Prinzing GmbH, 89143 Blaubeuren, Germany

Cast and milled – monolithic concrete manhole bases from Denmark

Following on from the commissioning of the first monolithic concrete manhole base production line with the Primuss System from Prinzing in 2009 (see CPI 5/2009), there are now already ten concrete production facilities using this system not even two years later in six European countries. Just recently, the family-run business of Gammelrand Beton A/S in Denmark took the step of investing in the Primuss System. After its run-in period, final testing was carried out by Prinzing technicians at the end of May. In the nine other concrete production facilities with a Primuss production line, manhole channels and connections are milled with a milling robot into partially hardened concrete blanks manufactured only a few hours beforehand from zero slump concrete on a Prinzing Atlas system. Gammelrand, however, decided on a solution with concrete blanks cast from self-compacting concrete. As the company only manufactures concrete manhole bases with a fixed diameter but with variable heights, the need for moulds is rather limited. All moulds in stock can thus be employed for any order.

Gammelrand Beton A/S in Svebolle, Denmark

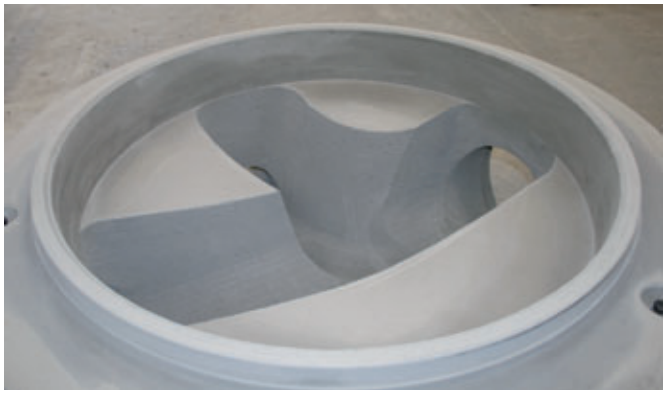
■ Mark Küppers, CPI worldwide, Germany ■

The present-day family business of Gammelrand A/S took its first steps in 1932 almost 80 years ago. The company first operated under the name of Svallerup Zementfabrik and was founded by Svend Pederson. He had laid the cornerstone for a successful business that has been growing from generations. In 1946, Svend Pederson purchased a quarry, from which high-quality rock substances are still extracted today. The excavated materials, including granite, gneiss, flint and limestone, provide the basis for manufacturing concretes of exceptional quality. In addition, sales of the rocks extracted provide a secondary source of income for the company. In subsequent years, Gammelrand continued its development and their range of products became impressively large.

Since 1st January 2001, the company is well known under its current title of Gammelrand Beton A/S after having undergone several prior name changes. It has attained supra-regional dimensions in the field of precast concrete components for civil engineering and road construction as well as the garden and landscaping sector. Gammelrand is also an important producer of ready-mix concrete.

Whilst concrete blocks and concrete paving stones are manufactured in one production hall, a production line for the pipe and manhole programme is located in a second hall with an extensive machine park. The manufacture of various concrete products is carried out on fully automated machines that assure consistently high quality for the goods. Their own fleet of trucks allows Gammelrand to react flexibly to customers' orders and supply them rapidly to the relevant construction site. In this way, the company scores points with its customers not only for the quality it produces but for its first class service as well.

At the current time, the family business is headed up by the 3rd and 4th generation - Ole Pederson and his son Morten.



Monolithic concrete manhole base section from the Primuss production line

Primuss milling bay with two processing points

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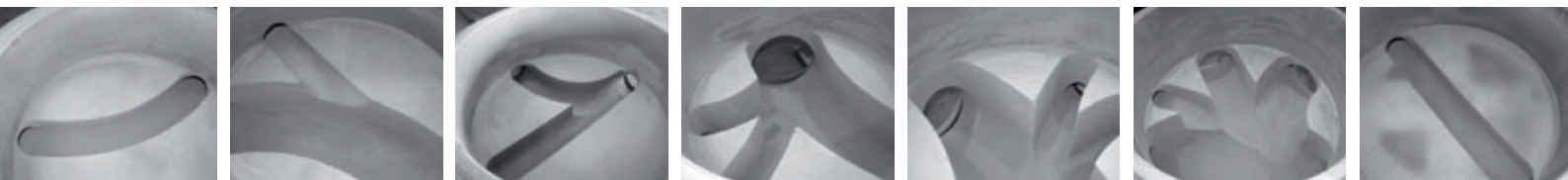

Transfer of SCC from the bucket conveyor to the concrete spreader

Concrete monoliths made from SCC

The first stage in manufacturing a concrete manhole base section - this, of course, includes Gammelrand as well - involves producing a concrete blank with the specified external dimensions (diameter and height) of the future manhole component. Gammelrand has consciously chosen a combination of casting moulds and milling robots – the first operator of a Primuss production line to do so. The company can see advantages here, particularly in the surface composition of the final products in comparison with conventional, machine produced manhole components made from zero slump concrete.

Neither is the company striving for vast quantities. At the moment, the eight casting moulds on hand allow eight monolithic manhole bases to be manufactured per shift. It is indeed probable that the range of moulds will be enlarged. Nonetheless, daily production will remain at a rate that would not keep up with the performance of an Atlas system for manufacturing the concrete manhole blanks.

After just a few weeks, Gammelrand has been able to record reliable empirical values as regards the partial hardening of a concrete blank. Sufficient early strength is necessary for milling the connections and channels but, in an analogous way, the hardening process should not be too advanced. What sounds perhaps somewhat problematical in theory, has swiftly become implemented as a routine matter at Gammelrand.

At the commencement of production each morning, the existing Fejmert mixer is initially employed only in providing SCC for casting concrete manhole base section blanks. All the moulds needed are filled in turn depending on the day's production target for manhole bases. The hardening times can be influenced through slight alterations in the concrete recipe (e.g. by the addition of retarding agents). The result is a larger time frame for later milling work by the robot.

Gammelrand has purchased a concrete spreader (loading capacity 2 m^3) from Avermann for filling the moulds. The concrete spreader is fed by a bucket conveyor, which also supplies the other production plants in the hall with concrete. Once filled, the spreader is attached to a crane rail and brought to the self-contained moulds prepared beforehand.

The two-part moulds consist of two shell halves, which are thrust together and locked tightly. The mould's base is made up of a support cap with a superimposed steel pallet, which is enclosed and fixed in position by the sides once the mould has been locked. A complete mould unit is created in this way. Spraying on release agent ensures that the partially hardened concrete blank can be later easily detached from its mould. Concrete is poured up to a specified height - that of the future component - into each mould, in fact with it standing on its head. The concrete surface visible in the formwork is the future base area, i.e. the bottom section, of the final manhole base.

About four hours after the first mould has been filled (this time reference is variable and, as has been indicated, dependent on construction component size, concrete recipe and also the ambient temperature), this same first mould is opened. The blank can be transported to the milling bay after its strength has been tested by means of a drop hammer. Gammelrand employs a special grab, which also forms part of the scope of delivery for the Prinzing Primuss system, for handling the blank.

The grab is attached to the crane rail and can be operated by a remote control unit. The grab first carefully lays hold of the partially hardened concrete blank, then grips it from under the spigot end and lifts it off the support cap. A special release device ensures that stripping the formwork remains a trouble-free operation. The support cap stays on the ground and the concrete blank

Carefully filling the casting mould with SCC

The formwork can already be stripped from the concrete monoliths after a few hours

is transported to the milling bay on its spigot end and set down there as it was cast i.e. on its head.

Primuss milling bay with two processing points

The milling bay at Gammelrand also possesses two milling points. This enables the milling robot to work continuously without any downtimes due to changeovers. Whilst the robot is milling fully automatically at one station, the previously milled manhole base section is removed from the second point by the grab and a fresh concrete blank is placed in readiness. This means that one employee is sufficient to operate the entire milling process. Both the spigot end, which supports the concrete manhole base up to its final hardened state, as well as the processing stations in the milling bay are equipped with fastening points, which guarantee that the blank will be set down in exactly the right position. Each manhole base is planned beforehand on the computer. Once the product parameters for the connections and the channel have been entered, the Prinzing programme creates the entire construction component in the computer and calculates the milling paths for the robot precisely. The data is stored in the system and a corresponding data sheet with all product information accompanies the manhole base sections from the manufacture of the blank right up to the final milling sequence. When a particular manhole element has reached the milling bay, a barcode is read in on the product by means of a hand-held scanner. The system recognises the stored product data and the fully automated milling procedure can begin.

Detaching the support cap

The stripped concrete element is carried on a steel pallet

The channel is first milled into each manhole base. The robot arm accesses the concrete blank from below and begins to mill the channel with its spherically shaped milling head and PCD cutting tools. In this process, the cutting head does not immediately penetrate the blank up to the maximum channel depth, but rather cuts it away in layers. Depending on the channel's geometry, the width of the areas being milled decreases against the channel axis with increasing depth. The operator always has the possibility of being able to intervene in the process via a remote control unit, but this intervention is, in fact, limited only to controlling the milling speed. Prior experience gained by the machine operator helps him know instinctively when the speed ought to be raised or reduced. Apart from this, the robot's feed motion is regulated automatically and adapted to the blank's actual hardened state.

Automatic evacuation of the milled material

At Gammelrand, as with other Primuss production lines, the decision was taken to evacuate the milled material by conveyor belt. Both processing points are situated at hall floor level. Directly underneath them, a large work pit has been set up in which the robot moves. At the bottom of this pit, a wide conveyor belt runs non-stop, transporting the milled material continuously out of the pit. Downward sloping panels on the side walls cause concrete particles to slide onto the conveyor belt from areas not covered by the belt itself. After its transferral to other conveyor systems, the milled material travels back to hall level where it is collected and can, for example, be fed back into production.

Automatic tool change

Once the channel is ready, the robot arm moves automatically to the tool storage unit set up at the rear of the milling bay. Here, the robot places the spherical head into the mounting provided and this milling tool is detached from the robot arm. The robot then attaches an appropriate new tool, normally a side milling cutter, and is prepared for the next process sequence – milling the connections.

The connections are always milled from the rear. In this case, the robot moves around the centre axis of the connection being milled. This cutting process is also carried out one layer at a time at the full width of the connection. The robot moves forward in steps until it reaches the channel where it forms the pipe connection area accordingly.

Once the first connection has been completed, the robot arm travels back and the concrete monolith is automatically turned at the specified angle by means of the clamping ring until the milling head is again positioned at the central axis of the next connection. The milling procedure can then begin again. Depending on the number and arrangement of the individual connections required, the milling

Scanning in the barcode activates the milling process

View of the work pit

process with its prior turning of the manhole element is repeated until all connections have been made. The monolithic concrete manhole base section is then finally ready. Whilst the milling robot changes processing point and works on the next monolith, the operator removes the completed component from its former processing point with the grab and sets it down at another. The element is brushed out here (pieces of milled material collect on the connection areas) and checked. The steel pallet is subsequently removed and the manhole base turned. The milled surfaces of both channel and connections correspond to all stated specifications entirely. This means that the monolithic manhole base is finally ready and can be brought immediately into storage, before it is transferred to a construction site in Denmark in order to fulfil its intended purpose.

Gammelrand sees a future in monolithic manhole bases

Ole and Morten Pederson are convinced that they have made the right step forward with their latest, highly-promising investment. After its short running-in time, the manhole base production line with this Primuss method has been running to their entire satisfaction. Both the production of the blanks with SCC and the milling bay have been operating practically trouble-free. The production manager was rapidly able to gain a good sense of the hardening periods needed in the mould and the right time for stripping the formwork.

For Gammelrand, the Primuss method is a high-tech solution unrivalled by any other standard system utilised up to now. The new plant enables the company to supply the market with individual manhole monoliths of exceptional quality. Monolithic manhole base sections have already become prevalent in numerous other countries, and Ole and Morten Pederson also see a bright future in Denmark.

Gammelrand also appreciated the advantage that it was possible to continue using previously functioning plant components in their production hall and that the Primuss production line could be integrated into current workflows. The existing mixer, for example, now also produces the SCC for the manhole blanks and the "old" bucket conveyor supplies the new production line.

Ole and Morten Pederson are very pleased with the surface quality attained with the concrete manhole bases, which need no post-processing. The milling work is very

Milling the channel

Milling head for cutting the channel

The milling speed can be controlled via remote control

Milling the connections

precise and the finished products are appreciated by their customers.

Besides all the mechanical engineering skills, dependable staff is, of course, also necessary for e.g. keeping to the right time frame with the milling process. In this case, Gammelrand relies on an experienced man who enjoys the complete trust of the management. A younger, very committed colleague is additionally being trained at the moment to use the system.

The family business owners see one other advantage in the fact that almost no waste occurs in production. Just concrete alone is needed for the production. This material is then removed again from the monoliths in specific amounts corresponding to the channel formation and collected at a central point. The milled material can then be fed back into the production flow at another point.

FURTHER INFORMATION

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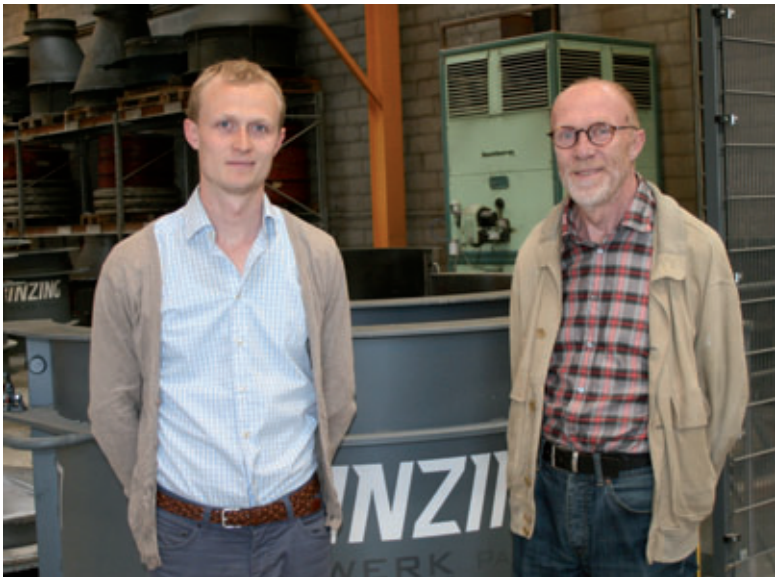

Morten and Ole Pederson – very pleased with the new Primuss production line