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Evolution of high-spec pre-stressed hollow core slabs

Pre-stressed hollow core slab structural elements are well known in the precast industry and do not need too much further explanation. However, since the late '80s some noteworthy initiatives were launched onto the Italian market seeking to satisfy the technical demands from long established precasters. The elements had greater loading and span characteristics and allowed the precast industry to make significant steps forward with new developments gaining acceptance and use in countries such as Spain, Portugal, Malta and Uzbekistan.



Nordimpianti's Slipformer for the production of large elements up to 1 meter high.



Nordimpianti's Slipformer producing a 1 m high hollow core slab.



Nordimpianti's Slipformer producing a 1 m high double T Beam.

The main type of element usually associated with precast floor is the hollow core slab. This type of element was developed around the mid-50s and spread rapidly around the world because of the many advantages it offers over traditional on-site slab casting.

The main advantages of the hollow core slabs are:

- Quick and easy installation
- High load capacity and rigidity
- Long spans without the need of temporary supports
- Excellent "ready to paint" lower surface finish
- Efficient span/height-ratio leading to reduced storey height
- Production flexibility



1987, the first 700 mm high hollow core slab produced by Nordimpianti's Slipformer at Gruppo Centro Nord in Italy.



1987, checking dimensions of the first casting of the 700 mm hollow core slab.

- Can be configured for seismic zones
- Excellent fire resistance and durability

The prestressed hollow-core slabs are cast continuously on a long production bed. There are two main types of machines to carry out this operation but both work with semi-dry concrete. The use of semi-dry concrete is important. It means that from the moment of manufacture the element is able to hold its shape until the concrete reaches the necessary strength when it can be cut according to the project specification. The elements can be configured to withstand considerable loads depending on their height, section profile and the pre-stressing cables used and making spans from 16 to 18 meters possible.

Until the mid-80s the production of hollow core slabs was limited to elements with a maximum height of 400mm due to the technical limitations of the casting machines. Two types of machines are used for casting, the Extruder and the Slipformer (a vibration-compaction machine). Which one is used depends on the manufacturer's requirements and the elements to be produced.

The extrusion technology is more widespread in the sector because the machines are simple to operate and they produce elements with excellent concrete compaction and also with a high quality surface finish. Previous decades of extrusion technology development had allowed element height production using the extruder to be pushed to 400-500 mm but some way had to be found to overcome even this limit to meet the demand for specific high-spec applications where hollow core slabs are used for industrial and infrastructure type projects.

The construction industry is always being challenged to design structures with elements that have longer spans such as those used in car parks and road bridges. Having the ability to produce floor slabs that have the same loading specifications but with greater spans means it is possible to reduce the number of columns, to the advantage of structural flexibility and also having a direct beneficial impact on construction costs. The initial problem with producing slabs with longer spans was that any increase in length meant an increase in element height in order to maintain design requirements. Hence the idea of producing prestressed elements combining two features: an element with a height greater than 500 mm incorporating transversal steel mesh reinforcement in addition to the pre-stressed strands.



2004, the first 1000 mm high hollow core slab produced at Gruppo Centro Nord in Italy.



Cross section of the 1000 mm high slab showing the pre-stressing wires and the transversal steel reinforcement mesh.

Nordimpianti, using its expertise in the field, developed a slipformer machine able to produce elements with the characteristics listed above. To achieve this, Nordimpianti worked closely with Gruppo Centro Nord, a well known leading Italian manufacturer of hollow core slabs. The first Slipformer machine producing 700 mm pre-stressed hollow core slabs was put into operation in Italy in 1987 by Gruppo Centro Nord in Novara. Gruppo Centro Nord then went on to consolidate its hollow core slab offering by producing elements 800 mm high and in 2004 manufactured, for the first time, an element 1 meter high with a span of over 25 m.

As well as the general advantages of these types of elements, large hollow core slabs offer additional benefits in applications where high-spec performance is required. 1m high hollow core slabs are used in projects such as: rockfall avalanche protection tunnels with spans from 14 meters and with loads from 4000 kg / m², coverings for industrial buildings with spans from 21 meters and with loads from 2200 kg / m² and railway bridges with spans from 25 meters and loads from 2000 kg / m².

With this milestone Nordimpianti not only managed to achieve a significant technological development for precast concrete but also worldwide point of reference in terms of hollow core slab applica-



1992, Franc Vella, head of Ballut Block Malta standing with pride next to the 700 mm hollow core slab produced by his company.



Valletta, Malta, Installation of double T Beams 800 mm high for a road tunnel cover.



Malta, Installation of a 26 meter large span element 760 mm high for a newly constructed logistics center.



Milan, Italy, Installation of a 24 m long 1 m high hollow core slab.



Andalo, Italy, Installation of Double T beams for a tunnel cover as a protection against rockfall.

tion expertise. Hollow core slabs with heights over 500 mm have recently been used in several projects in Europe, one of this was the "Logistics Centre for aluminium profile distribution" supplied by Ballut Blocks in Malta. The project used hollow core slabs 760 mm high with an incredible span of 26 metres and with a useful loading of 500 kg/m².

In addition to the 500 to 1000 mm high hollow core slabs the Nordimpianti Slipformer is also able to produce a double inverted T beam up to 1m high, another important element in the armoury of architects and designers.

Nordimpianti has been producing slipformers since its founding in the early '70s. Since then, this type of machine has undergone significant developments especially in terms of production flexibility, simplicity of operation and low maintenance costs.

The pre-stressed elements that can be produced with this technology are: Hollow core slabs for floors, Hollow Core Wall Panels, Inverted T-beams, Inverted I-beams, Vineyard posts, Lintels, Solid slabs, Posts, Grandstand panels, Slabs half, Slabs with lattice ribs, Inverted double T slabs, Inverted double T beams, Inverted triple T slabs and U panels.

Since its beginning Nordimpianti has proved its readiness to "step up to the plate" to meet any technical objectives head-on and is now in a great position to apply its experience and knowledge to all future challenges. ■

FURTHER INFORMATION

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