

Ratec GmbH, 68766 Hockenheim, Germany

# Special manufacturing techniques for Italy's national pavilion at the Expo in Milan

The Rome-based architect's office Nemesi & Partners designed the Italian Pavillon Palazzo Italia for the Expo 2015 world exhibition in Milan with a façade that is equally good-looking and pragmatic. The outside of the building, which resembles a petrified forest, impresses with a special cement that cleans the smog-laden air of the city. 80 % of the almost 100,000-square metre façade was manufactured from recycled material using around 2,200 tonnes of cement. Solar cells on the roof of the pavilion generate energy during the day. The Italian pre-cast element manufacturer Styl-Comp used a high-performance special mortar from Italcementi for the production of the façade elements and the majority of the elements were produced in specially manufactured battery moulds using the upcrete technology from Ratec.

The Palazzo Italia, the crown jewel of the host country of the Expo 2015, is an eye-catcher. According to Nemesi & Partners the pavilion is "inspired by a natural architecture, within which the branching fabric of the external 'skin' of the building generates alternating light and shadow, fullness and emptiness and thus creates a scenario that reminds one of the works of the Land Art." The fact that the environmentally friendly design looks like a tree from the movie "Avatar" only intensifies this feeling. The Palazzo Italia is designed to be a permanent installation and will remain standing after the Expo ends.

## Development of a biodynamic special mortar

The Styl-Comp Group has been active in the field of industrial architecture with concrete for over 50 years. It manufactures high-quality products, holds numerous patents, has profound know-how in this field and has already realised numerous architectural structures with concrete products. Special expert knowledge in the processing of hydraulic binding agents with photocatalytic properties and the manufacture of special moulds has been gathered in several projects, as a result of which the company can skilfully process this material and



Photos: Styl-Comp

*The special mortar consists of 80 % recycled aggregates, including waste from the cutting of Carrara marble. It therefore exhibits an extraordinary brilliance compared to conventional white cement.*

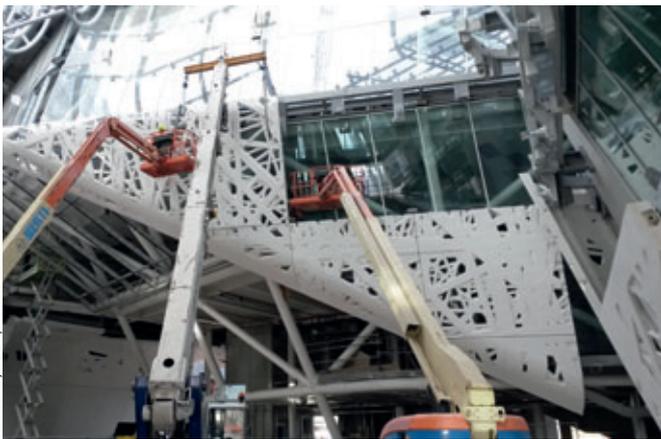
manufacture custom precast concrete elements. Styl-Comp required a special micro-cement and a particular production technique for this impressive project. For the construction of the façade of the Palazzo Italia, which resembles a petrified forest, the company decided to use a high-perfor-

mance special mortar from Italcementi, which is photocatalytic white, cement-based, self-balancing and has a particularly high flexural strength. In comparison with classic mortar the new material is very easy to process and is durable. The initial flowability is three times as high (300 mm com-



Photos: Styl-Comp

*The Palazzo Italia – the icon of the Expo 2015 in Milan*



Photos: StylComp

725 unique elements were used for the construction of the Palazzo Italia

pared to 100 mm) and the compressive strength twice as high (over 60 MPa compared to 30 MPa) as that of classic mortar. 15 researchers at Italcementi invested a total of 12,500 hours into the research and development of this new mortar, which is called "bio-dynamic" and is protected by five global patents.

The project engineering mainly took place in 3D. A total of more than 9,000 drawings were created for 9,000 sq. metres of façade with 725 unique elements. Thanks to the 3D design it was possible to control not only the complex product design, but also the manufacturing of the façade elements, the associated adjustable support and connecting elements and the installation.

Each element was modelled with special software and sent to production with intelligent technology.

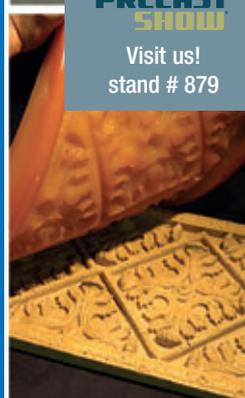
#### Industrialised manufacturing of the façade elements

The industrialised manufacturing process is based on experience. It uses moulds and formwork with perfect surfaces in order to guarantee high-quality surfaces of the complete product, which normally has a length of 4 m per side and different thicknesses. The majority of the façade elements for the Italian Expo pavilion were manufactured upright in a battery mould using the upcrete method in order to be able to implement the particularly delicate "branches" of the façade.

Upcrete is the name given to a method of pressure-filling a closed mould with concrete from the bottom to the top. The method was



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Example of an opened battery mould – special moulds that form the element geometry were clamped in the "pockets" of the battery for the façade elements of the Palazzo Italia.



Example of a battery mould with connected upcrete pump

developed by the Ratec Company from Hockenheim and enables the production of precast concrete elements with formwork-smooth surfaces on all sides, even with complex geometries. Even complete room modules with a floor and four walls can be manufactured in the installation position using this method.

This method achieves outstanding surface qualities, precisely formed element geometries without vibration and prevents air inclusions in the concrete. It is specially tailored to self-compacting concrete, but can in prin-

ciple also be used with normal concrete and subsequent mechanical compaction.

For the element geometry of the Palazzo Italia, the customer clamped specially made polyurethane moulds in battery moulds and filled them from below with the biodynamic mortar described above using an upcrete peristaltic pump. Due to filling from the bottom, the air is pushed upwards out of the formwork and optimum distribution of the concrete inside the formwork is guaranteed. Air inclusions are thereby prevented, comparable with injection mould-

ing for plastics and metals. The use of pressure filling in this project ensured that the particularly thin ramifications were also ideally formed.

What sounds simple has been constantly further developed since the first upcrete tests in 2006 and optimised to achieve a perfect interaction between pressure-resistant formwork, design of the pumping process and the concrete recipe.

Today the upcrete technology allows the production of highly complex element geometries that cannot be manufactured at all using conventional methods (e.g. with horizontal manufacturing) - or at least not with a comparable quality or speed.

Upcrete thus offers new and previously undreamt-of possibilities for the prefabrication of concrete elements and thus provides creative impetus for those who plan and design the buildings of the future and those who turn these buildings into reality.

The Italian architects Nemesi & Partners and the precast element manufacturer Styl-Comp have succeeded with the Palazzo Italia in creating a masterpiece that is trend-setting for such visions that are realisable today with modern upcrete production technologies. ■

FURTHER INFORMATION

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