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Spun, not stirred

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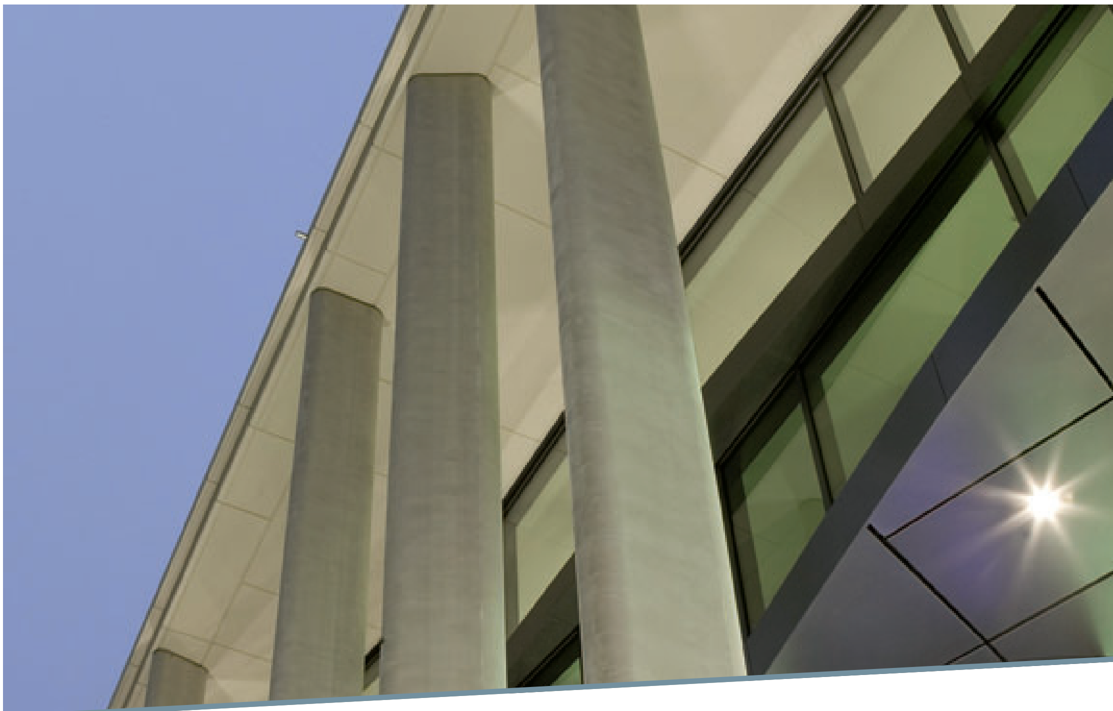

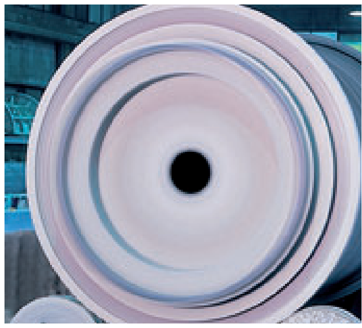

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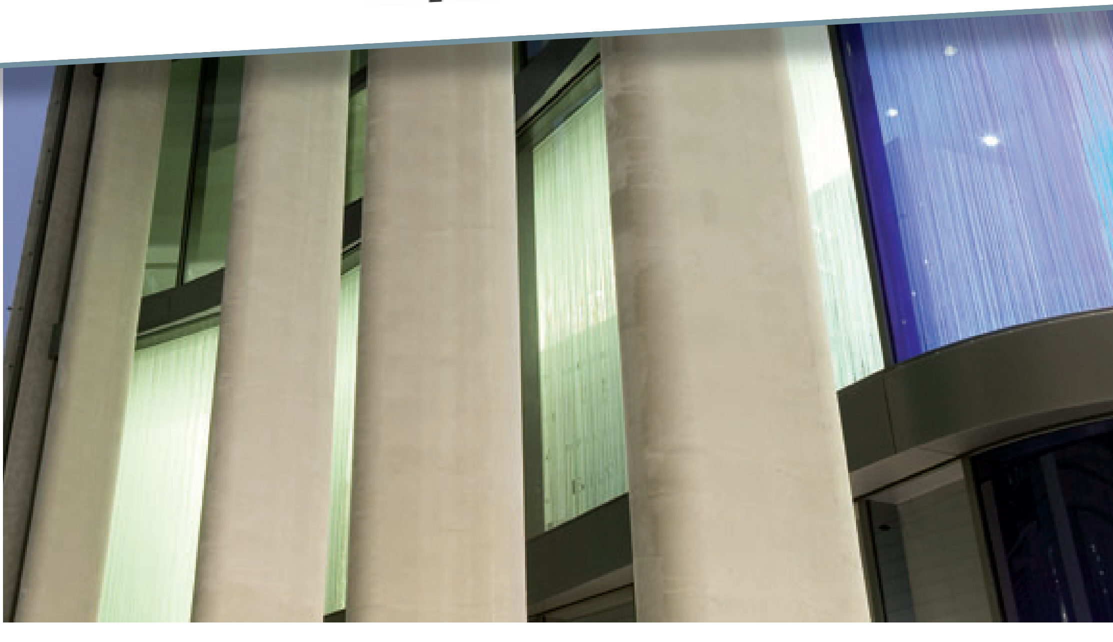
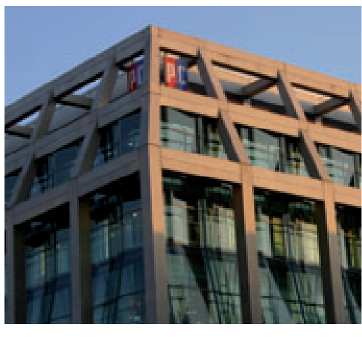




Spun, not stirred

Delicate fair-faced concrete columns made of spun concrete

Alongside the purely technical aspects, design plays an increasingly important role in today's modern architecture. Many distinctive buildings have been given their unmistakeable face by high strength columns made of spun concrete. This ideal combination of creative elegance and high load capacity gives rise to incomparable buildings.

Whereas columns made of spun concrete have been used in buildings in Switzerland for many years, few architects and planners in Germany have been aware of the advantages up to now. That is actually amazing, since it is possible to manufacture columns from spun concrete with small cross-sections even in the case of a high load distribution, thus enabling both aesthetic and economical solutions. Hence, structural elements manufactured from spun concrete are ideal above all for use as delicate and architecturally sophisticated fair-faced concrete columns for building facades. Even in predominantly functional structures, such as lamp posts, overhead electricity pylons, antenna masts or masts for motorway signs, made-to-measure productions from spun concrete can be a good choice.

Long spans but at the same time a thin cross-section

Roland Kastner, manager of the Traffic Division at the spun concrete specialist Europoles (Neumarkt), highlights the possibilities of use in architectural construction: "If long spans but at the same time thin dimensions are in demand, then spun concrete offers clear advantages over steel and composite steel columns. Firstly, the shaping is very flexible. It doesn't matter whether round, oval or rectangular cross sections are demanded: the columns can be manufactured up to lengths of 35 m in one piece. Colour and surface design can also be implemented according to the customer's request. Beyond that, the highly compacted and non-porous fair-faced concrete is very resistant to aggressive air, frost and other environmental influences and is thus particularly long-lived." A further advantage: Spun concrete columns are hollow inside and thus offer sufficient space for cables and pipes or the roof drains. Distracting external fittings can thus be dispensed with.

Low concrete coverage and high reinforcement content

Europoles has concerned itself for many years – in cooperation with renowned research partners, for example the Technical University of Munich or the TU Leipzig – with the use and further development of spun concrete, always with the goal of sounding out the limits of the feasible and investigating new manufacturing techniques and application possibilities. The company currently has a special approval from the German Institute of Building Technology (DIBt) and, depending upon requirements, uses a reinforcement content of 16% in a high-strength concrete of the quality C 100/115 – the current DIN 1045-1 actually only allows 9%. The degree of concrete coverage can also be reduced to a minimum of 2.5 cm – the actual minimum requirement here is 5 cm. The reason for the DIBt approval: due to the high centrifugal force, i.e.

Photos: Europoles

The concrete rotates in the formwork on the spinning machine for about 10 minutes at around 600 rpm

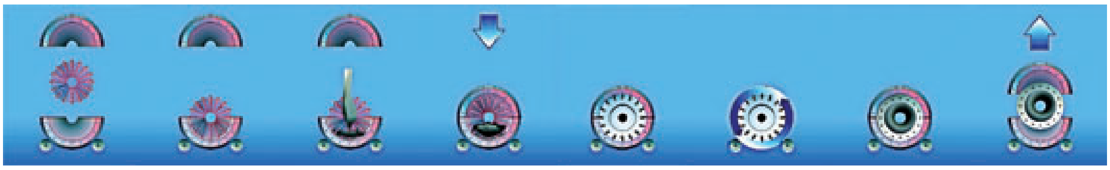
the enormous pressure during the spinning procedure in conjunction with the use of high-strength concrete, the latter exhibits a significantly higher degree of compaction. This enables Europoles to produce delicate column diameters and saves on raw materials. A further important research topic is fire protection. The fire protection class 'F 120' is currently being verified at Europoles by means of tests in the furnace and an in-house dimensioning method. The official DIBt approval is expected by the end of the year.

Manufacture of spun concrete columns

The manufacture of masts and columns from spun concrete requires extensive know-how and the latest production technologies. Below, we provide an insight into the individual production steps at the Europoles plant in Neumarkt.

1. Manufacture/pouring the mould: The reinforcement cages (round, oval or rectangular, depending on requirements) for the columns/masts are manufactured on a computer-controlled cage winding/welding machine. If required, recesses are already provided in both the upper and lower halves of the mould (for example, for floor slabs, or for the connections of foundations or façades).
2. Inserting and fixing the cage: The finished reinforcement cage is inserted into the lower half of a steel mould. The special prestressing steels are drawn in, anchored at both ends of the mould in tensioning heads and slightly prestressed.
3. Welding of built-in components: If special built-in components are necessary, these are placed inside the reinforcement cage or welded into it.
4. Pouring the concrete: Depending upon the application, the pre-mixed liquid high-strength concrete (up to quality C100/115) is poured into the steel mould. By means of dyeing the white cement, stone-like surfaces can be manufactured if desired by adding precisely selected aggregates in combination with the subsequent surface treatment.
5. Closing the mould: The two halves of the mould are closed and bolted together. The prestressing steels are tensioned against the mould.
6. Spinning process: The entire mould is then lifted onto the spinning machine and the spinning process begins. An electric motor rotates the mould with the concrete for about 10 minutes at around 600 rpm, so that the fresh concrete is pressed against the wall of the mould with twenty times the acceleration due to gravity. A cavity is produced inside the concrete mast due to the centrifugal forces.
7. Cooling and demoulding: After the spinning process, the concrete columns initially remain in the mould and are demoulded after reaching the prestress release strength.
8. Surface treatment: If surface treatment is required, this is done, for example, by means of sandblasting, charring, bush hammering or polishing.
9. Storage: The finished structural element is stored in a dry place until it is transported to the building site. Due to the low weight of the columns – they are hollow inside – they can be transported comparatively easily.
10. Installation: The installation usually takes place in the case of columns as a pendulum by means of anchorage with a centring mandrel on the ground or with protruding reinforcement at the head. Further installation options are clamping in the sleeve foundation or bolting to the foundation.

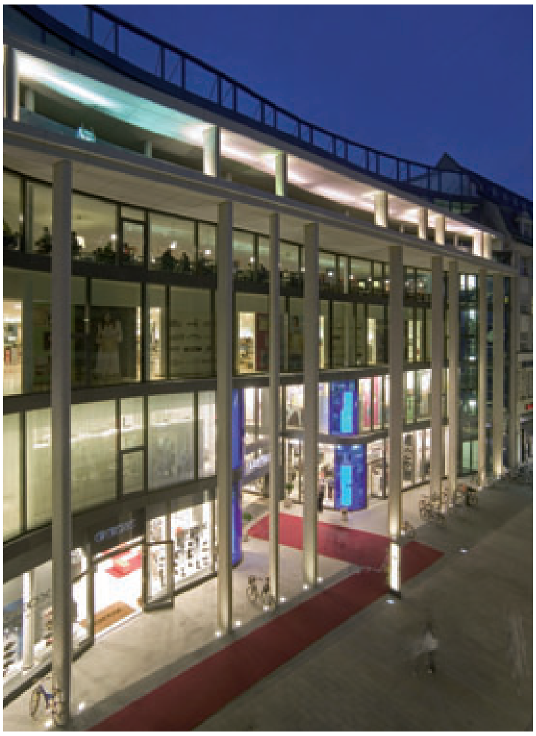
Manufacturing process



Spun concrete columns in practice

Karstadt in Leipzig

An impressive example of the use of columns made from spun concrete is the Karstadt department store in Leipzig. In the building planned by RKW Architekten (Düsseldorf), ten highly loaded columns support the overhanging roof of the modern glass façade. The columns have an extreme oval shape. Each column was manufactured using a special mixture of white cement with a marble aggregate as well as the addition of 0.1% of yellow-brown dye and lightly sandblasted after demoulding – to match the historic sandstone façades of the neighbouring buildings. A particular highlight is the water drainage technology integrated inside the columns. Hidden in the cavity inside the column is a noise-insulated drainpipe, which carries the rainwater from the roof downwards, and an accompanying heating system. This ensures that the water does not freeze when temperatures are below zero.



Lufthansa Aviation Center in Frankfurt

Lufthansa AG created an architectural highlight with their new award-winning head office at Frankfurt Airport. Europoles supplied the delicate, but highly loadable round spun concrete columns for the administration building, which was planned by Ingenhoven und Partner. The columns measure 27 metres in length and bear the loads of the enormous glass roof, which spans the entrance portal, passages and atria of the building. They are loaded with a weight of 450 tonnes, although their cross-section measures just 70 cm. The development of the precast concrete elements was enormously elaborate and could only be accomplished using the spun concrete method: In addition to the loading of the columns with 450 tonnes of roof load, they are additionally prestressed with 400 tonnes via prestressing steels. A concrete column with these dimensions was previously unknown worldwide. The columns are prestressed in order to prevent the formation of cracks and the resulting risk of buckling. Special prestressing steels exert pressure on the concrete and in this way hold it together. The spun concrete method results in extreme compaction of the concrete due to the centrifugal forces and enables the production of concretes of the quality C100/115. Columns not manufactured using this procedure would be very expensive or not possible with such extremely thin dimensions.

Photo: H. G. Esch / Lufthansa

Lake Constance Spa in Überlingen

Concrete was primarily used in the interior of the spa designed by Architekturbüro Prof. Dr. Rudolf Wienands. The floor slabs are borne by spun concrete columns, which are integrated at an angle into the building. Not one of the approximately 70 columns supplied stands upright; they are all 'effectively inclined'. The load capacity does not suffer as a result. The concrete columns are extremely loadable even at angles. The advantage of the concrete columns in fair-faced concrete quality: a higher resistance to the humidity from the spa water. A protective coating can be dispensed with completely. The spun concrete columns have such a resistant surface that they could be placed in the spa water without any problem at all.

Photo: Ingrid Friedl / Lufthansa

Opera House in Erfurt

Europoles supplied round columns with a length of 12 metres for the opera house in Erfurt. Due to the glass foyer of the building, which was planned by Architekturbüro Prof. Jörg Friedrich + Partner, they are shown to their best advantage and thus fit optimally into the generous spatial concept. Although a third of the building lies underground, the entire construction appears transparent and anything but pretentious. Despite their high load capacity, the approximately 30 round columns have a small diameter and thus fulfil the architects' aesthetic requirements. The production of these slim round columns was special: during the spinning procedure, special stainless steel plates or fixings also had to be spun-in. They support the glass facade of the opera house. Since the columns extend over several floors, semi-circular recesses also had to be provided for the floor slab penetrations.

Peek & Cloppenburg in Berlin

The Peek & Cloppenburg clothing store in Berlin, designed by architect Prof. Gottfried Böhm from Cologne, owes its characteristic appearance to its square concrete columns in heights of up to 25 metres. The columns with a four-sided formwork-smooth surface in the format 80 x 80 cm were additionally brightened up with marble white. However, not only the vertical columns, but also the beams that connect the individual columns were manufactured using the spun concrete procedure. The entire construction of square columns and beams bears the complete glass façade of the building and absorbs the entire wind load.

Biological Institutes at the University of Dresden
The Biological Institutes at the University of Dresden, designed by Gerber Architekten, are divided into two functionally structured building wings, which are connected by a glass hall as a meeting place. The round columns used here extend over four floors. In order to be able to absorb the enormous loads of the building, an extremely high reinforcement content of 15% was used. Advantage of the spun concrete columns: The use of these columns led to a shorter construction process overall. Since the columns extend over four floors, the complete 'support frame' of the building was erected with just one assembly procedure. The floor slabs of the building were only installed after the columns had already been erected.

Institute of Physics at the Humboldt University in Berlin

The slim shaping of the spun concrete columns was decisive for the Berlin architects George Augustin and Ute Frank for their employment in the construction of the new building for the Institute of Physics at the Humboldt University in Berlin. The building concept foresaw the use of inclined columns made of spun concrete. In order to loosen up the front of the building, about 60 round columns were integrated into two façade recesses in the otherwise smooth outer skin of the building. The columns are up to eight metres in height and, although they are all installed at an angle, they possess a very high load capacity. The advantage of using spun precast elements: a simpler assembly. Manufacturing the columns with in-situ concrete would mean excessively high expenditure. However, the shuttering of the inclined columns would be very laborious.

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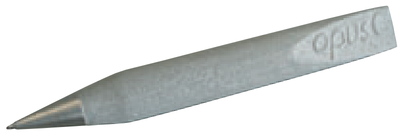

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