards of the Xella brand "multipor", which were used for the thermal insulation of existing facades.

The multipor products were in this case especially important as they were used inside insulation through a "vapor-open insulation" approach, which was crucial for such a heritage building. An exterior insulation was not an option because the historic outer façade had to remain intact. Next to the strong thermal insulation capability that met high energy efficiency requirements, additional benefits of multipor products in the renovation process were their lightweight, easy handling and a high fire protection features.
Furthermore, the Xella product was vital in delivering a healthy indoor air quality level throughout the building, as well as for meeting the environmental requirements and European Technical Assessment (ETA) standards of the EU buildings through their sustainable production processes.

Finally, Samyn's use of Building Information Modelling (BIM) technology proved to be decisive for the renovation and building process. The most innovative software was further used for the calculation of humidity transmission and temperature risk assessments to evaluate and lower the possibility of condensation and accumulation of moisture in the interior insulation.
This project for the European Council showed impressively how AAC was essential to achieve the most stringent standards for an energy-efficient, environmentally-friendly, modern and highly representative building. Samyn managed to renovate and integrate an outdated building and turn it into a highly functional, as well as symbolic, piece of art in the heart of Europe, while preserving its historical design - by using his skills as an engineer and the unique features of the multi-deployable material AAC.

The renovation of the Residence Palace for the Council's new "Europa building" is not the only famous renovation project in Brussels that featured an extensive use of AAC products. Other examples are the "Berlaymont" of the European Commission or the "Palatium". Next time you walk past these buildings, you might look at them with different eyes.

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# Mineral insulation as a sustainable solution that complies with all project requirements

● Valentina Zanotto and Marcus Knapp, Amstein + Walthert AG, Zurich, Switzerland

**While renovating a listed building, inside insulation is often the only way to improve the energy standard of the building. Because of numerous cases of building damages, this solution is currently considered a risky one by a lot of designers and craftsmen, and it is often realised only with thin insulation layers.**
**The project of the renovation for the school complex Ilgen in Zurich, Switzerland, shows, thanks to a long-time study, how a properly designed inside insulation can affect the performance of a wall system. The results are positive, as they do not show any damages so far. Which possible hurdles in designing and realising a well working renovation concept should be kept in mind?**

When renovating listed building, inside insulation is often the only possibility to improve the performance of the existing external walls. Because of numerous reported building damages in connection with inside insulation, this solution has gained an excessively bad reputation in the last years and it is often realised only with thinner insulation layers (suggested 6-8 cm).

However, an inside insulation system is not inevitably doomed to fail. Careful design as well as realisation are essential for a successful and sustainable inside insulation. Based on a use case with long-time measurements, the present article focuses on the topic of inside insulation, in particular on the parameters that need to be considered during the design phase and on the measures that have to be taken during the realisation phase.

## Inside insulation when renovating a listed building

In listed building, a modification of the appearance of the façade during a renovation is now allowed. The application of an inside layer of insulation is therefore often the only possibility to improve the performance of the walls and reach a good energy standard. This measure is usually part of a larger renovation strategy, which also includes the replacement of the existing windows with modern air tight ones, with equally air tight window joins. The reduction of the air infiltration does reduce the heat loss through ventilation but can also result in an increased air humidity of the indoor air, if the resulting air changes are not enough. A ventilation concept is therefore a necessary part of this kind of renovation project.
This kind of renovation solution is a challenge from the point of view of moisture protection, since an inaccurate design or execution can result in building damages.

### Design

An additional inside insulation causes a reduction of the temperature inside the existing construction, which could in turn increase the humidity at the interface layer between insulation and existing substrate. The biggest risks in this case are the formation of condensation on this layer and the displacement of the freezing point inside the construction.

Additionally, the new inside layer hinders the drying capacity of the wall towards the indoor space. This can be a problem particularly for the constructions with a relatively vapor impermeable outside layer (e.g. stone façade etc.).

Among the possible inside insulation systems, the favorite one in renovations is vapor permeable and “moisture active”, which means it can transport the vapor through other processes (e.g. capillary transfer) or can accumulate it and release it later.

This way the renovated system presents a certain condensation-tolerance, since the humidity can be managed inside the construction and still dry out towards the inside. This kind of system is usually realized by the means of "moisture active" insulation materials. Capillary active mineral insulation boards can achieve in these cases very good results. These solutions provide an effective vapor management only under specific boundary conditions. In order to achieve a well-functioning building component, a meticulous design considering all the relevant parameters and dynamic processes is necessary.
Since for an inside insulation all connections between external wall and internal walls or slabs constitute thermal bridges, they need a correct technical solution, which has to be defined in detail.

*Fig. 1: Photo of the school complex before the renovation.*

*Fig. 2: Photo of the school complex after the renovation.*

*Fig. 3: Photo of a classroom after the renovation.*

## Realisation

In order for the inside insulation to operate within its operation boundary conditions, even the most "tolerant" of the solutions depend on a technically correct execution. A particular focus should be reserved to some aspects, especially the interface between different crafts. Therefore, the control and coordination by the site supervision plays a central role.

- Hollows on the colder side of the insulation layer should be avoided, since they can allow the infiltration and convective movement of indoor air and therefore increase the humidity level. The correct execution of the adhesive mortar layer on the entire surface underneath the insulation plays here the most important role.
- Perforations of the insulation layer by electrical lines, technical ducts, fixing elements etc. represent leakages, and therefore weak points of the whole system. These should be avoided but, if not possible, they should be as air tight as possible.
- Measures for the protection of the outside envelope from rain (water tightness) are necessary in order to minimize the moisture load from the outside. Avoiding any moisture entrance from the outside is paramount in this kind of systems.

## Use case: Ilgen school complex in Zurich

The Ilgen school complex in Zurich-Hottingen was realized in the neoclassical style by the architects Ernst Diener and Otto Wolf in 1877. Both school buildings are protected as historical monuments.

Characteristic of the school buildings are the solid masonry walls, which are partly plastered and partly cladded with natural stone, as well as the ornaments on the building corners or over the windows. The very high ceilings with the wooden floors, typical of the time, are particularly distinctive for the inside.

All buildings were completely renovated according to the Minergie energy standard and the construction works ended in 2012. The monumental protection authority prescribed the maintenance of the outside appearance of the buildings.

*Fig. 4: Photos of the execution of the renovation measures on the external walls. The details of the inside insulation of the window joins are crucial.*

A key role in the renovation project was therefore played by the inside insulation of the facades as well as by the replacement of the windows. These are provided with an automatic opening system according to the $CO_2$ concentration level as well as according to the scheduled night ventilation for the mitigation of the high temperatures in summer.

## Renovation measures

In order to comply with the energy savings requirements without promoting the appearance of moisture damages of the building fabric, a "moisture active" solution was chosen for the external walls. The renovation measures were designed according to a careful analysis of the heat and moisture transport phenomena inside the construction elements, which were performed by the means of several different methods and tools.

This allowed for instance to define the for the project optimal thickness of 10 cm for the insulation layer, as well as to find an appropriate vapor permeable and capillary active insulation material (Xella Multipor mineral insulation boards). The following additional measures were also implemented:

- Air tight execution of all internal joins by the means of moderate or moisture adaptive vapor barriers, in order to preserve the drying potential towards the indoor space.
- Use of flexible insulation materials (e.g. insulating plaster) as levelling layer.
- Repair of the outside façade, especially concerning the rain protection (hydrophobic treatment)
- Flanking insulation to minimize the thermal bridges by the connections between façade and inside walls.

The analysis of the moisture transfer in the area of the wooden beams end showed that the execution of the inside insulation layer could result in an excessive reduction of the temperature in the wall area around the beam ends, and therefore in condensation. In order to ensure the structural wood protection for the beam ends, an unconventional solution was chosen in accordance with the building authority and dimensioned by the means of calculation tools. By leaving out the insulation of the walls around the wooden beams, a minimal ventilation of this zone with the "warm" indoor air takes place. This warms up the surfaces and allows the humidity release towards the indoor air. This measure significantly reduces the risk of building damages, as long as the connected heat losses are deliberately considered and taken into account for the renovation strategy.

Valentina Zanotto received her master's degree in architecture from Politecnico di Milano in 2007, where she went on working on research projects focusing on thermal comfort and on the dynamic performance of building envelopes until 2011, while also getting her Ph.D. Since 2012 she works as a building physics consultant at Amstein + Walthert AG in Zurich, where she specializes in heat and moisture transfer as well as in building simulation. She currently works as team leader in the building physics department. valentina.zanotto@amstein-walthert.ch

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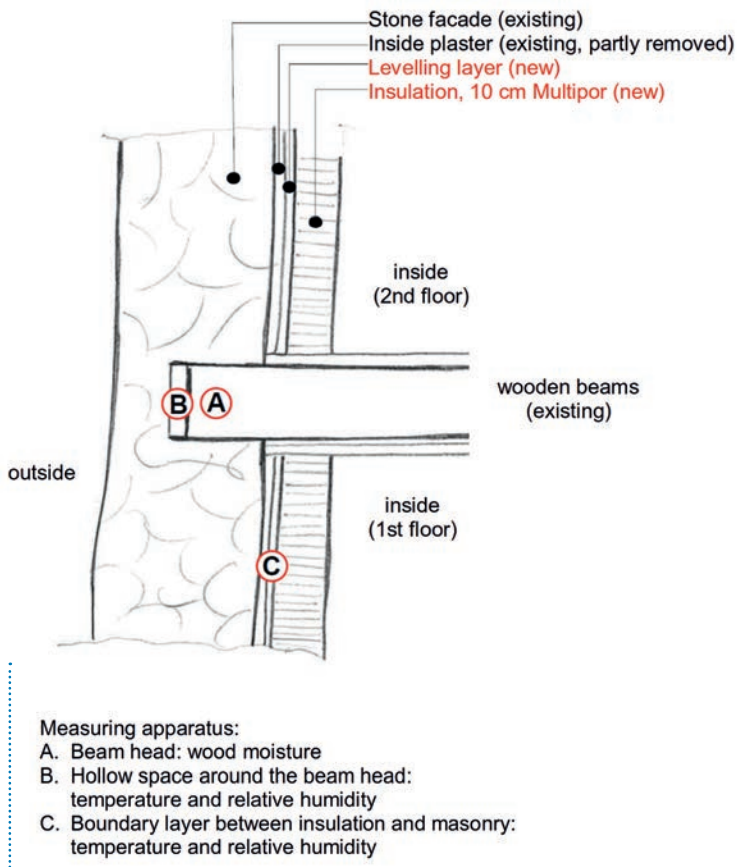


*Fig. 5: Sketch of the cross section of the external walls with indication of the measuring apparatus*

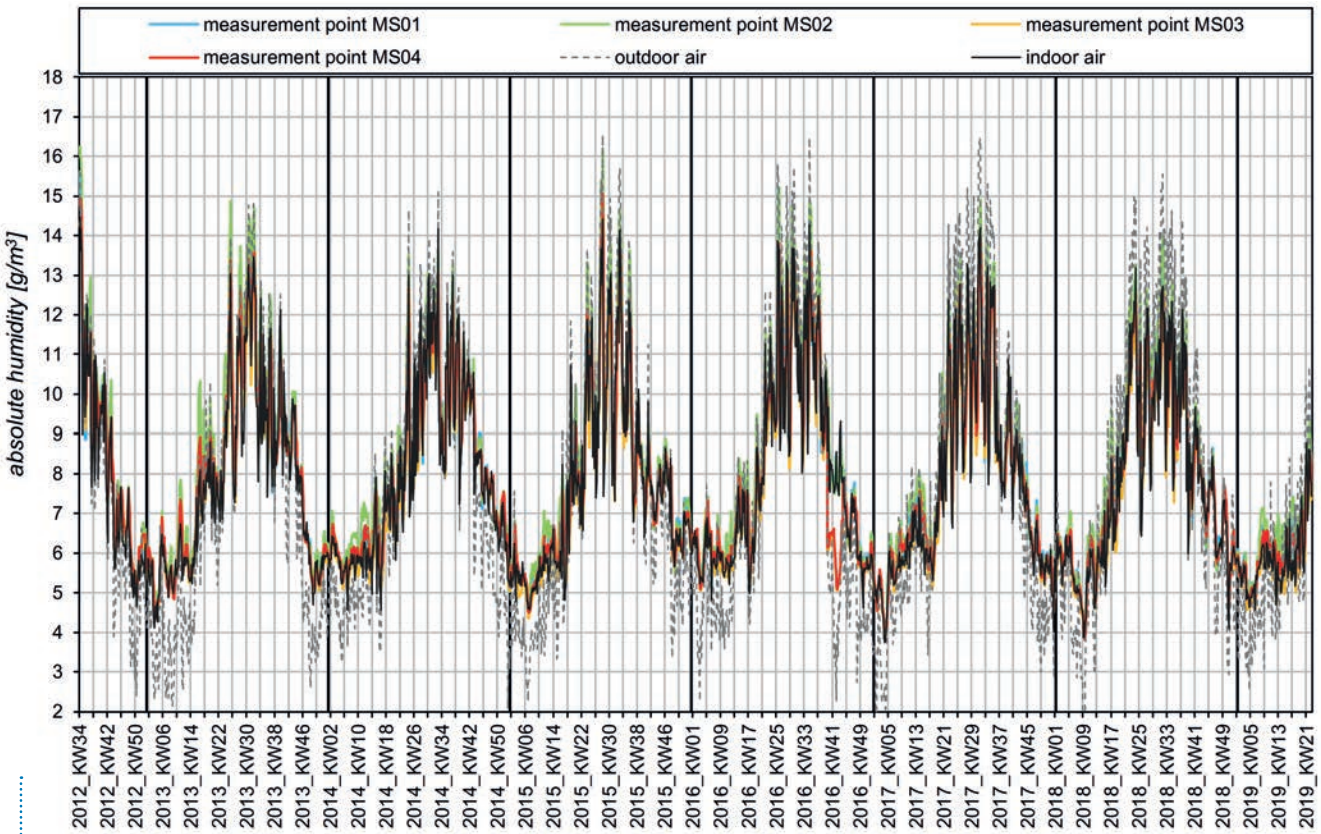


*Fig. 6: Daily average values of the absolute humidity of the layer between insulation and masonry.*

Before the start of the renovation works for the whole buildings, the possible effects of this strategy were tested by the means of four months long measurements on a sample wall. This way possible unexpected risks for the building fabric could be identified on time. The results of the measurements showed that all measures could be executed as planned.

## Moisture measurement

A long-time measurement campaign of the building, at four different positions, was started after the renovation in June 2012 and is planned to last 10 years. Goal of this monitoring project is to gather experience of the working conditions of inside insulation in real buildings over an extended period of time.

Focus of the study is the moisture level of the beam ends inside the external walls as well as the possible increase of the humidity behind the insulation layer. Two measuring positions were set on both the north-east and the south-west side, in order to ensure a minimal redundancy, hence allowing a wider comparison. The two facades are also provided with different outside layers, since the north-eastern one is plastered while the south-western and south-eastern ones are cladded with natural stone.

The absolute humidity between the insulation and the masonry layer (Fig. 6) shows values that are max 0.5 g/m³ higher than the humidity inside the classroom, and its course is similar for all measurement points. The measured values show no clear increase of the humidity level in this layer over the years.

The measured air temperature inside the classroom (Fig. 7), when occupied (i.e. excluding the school holidays), usually lies between 20°C and 27°C.

The humidity of the indoor air shows during the whole monitoring time a course that is lower than the maximum allowed by the standard SIA 180:2014 (clause 6.2.1.4 – Table 10) for comfortable indoor climate. The relative humidity usually lies between 20% and 35% in winter, which is relatively low for a high occupancy room usage like a classroom. This means that the moisture load of the indoor air can be well reduced by the means of the window ventilation and that the boundary conditions are particularly favorable from the point of view of moisture protection.

The measurement values have not exceeded any of the critical limits according to SIA 180 for either the inside insulation layer or the wooden beams ends.

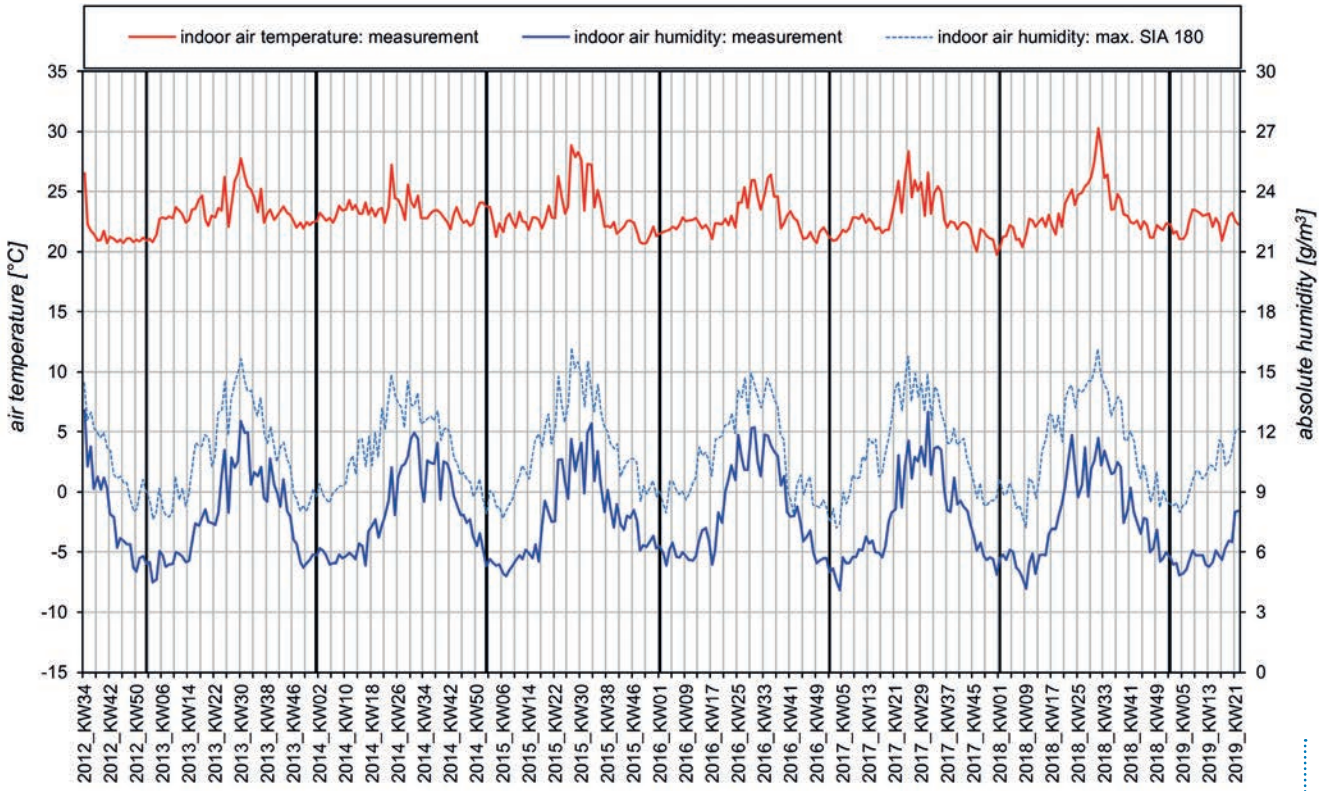


*Fig. 7: Weekly average values of the indoor air temperature and absolute humidity. Comparison with the possible maximum level for buildings without controlled humidity according to SIA 180, Table 10.*

This means that there have been no building damages so far, and there is no reason to expect any in the future.

## Conclusions

The case study of the Ilgen school complex shows that a renovation concept with inside insulation can on one side improve the energy standard and on the other side ensure a damage-free building, as long as the building physics is professionally evaluated and specific analyses for the given situation are performed.
The inside insulation with capillary active mineral insulation boards (here Xella Multipor, 10 cm) allowed the realization of a renovation that complies with all requirements. It achieves the desired architectural design and meets the requirements of the monumental protection, while at the same time reaching the Minergie sustainability and energy standard and ensuring a durable damage-free building fabric.

While designing and realizing an inside insulation system it is of particular importance to observe the following aspects:

- The correct estimation and consideration of the building usage and of the operating the humidity environment, as well as the definition of a ventilation concept
- Professional execution of the boundary layer between insulation and existing wall (adhesive product, details of the joins etc.)
- Reduction of the moisture entrance from the outside by the means of rain protection measures (e.g. hydrophobic treatment of the outside layer)

Infill development in Berlin, Germany

# Strategies for more living space

**Affordable apartments that offer high quality space for everyone have become a scarce item in major cities. Various strategies are now being used to increase the housing stock in Germany, whether by adding stories, converting attics or through infill development. A project in Berlin-Lichtenberg in Germany shows how this can be achieved. The city housing association HOWOGE and the commissioned architectural firm of Heide & von Beckerath have built two eight-story blocks of rental properties with approximately sixty apartments and a day care center as an infill development of the interior area of an existing residential complex. Both residential towers were built with Ytong autoclaved aerated concrete and Silka calcium silicate blocks.**

● Olaf Kruse, press spokesman and content marketing manager at Xella Deutschland GmbH, Germany


Berlin has grown at break-neck speed for several years. A Berlin Senate report forecasts that the number of inhabitants will grow by more than 266,000 to approximately 3.8 million by 2030. Other cities in Germany, such as Hamburg, Frankfurt, Cologne or Düsseldorf, also exhibit significant growth rates, although not in equal measure in housing construction. Plots are rare, particularly in city centers, and building approval procedures are long. The result: rents and the price of residential property grow dramatically. Political and urban planning solutions are therefore urgently sought to partly offset this development. In the meantime, cities increasingly rely on infill development. This means that existing plots should be used and gaps closed to create affordable housing.

The cities build taller and tighter. But in the process, one thing must not be forgotten: the quality of the new residential construction and the quality of the urban community. So how can a liveable, thoughtful residential architecture at affordable prices be created that simultaneously results in new urban identities in the city neighborhoods? The Berlin housing association Howoge put this question to selected architects who participated in a limited competition in the form of a tender process for a residential construction project on Paul-Zobel Strasse in 2015. The architectural office of Heide & von Beckerath found a spatial, cost-effective and structurally appropriate answer with their design for two monolithic residential buildings.

*Double-pack Ytong Jumbo blocks with a width of 42.5 cm were used for the exterior walls of the upper seven floors.*

*The architectural office of Heide & von Beckerath found a spatial, cost-effective and structurally appropriate answer to Berlins high demand of residential buildings with their attractive design concept.*

## Living communally in the neighborhood

Spaces such as those on Paul-Zobel Strasse shall now be further developed. Howoge therefore acquired the approximately 4,000-square-meter site several years ago in order to create new housing at moderate rents. Architect Tim Heide, partner in the Heide & von Beckerath office, explains his analysis of the location at the beginning of the design. "In GDR times, such open spaces were intensively used and cared for by the residents in their leisure time. After unification they became more and more overgrown. Today these spaces represent an urban planning problem. We therefore asked ourselves how one can respond to this location with an architecture that acknowledges the existing space and improves the courtyard. We were not simply concerned with infill development. The density that would result from the proposed physical structure should instead bring a new quality to the space. We wanted to add something positive and not simply take the space away." The latter was a particularly important concern for the long-established residents of the neighborhood. They feared that the small green area where the building would be erected would be taken from them, causing the quality of life in the neighborhood to suffer. The result was vehement protests by the citizens and vociferously voiced criticism. The fears of the residents were very important to Howoge and the architects. One of the key tasks for the planners therefore called for integration of community support into the urban development and architectural concept. The long-established and new residents should come into contact with each other and the sense of belonging should be strengthened.

## From traditional to experimental – apartments for diverse requirements

Heide & von Beckerath planned two eight-story residential towers on the site. In each case, the bicycle rooms are housed on the ground floor. A one-story day care center links the slightly offset residential buildings. Among the tasks that Howoge set us as architects was development of new ideas for communal living in addition to classical apartment floor plans," says Tim Heide. "They could, for example, be shared apartments for single mothers, seniors or students. Our goal was to combine living together individually and communally in these apartments." Tim Heide and Verena von Beckerath proposed reserving the mezzanine floor for this purpose. Every apartment consists of a kitchen and a bathroom for communal use. In addition, their own eight to eleven-square-meter room and a small terrace is available to every resident. The terraces are both an open area and private access to the apartments. "This way, one is not forced to use the main access from the staircase," says Tim Heide, explaining the concept. "These spaces are certainly small, but can be reached separately, which ensures an important element of privacy for each resident. We find such small details important in today's residential construction."

*Large apartments have up to three balconies. All balconies are the same size, have the same design and are oriented toward the sun's arc around both residential towers.*

The architects have also considered a special flexibility for the 2 to 5-room apartments on the regular floors. The rooms are arranged around an interior core of bathroom and kitchen. "If the resident dispenses with room doors other than the bathroom, an open, almost loft-like floorplan results around the kitchen/bath element," says Heide. "If the tenant prefers doors, he obtains many single rooms. They are approximately the same size, so the tenant can determine the specific use. A pretty simple floor plan principle." Every apartment has at least one private open space in the form of a broad, projecting balcony. Large apartments have up to three balconies. All balconies are the same size, have the same design and are oriented toward the sun's arc around both residential towers. Each building is accessed by an internal staircase. Approximately 30% of the apartments meet the eligibility conditions of social housing in size and features.

## Ytong and Silka for multi-story residential building

Special building construction is also necessary to obtain floor plans that are oriented to the needs of tenants. "We wanted a monolithic construction method with no thermal insulation, limited connection details and massive exterior walls that store solar heat," says Tim Heide. Although they were the same size, the openings in the façade were a further challenge for the support structure, because they were not placed above each other. Since these parameters were already fixed in the competition phase, the architects brought structural engineer Nicole Zahner from the StudioC office on board at the very beginning. "With all of these specifications, it was clear to us at early stage that we needed load-bearing exterior walls," Zahner explains. "We decided on large-format autoclaved aerated con-

sound is transferred between the apartments. Furthermore, the higher load-bearing capacity provides more living space due to the construction with slimmer walls. The load-bearing staircases also consist of calcium silicate blocks. Thus, Ytong and Slika form a great team in multi-story construction.

The façade exterior received plaster as weather protection and a dark paint that gives both residential buildings a striking exterior and will also promote thermal storage in the massive exterior walls. Inside, the walls are plastered in white. A special color and lighting concept provides a pleasant atmosphere and orientation.

### All information at a glance:

- Project:
  Paul-Zobel Strasse housing development in Berlin
- Architecture/construction planning:
  Heide & von Beckerath, 10623 Berlin, Germany
- Owner: HOWOGE Wohnungsbaugesellschaft mbH, 13055 Berlin, Germany
- Lot size: 3,933 m²
- Gross floor area 7,922 m²
- Living area 5,015 m2
- Commercial area: 270 m²
- Construction period: May 2017 to December 2018
- Residential units: 69, of which 21 are social housing
- Energy standard EnEV 2016
- Building material used in outer walls: monolithic Ytong Jumbo double pack (AAC) with a width of 42.5 cm
- Building material used in apartment separation walls: Silka XL Basic (calcium silicate block) on ground floor + staircases with elevator shaft

crete blocks from Ytong as solid wall construction. We had already used them in smaller buildings. In the two residential towers we calculated the distribution of loads and stresses very accurately beforehand, precisely in view of the unaligned windows. We absolutely wanted to build this exterior wall design massively, sustainably without ETICS, and at the same time highly stable and insulating. So, highly suitable for residential construction." Double-pack Ytong Jumbo blocks with a width of 42.5 cm were used for the exterior walls of the upper seven floors. In addition to their excellent insulation properties, they exhibit high noise and fire protection. The ground floor consists of prefabricated reinforced concrete elements. On the other hand, the apartment separation walls are built in Silka calcium silicate blocks, because here sound protection was the primary consideration. Thanks to their higher density, they ensure that less noise and disturbing

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