

BT innovation, 39116 Magdeburg, Germany



Increasing process and product quality as well as production capacity with new hydraulic butterfly battery mould

■ Christian Jahn, CPI Worldwide, Germany

Higher process quality, higher product quality and doubling of production capacity - the precast concrete manufacturer Beton-Fertigteil-Union (BFU) in the Black Forest region of southern Germany achieves all this with a new hydraulic butterfly battery mould and the associated two work stations with laser projection system. With the plant equipment from manufacturer BT innovation, BFU produces mainly solid walls, but also balconies and even columns for construction sites in southern Germany and Switzerland. With the exception of the filling side, the precast elements made of self-compacting concrete are absolutely smooth all around and of excellent quality.

“A surface cannot be smoother”, Volker Koch runs his hand over a solid wall that has just been produced and set up vertically in the production hall. The surface is even, no formations of air bubbles are visible, the colour is even throughout. “The quality of edges and surfaces of the window recess is also flawless. That really impressed me positively,” says the Graduate Engineer and Managing Director of the precast producer Beton-Fertigteil-Union (BFU), based in Schramberg-Waldmössingen in the Black Forest region of southern Germany. Koch is very satisfied with the product quality - and especially

with the new plant equipment that makes this high quality possible in the first place. In the production hall, which was completed in 2019, the new plant currently occupies just under a third of the usable space in one of two 1,750 m² hall bays.

The plant consists of the so-called butterfly battery mould and two work stations arranged directly next to it. Work station one is equipped with a device for automatically opening and closing the two formwork panels of the so-called butterfly formwork (the two formwork panels are connected to each other by a robust hinge), which was previously removed from the battery mould by an indoor crane and transported to the work station.

After the butterfly formwork has been opened on work station one, it is transported from there with the help of roller conveyors/friction wheel drive to work station two, where the preparatory work is carried out and shuttering parts, built-in parts and reinforcement are placed.

All plant equipment components come from manufacturer BT innovation, headquartered in the German city of Magdeburg, and are painted in orange and black, the corporate colours of precast concrete producer BFU.



Fig. 1: German precast producer BFU successfully commissioned the new butterfly battery mould with butterfly formwork from BT innovation at his production site in Schramberg-Waldmössingen at the beginning of 2021.



Fig. 2: The BFU headquarters in Schramberg-Waldmössingen was built in 2013 - of course using precast concrete elements from the company's own production.

The butterfly battery mould has its own control panel; likewise, the two work stations together with the roller conveyors have their own control panel. The entire control technology was supplied by Wiggert.

Process and product quality

“With the new plant equipment, we wanted to achieve two quality goals in particular: Firstly, we wanted to further automate the production process and achieve greater precision in the implementation of the production steps,” says Koch. We were able to successfully implement this plan because with the butterfly battery system, all preparatory work is carried out on the horizontally positioned formwork panels. This in turn makes it possible for laser projectors to project the positions of shuttering parts, built-in parts and reinforcement from above onto the formwork panels with high precision.

“Secondly, we have succeeded in increasing the already very high quality of our products even further,” says Koch.

This was achieved thanks to the outstanding quality of the formwork panels of the butterfly formwork - the steel panels are manufactured seamless and butt-free from one piece, finely levelled, blasted and ground according to the agreed roughness; they enable the production of perfectly smooth precast element surfaces. Thanks to the aforementioned laser system even the outer contours of the precast elements have an optimal geometry with minimal tolerances.



Fig. 3: Managing Director and Graduate Engineer Volker Koch of German precast producer BFU in front of a 3.48 m high wall - the highest wall the company has produced so far with the new butterfly battery mould.

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Fig. 4: Frontal view of the still unclad, movable tension wall of the butterfly battery mould; four hydraulic cylinders on the lower, longer edge of the tension wall ...



Fig. 5: ... and two hydraulic cylinders attached to the frame of the battery mould guarantee a tight closure of the casting compartments.

BFU also produces all precast elements in the butterfly battery mould from self-compacting concrete. The SCC has a high proportion of fine aggregates and is self-de-aerating – both of which contribute to the excellent surface quality of the precast elements, without cracks, gravel pockets or visible formations of air bubbles. With the exception of the filling side, the manufactured precast elements are absolutely formwork-smooth (fair-faced) all around, on five sides, including the edges and surfaces of recesses.

Production process

Battery moulds have been around since the 1960s. They are used for the simultaneous production of several flat precast concrete elements in a vertical position. For this purpose, concrete is poured from above into the casting compartments, which are formed from the bulkhead walls of the battery mould. The production method requires little floor space in the production hall and is considered efficient and cost-effective.



Fig. 6: The control panel for the two work stations, with a butterfly formwork each lying open (immediately to the left and right behind it) and the side view of the battery mould in the background – the battery mould has its own control panel.



Fig. 7: View from the side catwalk of the battery mould down to the two work stations with the butterfly formwork lying folded out – on the right-hand panel of the completely visible butterfly formwork, the shuttering for three columns for the interior of a building is visible.

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Fig. 8: For use in production at the manufacturer Beton-Fertigteil-Union, the profile of the MultiForm formwork beam was adapted and reinforced; it was also designed so that more MagFly magnets can be placed at smaller distances from each other. The shuttering can thus withstand high pressure when concreting vertically in the butterfly battery mould.

The plant manufacturer BT innovation succeeded in further developing the technology of the battery mould system and launched its new version on the market in 2016 under the brand name "butterfly battery mould" (see CPI Worldwide 02/2017). The innovation: so-called "butterfly formwork" is suspended in the frame of the butterfly battery mould - a butterfly formwork consists of two formwork panels, each of which is connected to one another on one of its long sides by a robust hinge (hence the comparison with a butterfly: the hinge reminds of the centrally arranged body, the two formwork panels on the left and the right of it remind of the wings). The casting compartments, into which the concrete is later poured from above, are created together with bulkhead walls already present in the battery as well as side and bottom shuttering parts, which are attached between the butterfly formwork and the bulkhead walls.

The design of the butterfly formwork has the decisive advantage that the formwork can be unfolded on a work station next to the battery. The two formwork panels of the butterfly formwork then lie next to each other and can be conveniently prepared in the horizontal plane at working height by the production workers for the subsequent concreting and provided with shuttering parts, built-in parts and reinforcement (similar to the preparation process at a tilting table).

"In our case, the formwork panels are each 8 x 3.5 m in size," says BFU Managing Director Koch. With optimised planning

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Fig. 9a+b: A lifting beam is connected to the hinge of the butterfly formwork.

Detailed view: When the butterfly formwork is lifted off the workstation, the arms of a special device gently guide the two formwork panels together; when the butterfly formwork is lowered onto the workstation, the two arms of the device guide the formwork panels apart.

using software from Precast Software Engineering, BFU is currently achieving an occupancy rate of up to 70 % of the surface space of the panel. The highest wall that BFU has produced so far with the butterfly battery mould stands in the courtyard in front of the administration building. "It has a height of 3.48 m - so, concerning the width of the formwork panel, the occupancy was of course optimal in this case," says Koch.

High-precision positioning of built-in parts using lasers

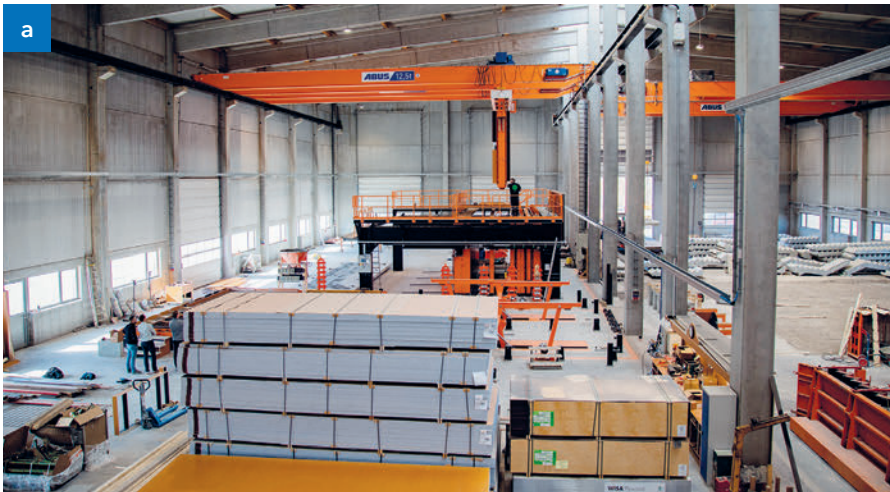
BFU uses two LP-HFD2 laser projectors with a green laser source from the manufacturer Z-LASER GmbH to project the

positions of shuttering parts, built-in parts or lattice girders with high precision onto the surface of the formwork panels of the butterfly formwork. The lasers are mounted in the hall at a height of 10 m above the surface of the formwork panels. In order to be able to project a thin, easily recognisable line onto the surface from this height, the projectors are additionally equipped with tele-optics.

The laser projectors are integrated into the computer-controlled processes of work stations one and two via special software. From the CAD/CAM data, which are created at BFU from the planning software of Precast Software Engineering, the data required for the laser projection are selected project-related and manually by the system operator at the Wig-



Fig. 9c-e: Two Abus indoor cranes, each with a load capacity of 12.5 tonnes, lift the prepared butterfly formwork until the backs of the two formwork panels touch (the prepared formwork panels face outwards).



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Fig. 10a+b: Hovering and positioning of the closed, prepared butterfly formwork above the battery mould. In the middle of the upper photo, directly next to the battery mould, the maximally extended, orange-coloured arms of the device for opening or closing the butterfly formwork can be seen.

gert control panel and loaded into the so-called LPM software of Z-Laser. Work stations one and two at BFU do not have a device for centring the butterfly formwork. Therefore, the laser system provides for the positioning of the laser drawing of the respective wall elements to be produced on the formwork panel by infrared remote control. In this way, the optimal pallet layout generated in the Precast Software Engineering software can be precisely mapped on the surface of the formwork panel.

The production workers can easily recognise the outlines of the parts to be installed, which are clearly projected onto the surface of the panel with a green laser line and set the parts effortlessly.

Once this work is done, the indoor crane pulls the hinge again and lifts the butterfly formwork with its two formwork panels off work station one. The formwork panels fold together (the two formwork panels prepared for concreting face outwards). The crane transports the butterfly formwork to the battery frame and hangs it there between two bulkheads. With only one butterfly formwork and its two outward facing formwork panels and the formwork panels of the bulkhead walls to the right and left of the butterfly formwork, two casting compartments can be formed at the same time.



Fig. 11: Freshly demoulded walls - with the exception of the filling side, all five sides and the edges and surfaces of the recesses are absolutely smooth.

Hermetic sealing of the casting compartments

When the butterfly battery mould at BFU is fully loaded, the butterfly formwork and bulkheads are braced with the fixed tension wall (end panel) and the movable tension wall so that the casting compartments withstand the hydrostatic pressure during concreting.

For hermetically tight bracing, the butterfly battery mould at BFU has a system with a total of six hydraulic cylinders - four cylinders attach to the longer lower edges of the fixed and movable tension walls (see Fig. 4); another cylinder attaches to the upper end of each of the shorter right and left edges of the fixed and movable tension walls (see Fig. 5).

Doubling the capacity

BFU produces with the butterfly battery mould in one-shift operation - the precast elements cure overnight for around twelve hours and are demoulded by the early shift.

In principle, however, the butterfly battery mould from BT innovation allows up to three concreting operations in three-shift operation and within 24 hours. This is because after only four hours, the SCC has reached an early strength of 3 to 8 N/mm² and the butterfly formwork can be removed from the

Beton-Fertigteil-Union - the company

The precast concrete producer Beton-Fertigteil-Union (BFU) is based in Schramberg-Waldmössingen, in the Black Forest region of southern Germany, about 90 km southwest of "Porsche city" Stuttgart.

BFU sees itself as an innovative and quality-oriented manufacturer of precast concrete elements. Customers are private builders, commercial investors and the public sector in the segments of residential, industrial and commercial construction.

The company produces precast concrete elements (walls, ceilings, stairs, special parts), structural precast concrete elements (columns, beams/joists, balconies, sandwich panels) and architectural precast concrete elements in various colours and with different surface structures and finishes.

References from BFU include the ice hockey stadium in Villingen-Schwenningen (completed in 2020), the Intersport Gruner shop building with a striking precast concrete façade in the city of Constance on Lake Constance (2009) or the BFU administration building in Schramberg-Waldmössingen (2013; see Fig. 2). BFU sells its products mainly in the southern German state of Baden-Württemberg and in neighbouring Switzerland, where the company also implements numerous projects with partners using the BIM approach.

With around 90 employees (of which around 63 work in production), BFU produces precast concrete elements with a volume of 16,000 m³ per year. According to Managing Director Volker Koch, the company's turnover in 2020 was around 16 million euros.

battery mould and stored in the hall until the precast element inside has completely hardened. At the same time, another prepared butterfly formwork can be placed into the frame of the battery mould again for the next concreting process - concreting is also to be automated in the near future with the help of a concrete pump.



Fig. 12: Ready for transport - with BFU's own trucks and inloaders from Faymonville, the high-quality, fair-faced precast concrete elements reach the construction sites in the southern German state of Baden-Württemberg and in neighbouring Switzerland.

PRECAST CONCRETE ELEMENTS

With the new butterfly battery mould from BT innovation, the medium-sized precast concrete manufacturer BFU can decisively increase the quality of its processes and products, and its production capacity is also growing: "So far, we produce around 16,000 to 18,000 m² of wall per year. I assume that we will be able to easily double this quantity in the near future thanks to the butterfly battery mould," says BFU Managing Director Koch confidently. The interest of customers in the sales regions of Baden-Württemberg and Switzerland in the high-quality precast concrete elements from Schramberg-Waldmössingen is already gratifyingly high. ■

FURTHER INFORMATION

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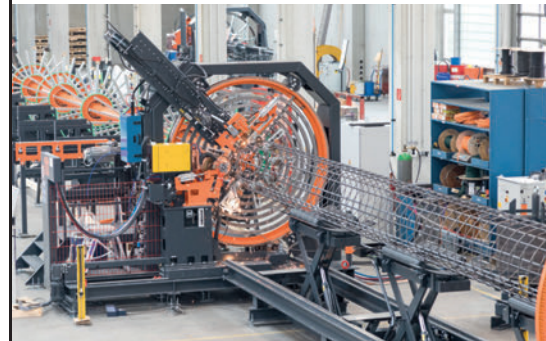
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