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Innovative self-reacting prestressing beds with flexible girder moulds installed at the Betard plant in Poland

Betard is one of Poland's leading manufacturers of prefabricated reinforced and prestressed concrete elements. Next to stairs, hollow core slabs and wall panels, they also produce prestressed concrete girders for bridges and industrial buildings. As being one of the n°1 precast mould suppliers in Poland since several years, Construx already installed different types of fully adjustable stair moulds at the Betard plant in Długołęka, near Wrocław. This is why Betard requested Construx to design a complete package of prestressing beds with a complementing flexible and adjustable girder formwork system.

Self-reacting casting beds

Betard required two prestressing lines, one needed to be 52m long and the other one 78m long. Betard insisted in getting a flexible and affordable solution for the two prestressing lines. They did not want to invest too much in foundation works because the prestressing lines might need to be extended or moved to another facility in the future. To meet this requirement, Construx designed the prestressing lines as self-reacting beds. This means that the bed takes all the prestressing forces and no abutments are required. Both beds are conceived as a modular setup with a live-end and a dead-end, both with a 6m long bed part connected to the end structure. In between both ends, the bed is assembled with 12m long modular bed parts.

All bed parts as well as the live-end and the dead-end are held onto the factory floor by means of sliding foot plates, so the entire bed can slightly move back and forth. The foot plates of the bed parts are fixed by means of mechanical anchors, the foot plates of both live-end and dead-end are fixed onto the factory floor with grouting anchors. So, the modularity consists in having a live-end with a 6m bed, a dead-end with a 6m bed and several 12m long (or shorter) bed parts fitted in between.

This setup allows Betard to be extremely versatile and flexible for future projects. The shorter, 52m long, bed is suitable to manufacture 2 prestressed elements of 24m in length. The other bed, which is 78m long, can accommodate 4 prestressed elements of 18m long. Both self-reacting beds have a 600T prestressing capacity, which is divided with following eccentricity: 90% at 300mm height and 10% at 1500mm height. Both live-ends are equipped with 4 single-action hydraulic rams with a 300mm stroke: 2n° with a 300T capacity and 2n° with a 100T capacity.

One hydraulic group with controls operates both live-ends. Both live-ends as well as both dead-ends are equipped with a very thick and solid steel pattern divider plate. The position of the holes in these plates is according to Betard's standards and is as high as 1500mm above the bed surface. In between both ends, the beds are 1500mm wide and 52m/78m long.



Live-ends of both self-reacting beds



Dead-end of self-reacting bed

PRECAST CONCRETE ELEMENTS

Taken into account the thickness of the different moulds, the workable width of the beds is 1000mm, which is the maximum width of Betard's prestressed elements. A repetitive pattern of holes along both sides of each bed allows the fixation of different types of girder moulds. It is a 50mm increment pattern which is very precisely laser cut every 1000mm on both sides of each bed. The 50mm modulus holes serve to bolt down the bottom of the moulds.

Both beds have incorporated heating pipes underneath which are connected to a hot water boiler. Another great advantage of these self-reacting beds is the speed of installation. From scratch, it didn't even take 2 weeks for the Construx technicians to have both beds completely installed and commissioned. Up to 2 weeks before commissioning, the customer can use the same facility for other purposes. When choosing the abutment type prestressing lines, the installation may easily take more than a couple of months for civil works. Works to be carried out at both ends (deep excavations and large and heavily reinforced foundations) and in between the abutments (heavy-duty reinforced floor). The future is with the multifunctional self-reacting beds: quick, flexible, versatile and above all value for money. It is one of the most economical ways of producing prestressed concrete elements.

Three different adjustable girder formwork systems

Betard invested in 3 different types of adjustable girder moulds, in order to cover all their requirements: I- and IV beam moulds, rectangular beam moulds and inverse T-beam moulds. All 3 types can easily be fitted onto the self-reacting beds, the 50mm increment pattern of the beds corresponds with the holes in the bottom of the moulds.

Construx also included an extra fixing system which consists of foot plates with the same 50mm increment pattern and a horizontal connection to the moulds. This system can be used when both sides of the mould are too close together and out of reach from the 50mm hole pattern of the bed. In length, the moulds are all 3 conceived as modular systems, they have 12m, 6m, 4m, 2m and 1m long parts. This avoids mould parts sticking out too far beyond the prestressed concrete elements, which would cause a large gap in between 2 elements. This would result in a waste of strand and a low bed efficiency.

The I- and IV-beam mould system for bridge beams and roof girders is suitable to manufacture elements of up to 1700mm high. Construx supplied 2 complete 32m long double-sided moulds. The first 32m long set consists of 4 moulds of 6m and 4 moulds of 2m. The second 32m long set consists of 2 moulds of 6m, 2 moulds of 4m, 4 moulds of 2m and 4 moulds of 1m. The mould is conceived as an open frame with a longitudinal rigid base and 1995mm high vertical posts.

Both sides of the mould are interconnected at the top of these posts with tie-rods and fixed onto the self-reacting bed with bolts through the holes in the base. The distance in between both sides of the mould can be adjusted in accordance with the 50mm increment pattern of the bed, although most of the I- and IV-beams are made with a 400mm standard base width.



Precast Moulds & On-Site Formwork

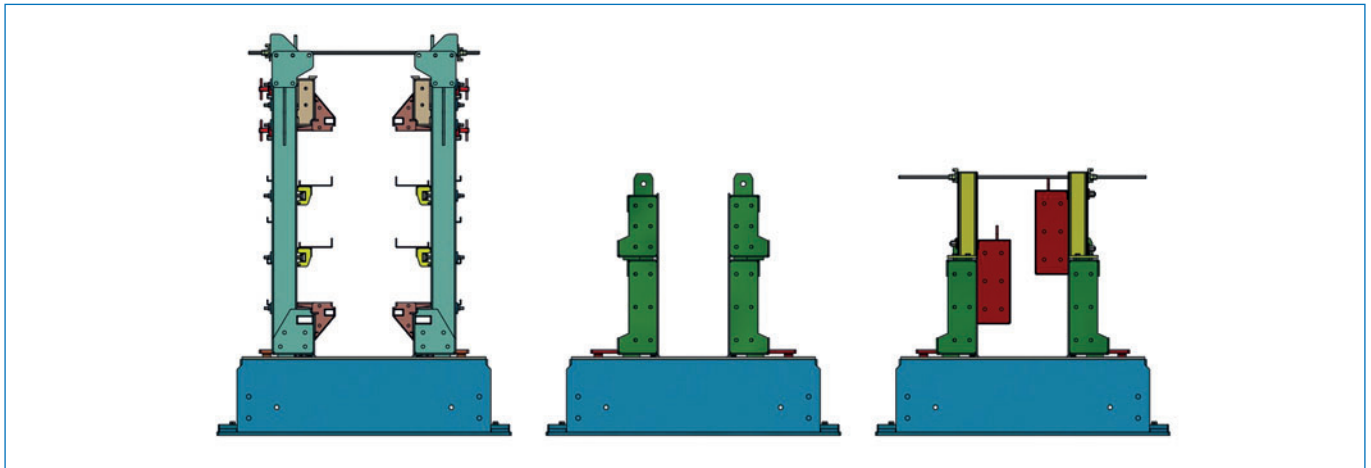


Shaping the Future
of concrete

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Three different adjustable girder moulds



Self-reacting bed with adjustable IV-beam mould



Demoulding of I-beam

The adjustable chamfers creating the taper of the flange of the I and IV shape are 125mm deep and have a 40° angle. A cut to measure plywood covers the gap in between top and bottom chamfers and is held in place by means of horizontal supports. The thickness of the flanges, top and bottom, may vary between 100mm and 250mm. This flexibility allows a wide range of girders, from 660mm to 1700mm high. Even rectangular prestressed beams can be manufactured with this mould system, by removing the adjustable chamfers and using shorter horizontal supports.

The rectangular beam moulds may be used for all sorts of prestressed elements with a height of up to 1000mm. Construx supplied 2 complete 26m long double-sided moulds. Both 26m long sets consist of 1 mould of 12m, 1 mould of 6m, 1 mould of 4m and 2 moulds of 2m.

The mould is conceived as a rigid flat panel system and consists of panels with 2 different heights: 400mm and 600mm. These panels can be used separate or on top of each other, thus avoiding finishing the concrete surface too deep down.

Both sides of the mould are interconnected at the top of the panels with tie-rods and fixed onto the self-reacting bed with bolts through the holes in the base or by means of the extra foot plate fixing system. The distance in between both sides of the mould can be adjusted in accordance with the 50mm increment pattern of the bed. The flexibility and modularity of this system, in height and in length, allows for future extensions by purchasing more and different sizes of panels.

The inverse T-beam moulds are designed to manufacture different types of prestressed beams, mainly for solid slab construction. This system reuses the panels of the rectangular beam moulds, mentioned above. These rectangular panels serve as a bottom form on which small vertical posts are bolted. Special 510mm high and 200mm thick box-out panels can be fit onto these posts, in order to form a 200mm recess on both sides of the girder.

When using the 600mm high rectangular beam mould panels at the bottom, the girder height can be up to 1100mm. Construx supplied 1 complete 26m long double-sided set of box-



Self-reacting bed with rectangular beam mould



Loading of I-beams



Pouring concrete in the inverse T-beam mould

out panels and vertical posts. The 26m long set consists of 1 panel of 12m, 1 panel of 6m, 1 panel of 4m and 2 panels of 2m, all double sided. Both sides of the mould are interconnected at the top of the vertical posts with tie-rods and fixed onto the self-reacting bed with bolts through the holes in the base or by means of the extra foot plate fixing system.

Very satisfied customer

Construx complied with the very short lead time and with Betard's requirement to obtain a multifunctional, flexible and versatile solution to manufacture their prestressed concrete elements. The outcome of achieving these objectives was a very satisfied customer, resulting in Betard's recent purchase of 4 fully equipped, 13m long and 4,5m wide, hydraulic tilting tables.

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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