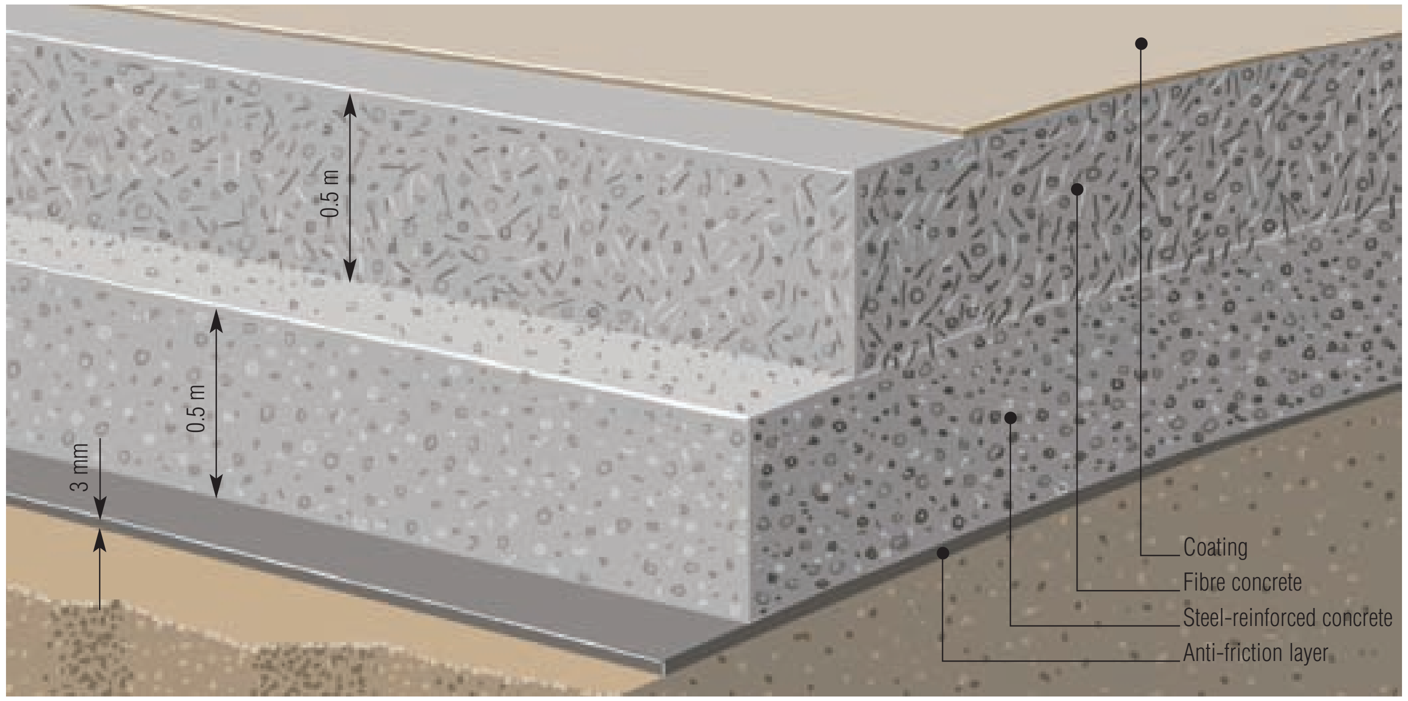
Fleet composition is also decisive for the order

The order for uninterrupted pumping of over 6,600 m³ concrete was given to the Hamburg pumping operation betonlift of neuland beton H.Burgis KG. A contributing crucial factor for betonlift winning the order was clearly the composition of the pump fleet which the company had at its disposal. The pumping operation's vehicle fleet includes, among other vehicles, five large Putzmeister "hall masters" – M 31-5 truck-mounted concrete pumps. These machines are especially suited to tunnel and hall use, due to their horizontal reach and particularly flexible boom kinematics. Even in the new, curved experimental building, they could guarantee that they could concrete the entire 24 m wide base from the farest point to the machine's driver's cab using a suspended end hose and without changing their location. Since the reinforcement had not only been wired, but also intricately welded, and it was essential for it not to be damaged by couplings, the use of horizontally assembled extension hoses and pipes was expressly prohibited by project management.



Structure of the immense foundation plate

Pumping start without cement slurry

Of the five Putzmeister type BRF 31-5 .16 H and BSF 31-5.16 H truck-mounted concrete pumps, first four and later all five machines pumped concrete simultaneously into the foundation base. The first cubic metres were already cast on Friday morning around 5 am. In order not to impair concrete consistency, pumping was initially carried out without cement slurry. Then, the concrete pumps with their flexible, 31-metre placing booms, each consisting of five arm segments, worked their way evenly from the centre of the nearly 300-metre long bottom formwork to the two far ends. The fifth machine acted as a "relay pump", continuing concreting operations as soon as one of the four "hall masters" working in the quartet had completed concreting in its section of the formwork. This made it possible to continue concreting when one area was completed without the otherwise unavoidable interruption (folding in the boom, dismantling the machine, changing to the next section, etc.).

For each of the 850 truck mixer batches, specialists investigated the concrete properties in a laboratory which they set up themselves before the batches were approved for use on the construction site. All relevant data, such as water-cement value, concrete temperature and consistency had to be exactly right before the huge concrete foundation could be poured in one piece.

Concrete construction experts from all across Germany observed this spectacular deployment of concrete pumps with great interest. On their recommendation, the concrete slab was manufactured from a pre-prepared, 15 cm-thick one-piece concrete subbase. The outer building shell was constructed around complex pile foundations reaching up to 20 m in depth.

Huge one-piece concrete slab

The bottom of the base plate structure itself consisted of a 3 mm anti-friction bitumen layer. Prof. Bernd Hillemeier from the Berlin University of Technology's Civil Engineering Department commented: "If the concrete contracts when it cools, the slab must be able to slide well so that it does not crack."

In a further step, a 0.5 m thick layer of reinforced structural concrete was cast. This first layer was properly "nailed" to the second layer immediately following it, which is also 0.5 m thick and made of steel fibre concrete, to form a monolithic block. Both concrete structures conformed to property class C30/37. While, in practice, a steel fibre content of 20 to 35 kg/m³ is sometimes encountered in concrete, the base plate of PETRA III had a steel needle content of 75 kg/m³ – more than double this amount (fibre reinforced concrete class 1.6). The reason for this was not the load expected on the area, but the demand for greater tensile strength and crack prevention. In order to achieve as uniform a distribution of nails as possible at this steel fibre density, the greatest importance had already been attached to apportioning fibres evenly (40 kg/m³ per 32 mm and 35 kg/m³ per 50 mm length) when loading the truck mixer at the concrete works). An extended mixing time before transfer to the concrete pumps has also been specified. Holcim supplied the concrete from four mixing works (Hamburg-Harburg, Hamburg Hafen-City, Eidelstedt and Appen). The concrete mixers' transportation times were between 10 and 30 minutes.

Extreme steel fibre content changes concrete flowability

Despite the relatively high proportion of cement (340 kg/m³) and filler (112 kg/m³), as well as the soft consistency (F3 or F4), the unusual coherence of the steel fibre content prevented the concrete from "flowing" easily from the truck mixer to the hopper. Instead, the material slid from the chute more like plugs, although it was evenly mixed without concentrations of needles. This naturally also influenced the suction behaviour of the concrete pumps. Nevertheless, as the two layers were concreted, the machines still achieved an average delivery rate of 30 to 40 m³/h each. This was preceded in the weeks leading up to the concreting operations by several pump tests to determine the ideal spread with the lowest possible w/c value and reasonable "willingness to pump".

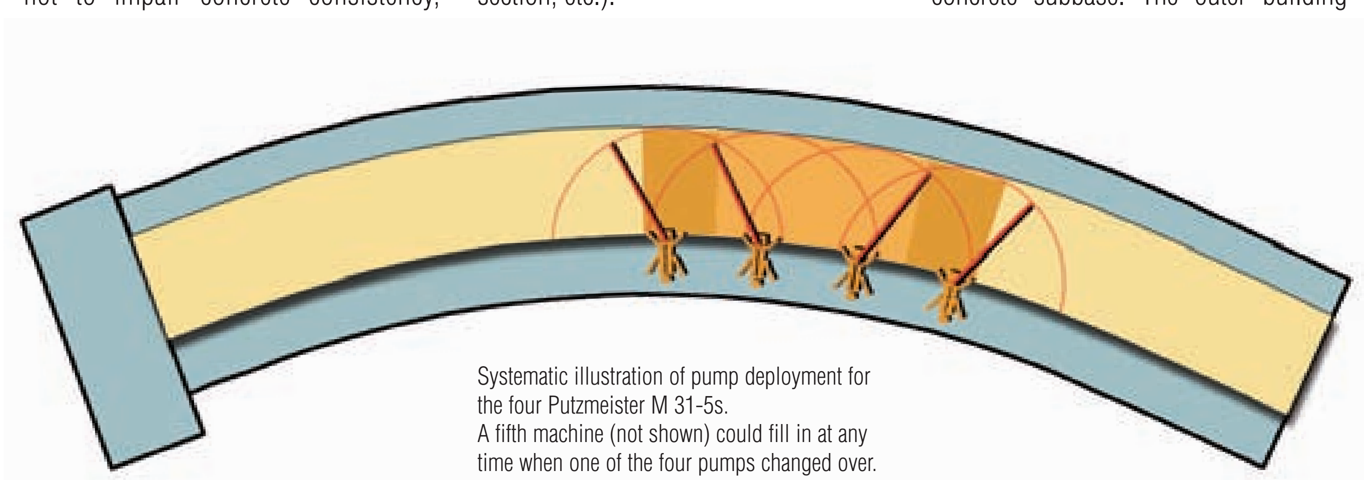
Bitumen allows concrete base plate to slide

Once concreting was complete, the properties of the anti-friction bitumen layer came to take full effect. The increasing temperature as the concrete slab set increased the flowability of the bitumen, which worked like a lubricating film. Once the concrete had cooled completely – approximately 40 days after installation – the bitumen layer had done its job and the base plate lay immobile like a monolithic block. Finally, the surface was sealed with an epoxide resin layer.

Thick plate is decisive in the success of PETRA III

PETRA III provides short wave x-ray light of a particularly high brilliance, and offers excellent potential for experimentation in extremely varied areas of application – from medicine to materials research. Fourteen measuring stations with up to 30 instruments are planned.

In the PETRA storage ring, electrons fly through special magnets (undulators) at close to the speed of light, emitting especially brilliant x-ray radiation. To ensure that the beam of light can reach


Systematic illustration of pump deployment for the four Putzmeister M 31-5s.
A fifth machine (not shown) could fill in at any time when one of the four pumps changed over.


The rigid concrete stands in the hopper


Steel fibre content of 75 kg/m³ in the concrete


A mobile fuel station took over the task of providing the concrete pumps with diesel

File under: A 1.00, A 4.00, BP 1.03, BP 4.03

BP 4068 GB

Non stop: 5 "hall masters" pump 6,600 m³ concrete with extreme steel-fibre content

At five o'clock on Sunday afternoon, two and a half days of continual concreting came to an end for five Putzmeister "hall master" M 31-5 truck-mounted concrete pumps in Hamburg. Shortly beforehand, the last section of the base plate of 6,600 m³ concrete with an unusually high steel fibre content of 75 kg/m³ was completed. This thick and hard-to-pump concrete was delivered without interruption into the base of PETRA III, a new experimental building used by the German Electron Synchrotron (DESY).

1

Illustration of the DESY Hamburg research centre with electron accelerator ring and PETRA III experimental building

The result was a base plate measuring 280 m x 24 m x 1 m, presumed to be the longest monolithic (manufactured in one piece) concrete base in the world. It acts as a foundation for the new experimental building, which is currently being built for the PETRA III project at the DESY research centre in Hamburg. The new building is part of a 2,300 m long ring tunnel, which was built in the 1970s and since then has served as a storage ring for particle physics, among other purposes. Since summer 2007, the accelerator has been remodelled and is to be started up in 2009 under the name PETRA III. "Fortunately, everything went like clockwork", the PETRA III project manager Prof. Edgar Weckert was pleased to report, "that was a logistical tour de force...!" The main contractor for the spectacular construction site is Ed.Züblin AG, North Directorate (turnkey construction area).

Up to five M 31-5s concrete the new DESY experimental building's base plate, which is 1 m thick, 24 m wide and almost 280 m long

the highly-sensitive experiments unimpeded, the floor of the building must be free of vibration and as separate as possible from the rest of the structure. This requirement is fulfilled by a single, thick, one-piece concrete slab. "If an experimenter walks along the concrete slab, it must not move more than one micrometer (a thousandth of a millimetre) at a distance of two metres", explained Dr. Hermann Franz, project manager for the PETRA III experiments. Moreover, any unevenness in the concrete slab must not amount to more than four millimetres over ten metres length. PETRA III, known in expert circles as the "word's best storage ring x-ray radiation source" is expected to be commissioned in 2009.

Concreting meticulously prepared by the pumping operation

At betonlift, too, this spectacular pump deployment required a certain outlay in terms of organisation and personnel. At times, up to 30 people were involved in the preparations. During concreting, trailers were available for catering and for the betonlift workers to warm up in, as was a fully-equipped workshop for vehicles (including a Putzmeister hydraulic power pack for emergency operation, oil bonding agent in case of leakages, replacement concrete vibrators for the concrete pumps, spare wheels, etc.). A small, mobile fuel station was on hand so that the pump operators could refuel their machines. The six machine operators worked in shifts and were taken to a nearby hotel by shuttle during their rest periods.

As with similarly extensive projects in the past, concreting at DESY was secured by the two betonlift officers with statutory authority, Jürgen Bitsch (technical manager) and Franz Syrowatka (business manager), and preparations planned in meticulous detail. The casting of 6,600 m³ of concrete was carried out as a routine operation and without any problems.

Jürgen Bitsch and Franz Syrowatka of betonlift demonstrated their experience in preparing this large-scale concreting operation

M 31-5 hall master technical data

Placing boom:	
Fold system type	5-arm Multi-roll Z-fold system (MZR)
Vertical reach	30.5 m
Horizontal reach	26.6 m (gross)
Depth of reach	20.4 m
Unfolding height	5.7 m
Length of the end placing hose	4.0 m
Diameter of the boom delivery line	125 mm (permitted up to 85 bar)
Slewing circle	365°
Extent of supports (normal operation)	6.3 m front, 6.3 m rear
Extent of supports (OSS operation)	4.6 m front, 4.9 m rear

Possible pump assemblies:	**16 HLS**	**16 H**	**14 H**
Delivery rate	160 m³/h	160/108* m³/h	140/88* m³/h
Concrete pressure	85 bar	85/130* bar	70/112* bar
Delivery cylinder diameter	250 mm	230 mm	230 mm
Delivery piston stroke	2,100 mm	2,100 mm	2,100 mm
Strokes/min.	26	31/21*	27/17*

The core pumps with S or C transfer tube can be combined (optional).

* Data for rod / piston side charging. Maximum delivery rate and maximum delivery pressure cannot be achieved at the same time. All data values are maximum theoretical values.

The Putzmeister Group
Concrete Technology PCT · Mortar Technology
PMT Pipe Technology PPT · Water Technology
PWT Industrial Technology PIT · Belt Technology
PBT Underground Technology PUC

Putzmeister Concrete Pumps GmbH
Max-Eyth-Str. 10 · 72631 Aichtal/Germany
P.O.Box 2152 · 72629 Aichtal/Germany
Tel. +49 (7127) 599-0 · Fax +49 (7127) 599-520
E-Mail: pmw@pmw.de · www.putzmeister.com