



Italcementi's challenges

The imposing structure and the complex construction features of the Dives in Misericordia Church were a big challenge for all the undertakings and professionals involved in the project.

To cope with the height of the sails – the tallest of which is 26 m high – and their double curvature, Italcementi had to fully exploit its expertise to figure out definitely innovative technical & structural solutions, which Richard Meier himself described as a triumph of engineering.

The structural solution

The self-supporting sails were divided into large, double-curved precast concrete blocks, weighing 12 tons each. The joint between one block and another is the most distinctive and original element of the entire structure: it was designed and executed to permit connection between the pre-tensioning bars and to compensate for the unavoidable size tolerances of the prefabrication process, for ensuring static continuity to the structure.

Making the precast blocks

There were four problems that Italcementi had to face and which were eventually coped, namely:

- The design and the construction of the formwork, reducing the cost to viable levels, exploiting all possible advantages and minimizing the difficulties arising out of having to work on spherical – hence variable – geometrical shapes;
- The graphic representation of the single blocks, which had to be developed without errors. The CAD-CAM system was of enormous help for giving the immediate input to the mechanical workshop in charge of constructing the metal templates to frame the precast blocks within the joint and to drill all the holes for allowing the passage of bars and suspension cables to within millimeters of precision;
- A solution for how to handle the formwork, made of both mobile and interchangeable parts (in other words linked to the geometry of the individual precast blocks), to be positioned each time in a way that had to comply with the much higher tolerances than normally asked of a precast concrete product manufacturer;
- The study of the form walls in contact with the concrete and the vibrating system, to eliminate any trace of air bubbles from the exposed surface of the final blocks.

Lifting and assembling the blocks on site

Each precast block had to be lifted and set in place next to others with the utmost precision according to the sail's geometry. Moreover, blocks had to be so maneuvered - this time with absolute precision - to permit interconnection of the bars, then returned to the ideal position and left static during the early stages of joint execution. All this had to be accomplished within a limited area of action, and without it being possible to hook the vertical of the blocks' center of gravity on any lifting or support system. In this respect, no solution making use of scaffolding or traditional lifting devices was possible. However, an answer was found by devising a special, 32-m high lifting machine. This machine enabled each precast block to move toward the three ideal X-Y-Z axes and to accomplish the three rotations on those same axes resulting in the six movements with permit a solid to achieve any position in space. Indeed an original and complex machine that, although drawing on all the opportunities modern technology can afford, is reminiscent of the machines that were used to build ancient cathedrals.

The material

The aesthetic quality, among other things, that Meier wanted to achieve urged Italcementi to develop and patent a new type of cement: Bianco TX Millennium. In addition to featuring very high strength and greater workability, this cement provides a surprising extra: when exposed to light, the photocatalyst particles in the white cement trigger a self-cleaning process on the surface, so that organic deposits are eliminated. This process favors the preservation of the original aesthetic appearance of the structure over time. Enthusiastic about the new material, Meier defined Italcementi as "the most extraordinary enterprise that I have ever known".

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