PRECAST CONCRETE ELEMENTS

Dusaspun, established in 1982, is one of the leading manufacturers of precast concrete elements for infrastructure and building construction projects in the Indonesian market. With its more than 1,000 employees, the company produces precast element solutions at all important locations in the country. In 2013 Dusaspun was awarded the contract to manufacture the façade elements for a hotel construction project in Solo in central Java. The hotel building is being built as a skeleton structure with concrete columns and will be given a curtain wall made of precast concrete elements.

Manufacturing using a conventional method or in one of the customer’s existing production plants was impossible due to the short construction time, the limited space available at the production location near the building site and the high requirements for the surface quality of the elements.

A suitable and user-friendly production solution – vertical if possible – was necessary. This was finally found in the upcrete technology and the plant went into operation in summer 2014.

upcrete was developed by the Hockenheim-based company Ratec and represents a completely new approach to the vertical production of general precast concrete elements extending up to 3D room modules. Ratec has been developing rational formwork solutions for 20 years for customers in Indonesia.

Indonesia is presently experiencing a building boom. Apart from residential building and infrastructure projects, up to 800 new hotels with a total of 100,000 rooms are to be opened in the next ten years. In order to meet the needs in such a short time, market-driven solutions are required for the country’s building industry. One of the leading Indonesian precast concrete element manufacturers uses the upcrete technology from the Hockenheim-based company Ratec.

Vertical manufacturing of 6-sided formwork-smooth solid elements up to 3.90 m high and 9.00 m wide, accommodating arbitrary window cut-outs

**Figure 1:** Building boom in Indonesia: hundreds of new hotels will be built in the next 10 years.

**Figure 2 & 3:** The solid elements produced using the upcrete technology will be used as a curtain wall for the building, which is being erected as a skeleton structure.
over 72 countries worldwide. Beginning with the switchable magnet box through to state-of-the-art formwork solutions for automated circulation plants and special formwork, Ratec has decisively shaped and advanced magnetic shuttering technology in the past.

Technology for 6-sided formwork-smooth elements

A major advantage of the upcrete technology in comparison with other production methods is the possibility to produce 6-sided formwork-smooth elements that are virtually free of bug holes and need only a coat of paint on the building site. Rework that is otherwise often required, such as the plastering of wall elements, is thus entirely unnecessary.

RATEC – the home of the shuttering magnets
Flexibility and durability in perfect harmony

e.g. SAS, the shuttering system for the manufacture of facades, sandwich walls, solid walls and floor systems, is available in lengths of up to 8000 mm and heights from 60 mm to 400 mm. The system is used in both manual handling and robot operation. The economic aspects are: reduced consumption of shuttering timber, reduced shuttering and demoulding times, simplified cleaning and improved quality of the final product. Simple, flexible, fast, safe and efficient positioning is ensured by the switchable RATEC automatic system. RATEC magnetic components with adhesive forces from 450 kg to 2100 kg are used here depending on requirements.

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What is unique about the upcrete method is that a closed mould is filled with self-compacting concrete from the bottom, which enables complex elements to be manufactured in the installation position. Technically, this is achieved through the fine matching of pressure-resistant formwork to the appropriate pump equipment (UPP 100, also developed by Ratec) and the corresponding concrete mix design.

The biggest challenge in the development of the vertical production solution was the dimension of the elements to be manufactured: the solid walls with window cut-outs were to be up to 3.90 m high and 9 m long. These element sizes have been rather unusual for battery manufacturing until now, firstly due to the stress on the mould due to the formwork pressure and secondly due to the problems that occur when using conventional concrete, in particular with cut-outs. Conventional battery manufacturing with normal concrete filled from the top was ruled out on account of the possible desegregation of the concrete, resulting in air inclusions and ‘bug holes’. Especially in the case of very high elements and in the regions underneath cut-outs, the upcrete method offers a unique solution in vertical manufacturing for the attainment of a high element quality.

Further reasons for choosing the upcrete method with self-compacting concrete were the advantages of being able to dispense...
upcrete® – the revolution in the production of precast concrete elements

The new pump car and improved pocket battery mould are the consistent further development of the innovative upcrete® system from RATEC. Almost any conceivable precast concrete element geometry can be realised with upcrete®. Self-compacting concrete (SCC) is pumped into the mould from below, allowing complex structural elements to be manufactured in a single work step. The flexibility of the system offers unique potentials for shaping, dimensions and economy – while at the same time achieving top quality and all sides smooth surfaces. Use this freedom – upcrete®, the variable system for more possibilities.
PRECAST CONCRETE ELEMENTS

with the vibration technology required with conventional concrete and the crane necessary for handling the concrete bucket when filling from above.

Ratec developed a particularly sturdy, practically usable battery mould which requires very little conversion work, despite the impressive size of the elements, and which caters to all the work steps in the customer’s production and enables smooth processes.

Not only technical feasibility is decisive, but also efficiency in the production process

The element geometry is formed by Ratec magnetic profiles of the types SAS and PSV with integrated magnets inside the battery pockets. The lower support always remains at the same height, while various element heights are realised by the upper shuttering. The upper support/shuttering has to be removed anyway in order to lift the elements and can be attached again for the next element in the necessary height with no further work. Handling is done using a crane lifting beam. The constant height of the lower shuttering additionally ensures a reduction in the working height with lower elements and enables the concrete filling connections to remain in the same place at the end faces of the elements.

Element thicknesses of 80 – 120 mm can be realised flexibly through the simple exchange of the prefabricated timber boarding on the supports. Further advantage for the production process: the battery is mechanically clamped, very simple to open and close manually and is thus almost completely maintenance-free.

Circumferential tongue and groove profiling with maximum dimensional accuracy

Due to the method of construction of the hotel building, circumferential tongue and groove connections were required for some elements, which are implemented by means of appropriate magnetic profiles in the formwork. Only the pressurised filling from the bottom up makes it possible to manufacture this 4-sided profiling on the element in vertical production, since the formwork can also be closed from above, and an opening is only required to allow air to escape. At Dusaspun the formwork is filled using a UPP 100 rotor pump from Ratec with a hose diameter of 100 mm.

The capacity of the pump is infinitely variable from 0 to 22 m³/h. The specially developed UCI concrete inlet connection leaves a formwork-smooth finish on the element, so that no rework is necessary at this point either.

The concrete recipe for the SCC was tailored to the local aggregates in agreement between the concrete technologists from Ratec and Dusaspun.

Figure 11: Easier work for the production staff – even with elements of different heights the lower shuttering remains at the same height

Figure 12: Installation, commissioning and detailed training of the personnel on site by the Ratec team

Figure 13: Concrete is fed via special UCI concrete inlets that leave a formwork-smooth finish on the structural element
The production solution developed by Ratec using the upcrete method makes compact manufacturing possible for Dusaspun, tailored to the available space, wherein the full flexibility is provided by the possibility of extension and the mobility of the plant.

The design as a 4-pocket battery mould is aligned to the basic needs of the customer and can be extended in this case with no great effort by a further four pockets to increase production capacity.

The battery mould has been developed as a mobile system so that it can be transported at any time to a different production location if necessary.

The result is space-saving, fast and material-friendly production as well as top-quality elements that give Dusaspun a clear competitive advantage in the booming Indonesian market.

Adaptation to the size of the elements was ground-breaking for the further development of the upcrete method. Enquiries from other customers that Ratec is currently handling show that there is a need for vertical manufacturing solutions for particularly large elements. In upcrete, a solution exists for this that can meet this need and offer new possibilities at the same time.

The upcrete technology represents a supplement that enables the production of precast element geometries that cannot be manufactured using conventional methods, or at least not in the requisite quality. Hence, manufacturers of precast concrete elements are given entirely new opportunities to supplement their portfolio accordingly.

Figure 14 & 15: The battery mould can also be used with the corresponding central profiles for the production of two (or more) elements per battery pocket.