



Methods Without Formwork Molding of Reinforced Concrete Products

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ABSTRACT

The article discusses the technology of without formwork molding of reinforced concrete products. Various forming technologies are given and cement consumption is analyzed, as well as the advantages of this technology.

Keywords:

Without formwork forming of reinforced concrete, extrusion, slipforming, vibroforming

Introduction

In the world, prefabricated frame housing construction is intensively developing, minimizing the specific costs of concrete and metal, reducing construction time. Even high-rise buildings are built within a few months. For example, in China, in Hunan province, a turnkey 5-star hotel with 30 floors was built in just 15 days. And all this becomes possible with the use of the technology of without formwork forming of reinforced concrete.

The technology of continuous non-formwork forming of reinforced concrete products on long stands was developed in the nineties of the last century in Western Europe, Russia, and China. But the term formless molding of reinforced concrete is not entirely correct, because it is impossible to make a reinforced concrete product without formwork. It will be correct to speak in a sliding formwork. But the term formless forming on a long stand has taken root so firmly, so we will leave it as the main one [1].

Method and methodology

The method of formless molding of reinforced concrete products consists in the fact that the reinforcing frame of the product is formed by placing longitudinal reinforcement on the stand of formless molding (Fig.1). The longitudinal reinforcement is fixed and tensioned on the stops of the formless molding line. The concrete mixture is placed on the without formwork molding stand using a molding machine. At the same time, the molding machine during laying moves relative to the formless molding stand and performs vibrocompression and molding of the laid concrete mix. Moreover, at the stage of forming the reinforcing frame, dividers are installed on the formwork-free molding stand, consisting of a base, at least one spacer and a forming element. At the same time, the separators are made with the possibility of supporting the longitudinal reinforcement at a certain level, and before the stage of laying the concrete mix, the transverse reinforcement is fixed on one layer of the longitudinal reinforcement. In this

case, the base of the divider is fixed on the without formwork molding stand before the placement of the longitudinal reinforcement. After placing the longitudinal reinforcement, a spacer is fixed on the base. And after fixing and tensioning the entire longitudinal reinforcement, the shaping element is fixed on the base of the divider.



Fig.1 Without formwork forming stand

Carrying out work

Modern technologies for continuous molding of reinforced concrete products on long stands differ in molding methods. At present, the following methods are most widely used:

1. Extrusion (Finland, Italy, Great Britain, Canada, China); extrusion combined with vibration (Germany).
2. Slipforming (multi-layer molding):
 - a) vibroforming combined with ramming (Germany, Italy);
 - b) vibroforming combined with simultaneous horizontal reciprocating movements of the void formers and side formwork (Belgium).
3. Vibroforming "in one step" (Spain, Russia, China).

The preference in choosing the type of technology is due to two factors: - the presence of manufacturers of process equipment; - quality indicators of available inert materials.

According to the range of products, vibroforming is unrivaled. This method can produce any products of constant cross section.

In terms of the speed of transition from one product to another, vibroforming outperforms layer-by-layer molding.

In terms of the quality of raw materials, vibroforming is the most unpretentious

technology, since low-quality inert aggregates can be used.

In terms of equipment reliability and ease of maintenance, vibroforming is also preferred, especially after the invention of the vibroblock, which does not break at all.

In terms of operating costs, the extruder has the highest, slipformers and vibroforming machines are close in terms of operating costs.

One of the factors affecting the operating costs and the cost of products is the consumption of cement. Here are the figures taken from the practice of operating vibroforming machines, extruders and slipformers in the table below.

Consumption of cement when forming floor slabs

Table 1

Molding method	Concrete grade, kg/cm ²	Void (slab width 1.2 m)	Consumption of cement M500 up to kg/m ³
Extruder	550	0%	380-460
	600	0%	420-480
Slipformer	400	9%	400-460
	550	9%	430-500
Vibroforming	400	0%	400-480

To facilitate a comparative analysis of different methods of continuous formless molding (Fig. 2), sections of hollow-core decking slabs made by extrusion, layer-by-layer molding and vibroforming are shown.

Extruder emptiness 0,40	
Slipformer emptiness 0,39	
Vibroforming emptiness 0,40	

Fig. 2 Sections of hollow core slabs made by extrusion, layer-by-layer molding and vibroforming

Work results

Formworkless molding technology has a number of advantages:

- improving environmental performance in the production of products (reduction of dust content, sound insulation level);
- decrease in energy intensity of production (decrease by 50 - 70%);
- increasing the volume of products produced per square meter of production space;
- reducing the consumption of steel bars (reduction by 30 - 40%);
- reducing the number of service personnel (halved);
- possibility of increasing the length of the product (increases twice);
- pleasant surface and foundation-base zone;
- fire resistance (2-4 hours degree of fire danger);
- possibility of perception of high loadings;
- minimum allowable deviation of geometric dimensions;
- smooth level work surface;
- excellent sound barrier (due to voids);
- quick installation (reduces interim financing);
- economical bench method of manufacturing;
- unlimited design possibilities;
- flexibility in design and application.

Conclusion

Taking into account the above indicators, it is obvious that the aggregate-flow method for the production of hollow core slabs is no longer able to compete on equal terms with modern technologies of formless molding. Plants - manufacturers of reinforced concrete structures are forced to re-equip production for modern, economical technologies.

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