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Dr.-Ing. Holger Karutz



Alexander Olbrich

Building for the future – with concrete, of course!

Particularly since the merger of the United Arab Emirates in 1971, a global trade and tourism center of constantly growing importance has emerged in and around Dubai at an incredible speed. In 2006, Dubai alone was home to a quarter of all the world's construction cranes - a superlative that is hard to believe, but true! Since early times, a major goal of the countless building activities has been to achieve independence from oil and to develop other sources of income. A feasible goal, with which the United Emirates are on a very good way.

Saudi Arabia, too, wants to create a different profile for itself in addition to the income from the sale of oil, which will decrease in the long term. The USD 500-billion NEOM project, a megacity that will be completely independent of oil and powered exclusively by wind and solar energy, is particularly prominent. Wherever possible, services and standard processes are to be automated. Autonomous vehicles, air taxis, its own factory for the production of green hydrogen as energy source and much more: NEOM is to serve as a model for the whole world; how to build and live better, more sustainably and even completely energy self-sufficiently.

In both the United Arab Emirates and Saudi Arabia, one thing was and is clear: concrete is the material of choice for construction. Perhaps not always with the simple gray standard concrete, but probably increasingly with high-performance concretes that set ever new standards. But this is precisely what unites the urge for the new with the simultaneous security of the known: Building is done with concrete.

And anyone who builds with concrete must read CPI Concrete Plant International. In our journal you find everything you need to work with concrete. Whether in the United Arab Emirates, Saudi Arabia, or anywhere else in the world; CPI Concrete Plant International is always the right choice!

بناء مستقبل أفضل - باستخدام الخرسانة بالطبع!

لقد ظهر مركز تجاري وسياحي عالمي في دبي وحولها والذي تنزأ أهمية بسرعة مذهلة وبلا توقف، وذلك على وجه الخصوص منذ اندماج دولة الإمارات العربية المتحدة في عام 1971. كانت دبي وحدها موطناً لربع جميع رافعات البناء في العالم في عام 2006 - وقد يبدو هذا الأمر مبالغاً يصعب تصديقها، ولكنه حقيقي! فمئذ القدم، تمثلت إحدى الأهداف الرئيسية لأنشطة البناء التي لا حصر لها في الابتعاد عن الاعتماد على النفط وإنشاء مصادر أخرى للدخل. وهو هدف ممكن تحرز الإمارات العربية المتحدة تقدماً جيداً للغاية نحو تحقيقه.

ترغب المملكة العربية السعودية أيضاً في خلق صورة مختلفة لنفسها بخلاف الدخل الذي تجنيه من بيع النفط الذي سينخفض على المدى الطويل. تجدر الإشارة في ذلك خاصة إلى مشروع نيوم (NEOM) الذي تبلغ تكلفته 500 مليار دولار أمريكي، وهو مدينة ضخمة لن تعتمد على النفط مطلقاً وستعمل باستخدام طاقة الرياح والطاقة الشمسية حصرياً. ستتم فيها أتمتة الخدمات والعمليات القياسية حيثما أمكن ذلك، وسواء من حيث تمتعها بالمركبات ذاتية القيادة أو سيارات الأجرة الطائرة أو مصنعها الخاص لإنتاج الهيدروجين الأخضر كمصدر للطاقة وغير ذلك الكثير، فإن الهدف من مدينة "نيوم" هو أن تكون قدوة للعالم بأسره من حيث كيفية البناء والعيش بشكل أفضل وأكثر استدامة، وحتى تحقيق الاكتفاء الذاتي من الطاقة بالكامل.

ثمة أمر واضح في كل من الإمارات العربية المتحدة والمملكة العربية السعودية في الماضي والحاضر، ألا وهو أن الخرسانة هي المادة المفضلة للتشييد. ربما ليس المقصود بذلك البناء بواسطة الخرسانة الرمادية البسيطة المعتادة دوماً، بل باستخدام أنواع الخرسانة عالية الأداء الأخذ استخدامها في النمو والتي تضع معايير غير مسبوقه. لكن هذا بالضبط ما يجمع بين الرغبة في التجديد مع الشعور بالأمن الذي يبعث عليه استخدام خامة مألوقة؛ حيث ما تزال الخرسانة هي المادة المستخدمة في البناء في الحاليتين.

يجب على جميع مستخدمي الخرسانة في أعمال البناء مطالعة مجلة CPI Concrete Plant International "المجلة الدولية لمصانع الخرسانة". تجد في مجلتنا كل ما تحتاجه للعمل بالخرسانة، وسواء كنت موجوداً في الإمارات العربية المتحدة أو المملكة العربية السعودية أو في أي مكان آخر في العالم؛ فإن مجلة CPI Concrete Plant International هي الاختيار الصحيح دائماً!



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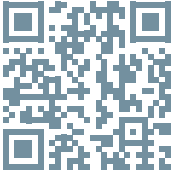


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Place of publication: ISSN:
Cologne, Germany 1862-3662

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Bank connection:
Deutsche Bank, Account no.: 6800080, BIC: 370 700 24
SWIFT CODE: DEUTDEBKOE, IBAN-No.: DE88370700240680008000

Print / Enclosures and supplement delivery:
Kopp Druck und Medienservice GmbH
Dieselstraße 2 · 50996 Cologne · Germany

Postmaster | send address changes to:
CPI – Concrete Plant International, Industriestraße 180, 50999 Cologne, Germany

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Sustainable and cost-effective construction with recycled concrete

التشييد المستدام والفعال من حيث التكلفة باستخدام الخرسانة المعاد تدويرها

Concrete, the universal building material of the industrial age, is facing new challenges: The rising global demand for primary mineral raw materials acts as a price driver. And environmental compatibility, climate protection and CO₂ emissions have also become important market factors in the building sector. The universal building material of the future must be sustainable. A highly innovative answer to this challenge is now presented by the precast concrete manufacturer Büscher from Heek in Münsterland: High-quality precast concrete elements made from recycled concrete. Büscher is the only company in Germany to date to have received general building authority approval (abZ) from the Deutsches Institut für Bautechnik (DIBT Berlin, German Institute of Building Technology) in June 2021 for precast concrete elements made of recycled concrete with 100 percent natural stone substitute. In the precast elements of the "Büscher wall", the raw materials gravel and sand are completely replaced by mixed demolition material. The manufacturer is currently demonstrating how much more future potential there is in the Büscher wall by building a three-family house.

تواجه الخرسانة، وهي مادة البناء العالمية في العصر الصناعي، تحديات جديدة تتمثل في: يعمل الطلب العالمي المتزايد على المواد الخام المعدنية الأولية كمحرك للأسعار. كما أصبح التوافق البيئي، وحماية المناخ وانبعاثات ثاني أكسيد الكربون، من عوامل السوق المهمة في قطاع البناء. يجب أن تكون مواد البناء العالمية للمستقبل مستدامة. ويتم تقديم إجابة مبتكرة للغاية لهذا التحدي من قبل الشركة المصنعة للخرسانة الجاهزة Büscher من بلدة "هيك" في إقليم مونسترلاند: إن عناصر الخرسانة الجاهزة عالية الجودة مصنوعة من الخرسانة المعاد تدويرها. وتعد Büscher الشركة الوحيدة في ألمانيا حتى الآن التي قد حصلت على موافقة الهيئة العامة للبناء (abZ) من Deutsches Institut für Bautechnik (DIBT Berlin، المعهد الألماني لتكنولوجيا البناء) في يونيو 2021 لعناصر الخرسانة الجاهزة المصنوعة من الخرسانة المعاد تدويرها باستخدام بديل الحجر الطبيعي بنسبة 100٪. في عناصر الخرسانة الجاهزة المستخدمة في "جدار Büscher"، تم استبدال المواد الخام والحصى والرمل بالكامل بمواد هدم مختلطة. وتوضح الشركة المصنعة حاليًا مقدار الإمكانيات المستقبلية الموجودة في جدار Büscher من خلال بناء منزل يضم ثلاث عائلات.

"According to a study by the Bundesverband Baustoffe - Steine und Erden (Federal Association of Building Materials - Stones and Soil), more than 250 million tonnes of demolition material are produced in Germany every year," says Managing Director Hans-Jürgen Büscher, describing the challenge. "Nevertheless, building rubble has so far mostly been used

as filling material in road and underground construction, or it often goes to landfill. Predominantly in the conurbations, but also in northern Bavaria, cities hardly know what to do with the increasing volumes." So why not recycle building rubble and use it not only in part, but 100 per cent as a substitute for primary raw materials in concrete production?



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Demolition of a building: the components are valuable raw materials for the production of new components.



In its sister company Containerdienst Büscher, the group of companies deals with the disposal and processing of building rubble. The waste product building rubble is an economically attractive recyclable material for the Büscher group of companies.

Due to its general building authority approval, Büscher is allowed to use up to 100 percent recycled aggregate including crushed stone sands similar to type 3 for its precast concrete elements made of recycled concrete in exposure classes XC1 and X0 (dry). According to the standard applied to date, only coarse recycled content of a maximum of 45 per cent for type 1 aggregate and up to 35 per cent of type 2 aggregate is permitted for mixed demolition material.

According to an LCA study, the Büscher group of companies in Heek achieves a 13 percent reduction in its CO₂ emissions just by using only recycled material to replace the aggregate. This means that the "Büscher wall" makes a significant contribution to climate protection even during its production.

The possible applications for the "Büscher wall" made of recycled concrete with 100 percent natural stone substitute are manifold. The group of companies from Heek is allowed to build load-bearing and non-load-bearing interior wall elements up to building class 4 from this material. Wall lengths of up to 11 metres and wall heights of up to 3.70 metres are possible.

Building rubble becomes a sustainable building material

The Büscher group of companies came into being from 1961 with the foundation of the concrete plant. There, the company produces precast concrete elements of all kinds. In its sister company Containerdienst Büscher, the group of companies deals with the disposal and processing of building rubble. Since the 1990s, the group of companies of the two managing directors Hans-Jürgen and Wolfgang Büscher and their team of employees have been researching innovative technologies and building materials with a view to sustainable value chains. The idea: upgrading the waste product building rubble into an economically attractive recyclable material. Its use in the production of prefabricated building components can make concrete a sustainable building material of the 21st century.

"This is unique and a big step in the circular economy," says Wolfgang Büscher. The group of companies also "lives" this circular economy itself in accordance with its slogan "Büscher - Back for the future". The sister company of the precast concrete plant, Containerdienst Büscher, plays an important role in this. He provides the means of transport for the delivery of building rubble and takes over the professional processing of the demolition material on the company premises. It is sorted, screened, refined and thus recycled into a sustainable raw material for the building industry. The special, certified production process ensures a consistently high quality of the recycled material. The Büscher concrete plant then processes these recycled raw materials in the production of high-quality interior wall elements.

The implementation of this idea requires high standards both in the processing of building rubble and in the production of concrete components. In about eight years of research, the Büscher group of companies has invested a lot of money to develop these standards and to prove their practical suitability in terms of quality and cost-effectiveness. Among other things, the processability of the recycled material as well as



The Büscher concrete plant processes recycled raw materials in the production of high-quality interior wall elements.

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"Back for the future" is the motto of the Bücher group of companies.

the compressive strength and surface quality of the finished product had to be proven. In addition to its own experts, the medium-sized company from Münsterland also worked together with concrete technologists from various universities. The Deutsche Bundesstiftung Umwelt (DBU - German Federal Environmental Foundation) funded the project with 250,000 euros.

In the meantime, the medium-sized manufacturer of precast concrete elements has received several awards for this research activity, including the "Innovative through Research" seal of quality from the Stifterverband für die Deutsche Wissenschaft (Donors' Association for the Promotion of Sciences and Humanities in Germany) twice. In 2019, the Bücher Group beat 5399 competitors in the competition for Germany's most important business award. The Oskar Patzelt Foundation rewarded the Heek-based company's commitment to sustainable management with the "Großer Preis des Mittelstands" (Great Award for Medium-Sized Businesses).

Apartment house as reference object

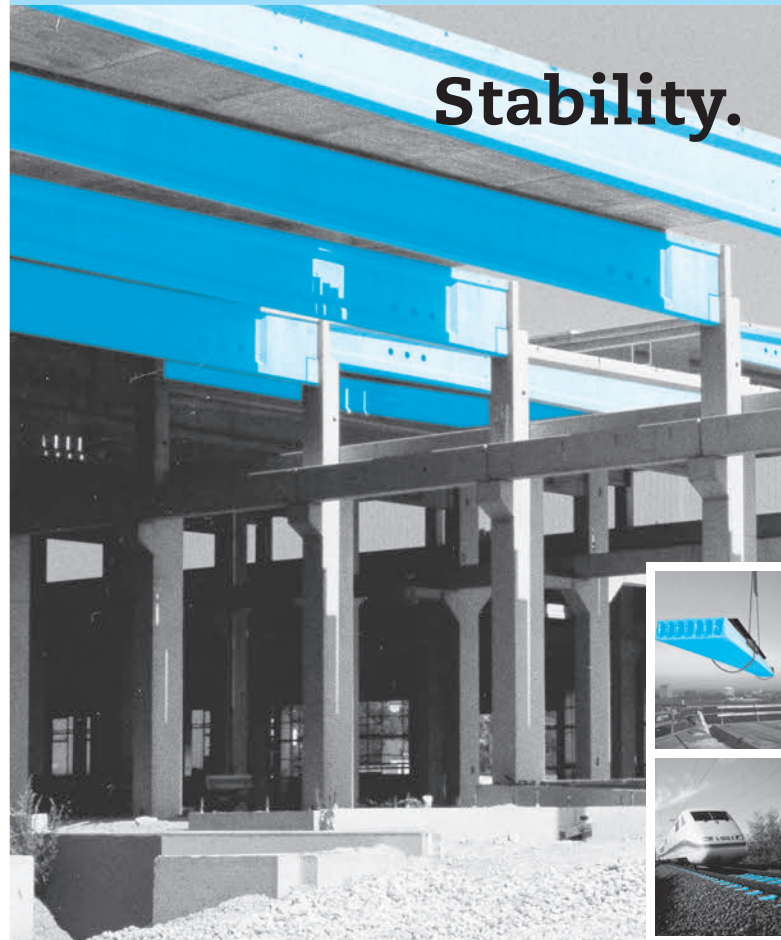
Now the "Bücher wall" made of 100 per cent recycled sand and stone is proving the potential of this new building material in a practical project. In Heek, the first recycling house of its kind is being built with ready-to-paint precast elements made of recycled concrete with 100 per cent natural stone substitute. The building project is to become a "real reference object for innovative building technology" and be completed in December 2022. While the use of precast concrete elements in the construction of residential buildings has so far been considered the exception, the use of elements made of recycled concrete is now intended to prove that with the Bücher wall "individual construction is also possible in a sustainable way".

Elementary building with recycled raw materials, that is the "Bücher wall". With their reference project, Hans-Jürgen and

More information about this project:



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The two brothers and owners of the Büscher group of companies, Hans-Jürgen (right) and Wolfgang Büscher (left).

Wolfgang Büscher now wants to convince the construction industry in particular. The building industry tends to be conservative when it comes to new production processes and products. This makes it all the more important for the two brothers to now make as many architects, municipalities, builders and possible partners from the construction industry aware of the advantages of the "Büscher wall". All interested parties should be able to see for themselves the possible applications and advantages of the "Büscher wall" at the practical object. By granting licences, the Büscher group of companies wants to promote the supra-regional use of its precast technology. Interested companies can request further information at info@zurueckfuerdiezukunft.de

According to Hans-Jürgen and Wolfgang Büscher, there are enough convincing arguments for the "Büscher Wall". Finally, the recycled wall elements solve several problems at the same time: it saves on the purchase and transport of scarce and expensive raw materials such as sand and gravel. It offers a genuine sustainable reuse of the demolition material that is flooding the market in ever-increasing quantities. Büscher calculates that around 200 tonnes of recycled building rubble can be used to build a single-family house. Finally, the use of prefabricated concrete elements digitally planned according to customer specifications, produced rationally and resource-efficiently in the factory and delivered ready to be painted can shorten construction times quite considerably.

Economic substitute for primary raw materials

"Our goal is to return the construction and demolition waste generated during the demolition of old buildings to the recyclable material cycle and thus use it as a raw material in the sense of urban mining in order to conserve natural resources," say the two managing directors. Through the complex reprocessing and reuse in concrete production, the demolition material becomes a sustainable and economic substitute for primary raw materials. While Hans-Jürgen Büscher was sometimes ridiculed for this vision in the past, he now sees himself impressively confirmed by the results of years of development work and the DIBt approval: "With our



Assembly of the environmentally friendly concrete components from the Büscher concrete plant.

process, precast concrete elements can be produced with 100 per cent natural stone substitutes". All that needs to be added is water, cement and the additives required for the respective recipe. "The entire part then consists of 80 per cent recycled materials. This high percentage is unique." ■

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Lintec & Linnhoff Holdings Pte Ltd, Singapore 638072

Lintec & Linnhoff launches new manufacturing plant in Malaysia

شركة Lintec & Linnhoff تفتتح مصنعًا جديدًا في ماليزيا

Lintec & Linnhoff has kicked off production of its asphalt and concrete batching plants at its newest facility, a manufacturing site in the state of Johor, Malaysia. New models for customers are already rolling off the production lines at the plant, which began limited-scale operations in 2021 before ramping up in 2022. The manufacturing facility covers 88,888 sq. ft of space, with two planned future expansions.

لقد بدأت Lintec & Linnhoff إنتاج مصانع خلط الأسفلت والخرسانة في أحدث منشأتها، وهو موقع تصنيع في ولاية جوهور، ماليزيا. وبدأت النماذج الجديدة للعملاء بالفعل في إطلاق خطوط الإنتاج في المصنع، الذي بدأ عمليات محدودة النطاق في عام 2021 قبل زيادة الإنتاج في عام 2022. تغطي منشأة التصنيع 88.888 قدمًا مربعًا من المساحة، مع وجود توسعتين مستقبليتين مخطط لهما.

Lintec & Linnhoff is manufacturing Linnhoff asphalt mixing plants and Eurotec concrete batching plants at the factory, which replaces the previous manufacturing site in northeastern Johor. These plants are globally distributed, with most going to customers in South-East Asia, the Middle East and Africa.

Plans for the new Malaysia facility were launched in 2019 and work was completed in 2021. After unavoidable interruptions caused by the Covid pandemic, Lintec & Linnhoff is now ready to showcase its newest facility and is extremely proud of the latest addition to its global manufacturing portfolio.

Daniel Chan, Chairman at Lintec & Linnhoff Holdings, said the new factory is a great demonstration of the Group's resilience and focus: "Over the past two years, the whole world faced the challenge of Covid and many projects were put on hold. We faced our own roadblocks, but we were determined to bring our vision to life for this new Malaysian factory. Our investment and hard work have now paid off and we can't wait



Daniel Chan, Chairman (Left), and Tan Suan Yap, Executive Director (Right) inaugurate Lintec & Linnhoff Holdings' newest manufacturing facility in Johor, Malaysia.

to welcome customers to see the new facility. Our first plants have already been delivered and the future is very bright."



Lintec & Linnhoff Johor Factory exterior and interior



Lintec & Linnhoff Holdings celebrating the launch of the new factory

The factory employs a team of 50 and that number is expected to grow in the coming months. Being strategically located in Johor, the plants can be shipped easily to customers across Asia, the Middle East and Africa via the three ports in close proximity. Some plants will be transported by land to Singapore, before shipping via Jurong Port. Others will go via two other nearby Malaysian ports in Johor. The new factory is just 36 km from the Lintec & Linnhoff global headquarters in Singapore.

The current facility is phase one of the planned development for the whole site that covers 282,000 sq. ft. During the launch of the manufacturing facility, Lintec & Linnhoff had a ground-breaking ceremony to launch phase two of the development that further expands the facility by 76,850 sq. ft. This expansion is in line with Lintec & Linnhoff's plans to manufacture Lintec containerised asphalt and concrete plants in the facility. Along with this, there will be further investment in additional equipment for the factory to increase production capacity and efficiency.

Phase three of the development will further expand the open-yard area for storage of stock plants and components, and create more space to conduct rigorous testing and erection of multiple plants before they are delivered.

The first plant to roll off the production line was a Eurotec Eco60 concrete plant which was shipped to a customer in Madagascar. The second order was for a Eurotec Ecotec ECT60 concrete plant and a Linnhoff TSD1500 MobileMix asphalt plant which went to a customer in Papua New Guinea.

FURTHER INFORMATION



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Rieker Investment GmbH acquires shares in Kobra

شركة Rieker Investment GmbH تستحوذ على أسهم في Kobra

Kobra Formen GmbH was founded by Rudolf Braungardt more than 30 years ago and has become one of the world's leading mould manufacturers. With approx. 500 employees worldwide - around 400 at the headquarters in Germany - and 6 subsidiaries in Europe and North America as well as sales partners in Canada, Europe and Asia, Kobra works in a technologically ground-breaking way in the concrete product industry. The company is proud of its impressive development and wishes to pay special thanks to its employees and customers, who made such success possible.

تأسست شركة Kobra Formen GmbH على يد رودولف برونجاردت منذ أكثر من 30 عامًا، وقد أصبحت واحدة من أبرز الشركات المصنعة للقوالب في العالم. تعمل شركة Kobra بطريقة تقنية رائدة في صناعة المنتجات الخرسانية وذلك بدعم من ما يقرب من 500 موظف حول العالم - حوالي 400 في المقر الرئيسي في ألمانيا - و6 شركات تابعة في أوروبا وأمريكا الشمالية بالإضافة إلى شركاء مبيعات في كندا وأوروبا وآسيا. تفتخر الشركة بتطورها الرائع وتتمنى أن تتقدم بشكر خاص لموظفيها وعملائها الذين ساهموا في تحقيق هذا النجاح.

Kobra is a medium-sized company, whose success is largely based on healthy and sustainable development strategies. This also includes setting up the company for the next generations. The process started a few years ago by strengthening the management with Jan Streckenbach, Heike Giessmann and Stefanie Schaarschmidt, who manage the company together with the managing partner, Holger Stichel.

Kobra is very glad to be able to continue shaping Kobra Group expansion with a strong partner at shareholder level. Rieker Investment GmbH, a firm which pursues long-term, non-sector-specific investments in medium-sized companies, has acquired shares in Kobra with effect from 1st September 2022. Rieker is a family business like Kobra with a long tradition and a shared vision of corporate management. The shared values - sustainability, healthy growth, innovation and quality - are the basis for cooperation. As part of the Rieker investment family, Kobra is geared up for the next decades and can continue its corporate strategies in the same way for the long term.

The operational business will continue - unchanged - to be managed by Kobra's international team. This offers employees a secure job and numerous development opportunities in a healthy company. All internal company structures will re-

main in place in a similar way. Customers and business partners will be supported as usual by all their known contact persons.

Kobra looks forward to a continued successful future shaped together with our team, customers and business partners. ■



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FURTHER INFORMATION



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Quality control of recycled concrete aggregates using Laser-Induced Breakdown Spectroscopy

مراقبة جودة الركام الخرساني المُعاد تدويره باستخدام مطياف الانهيار بالليزر

■ Francesco Di Maio, Cheng Chang, Ali Vahidi, Abraham T. Gebremariam and Peter Rem, Resource & Recycling, Department of Engineering Structures, Faculty of Civil Engineering and Geosciences, Delft University of Technology, The Netherlands

The replacement of natural aggregates with recycled aggregates is hampered by the industry's perception that recycled aggregates are highly variable in quality and that the cost and time-lag to ensure the quality of recycled aggregates for high-end applications is prohibitive. There is a need to cost-effectively measure the quality of recycled aggregates and make this information available online to ensure that it meets the industry's requirements. Therefore, innovative recycling technologies that can efficiently identify different contaminant materials play a vital role in upcycling End-of-Life (EoL) concrete and implementing a circular economy.

إن استبدال الركام الطبيعي بالركام المُعاد تدويره يعوقه تصوُّر الصناعة أن الركام المُعاد تدويره متغيّر بدرجة كبيرة من حيث الجودة وأن التكلفة والتأخير الزمني لضمان جودة الركام المُعاد تدويره للاستخدامات المتطورة باهظة التكلفة. ويتعيّن قياس جودة الركام المُعاد تدويره بطريقة فعالة من حيث التكلفة وإتاحة هذه المعلومات عبر الإنترنت للتأكد من أنها تلبّي متطلبات الصناعة. لذلك، تلعب تقنيات إعادة التدوير المبتكرة التي يمكنها تحديد المواد الملوثة المختلفة بكفاءة دورًا حيويًا في إعادة تدوير الخرسانة في نهاية العمر الافتراضي (EoL) وتنفيذ الاقتصاد الدائري.

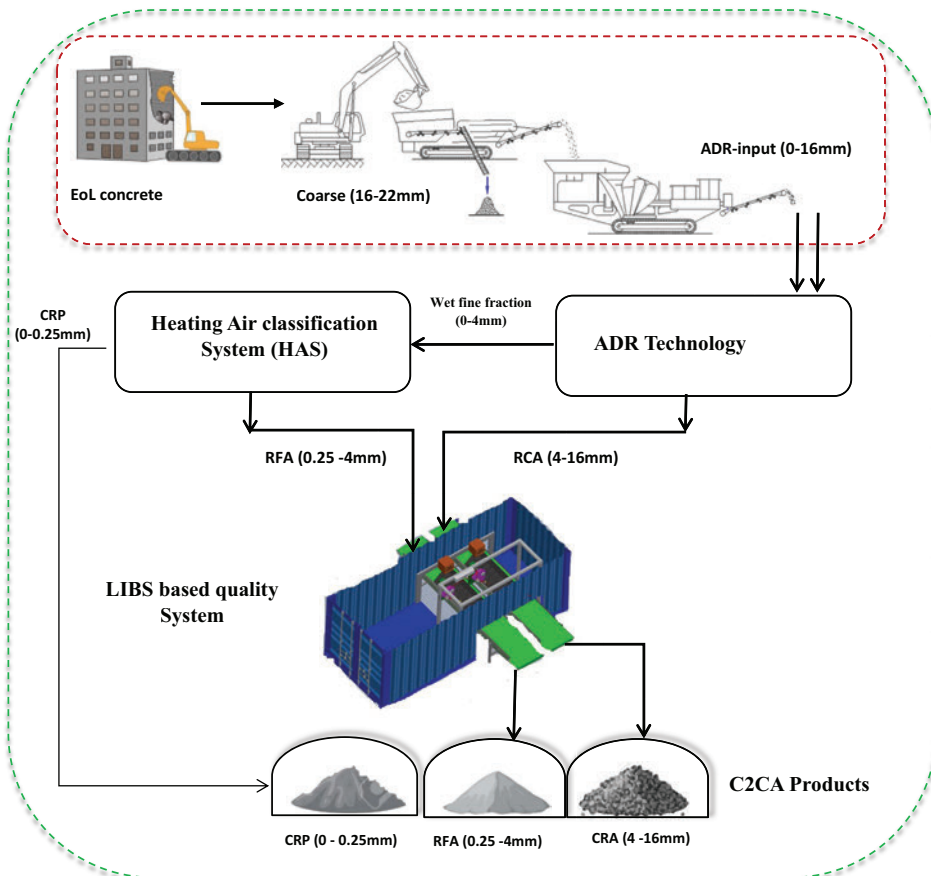


Fig. 1: A sketch of EoL concrete recycling approach based on C2CA technology.



■ Dr. Francesco Di Maio is the research director of the Resources & Recycling lab of the Delft University of Technology. He is involved in projects to develop effective and economically feasible technologies (and methodologies) that produce high-quality raw materials from EoL products. F.DiMaio@tudelft.nl



■ Cheng Chang is a Ph.D. student in the Section of Resources & Recycling at the Delft University of Technology. His research involves quality and monitoring assessment of recycled concrete using Laser Induced Breakdown Spectroscopy (LIBS) and Radio-frequency identification (RFID) tags. C.Chang-1@tudelft.nl



■ Ali Vahidi is a PhD Student at the Delft University of Technology. His main research interest is concrete recycling and RFID-based material passports for construction materials and products. A.Vahidi@tudelft.nl



■ Dr. Abraham Gebremariam is an Assistant professor at the Delft University of Technology, Resources and Recycling section. His main research interests are recycling construction materials, sustainable materials, the circularity of engineering materials and structures, cementitious materials/systems, and carbonation technologies. A.T.Gebremariam@tudelft.nl



■ Prof. Dr. Peter Rem chairs the Section Resources & Recycling of the Delft University of Technology. P.C.Rem@tudelft.nl

This article presents the Laser-Induced Breakdown Spectroscopy (LIBS)-based quality system's concept and implementation along with the C2CA concrete recycling facility (Fig. 1). C2CA is a set of technologies that enable the recovery of high quality recycled coarse aggregates (CRA), recycled fine aggregates (FRA) and recycled cement paste-rich powder (CRP) from EoL concrete. One of the advanced technologies C2CA embraces is the LIBS-based quality system which is used to characterize and identify the quality of coarse and fine recycled aggregates through the value chain. This is done by integrating the conveyed information from the LIBS into radio-frequency identification (RFID) tags, where the information about the quality of the recycled aggregate is tracked and accessed securely when needed by all actors involved in the value chain and the stakeholders. Doing so addresses some of the existing barriers to recycling concrete and improves adverse client perceptions of recycled products. By openly displaying the quality of recycled products, it is possible to build trust and accountability throughout the value chain. This is something missing from recycling industries, and here the C2CA approach tries to address some quality-related barriers.

Directly after Advanced Dry Recovery (ADR) and Heating Air classification System (HAS)[1, 2], the 0~4 mm and 4~12 mm recycled aggregates are inspected by the LIBS setup to assess their composition in terms of contaminants and particle size distribution of aggregates. This data will be available for clients by scanning RFIDs in the aggregate products. A sketch of the entire process of recycling is shown in Figure 1.

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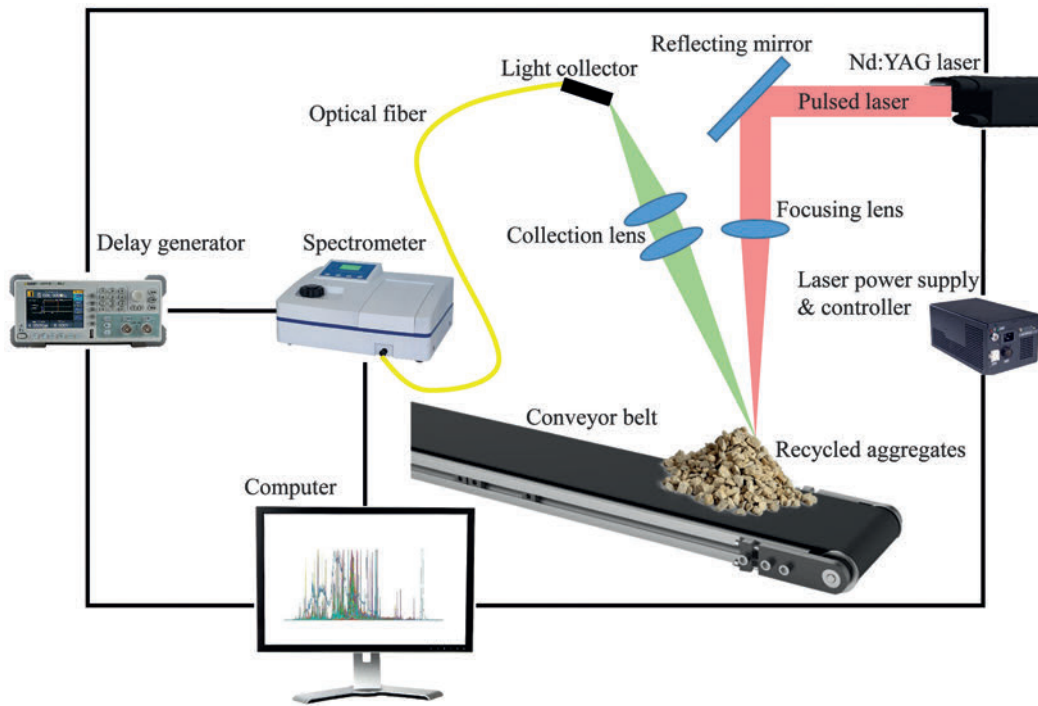


Fig. 2: LIBS system sketch.

Experimental setup

The LIBS system consists of a conveyor belt, a compact optical module, and an Nd:YAG nanosecond pulse laser. A typical delay time of 1.5 μ s after the laser pulse is employed to acquire the spectra to avoid interference from continuous laser-induced plasma radiation. The spectrometer was triggered with a digital delay pulse generator (Quantum Composers). Samples are moved at speeds of 20-100 cm/s (Fig. 2).

In this study, a total of eight potential contaminants are considered as target contaminant material inflows of coarse and fine aggregates resulting from the upcycling of EoL concrete. Such contaminants are bricks, cement paste, foam, glass, gypsum, mineral fibers, plastics, and wood. These contaminants degrade the quality of the aggregates even at low concentrations, so it is essential to identify their presence and measure their concentrations along with the main products



Fig. 3: Representative samples of different waste streams from construction and demolition wastes.

of recycling which are recycled coarse aggregates (RCA) and recycled fine aggregates (RFA).

Chemometric methods

For LIBS quality assessment methods to provide precise outcomes, there are basically two options. Firstly, to take into account that the conditions at which LIBS acquires data change continuously while monitoring raw material/solid waste and correct for these changes. For example, changes may occur in the condition of the surface hit by the laser beam, the angle of incidence, the moisture content, the dust, the distance from the laser focal point, etc. Secondly, to keep the conditions always the same. When LIBS is used to detect production errors in a flow of identical products, the products, and so the conditions, should always be the same: if they are not, a problem/defect has been detected.

When inspecting raw materials, the conditions are continuously changing because each particle has a different shape and orientation. Therefore, LIBS will respond differently, even if the material is the same. Two ways to deal with such changes are, firstly, to carefully measure all those conditions and apply proper corrections to interpret the spectra's information. Secondly, to adapt the acquisition of individual spectra to the development of the laser-induced plasma: e.g., do not start the acquisition of the spectrum after a fixed delay time with respect to the laser pulse but choose the exact right time to start acquiring the spectra based on the plasma condition.

An efficient method is proposed to identify and classify EoL concrete waste along with RCA and RFA in motion on conveyor belts via laser-induced breakdown spectroscopy (LIBS) coupled with a cluster-based identification algorithm. The algorithm [3] combines principal component analysis (PCA) and chi-square distribution to generate its database for each material from the spectra resulting from the LIBS. Data from

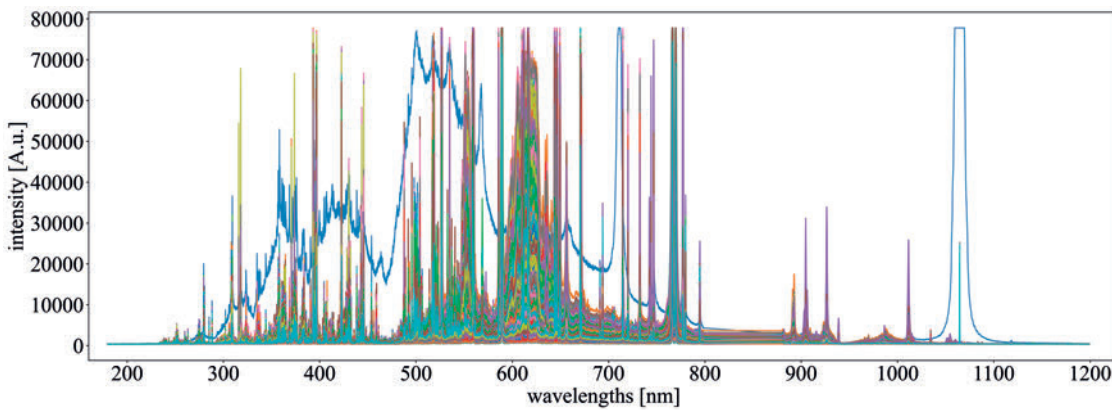


Fig. 4: LIBS raw spectra of bricks.

the LIBS single-shot spectra (Fig. 4) of EoL samples are applied to train and validate the classification model.

RFID tags as material passport

Radio Frequency Identification (RFID) technology is a common technology for asset tracking and supply chain management application that can be used in recycled concrete supply chains [4]. The minimum components of an RFID communication system consist of at least one reader, one tag, and antennas to enable energy transmission in voltages on wires and waves in the air [5]. The primary factors to be considered when choosing the right tag for this communication system are the operating frequency, reading range, memory capacity, cost, surface types, and external pressures over the time that tags must withstand. Passive RFID tags are a cost-effective and environmentally friendly tool that could be used as a material passport that can perform adequately over a long time and against external forces (Fig. 5).

After the LIBS analysis, the processed data are linked to the RFID tag with the unique code that is automatically placed into the recycled aggregate flow. This way, any authorized actor or stakeholders of the recycled aggregates value chain can read the RFID codes, access the report to choose the application of the material, and ensure the recycled aggregates in terms of the environment and quality. This way, the recycled aggregates will be monitored and sorted by their properties and further linked to an external database as a material bank.

Conclusions

The proposed approach is a reliable identification technique based on the LIBS spectral emissions for secondary materials

produced from EoL concrete in motion. The model's overall accuracy reached 0.97, according to the results of the validation set classification. This research suggests LIBS may be well suited for fast and in-line analysis of recycled concrete aggregates in industrial applications. This approach presents an innovative approach for the quality characterization of secondary materials produced from EoL concrete being transported on conveyor belts and, therefore, can be of great value for the processing and high-end utilization of EoL concrete. The possibility of linking the data with RFID tags enables transparent communication about the quality of recycled aggregates with stakeholders or clients. Incorporating RFIDs along with the material/product can be used to trace and track all useful information about the product, including its lifespan. Consequently, the transition toward achieving a circular economy is foreseeable. ■

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Fig. 5: Sketch of RFID tags as a material passport.



New ice and hot water plant tempers fresh concrete energy-efficiently even under changing conditions

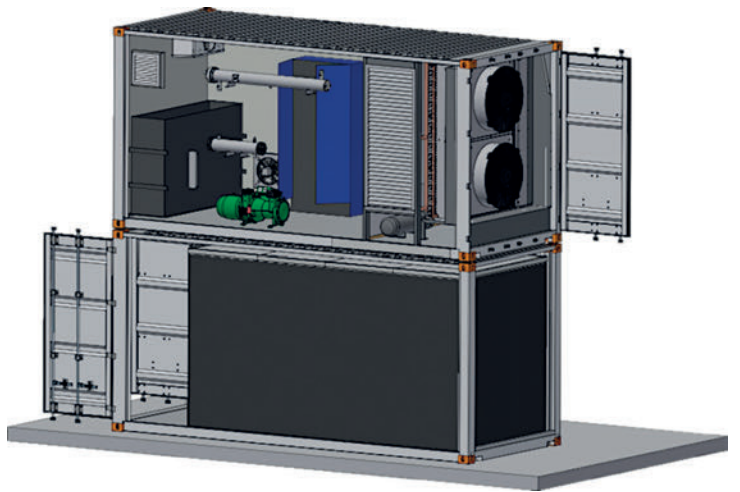
مصنع جديد للثلج والماء الساخن يخفف من طاقة الخرسانة الطازجة بكفاءة حتى في ظل الظروف المتغيرة.

Climate protection and the increasing scarcity of resources are just two challenges that the construction industry will face in the future. This makes it all the more important to produce concrete, a CO₂-intensive building material, as durable and long-lasting as possible. Only careful curing can achieve the quality required for this. Otherwise, cracks can still form months later, causing massive damage to the structure and necessitating costly repairs. However, particularly high or low ambient temperatures, which are becoming increasingly frequent and prolonged even in more temperate climates in Europe and North America, make temperature-controlled concrete production more difficult. The results are very high energy costs for concrete cooling and heating as well as rising emission levels. The new CombiWater from KTI-Plersch Kältetechnik GmbH, specially developed for concrete production, now provides a remedy. The flexible and energy-efficient heat pump produces iced water in summer and hot water in winter. The recirculation principle keeps the water, once at the right temperature, efficiently cold or warm even during idle times in the insulated tank.

إن حماية المناخ وندرة الموارد المتزايدة يمثلان مجرد تحديين ستواجههما صناعة البناء في المستقبل. هذا يجعل الأمر أكثر أهمية لإنتاج الخرسانة، وهي مادة بناء كثيفة الاستخدام ثاني أكسيد الكربون، وممتينة وطويلة الأمد قدر الإمكان. ولا يمكن سوى للمعالجة الدقيقة تحقيق الجودة المطلوبة لهذا الغرض. بخلاف ذلك، يمكن أن تظل الشقوق تتشكل بعد أشهر، ما يتسبب في أضرار جسيمة للبناء ويستلزم إصلاحات مكلفة. ومع ذلك، فإن درجات الحرارة المحيطة المرتفعة أو المنخفضة، والتي أصبحت متكررة بشكل متزايد وطويلة الأمد حتى في المناخات الأكثر اعتدالاً في أوروبا وأمريكا الشمالية، تجعل إنتاج الخرسانة التي يتم التحكم في درجة حرارتها أكثر صعوبة. والنتيجة هي تكاليف طاقة عالية جداً لتبريد الخرسانة وتسخينها بالإضافة إلى ارتفاع مستويات الانبعاثات. توفر الآن مضخة CombiWater الجديدة التي تنتجها شركة KTI-Plersch Kältetechnik GmbH، والتي تم تطويرها خصيصاً لإنتاج الخرسانة، علاجاً. تنتج هذه المضخة الحرارية المرنة والموفرة للطاقة الماء المتأرجح في الصيف والمياه الساخنة في الشتاء. يحافظ مبدأ إعادة التدوير على الماء، بمجرد أن يصل إلى درجة الحرارة المناسبة، بارداً أو دافئاً بشكل فعال حتى أثناء فترات الخمول في الخزان المعزول.

"Massive concrete components are needed for the construction of infrastructure projects such as airports, but also for dams, tunnels and bridges," knows Michael Walleter, Sales Manager at KTI-Plersch Kältetechnik GmbH. "These structural elements require a fairly long time to cure thoroughly." However, fluctuating, very high or low ambient temperatures during this period make controlled, high-quality concrete production impossible. Temperature differences within the component, for example, cause the individual areas to cure at different rates. Cracks develop as a result, which need to be filled afterwards or, in the worst case, lead to a tear off in the concrete element. Excessively cold temperatures also cause the still moist concrete to freeze, which greatly impairs the stability and durability of the finished component.

A conventional concrete cooling system, such as those used in desert regions, usually uses flake ice as a cold water substitute. This means that very low concrete temperatures can be achieved, but these are not needed at all for less com-



The new CombiWater from KTI-Plersch Kältetechnik GmbH, specially developed for concrete production, produces ice water in summer and hot water in winter.



Like many plants from KTI-Plersch, the CombiWater is installed in a sea container and is delivered turnkey.

plex applications at more temperate latitudes. Especially for small and medium-sized businesses in these areas, it can be worthwhile to resort to a much more energy-efficient cooling system with ice water. The demand for alternative and low-emission fuels is also increasing in the area of concrete heating for cold ambient temperatures. "Climate protection and corresponding guidelines are playing an increasingly important role in the construction industry," confirms Walleter. "Furthermore, there are fluctuating climatic conditions, which are becoming increasingly common in Central Europe with record summers and winters. Both are an increasing problem for the local concrete production."

High-quality concrete production 365 days a year

The new CombiWater from KTI-Plersch operates on the principle of a heat pump that can run in both heating and cooling mode as required. In summer, the system produces the ice water (< 1 °C) required for cooling the concrete. As soon as the ambient temperatures drop, the system can be easily switched to hot water heating. "With the CombiWater you literally kill two birds with one stone and save the purchase and maintenance costs for two separate systems for cooling and heating," explains Walleter. "This makes it particularly suitable for use in more temperate latitudes, where cold winters alternate with hot summers."

The CombiWater can switch between two operating modes for both ice and hot water production: In open-loop operation, it cools with an output of 61 kW and heats with 92 kW. At a temperature difference of 21 °C to < 1 °C, this corresponds to about 2.5 m³/h of water in the cooling case and about 1.8 m³/h of water from 10 °C to 55 °C in the heating case. If the insulated tank is full and no temperature-con-

"With CombiWater, you literally kill two birds with one stone and save the purchase and maintenance costs for two separate systems for cooling and heating," explains Michael Walleter, sales manager at KTI-Plersch Kältetechnik GmbH.



trolled water is currently required, the system effectively keeps the cooled or heated water at the desired temperature in recirculation mode. "This function is particularly useful when there is no concrete production," explains Walleter. "For example, the water does not need to be cooled or heated from scratch after a night's rest, which reduces overall energy consumption."

High concrete quality even in remote or confined locations

Like many plants from KTI-Plersch, the CombiWater is installed in a sea container and is delivered turnkey. It is therefore very mobile and can be transported quickly and easily to new, even more remote locations. Thanks to the plug-and-play solution, installation time is kept to a minimum, saving manpower and resources on site. Only the water and electricity supplies need to be connected; there is no need for a chimney installation. "Due to the compact container design, the ice and hot water plant is also suitable for high-quality concrete production on inner-city construction sites, where space is often at a premium," adds Walleter. ■

FURTHER INFORMATION



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New Experimental Block-Making Machine

ماكينة تصنيع الطوب التجريبية الجديدة

- Dipl.-Eng. Thomas Roske, IAB - Weimar Institute of Applied Construction Research gGmbH, Germany
- Dipl.-Eng. Peter Ortmann, Knauer Engineering GmbH Industrieanlagen & Co. KG, Germany

This report outlines the path from a vision to its implementation. The completed project constitutes a follow-up by the IAB Competence Centre for Sustainability and Resource Efficiency in the Construction Industry and was implemented with major support from the state of Thuringia as part of investments in research-related equipment infrastructure (Reg.-No. 2021 WIN 0006). The existing block-making machine at the IAB, with its outdated technology, poor adjustment possibilities and lack of filling carriage units, could no longer meet the demands of future developments. In addition, the ever-increasing maintenance work made a suitable replacement necessary.

يحدد هذا التقرير المسار من الرؤية وحتى تنفيذها. يشكل المشروع المكتمل متابعة من قبل مركز كفاءة IAB للاستدامة وكفاءة استخدام الموارد في صناعة التشييد والبناء وتم تنفيذه بدعم كبير من ولاية تورينجيا كجزء من الاستثمارات في البنية التحتية للمعدات المتعلقة بالبحوث (رقم تسجيل 2021 WIN 0006). لم تعد ماكينة تصنيع الطوب الحالية في IAB، بتقنياتها القديمة وإمكانات التعديل الضعيفة، ونقص وحدات النقل المملوءة، قادرة على تلبية متطلبات التطورات المستقبلية. بالإضافة إلى ذلك، فإن أعمال الصيانة المتزايدة جعلت توفر البديل المناسب ضروريًا.

After successful completion of the tendering procedure, the choice for the purchase of the mould and compaction system fell to Knauer Engineering GmbH Industrieanlagen & Co.KG. An existing Type KS250 small board machine served as a template for the special design of the new experimental block making machine with a conventional impact vibration system. Special solutions had to be incorporated into this machine, which was adapted to the requirements for machine utilisation at the IAB. These included:

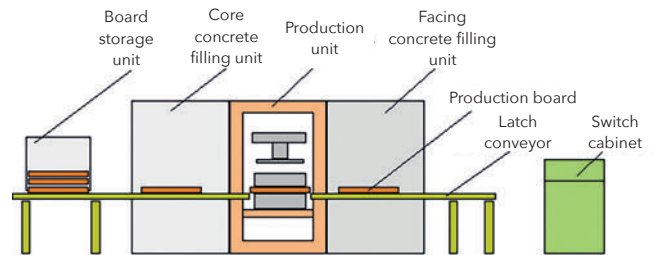


Fig. 1: Diagram of the main components of the mould and compaction system

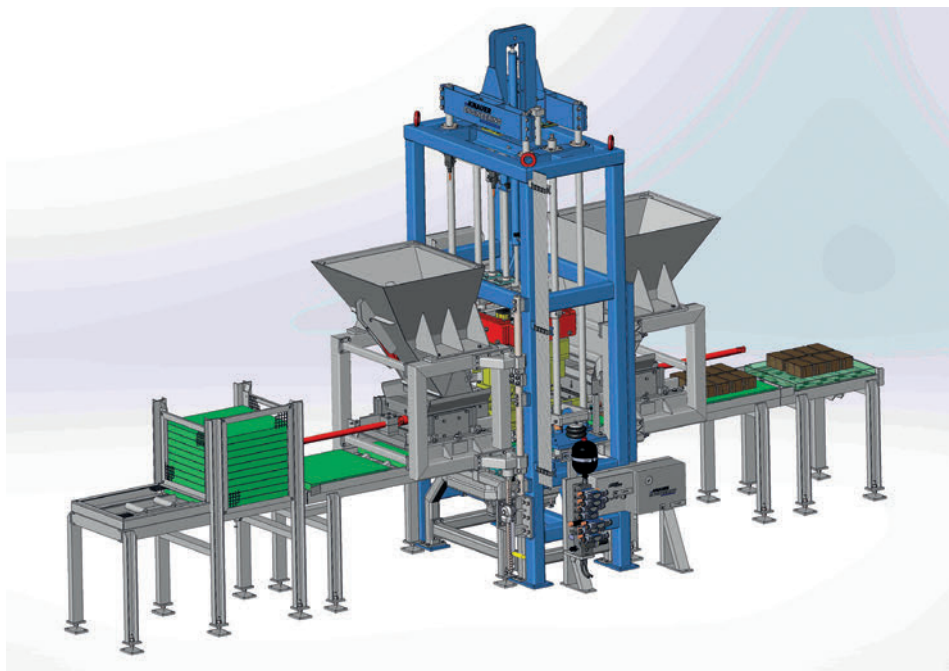
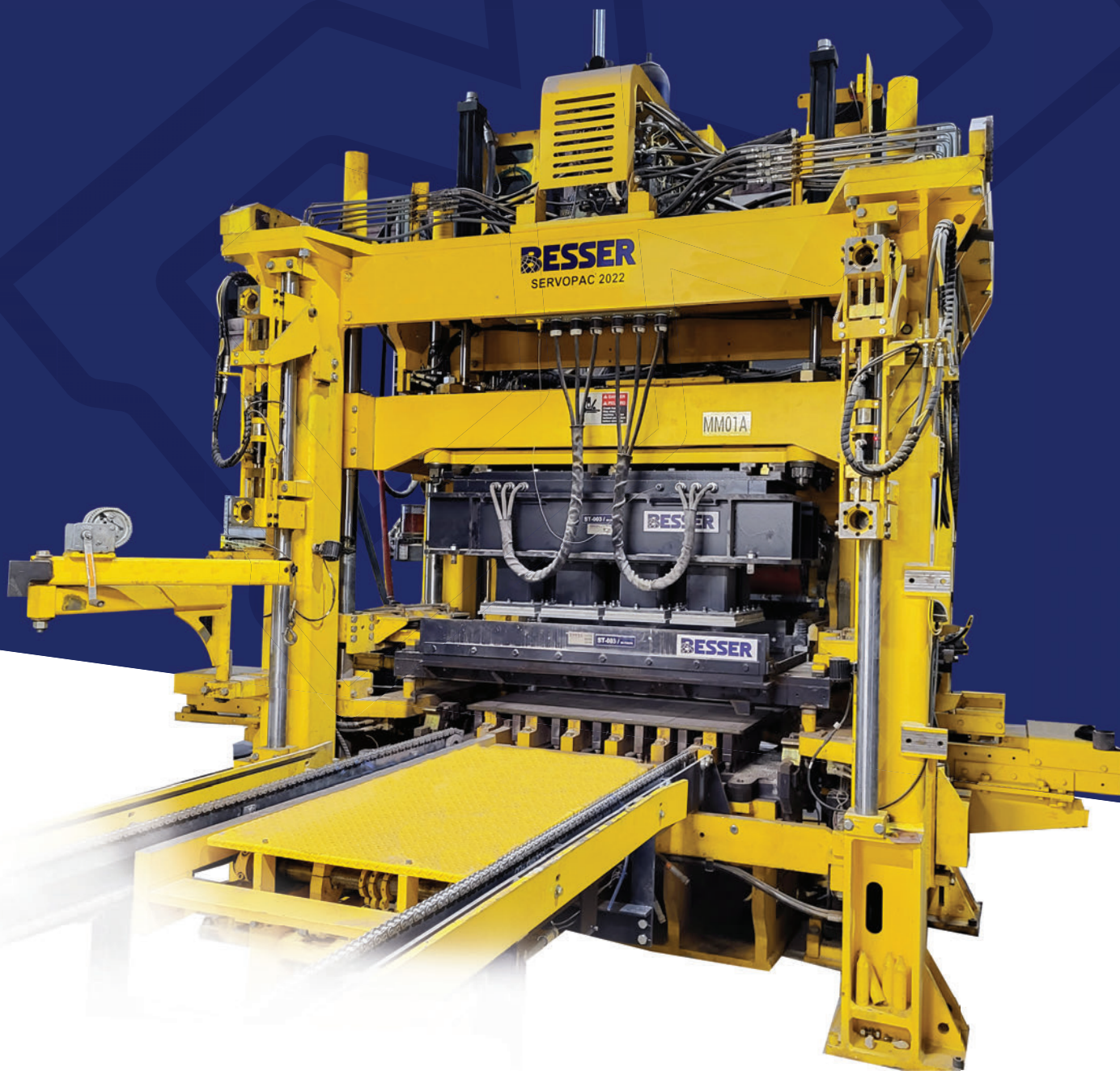


Fig. 2: Finished CAD model of the mould and compaction system

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■ Dipl.-Eng. Thomas Roske; 2007 until 2013 Master studies in mechanical engineering specialising in construction machinery technology at Technische Universität Dresden; Extra-curriculum activities at the Institute of Materials Science and at the Institute for Mobile Machinery; Since March 2013 research associate at the IAB – Weimar Institute of Applied Construction Research gGmbH in the mechanical engineering faculty (main focus of activities: machine design and FEM calculations); Since August 2020 Head of the IAB Faculty of Mechanical Engineering
t.roske@iab-weimar.de

- Easier access to the machine, plus production of products up to 300 mm height through the possibility of adjusting and swivelling the silo and filling carriage unit
- Initial delivery of 2 mould sets (mould + tamper head with heating possibility) for manufacturing paving blocks and hollow blocks as standard products
- Possibility of manually increasing the superimposed load mass with additional weights
- Possibility of modifying the mould clamping unit for using impact or harmonic compaction systems with impacts of up to 20 g at 60 Hz
- Possibility of adjusting the height and variation of the impact bars to investigate the effects on compaction and the mould

- Switch cabinet with external control panel for operating the machine with possibility of direct process monitoring
- Mobile recording unit with up to 8 sensors for measuring the incidence of accelerations on the machine
- Latch conveyor through the machine for producing blocks fully automatically from batches up to 2 x 250 l using previously refillable storage silos

Design work progress was checked at regular intervals and implementation details were discussed. This meant that requests for changes could be incorporated immediately, which were always implemented by Knauer in a prompt, uncomplicated manner. It was possible to manufacture the system components in a timely manner through releasing the design piece by piece.

Parallel to this, preparations for the new experimental block making machine were made at the IAB by dismantling the old machine and carrying out foundation simulations. The existing machine foundation on steel springs for decoupling vibrations was tested for its suitability with the new loads. Key points here were the computation of the eigenfrequencies and their forms as well as foundation vibration amplitudes during machine operation.



Fig 3: Component production at the contractor

This was followed by the machine's pre-assembly and its first functional tests at Knauer before delivery to the IAB including final assembly and commissioning.

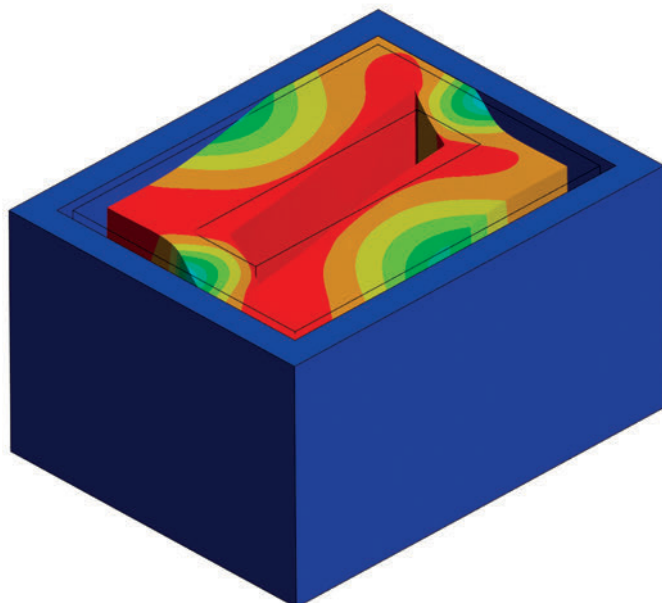
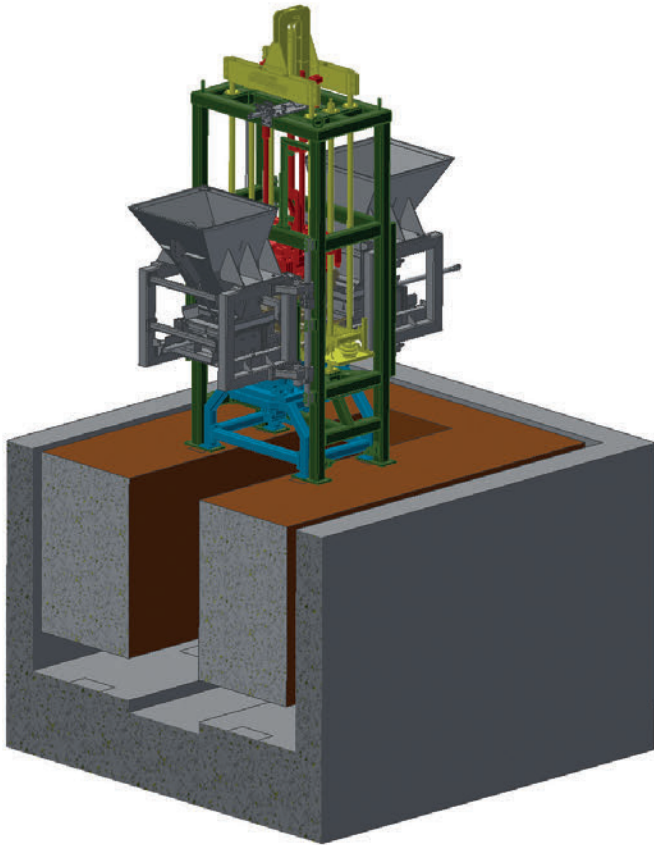
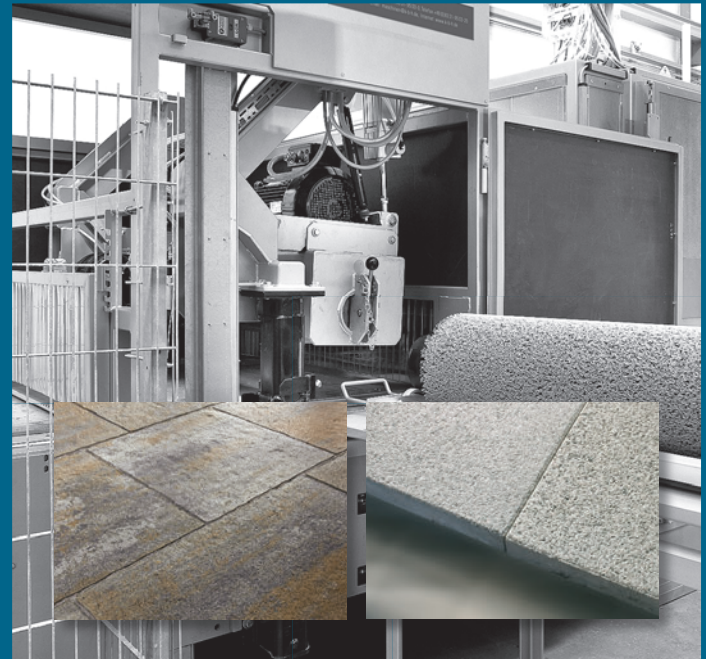


Fig. 4: IAB foundation simulation for appropriate vibration decoupling from the surrounding area



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Fig. 5: Mould and compaction system immediately after set-up



The new machine features the following main machine parameters:

- Vibration table with 4 unbalance exciters with a maximum centrifugal force of 20 kN each and unbalance or exciter force adjustment by means of a 4 shaft drive
- Maximum acceleration amplitude 20 g at 60 Hz
- Exciter frequency range 35 - 70 Hz
- 3 Manually adjustable and removable impact bars
- 2 tamper vibrators with maximum centrifugal force of 6.5 kN each
- Adjustable superimposed load pressure in the range of 0.2 - 7.5 kN
- Increase of the superimposed load mass by up to 150 kg
- Swivelling and height-adjustable core and facing concrete silos
- Freely programmable filling carriage movements
- Siemens SPS S7-1200 control unit
- Manual and fully automatic operations
- Recipe management for storing function and movement sequences in relation to quantity

Initial commissioning trials for an influence analysis and fine-tuning of adjustable machine parameters have already been carried out. The limits of different operating systems were determined in this way in order to be able to react optimally to product requirements in future project work. Larger applications in ongoing projects with industrial partners of the IAB are already planned, e.g. producing a lightweight concrete hollow chamber block with a new type of honeycomb geometry. This will have significantly improved sound and thermal insulation and will be employed in constructing a complete test wall, which will then be used for sound and thermal insulation measurements at the IAB.

There are already plans to equip the machine in future with a circulation system, so that a small-scale demonstration concrete production facility can be created that can be utilised wholly in line with the aims of the Competence Centre for Sustainability and Resource Efficiency in the Construction Industry and for developing solutions in advancing digitalisation in concrete factories. The circulation system is to include, among other things, the HiCon (block height measurement) and QuCon (block surface monitoring) quality control systems developed by the IAB, a drying rack and a sorting robot in order to create the relevant stations in a concrete block factory. In addition, the purchase of further moulds with tamper heads should make it possible to manufacture more typical concrete products from high-quality secondary raw materials and light granulates from previously non-recyclable construction waste. Thus, a block making machine will be available at the IAB for the practical development and testing of new and innovative concrete products. No ongoing production has to be stopped for this purpose and interested parties can draw on the comprehensive expertise of the Weimar construction materials experts and process engineers. ■

FURTHER INFORMATION



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Besser Company, Alpena, Michigan 49707, USA



New Patented Vibration System

نظام اهتزاز جديد حاصل على براءة اختراع

For many generations, there has been a debate between selecting a machine with mold or table (impact) vibration. With the Servopac® Infinity, producers no longer need to decide between types of vibration. The Servopac Infinity redefines production with a game-changing, patented vibration system. Depending which product is being produced, the producer can set up the machine to run either mold vibration or table vibration.

على مدار عدة أجيال، كان هناك نقاش بين اختيار آلة تعمل باهتزاز القالب أو الطاولة (التصادم). ومع ظهور Servopac® Infinity، لم يعد المنتجون بحاجة إلى الاختيار بين أنواع الاهتزاز. إن ماكينة Servopac Infinity (سيرفوباك إنفينيتي) تعيد تعريف الإنتاج من خلال نظام اهتزاز حاصل على براءة اختراع وغير قواعد اللعبة. ويمكن للمنتج إعداد الماكينة لتشغيل إما اهتزاز القالب أو اهتزاز الطاولة وذلك اعتمادًا على المنتج الذي يتم إنتاجه.

Generally, mold vibration is used for taller products to provide precise height control and dense product, while table vibration provides better density in shorter products. With both vibration modes, the operator has full control over the frequency and amplitude independently. This allows fine tuning of the vibration to create the perfect vibration needed for the product.

Beyond offering two types of vibration the Infinity offers the hallmark features of the Servopac Family. The Infinity provides maximum machine productivity with:

- No pit needed for the foundation
- Optional side mounted core puller
- Increased mold life through precise Servo vibration
- Mold and height changes in less than 15 minutes
- Besser and competitive mold capability
- Touch screen operation for machine controls
- Streamlined design for easier maintenance
- Capability of product height between 1-12" (25-300 mm)

First introduced in 2008, the Servopac Family of Machines, now four models strong, has steadily revolutionized concrete products production for producers around the globe. These machines offer the responsiveness, reliability, and versatility to produce the ever-growing variety of concrete products demanded by today's marketplace.

FURTHER INFORMATION



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With the Servopac Infinity, producers no longer need to decide between types of vibration.

Topwerk Group, 57299 Burbach-Wahlbach, Germany

Launch of a rubber matrices production in the Middle East

إطلاق إنتاج المصفوفات المطاطية في الشرق الأوسط

Topwerk Middle East, a member of Topwerk Group, announces the start of the rubber matrices production in its regional office in Dubai as of 1st May 2022. The new business line adds up to the existing service package for concrete industry projects in the Middle East.

أعلنت شركة Topwerk Middle East، العضو في مجموعة Topwerk، عن بدء إنتاج مصفوفات المطاط في مكتبها الإقليمي في دبي اعتبارًا من 1 مايو 2022. يضيف الخط الجديد للأعمال حزمة الخدمات الحالية لمشاريع صناعة الخرسانة في الشرق الأوسط.

Topwerk Middle East was established in 2005 to serve customers in the Middle East with spare parts, technical consulting, and services. Over the years, the Topwerk Middle East has established an extensive customer base & network in the region. It has been designated as a reliable partner for supply, assembly, and After Sales support for the concrete industry in the Middle East and Gulf region.

The After Sales and spare parts business has always been significant for the team of Topwerk Middle East. Since 2005, the warehouse of a total area of 560 sq. m. covers the demand for spare parts for all machinery of Topwerk Group. Engineers of Topwerk Middle East maintain constant contact with its customers, regularly visit the concrete plants in the region - even when there are no requests - and provide technical support and advice. "We strive for excellent service support, constantly researching the market, understanding the customer needs, and will-



Mohammed Tayseer Qasem,
the Managing Director of
Topwerk Middle East



The office of Topwerk Middle East in Dubai is a central location for sales, service, spare parts, and, lately, rubber matrices production workshop to meet the needs of the concrete industry in the region.



Rubber matrice production for customized concrete slabs in the Topwerk Middle East office in Dubai

ing to support the customer in all aspects of their business," states Mohammed Tayseer Qasem, the managing director of Topwerk Middle East.

The next step toward improving the service for customer benefits is launching the production of vulcanization molds (matrices) based on customer requirements and suggestions. SR Schindler is a technology partner in the value-adding industry that can offer a genuinely local presence with technical specialists, a local spare parts warehouse, and a local production of matrices.

After a careful analysis of the customer demands & latest trends, such as increasing individualization in After Sales, Mohammed Tayseer and his team decided to take all measures to ensure customer satisfaction and sustainable devel-

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Production of highly sophisticated concrete products resembling the ceramic finish is possible with rubber matrix molds

opment of the After Sales business. “We have noticed a significant gap in the market for decent quality rubber matrices; many machines with outdated technology require a long time to replace the matrices, which costs money and reduces efficiency,” states Bassem Dabbas, the technical director of Topwerk Middle East.

The required production technology was chosen in cooperation with the surface treatment engineering manufacturer SR Schindler. Since SR Schindler is one of the world’s largest suppliers of rubber matrices for hermetic presses, the experts provided their colleagues in the Middle East with professional training and testing of the equipment to match the highest quality. There are no constraints on the design or surface required for the finished product; over 1.500 different finishes and sizes are available for sophisticated patio, garden, landscape design, ecological road, and path construction. The highly qualified staff offers the full range of support: from consulting regarding machinery and technology to the training of customers’ employees and supply of high-quality spare parts, locally available from the warehouse in Dubai. The team of Topwerk Middle East is there to meet the demands for diverse shapes and sophisticated surface designs. Recently, Topwerk Middle East has received large orders from clients to manufacture face matrices. ■

FURTHER INFORMATION

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Easy digital identification of suitable production pallets

التحديد الرقمي السهل لمنصات الإنتاج المناسبة

The digitization process is progressing in all industries and business models are changing at increasing pace. For companies in the concrete industry, this process holds many interesting potentials that need to be exploited. As a start-up, Production Boards uses its digital platform to connect suppliers and buyers of production pallets simply, quickly, and effectively. On the platform, interested parties can receive non-binding offers from all over the world.

إن عملية الرقمنة تتقدم في جميع الصناعات وتتغير نماذج الأعمال بوتيرة متزايدة. وبالنسبة للشركات العاملة في مجال صناعة الخرسانة، تحمل هذه العملية بين طياتها العديد من الإمكانيات المثيرة للاهتمام والتي يجب استغلالها. تستخدم شركة Production Boards، بوصفها شركة ناشئة، منصتها الرقمية لربط الموردين والمشتريين بمنصات الإنتاج ببساطة وبسرعة وبفعالية، حيث إنه على المنصة، يمكن للأطراف المهتمة تلقي عروض غير ملزمة من جميع أنحاء العالم.

After decades of limiting the production pallet market for concrete block production to wood and steel panels, interesting and innovative panel types were added over the years - each with its own special characteristics. At the same time, the pool of potential customers and suppliers expanded to ever larger regions. This was the basis for the idea to combine information on the various types of production pallets, which are fundamentally similar but, in many ways, also very different, on one single international platform. The platform allows easy identification of relevant providers and suppliers,

facilitates uncomplicated addressing of technical inquiries, and provides a comparison of various offers.

The concepts and the business plan for such a platform were developed through a series of workshops. A business developer was commissioned, who implemented the new trading platform with the help of two agencies for web design and web portal programming: production-boards.com.

Special attention was paid to user-friendliness and concentration on the essentials.

PRODUCTION-BOARDS.COM

Request for Production Board Market Insights

Material

Wood

Wood with Coating

Steel

Plastic

Board measurements

Length (mm) * 1400

Width (mm) * 1100

Thickness (mm) * 50

Next step >

Following registration on the platform, the interested party can request to receive offers from different manufacturers of production pallets.



Whether made of wood, wood with coating, steel or plastic - all common types of production pallets can be selected.

Application of the platform

Following registration on the platform, the interested party can request offers from different manufacturers of production pallets. Entering all the information for the requests takes only a few minutes and is divided into three steps:

1. Entering information about the desired product
2. Entering delivery information
3. Entering the currency and Incoterm

Optionally, characteristic data can be added for each plant. In the process of using the platform, the user is simply guided through the corresponding pages. This allows even more precise offers from the manufacturers to be created.

After a maximum waiting time of five working days, the user receives comparable offers with prices and technical data from different suppliers and for different pallet types - without the need for market research and countless inquiry letters. And the whole service is completely free of charge for the user. In the inquiry process, the user remains anonymous and can contact the manufacturer once the offers have been received. ■

FURTHER INFORMATION

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Gina Weber, Product Manager Digitalization, R&D Department, Masa Andernach

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At Masa, we think of nothing but concrete – and how to shape it for the building materials industry. The machines we design and build are used for the production of concrete blocks, pavers, landscape products, as well as sand-lime bricks, aerated concrete blocks and panels. In other words, we are real concrete heads with a passion for reliable, high-performance machines.

One of our smart concrete heads, Gina Weber, has co-developed a solution that clearly visualizes the available digital machine data across all sites in one dashboard. As a result her work enables concrete block manufacturers to draw faster conclusions about the productivity of their plants and makes it easier for them to uncover valuable insights to optimize their operation.

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The Power of Post-Production Automation

قوة أتمتة ما بعد الإنتاج

A growing number of concrete pipe producers are turning to robotics to improve efficiencies and meet demand. Oldcastle Infrastructure, a CRH company, found the Afinitas Roco post-production automation system to be a great fit to increase efficiency at its pipe plant in Ogden, Utah, USA.

يتجه عدد متزايد من منتجي الأنابيب الخرسانية إلى استخدام أجهزة الروبوت لتحسين الكفاءة وتلبية الطلب. وقد وجدت شركة Oldcastle Infrastructure وهي إحدى شركات مجموعة CRH (سي آر اتش)، أن نظام التشغيل الآلي لما بعد الإنتاج Afinitas Roco مناسب جدًا لزيادة الكفاءة في مصنع الأنابيب الذي يقع مقره في مدينة أوغدن، يوتا، الولايات المتحدة الأمريكية.

Efficiency is an important priority for Oldcastle Infrastructure, a CRH company, and that means optimizing the current workforce and finding ways to meet increasing production demands. The company has found a solution on the post-production side of its pipe plant in Ogden, UT, working with Afinitas to automate manual production processes. Afinitas supplied the solution with Roco, its robotic post-production pipe handling system.

“By eliminating the movement of people and equipment on the production floor, Roco has created a safer, cleaner environment in the plant, and those are important benefits,” said Troy Banks, engineering manager for the three Oldcastle In-

frastructure facilities in Ogden, UT. “Another justification for increasing the level of automation in the post-production process is to reduce the level of dependency on labor, given current constraints in the market.” With Roco on board, the Oldcastle Infrastructure pipe plant needs just one technician to oversee the Roco robotic system, freeing up the production team to work in other areas.

Fully Automated Post-Production

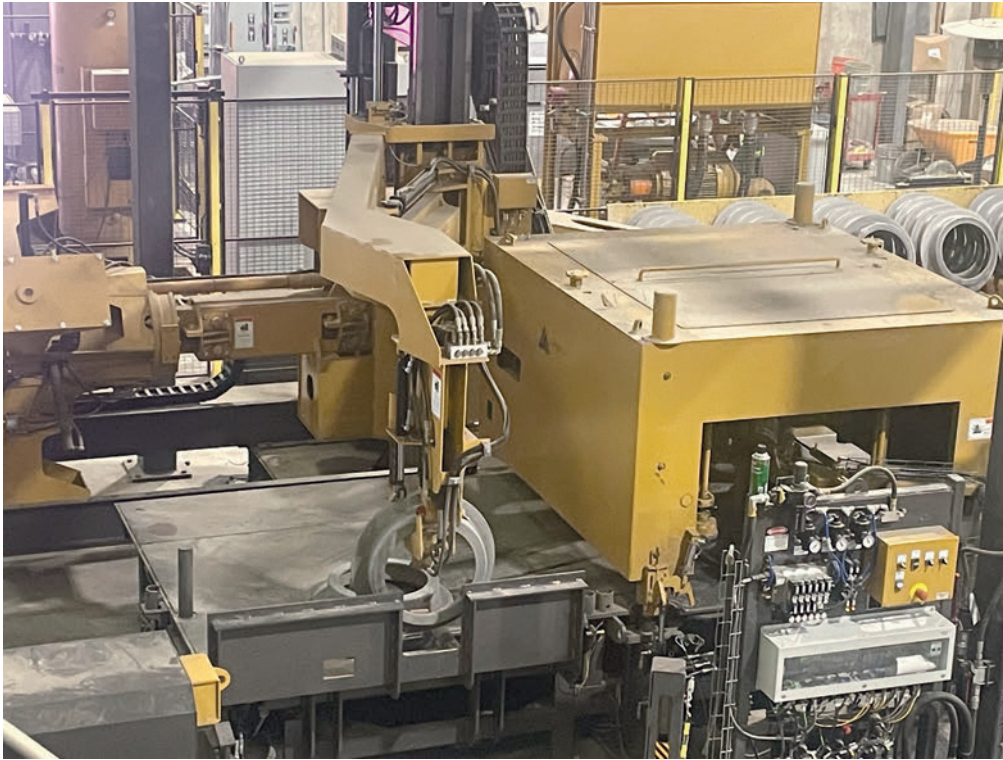
Once the pipe is produced, the Roco handling equipment removes the pallets and headers from the fresh pipe, stacks the joint rings and places the product on a conveyor for further



Afinitas Roco system layout at the Oldcastle Infrastructure pipe plant in Ogden, UT.



Pipe begins the Roco automated finishing process. Roco handling equipment automates the removal of the pallet and header from the finished product, stacks the joint rings, and places the product on a conveyor for further processing or transport outdoors.



The removed pallets are cleaned by a dedicated pallet cleaner. The cleaned pallets are picked and stacked on trays in a storage and retrieval area.

processing or transport outdoors. Additional modules can be added for automated deburring, marking, vacuum testing, joint ring cleaning, storage and retrieval. The system deploys all those modules to achieve a fully automated post-production process.

The beauty of the Roco system is that it can be added to whatever pipe production equipment is already in service at a plant, according to Chris Fitzpatrick, senior operations manager for Oldcastle Infrastructure.

At the Ogden facility, the production side was already fully automated with a variety of equipment from other manufacturers, including a packerhead system at the core, producing pipe from 12" (300mm) to 48" (1200mm). There was some automation on the post-production side, but most of the finishing required manual labor.

"On the front end, we always had automation surrounding the packerhead," Fitzpatrick said. "The problem was that the back end was not automated, so on the front end, we had headers being loaded, pallets being loaded, pipe being made, taken off the machine and sent to the kiln," he added.

"But then, when we process the pipe to get it ready for our customers, we have to manually knock off the pallets, knock off the headers, and manually stack them back to the loaders," he said. "We need employees there with hammers, knocking off pallets and headers, and then manually deburring and stenciling – all the work that goes into making this a finished product for our customers."

An additional benefit is the speed and fluidity of post-production, Fitzpatrick said. "I like the efficiency enabled by the

design of the machine – using the shuttle to create independent stations. It makes for a much faster process, as each station is only 60 seconds or so to complete. So, a stick of pipe is processed every 60 seconds."

Meeting Demand

A growing number of concrete pipe producers are turning to robotics to improve efficiencies and meet demand, according to Derek Von Cannon, Afinitas vice president of sales. Afinitas is focused on helping plants reach that higher level of automation and showing them how the investment can pay off.

"We're definitely focused on post-production automation," Von Cannon said. "For me, it's one of our biggest efforts. Roco has been one of the machines we've been pushing for that reason. In a labor-constrained market increasing automation enables producers to keep up with demand."

In addition, "the ergonomic and safety advantages of automation are obvious," Von Cannon said. "With less physical strain, experienced workers may be more inclined to stay on longer because they're not exposed to the repetitive movements that take place at a plant."

Fantastic Engineering Support

Every pipe plant is a little different in terms of equipment, available space and workforce. So Afinitas works extensively with plant personnel to design a system that meets each plant's specific situation. For the Oldcastle Infrastructure Ogden facility, that meant blending with pipe production equipment of various ages and from a few different equipment manufacturers and filling in the gaps.



Pipes coming out of the vacuum tester.

"It wasn't like plug-and-play equipment," Banks said. "There had to be a lot of onsite visits, verification, and a lot of back and forth to make sure everything could sync up well. We had to work with the existing building, double-checking and triple-checking to make sure everything fit and still had maneuverability."

The Afinitas team stayed with the project from the early concept phase, through installation, commissioning, training of operators, and adjustments needed after the new production line started with Roco on board.

"The engineering support was fantastic," Banks said. "Not everything was directly off the shelf. There were aspects specifically tailored for our needs. I'm grateful for that."

Fitzpatrick agrees. "They were also great in terms of the pre-construction as we were doing our site work and nearing the installation date," he said. "They were great in helping us coordinate and plan. It wasn't just the Roco that we were installing. We were making changes to the front end of the dry-cast operation, so we really had to synchronize those two builds together to make sure that we delivered and came back online with production."

Even with full automation, pipe production is an intricate process involving many movements that need to be coordinated. Because of that, "the front end is always going to be the hurdle in terms of speed and operational efficiency," Fitzpatrick said.

"We made some upgrades to speed up the throughput on the front end, but the Roco post-production equipment is still the fastest part of the process," Fitzpatrick added. "Roco will process any size of pipe in about a minute. There's not a lot of equipment out there that can keep up in terms of how fast it will actually make the pipe, so Roco can process the pipe faster than we can make it."



The bell and spigot end of the pipe are automatically deburred. Rotating cones deburr both the inner and outer edges of the pipe. The deburrers automatically adjust to the pipe diameter entering the system.

Increasing the speed on the front end is a future goal, Banks said. "But the number one priority is keeping up with our production and this new automation enables us to do that and to continue to deliver for our customers." ■

FURTHER INFORMATION



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The precast plant of the future

مصنع الخرسانة الجاهزة المستقبلي

The production of precast concrete elements with battery moulds ensures that the elements have formwork-smooth main visible sides. Thanks to various developments by the Magdeburg-based company B.T. innovation GmbH over the past few years, especially regarding the Butterfly Formwork® and the optimisation of battery moulds, the production technology around battery moulds has developed into a highly productive and precise production system, which delivers dimensionally accurate precast elements and meets the highest demands.

إن إنتاج عناصر الخرسانة الجاهزة باستخدام قوالب البطاريات يضمن أن يكون للعناصر جوانب مرئية رئيسية ناعمة الإطار. وبفضل التطورات المختلفة التي شهدتها شركة B.T. innovation GmbH التي يقع مقرها في مدينة ماجديبورغ على مدى السنوات القليلة الماضية، خاصة فيما يتعلق بمنصة Butterfly Formwork® وتحسين قوالب البطاريات، فقد تطورت تقنية الإنتاج القائمة حول قوالب البطاريات إلى نظام إنتاج عالي الإنتاجية ودقيق، والذي يوفر عناصر خرسانة جاهزة دقيقة الأبعاد وتلبي أعلى المتطلبات.

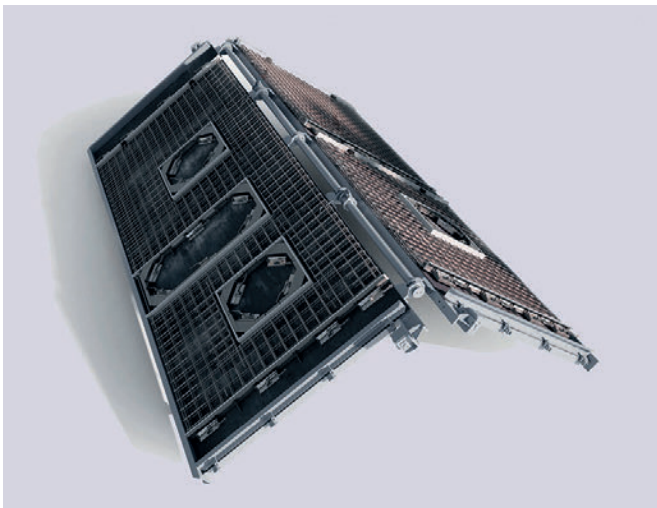
In a classic battery mould, formworks are mounted upright between two bulkheads or tensioning walls, creating a concreting chamber on the vertical formwork surfaces of the bulkheads. The inserted concreting chambers are concreted for the production of a finished part, after the battery mould has been braced. By using butterfly formwork, the work on a battery mould can be accelerated enormously and the quality of the precast elements can be improved. Butterfly formwork is a special type of bulkhead for battery moulds. They consist of two formwork panels that are connected to each other via a massive swivel joint.

Innovation in Waldmössingen

In a completed project by BT innovation at Beton-Fertigteile-Union GmbH & Co. KG (BFU) in Waldmössingen, Baden-Württemberg, a battery mould with butterfly formwork

was put into operation. The battery mould has suspended butterfly formworks. These are unfolded outside the battery mould at predefined workstations and prepared there for concreting in a horizontal position. By preparing the formwork in this way, the formwork surfaces can be walked on or accessed from the outside at any point, which means that the butterfly formwork can be set up quickly and precisely. The butterfly formwork prepared outside the battery mould is hooked into the battery mould from above with the help of a crane. As a butterfly formwork has two sides on which precast elements are produced, the capacity of a battery mould is thus doubled, as concreting chambers are created between each bulkhead on both sides of a butterfly formwork.

After bracing the battery mould, it is concreted. Once the concrete is stable, the precast concrete elements can be removed from the battery mould together with the butterfly



Butterfly mould before concreting



Battery and butterfly formwork at BFU

for faster construction



Mounting the Butterfly Formwork® in the battery mould



Butterfly Battery® with MagFly AP® magnetic stands

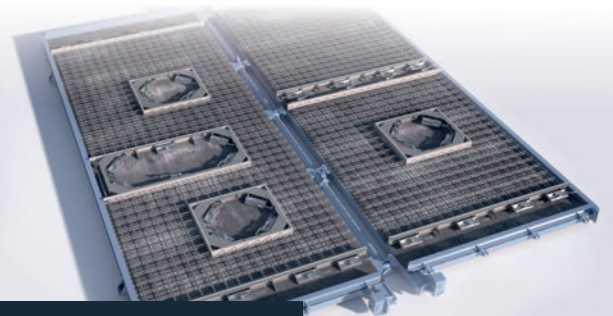


Butterfly Formwork when folded up

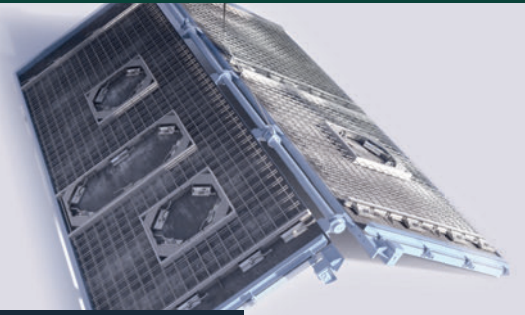
Butterfly Formwork®

Combine the advantages of horizontal preparation and vertical production

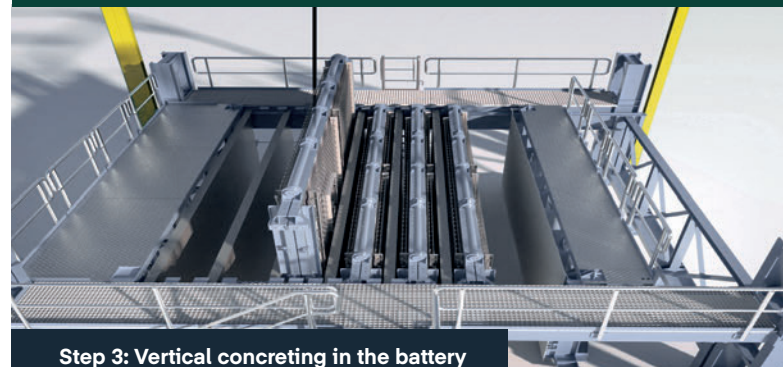
- ✓ Concreting up to 4 times per day
- ✓ Reduction of production costs by up to 40%
- ✓ Production of excellent smooth concrete elements



Step 1: Horizontal preparation



Step 2: Folding up the formwork



Step 3: Vertical concreting in the battery



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Production of room cells for modular construction

formwork, even before lifting strength has been reached, so that the battery mould is immediately available for another cycle. In this way, several cycles can be achieved per day, which, in addition to increasing the capacity by doubling the number of concreting chambers, also increases the productivity of the plant.

From the region for the region

This technology's advantages are constantly being developed further and there are already plans for new projects. In the northern part of Saxony-Anhalt, a battery mould with butterfly formwork is to be erected in a circulation system.

At the core of the circulation system is a battery mould with suspended bulkhead walls. What is new is that the butterfly formwork is prepared successively in a circulation around the battery mould, at specialised stations. This technique allows the flow of goods through the production facility to be kept streamlined and the butterfly formwork to be prepared in short cycle times. Common robot technology can support the production. The butterfly formwork, prepared in a horizontal position, is automatically guided through the production facility and automatically hooked into the battery mould. This can be done from "above" as well as from "below". With this technique, butterfly formwork is prepared quickly and precisely, and the battery mould is loaded immediately. As a result, the productivity of the battery mould is further increased. Inserting the butterfly formwork from below offers the advantage that such systems can also be operated in halls with low crane hook heights.

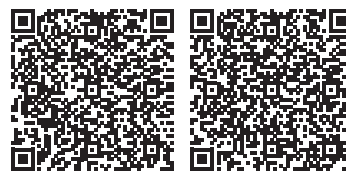
If an additional bypass station is created, decoupled from the circulation system, in which prepared butterfly formwork can be partially concreted and temporarily stored until the concrete is stable, the accessibility of sandwich walls in the battery mould is also possible without any problems.



Construction of a modular building

B.T. innovation GmbH

The name BT innovation stands for the future of product developments in the construction and precast concrete industry. The extensive portfolio comprising the areas of sealing, formwork magnets and systems, connection technology and consulting is further complemented by the high-quality machinery and production facilities of the partner company MAX-truder GmbH. With its patented solutions, B.T. innovation GmbH has been making an essential contribution to the successful implementation of construction projects all over the world for over 30 years. ■



CPItv
Videos on the efficient production of precast concrete elements with the Butterfly Formwork®

FURTHER INFORMATION



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Modular construction and 3D Prefabricated Bathrooms Units (PBU)

بناء معياري ووحدات حمامات مُسبقة الصنع ثلاثية الأبعاد (PBU)

Construction with 3D Prefabricated Bathrooms Units (PBU) can allow great advantages in efficiency, productivity, quality, and execution times compared to traditional systems. It could be considered as part of the so-called Construction with Prefabricated Pre-finished Volumetric elements (PPVC). This is a booming construction system, through which prefabricated three-dimensional concrete modules are used, which are pre-finished in a factory, prior to their installation on site.

إن البناء باستخدام وحدات الحمامات الجاهزة ثلاثية الأبعاد (PBU) يمكن أن يتيح مزايا كبيرة في الكفاءة، والإنتاجية، والجودة وأوقات التنفيذ مقارنة بالأنظمة التقليدية. ويمكن اعتباره جزءًا مما يسمى البناء باستخدام عناصر حجمية مُسبقة التشطيب ومُسبقة الصنع (PPVC). وهذا نظام بناء مزدهر، يتم من خلاله استخدام وحدات خرسانية مُسبقة الصنع ثلاثية الأبعاد، والتي تم الانتهاء منها مسبقاً في المصنع، قبل تركيبها في الموقع.

The advantages are numerous, it allows advancing with the production of these 3D modules in parallel to other initial phases of the construction project, considerably reduces the installation times, the necessary personnel and their qualification, and it allows achieving great efficiency, productivity and quality control, by carrying out most of the processes in the controlled environment of an industrial factory.

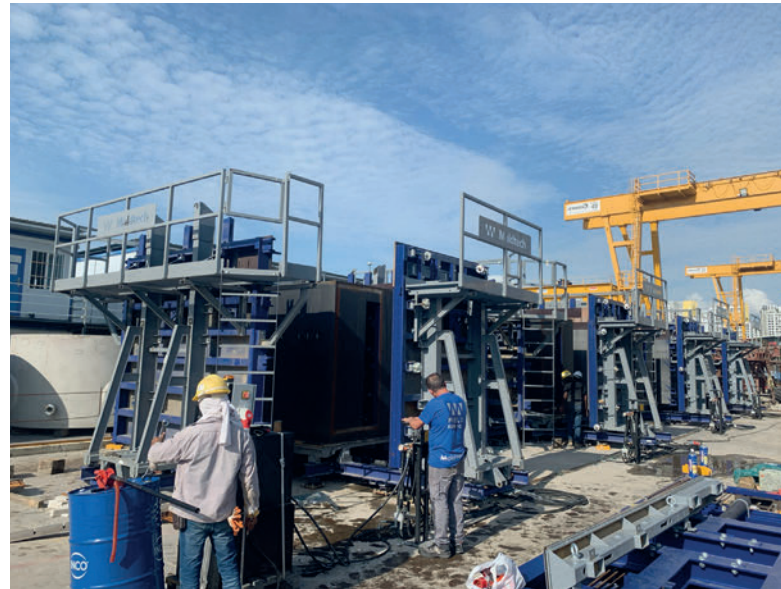
In the case of 3D PBU, even more efficiency can be achieved, with the finishing percentage reaching up to 90%, including waterproofing, tile installation, plumbing, electricity, finishes and accessories. So, these 3D bathrooms units are also used in combination other construction methods such as cast-in-situ or traditional precast construction with 2D elements.

Moldtech has recently installed 10 hydraulic moulds for the production of different types of 3D PBU for residential projects in Singapore. The client is one of the largest building contractors in the country, with extensive experience in the production of this type of elements and its own highly automated precast plant to ensure high efficiency and quality in the supply of precast elements.

The installed moulds allow a multitude of adjustments for different parts, such as wall thicknesses, unit heights, protruding reinforcements or the position of windows and doors, and ensure a very efficient manufacturing due to its completely hydraulic demoulding system. This allows an improvement



Hydraulic PBU mould



Testing of the mould by the Moldtech field service



Demoulding of a casted element



Casted element

in quality and productivity, being able to produce up to two pieces per day.

The exteriors are opened by means of hydraulic cylinders allowing the automatic extraction of door and window formworks. The hydraulic shrinking cores, allow demoulding of monolithic 3D PBU with straight walls in record time.

At Moldtech they are highly specialized in the design and manufacture of flexible moulds for 3D Modules (PPVC) and Prefabricated Bathrooms Units (PBU). The modular molds allow to adjust measurements in width and length of pieces within the same project and for future projects with low additional investment. As an option, the moulds can also feature an efficient heating system for accelerated concrete curing. In addition to the moulds, Moldtech can install accessory equipment for complete PBU and PPVC plants. Their adjustable hydraulic turners allow parts of different sizes to be rotated 180° to place them in their final installation position. They also design and install automated lines for the complete

finishing of parts in the factory, through a circulation system that allows great efficiency and flexibility.

Moldtech has wide experience installing this type of precast plants, with clients in countries such as Singapore, the United States, Malaysia, France, Saudi Arabia, Sri Lanka, or Hong Kong. ■

FURTHER INFORMATION



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New complete precast plant in Macedonia

مصنع للخرسانة الجاهزة جديد كامل في مقدونيا

Fabrikarpos is a leading precast construction company in Macedonia. Bianchi Casseforme s.r.l supplied all the equipment for their new precast concrete production factory.

تعد Fabrikarpos شركة رائدة في مجال الإنشاءات الجاهزة في مقدونيا. وقد زودت شركة Bianchi Casseforme s.r.l جميع المعدات لمصنعها الجديد لإنتاج الخرسانة الجاهزة.

The company was founded in 1948, under the Government of the Republic of Macedonia, the Minister of Industry and Mines, to accelerate the reconstruction of the country destroyed by World War II, adopted a directive n. 1334, to reconstruct the country.

The development of Fabrikarpos from its foundation till today has always been of growth, guided by three fundamental principles: Specialized products, constant modernization, adoption of new technologies and research.

Like many successful companies, Fabrikarpos bases its future development in finding and adapting new trends in architecture and construction, trying to satisfy its investors with the fastest, cheapest and the highest quality.

Fabrikarpos produces concrete and reinforced concrete elements with a well-developed range of products. The factory's activity extends from the production of reinforced concrete elements for the construction of industrial buildings, substations, transmission lines, bridges, to the production and installation of urban products.

In the spring of 2021, Fabrikarpos decided to expand its business with the construction of a new production plant for precast elements. Their chosen partner for this new facility was Bianchi Casseforme s.r.l., an Italian family-owned company, active worldwide since 1964 with a complete range of

services and products for the precast industry and industrial building precast sectors.

Equipment

- The prestressed elements production line includes: universal casting bed 100 m long and with a maximum useful width of 120 cm. The side moulds are placed on to this bed and locked by a special clamping device. Strands anchoring structures placed into pits in the floor for a prestressed force of a maximum of 1000 Ton capacity. Bianchi also supplied all hydraulic equipment for pre-stressing and relaxation strands: this included one hydraulic pump unit for the operate of simple effect relaxation cylinders, one prestressing hydraulic pump unit capable of operating alternatively two separate strand pre-stressing jacks, one 25 ton x 400 mm stroke individual strand pre-stressing jack and finally a strand pulling machine, to be placed between the strand reels and the stressing head, able to uncoil the strand and push it along the bed, with the help of a worker.

Several types of side mould were supplied for producing prestressed beams:

- T/L/R Beams: a pair of moulds length 31,5 m to produce concrete elements with rectangular, "L" or inverted "T" profile with linear section with variable base widths, and a height max. of 1400 mm. Curing of the prefabricated



Mould sides for double slope beams



Mould sides for I beams



Double mould for columns



Strands anchoring structure

elements after casting is by high pressure steam that run through finned pipes placed inside these moulds.

- Double slope beams: a pair of moulds to produce pre-cast concrete roof elements with a double slope of 12%, variable in length from 12 to 33 meters. Curing of the prefabricated elements after casting is by high pressure steam that run through finned pipes placed inside these moulds.
- Mould sides for I beams: a pair of moulds with a maximum length of 25 m to produce I beams with base width of 42 cm, height 120/140/160 cm. The side were divided

into two parts and changes to the height were achieved by inserting intermediate pieces 200 mm high. Curing of the prefabricated elements after casting is by high pressure steam that run through finned pipes placed inside these moulds.

- Mould sides for T beams: a pair moulds with a maximum length of 19 m to produce T beams with base width of either 15cm or 20 cm, and adjustable in height from 60 cm to 120 cm. The side were divided into two parts and change of height is achieved by inserting an intermediate pieces of 100/200/300 mm.

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Mould sides for T-beams



Self-reacting mould for TT slabs

All the moulds were manufactured out of sheet plate 6 mm thick, stiffened by a frame composed of other folded sheet plates and structural profiles.

Double mould for columns: Battery mould 36,00 m long of two parallel lines to produce columns rectangular in cross section, variable in size from 40cmx50cm to 100cmx100 cm, with the possibility of creating corbels on three sides in pre-defined sections of the mould. The mould was designed with a base frame and two separate soffits adjustable in height from 40 to 100 cm in steps of 10 cm, all mounted on top of vibration adsorbing pads. The moulds surfaces were all manufactured using 5 mm thick steel plate, stiffened by a frame composed of other folded sheet plates and structural profiles. Two external sliding sides with one steel plates 100 cm high. One double faced internal fixed side 100 cm high. The initial order included One number soffit 70 cm wide and one number soffit 50 cm wide. Hydraulic plant for to open/close the laterals side; it is complete with hydraulic pump unit, cylinders, and pipes. Finally, the mould was equipped with pneumatic vibrators plant.

Self-reacting mould for T beams/purlines: One mould 18,00 meters long divided into 4 parallel casting channels each able to produce pre-stressed beam beams 100mm wide at their base and 350mm at their widest and a maximum 650 mm high, shorter elements 110mm wide at their base and 350mm wide at their widest and 450 mm high can also be produced. The mould was entirely made of steel and featured prestressing strand heads at both ends to support a maximum self-stressing load of 450 tons also include was the pneumatic vibrators plant. The strands are cut under tension, as no relaxation was required.

Self-reacting mould for TT slabs: one mould to produce 16,00 meters of pre-stressing TT slab elements with a maximum slab width of 249 cm, variable in height with a maximum depth of 70 cm, vertical ribs base of 140 mm and constant in thick. The mould is entirely made of steel and features: a

base frame which supports of all the parts of mould including the sliding laterals parts of the mould, all mounted on vibration absorbers. Two hydraulic opening lateral side sliding on the base frame to maintain thickness of the vertical ribs. Two upper side shutters 50 mm which create the slab section of the beams. Two 14cm wide base soffits 16m long interchangeable if required including steel chamfer and rubber gaskets. One fixed central core made with bended steel plate 6 mm thick. The mould was entirely made of steel and featured prestressing strand heads at both ends to support a maximum self-stressing load of 300 tons, strand relaxation cylinders with collars were also supplied along with pneumatic vibrators. ■

FURTHER INFORMATION



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Construx bv, 8531 Hulste, Belgium

Belgian 3D mould manufacturer supplies 2 fully adjustable and automated substation moulds and a 180° turning station

الشركة المصنّعة البلجيكية للقوالب ثلاثية الأبعاد تزود قالبين لمحطة فرعية مؤتمتة وقابلة للتعديل بالكامل ومحطة انعطاف 180 درجة

As one of Europe's leading mould manufacturers, Construx conceived over the years a full range of state-of-the-art substation moulds. Either fixed, adjustable, or fully automated; substation moulds are among the most complex 3D-moulds due to the special design and technical specifications of these electrical transformer housings. Being 'Top of Mind' in electrical substation moulds, Construx became a leading supplier for most of the major European precast substation manufacturers.

باعتبارها واحدة من الشركات المصنّعة للقوالب الرائدة في أوروبا، ابتكرت شركة Construx على مر السنين مجموعة كاملة من أحدث قوالب المحطات الفرعية. وتعد قوالب المحطات الفرعية التي تكون إما ثابتة، أو قابلة للتعديل، أو مؤتمتة بالكامل، من بين أكثر القوالب ثلاثية الأبعاد تعقيدًا نظرًا للتصميم الخاص والمواصفات الفنية لمبنيات المحولات الكهربائية هذه. نظرًا لكونها "أول ما يخطر بالبال" في قوالب المحطات الكهربائية الفرعية، أصبحت شركة Construx موردًا رائدًا لمعظم الشركات المصنّعة للمحطات الفرعية الجاهزة في أوروبا.

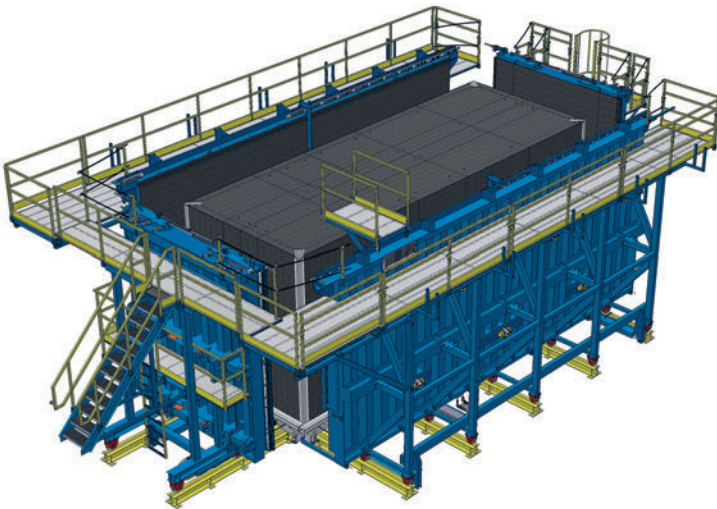
Recently, Construx supplied 2 fully adjustable and automated substation moulds and a 180° turning station to 2 different German customers. Both moulds have many possible combinations in length and width and are PLC-controlled. For one of the customers, Construx also supplied a 65T capacity 180° turning station.

Electrically and hydraulically operated and PLC-controlled fully adjustable moulds

The automation on these moulds is far above existing standards. The moulds are centrally operated with a PLC, which

means that all movements are fully controlled. The substations are poured upside-down and turned 180° on a 65T capacity turning station before they are transported by an overhead crane to the finishing bay. These fully adjustable, and electrically and hydraulically operated substation moulds are conceived to manufacture substation with a great variety of lengths, widths and heights. The use of interchangeable longitudinal and transverse inserts, bases and height adjusters ensure a full adjustability.

The outside moulds have 3 hydraulically movable panels, the fourth panel can be opened electrically over a distance of



Substation mould 3D design



Fully adjustable substation mould in one of the Construx production facilities



PLC controlled fully hydraulically and electrically adjustable mould

3000mm. The inside moulds have a fixed part and a movable part with modular intermediate parts. These interchangeable inserts can be fit in individually or together. The width of each module and of the complete inside mould can be adjusted with one single movement by means of electric spindles. The interchangeable inserts can be prepared on beforehand in order to speed up the adjustment of the mould.

When demoulding, first the inside corners are pulled down hydraulically after which the wall panels are also pulled down hydraulically, this leaves an 8mm opening on all sides. All hydraulic rams and electric spindles are controlled by means of a PLC with touchpad which also shows the workflow graphics. This way of controlling all movements makes the demoulding a fool-proof procedure. Vibrating the elements is done with high frequency vibrators.



Substation mould n°1:
24 possible combinations of length and width

Fully adjustable mould with 8 different lengths and 3 different widths:

- Inside length adjustable from 2180mm to 6380mm, with 600mm increments
- Inside width adjustable: 2300mm, 2500mm and 3780mm
- Inside height from 2500mm to 3600mm, steplessly adjustable
- Wall thickness adjustable from 100mm to 200mm, with 20mm increments
- Floor thickness from 120mm to 300mm, steplessly adjustable

Substation mould n°2:
33 possible combinations of length and width

Fully adjustable mould with 11 different lengths and 3 different widths:

- Inside length adjustable from 3800mm to 8880mm, with 500mm increments
- Inside width adjustable: 2300mm, 2800mm and 3300mm
- Inside height from 900mm to 3700mm, steplessly adjustable



Interchangeable insert



Fully automated 180° turning station with 65T capacity

- Wall thickness adjustable from 100mm to 220mm, with 20mm increments
- Floor thickness from 100mm to 280mm, steplessly adjustable

180° turning station

For manipulating the substations, Construx conceived a 180° turning station with a 65T capacity. This device consists of a set of 2 combined 90° tilting stations with a 6m transport system in between, so the customer can either tilt the elements 90° or turn them 180°. It also has a 14m long transverse movement for transporting the substations to the finishing bay.

Shaping the Future of Concrete

Construx meets the requirements of every customer, in order to obtain the most appropriate solution to manufacture their precast electrical substations. Construx is an engineering-driven manufacturing company relying on the commitment, creativity and experience of its employees. Their aim is to establish a partnership, rather than to be a supplier, in providing turnkey solutions for precast and on-site formwork issues.

FURTHER INFORMATION



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Another Successful Implementation of the Flexible 3D Mould System

تنفيذ ناجح آخر لنظام القالب المرن ثلاثي الأبعاد

Sanitary or bathroom pods, as prefabricated, pre-finished elements, are a common application of volumetric precast concrete elements often used in residential or hotel building projects. In Asia, the term PBU (Prefabricated Bathroom Unit), is commonly used to describe such elements. One of the main advantages of this system is the completion of architectural fit-out and MEP works in a controlled environment, resulting in better productivity and consistent quality. This results in an increase of complexity in the coordination and preparation of element drawings - making the level of detailing very crucial.

تعتبر الصناديق الصحية أو الحمامات، كعناصر مُسبقة الصنع مُسبقة التشطيب، تطبيقاً شائعاً لعناصر الخرسانة الجاهزة الحجمية والتي غالباً ما تُستخدم في مشاريع المباني السكنية أو الفندقية. في آسيا، يُستخدم مصطلح PBU (وحدة الحمام الجاهزة) بشكل شائع لوصف هذه العناصر. تتمثل إحدى المزايا الرئيسية لهذا النظام في استكمال التجهيزات المعمارية وأعمال الهندسة الكهربائية والميكانيكية في بيئة خاضعة للرقابة، ما يؤدي إلى إنتاجية أفضل وجودة منسقة. وينتج عن هذا زيادة التعقيد في تنسيق وتحضير رسومات العناصر - ما يجعل مستوى التفاصيل بالغ الأهمية.

With the flexible 3D mould kit, Ratec was able to provide an economical solution for the production of such elements of the highest quality. Ratec Asia, the company's Asia office based in Singapore, was directly involved in the planning and realization of a modern PBU production factory in the Philippines. The project involved the development of the PBU system, the planning and design of the production factory, and the supply of moulds and other equipment for their customers, Makati Development Corporation (MDC) and its subsidiary company MDC ConQrete, Inc. (MCI).

MDC is a leading Engineering, Procurement, Construction, and Construction Management company in the Philippines. The company is a wholly-owned subsidiary of top Philippine real estate developer Ayala Land, Inc. MCI, on the other hand, manages MDC's ready-mix concrete and precast production facilities and is the Philippines' leading supplier of high-quality concrete and precast concrete elements. These products are manufactured in various precast plants, allowing the company to serve hundreds of MDC projects across the country.



Four moulds of the flexible 3D mould kit were installed for the production of PBU (Prefabricated Bathroom Units).

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A turning unit was part of the scope of supply.

MDC has been a customer of Ratec and Ratec Asia for a long time - working together to innovate solutions in the field of magnetic formwork systems and pumping technology for MDC's precast plants.

The project with MDC began in the third quarter of 2019 when the company invested in PBU production. With extensive experience in PBU and modular construction in Singapore, Ratec Asia was engaged as a suitable partner for an end-to-end solution. Several flexible 3D mould kits from Ratec Asia have also been used in Singapore since 2019, allowing MDC an opportunity to get a close-up, hands-on experience with the formwork technology offered.

As part of the end-to-end solution provided to MDC, Ratec Asia was involved as a consultant in the development of the construction system, pushing for the adaptation of the Design for Manufacturing and Assembly (DfMA) philosophy and methodology. DfMA is one of the important pillars defined by the Singapore Building and Construction Authority as

part of its industry transformation roadmap. The strong level of adaptation of Prefabricated Prefinished Volumetric Construction (PPVC) and PBU, among other DfMA technologies in Singapore, provided the Asia Team ample opportunities to gain hands-on in-depth experience and knowledge in design and detailing, planning, production, and management of such construction systems. Through the experience gained in the application of DfMA throughout numerous projects, the Ratec Asia team has been able to provide MDC with holistic support in adapting the modular principle, preparing element drawings, and planning the plant, always with cost efficiency, productivity, and quality in mind.

The plant in San Felix, Batangas near Manila has a production floor of 30 Metres in width and 120 Metres in length. Together with MDC, Ratec Asia created the design concept for the bathroom modules and developed the requirement profile for mould development based on the various production parameters.

A total of four moulds were installed to produce two variants of the PBU system with a floor area of 4,12 Square Metres. For other variants, the formwork can be converted when necessary. For this purpose, the inner core and the outer panels are made up of standardized sections that can be adapted to other geometries by replacing or removing them. This way, the mould can be varied 450 Millimetres lengthwise and 300 Millimetres in width, and cover wall thicknesses between 75-125 Millimetres. Even the height of the modules can be changed from 2.00-2.90 Metres by adjusting the floor shuttering. Based on the customers' requirements and parameters provided, the moulds can be reconfigured to up to 63 different marking or module types - again demonstrating its flexibility.

Since the conversion of the mould takes up to a few days, the successive continuous production of each variant over a longer period optimally exploits the advantages of the 3D mould kit. Besides flexibility, this mould system is also characterized by a patented shrinking mechanism in which the inner core is shrunk, and the element is raised in the same operation - allowing a soft demoulding process - resulting in better productivity and quality of the end product. A turning station was also included in the scope of delivery. Further formwork components for recesses such as shrinkable doors and window frames were also provided.

The plant was designed to achieve MDC's target of producing up to 2000 PBUs per year. The experience of the German and Asian teams in modular construction and mould development enabled Ratec to adequately support MDC in the development of the PBU system, the planning of the factory, and the equipment with formwork and machine technology. In addition to the formwork planning and optimization, the overall processes in production were optimized as part of the installation planning, minimizing handling and processes to optimize output. Special considerations in the alignment of formwork, crane planning, and equipment placement are taken to ensure this.

The project was an international collaboration of teams from the Philippines, Singapore and Germany.



With the team having ample experience and hands-on knowledge of actual production, Ratec can provide initial production management support to their customers, shortening their learning curve.

Results

Compared to conventional project-related installed moulds, the use of the 3D mould kit can achieve up to a 77% increase in efficiency, measured by man-hours, and a 64% increase in speed, measured in the total time for the completion of a PBU. "This project was challenging in many ways," says Raymond Chan, Director of Ratec Asia. "An international collaboration of teams from the Philippines, Singapore, and Germany, as well as the aligning of different expectations and requirements - was made even more difficult when the pandemic struck. But MDC's determination remained strong and their confidence and trust in us never wavered in the light of the many challenges. We are glad that we never let them down. When we visited the plant for the first time, one word immediately came into mind: impressive! Kudos to all involved. Great job."

Milbert C. Payumo, MCI Precast General Manager at MDC, was very satisfied with the outcome: "Ratec has been a great partner in providing solutions and products to our company. Ratec catered to our requirements by efficiently producing quality precast products using their high-precision moulds and forms, and in turn, effectively cutting our costs for defects and reworks. As our catered products continue to grow, we are excited and confident to work with Ratec who will accompany us in championing our future expansions." ■



Video about the flexible 3D mould kit in PBU production in the Philippines



FURTHER INFORMATION

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Variables in the execution of floors with modern pre-stressed concrete hollow core slabs

المتغيرات في تنفيذ الأرضيات باستخدام الألواح الأساسية المجوّفة الخرسانية مُسبقة الإجهاد الحديثة

Handling multiple variables at once in engineering often requires successive iterations before concluding cause effect relations. In this article they will be named and treated separately, with a short description and eventually in the best case, an order of magnitude of the benefit that adopting each of the options considered suitable supposes in modern precast.

إن التعامل مع متغيرات متعددة في وقت واحد في الهندسة غالبًا ما يتطلب تكرارات متتالية قبل إبرام علاقات السبب والنتيجة. وفي هذه المقالة سيتم تسميتها ومعالجتها بشكل منفصل، مع وصف موجز وفي النهاية في أفضل الأحوال، ترتيب حجم المنفعة التي تتبني كل خيار من الخيارات التي تعتبر مناسبة في الخرسانة الجاهزة الحديثة.

Obviously, the starting point when dealing with the production of hollow core slabs is the concrete used. The machines of mechanical casting work with a zero-cone concrete, while the in the flow casting it is sought to obtain a degree of plasticity on the concrete using advances in the plasticizers and water reducers available in concrete industry.

Geometry

It is surprising to see how the "Gosudartsvenny Standards" still read hollow core spans in fix increment steps of 600 mm, or in Uzbekistan most of the slabs used at the sites are of thicknesses 220 mm. and 300 mm. and yet the users are still having to deal with and accept certain limitations referred to the geometry of the pre-stressed concrete elements.

Width of the slabs

At the final stage in the production of hollow core slabs, they are cut to specific span lengths. The most frequently used width is 1.2 m although in certain Eastern Europe countries the 1.5 m. width is used as well. For thicknesses of up to 300 mm. it is also possible to produce them 2.4 m. wide would the

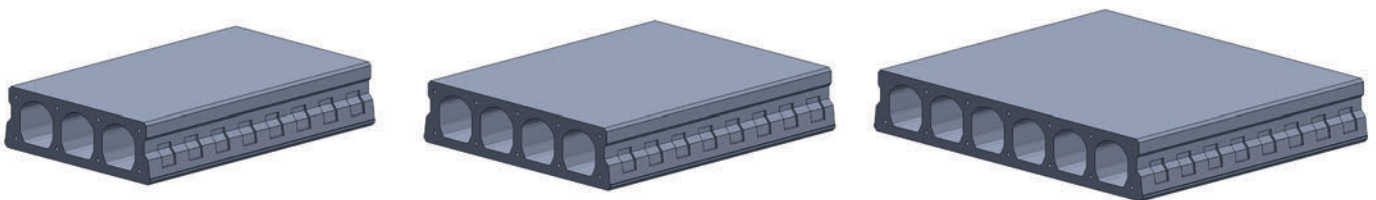
elevation means and the safety working conditions allow it. However, the floors might not be sized as a multiple of 1.2 m. in which case a small shuttering is provided to finalize with in-situ concrete, or a longitudinal cut is made on a standard slab to fill the gap.

The production of 1.2 m. wide slabs to cut them on their full length to obtain a smaller width, means a loss of material with added value, since the slab is already finished. Therefore, the cost of the fabrication waste is not only associated to the loss of materials but also to the labor, and the crushing and steel separation tasks.

When the plastic concrete flows through a static mold, the fractional width is obtained reducing the number of cores or modifying the thickness of the removable mold sides for a fine adjustment. This method avoids the production waste.

Thickness of the hollow core slab

In the same way that any length or width of hollow core slab can be obtained, it is also possible to cast them in any thickness.



Hollow core slabs with a width of 1.2 m or fraction thereof without production losses.

Nowadays, when the thickness of the necessary slab is not available on the pre-caster's catalogue, the next superior thickness must be often used, which results in additional weight of the structure with the related increase of its inertia.

In projects involving a big carpet area, a dedicated mold of specific thickness is justified, and its cost easily balanced by the materials saving.

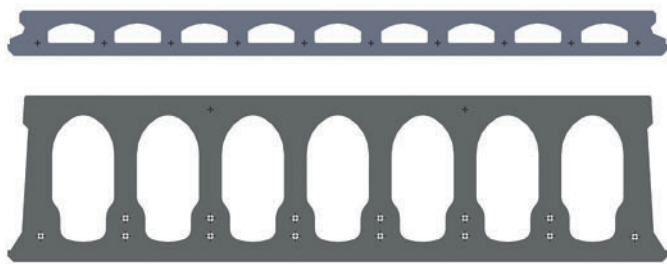
Number and shape of the cores

Both the flow formers and the mechanical casting machines have a restricted width due to the size of the production beds. However, in the second case, the mechanisms necessary to the production with a given number of cores are confined

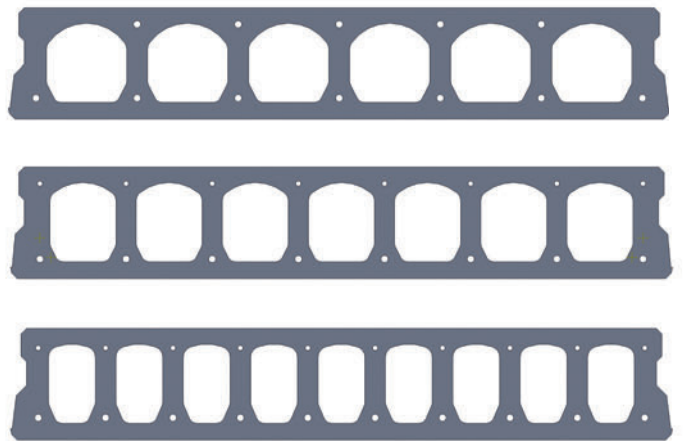
within a limited available space. The higher the number of cores, the more transmission elements and driving units are required.

A flow of plastic concrete can be shaped with the number of cores of the customer's preferences and according to the codes, from 80 mm to 600 mm.

Less circular cores as big as possible doesn't necessarily mean less weight per square meter of hollow core slab.



Different shapes of the cores



Different number of cores for the same slab thickness.

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The number of cores is influential in the shear capacity of the slabs, the strand patterns, and their assembly mode

Strand pattern

The number and shape of the cores result in the available space to place the pre-stressed strands or wires. The higher the number of cores, more theoretical positions to place the steel, while the concrete cover distances are respected.

In the following figure, in the slab with 6 cores it is possible to place 3 additional strands compared with the 4 cores design and with a more uniform distribution across the section. Consequently, a bigger number of strands results in a higher bending moment capacity for the same slab thickness. Such strand distribution is favorable when the slabs are cut at the end of the production process because it avoids the pre-stressing concentration in certain spots which could cause the shearing of the slab; this is called the ‘spalling’ effect.

Another way of avoiding this inconvenient with heavily reinforced pre-stressed slabs, is the production of the slabs with a track of exposed wires at both ends. See ‘Building Method’.

Building system

The pre-stressed concrete hollow core slabs can participate in different ways in the building method, provided they are produced with certain characteristics.

Exposed wires

Instead of cutting the concrete slabs according to preset spans, they are produced with the strands protruding a fix distance from both ends.

During the fabrication, the concrete is held upstream the mold while the casting machine keeps on moving forward. A track of exposed wires without concrete is then obtained with a length and position set by the machine automation. In this production modality, with the ‘exposed wires’ operation mode enabled, the concrete cutting machine is no longer

required. The slabs are cut easily at the exposed wires so that half of the track belong to each of the two consecutive slabs.

The behaviour of the slabs produced with tracks of exposed wires with regard the rest of the building structure and to the supporting beams is as follows:

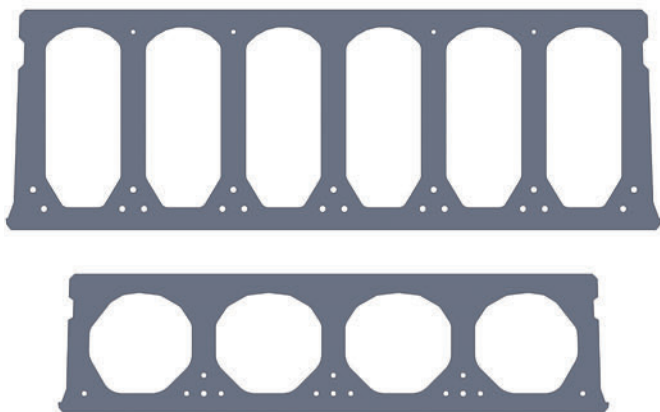
- a) The slabs may be designed with additional pre-stressed steel across the section without being affected by the spalling effect the cut happens at the track without concrete.
- b) The track of exposed wires protruding at the end of the slabs work in dowel action with the grout pored at the joint and the loops of the supporting beams.
- c) The exposed wires then work avoiding the tension across the longitudinal joint between adjacent slabs, this is collaborating in the membrane function of the hollow core slabs on a floor.

Furthermore, the lines of exposed wires help to a partial restraining of the slab, which avoids the torsion with respect to the slab’s central longitudinal axis. Therefore, the stresses and vibrations are not transmitted, favoring the integrity of the joint during the life of the building.

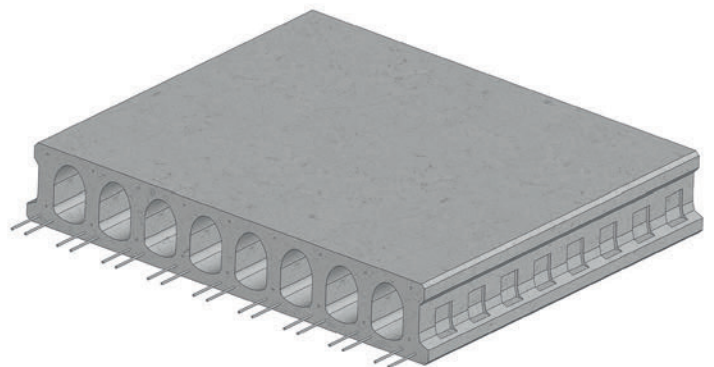
The production of slabs with exposed wires has an advantage when comparing with the use of reinforced concrete filigree slabs, since they do not require reinforcement bars or a grid band across the joint, which is an intensive labor task.

Side indenting

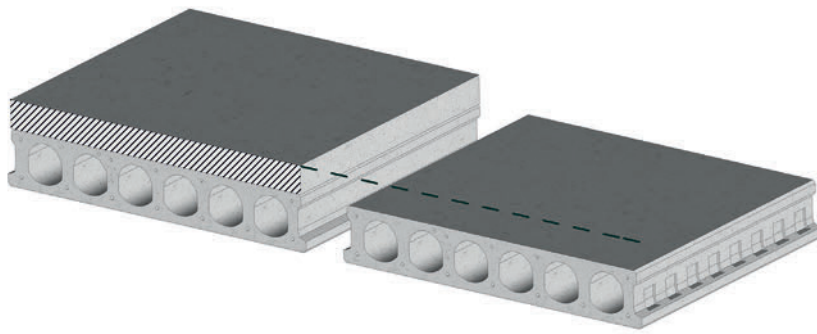
Both the mechanical molding and the concrete flow casting machines produce the hollow core slabs with smooth surfaces, according to the terminology of the Eurocode 2. At the factories, the slabs’ top surface is scratched so that the concrete topping attaches well and it is really working in composite action with the slabs in the presence of a utilization load. However, the slabs may increase the capacity to generate additional friction between them and the concrete added at the longitudinal joint, this is between concretes cast at different times, provided the surface interface gathers certain charac-



#19 cables distributed in 7 positions, or #16 cables distributed in 5.

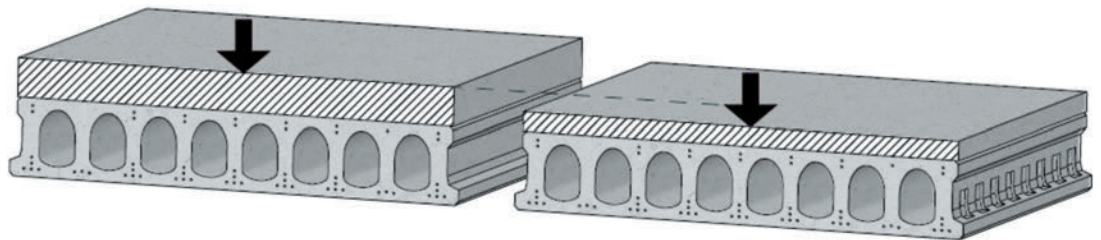


Hollow core slab with exposed wires at both ends



Comparison of hollow core slab with topping and without topping.

Different heights of topping on a hollow core slab.



teristics. Most of the international codes deal with the friction at the concrete surfaces.

The American ACI318 distinguishes between smooth surfaces and intentionally roughened, provided there is 1/4" from peak to valley. In this case, there is a mechanism for the transmission of additional shear.

The Eurocode 2 about concrete structures is not using the term roughness but the indenting and it defines its geometry in the paragraph 6.2.5.

Another chapter of the same code, 10.9.3 (12) indicates that if the slab concrete surface is smooth the friction between slabs and concrete at the joint must be limited to 0,15 N/mm².

Note: as order of magnitude, an indented surface even without compression forces across the joint, develops an average friction of up to around three times this value. (See for example: 'Precast Concrete Structures, 2nd Edition published by IPHA).

The European Norm EN1168 about the design of the concrete elements mentions specifically the side indenting in the Annexes when states that in seismic zones the hollow core slabs must have a side indenting or in its absence a concrete topping of at least 40 mm. with steel grid must be laid on the top.

Else, the Joint Research Center also mentions the side indenting on the slabs to increase the friction at the joint; see the EUR JRC37588 document

Some countries have decided building the floors with hollow core slabs without topping. The friction generated by a topping of a certain thickness is given by the general equation

$$V_c = b_w * d * f_v$$

Provided the side indenting creates an additional friction at the longitudinal joint equal or bigger than the friction de-

veloped by the concrete topping, and the live loads are uniformly distributed, the topping may be removed.

Top marking of the hollow core slabs

The definition of indented surface is not applying to the sides of the slabs only, but to the top surface as well.

Connection of hollow core slabs in continuity

Regarding their assembly, the hollow core slabs can be placed simply supported or with the ends restrained.

The Bulletin 6 of the Federation International of Concrete (fib - Lausanne, Switzerland) treats the connections for continuity and the negative bending moments. In the conclusions, they find the hollow core slabs with higher number of cores have higher bending moment and shear capacities.

Conclusion

The decision on the utilization of plastic or zero cone concrete in the production of hollow core slabs and other pre-stressed concrete elements, must be made taking in consideration all the variables affecting the production cost in comparable value units. ■

FURTHER INFORMATION



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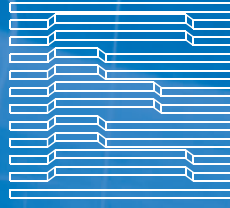
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