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PREFABRICATED MONOLITHIC GAS BLOCK SYSTEM

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Abstract

The article presents an analysis of prefabricated monolithic ceilings (PMC) of various manufacturers, which have received the most widespread use. The task of reducing the weight of building structures while maintaining the bearing capacity is relevant in modern construction. Prefabricated monolithic construction systems correspond to modern trends, but require special attention and study. The article presents an analysis of the advantages and disadvantages of prefabricated-monolithic slab structures, identified and identified problems of use that require further detailed study to ensure the reasonable use of SMP structures in the construction of buildings and structures.

Keywords: prefabricated monolithic floors, structural elements, energy efficiency, foam block, gas block, concrete mix, reinforcement, formwork, analysis

Introduction

Reducing the weight of construction structures, reducing the consumption of materials, as well as achieving a significant economic effect by ensuring their load-bearing capacity is a constant issue for designers and builders.

Wall, frame, frame-wall and frame-core structural systems are used in our country and in the design and construction of monolithic buildings.

Load-bearing reinforced concrete is widely used in heavy concrete and masonry systems, increasing the mass of structures and buildings. One of the efforts to solve this problem is the emergence of porous media and roofing sheets. Such plates are much lighter than prefabricated and monolithic composite panels.

The next step in lightening the constructions was the use of prefabricated monolithic iron bars. When designing them, all the positive and negative aspects of composite and monolithic media are taken into account.

In the countries of the European Union, the weight of the use of monolithic composites ranges from 20% to 35%, in the Russian Federation they have been used in small quantities since 2008, and in the conditions of Uzbekistan they have not been used until now. The relative weight of monolithic composite panels is low, they have high heat and sound protection, they are exempted from the labor-intensive technological process of making and removing coatings, special lifting techniques are not involved, and they also have other additional benefits [1].

The main part

Reinforced concrete structures.

The most widely used type of scaffolding in construction is reinforced concrete flat scaffolding. According to the construction technology, they are divided into:

- monolithic,
- assembled
- assembled
-monolithic types.

Monolithic media.

The technology of building the construction site itself, without joints connecting the structures, is called "monolithic reinforced concrete construction"

Monolithic reinforced concrete frames belong to this category and are among reliable and universal constructions. Their advantages are durability, the ability to give the desired shape, fire resistance, the possibility of using local raw materials, saving steel, while their disadvantages are high specific weight, laborious installation of roofs and coatings that do not

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meet modern construction trends, high labor consumption, etc. [2]. In addition, monolithic construction depends on climate and weather conditions. For example, the preparation of monolithic reinforced concrete structures at temperatures below +5ºC and above +30 0C dramatically increases the cost of the process, as it requires different heating-cooling methods and equipment.

All this requires the development of other new types of media structures.

Cumulative averages. Precast reinforced concrete structures are built from reinforced concrete slabs prepared in enterprises. They are made in specialized enterprises from concrete not lower than V15 class and prestressed or unstressed steel reinforcement. One of their advantages is that there is no need for separate calculations due to the fact that the maximum loads on the bearings are calculated during production. In the process of designing, it is necessary to select the required size and loads from the catalog of reinforced concrete structures [3,4]. The most common types of composite panels are:

- non-porous reinforced concrete slabs, rectangular in shape, thickness from 100 to 160 mm.;

- porous steel concrete slabs, the cut of pores is circle, square, oval, circle diameter is 140 and 160 mm, slab thickness is 160, 220, 260 and 300 mm, the most common ones are 220 mm thick and 160 mm in diameter, length is up to 2-8 m.

- reinforced concrete slabs with ribs are reinforced with additional ribs, have a large load-bearing capacity, are used in the construction of infrastructure and industrial buildings, are 1.5 and 3.0 m wide, and 6 and 12 m long.

Compared to cast monolithic partitions, the advantages of precast reinforced concrete partitions are as follows:

- increased heat and sound insulation when porous composite plates are used;

the speed of installation of structures in place;

inviolability of installation work to climatic conditions.

Precast reinforced concrete in relation to the construction process of cast structures assembly of constructions is quite light, but requires special lifting equipment. Therefore, searching for lightweight structural solutions that require minimal labor instead of prefabricated reinforced concrete structures is one of the urgent issues [5,6].

Stacked monolithic media (SMM).

These types of concrete slabs, which include both monolithic and composite concrete slabs, are composed of a lightweight block and various filler blocks. At the construction site, monolithic concrete is filled and a surface layer is formed.

In recent years, due to the changes in the construction industry, the division of construction organizations and changes in specialization, a number of new requirements have been imposed. One of them is the preparation of separate, relatively small and light constructions in the object itself during the restoration of buildings. One of such solutions is called monolithic media systems. These systems maintain a good balance with aerated concrete, foam concrete, expanded clay concrete, expanded polystyrene concrete, thermoblocks, porous bricks and insoluble monolithic coatings. Among the main problems during the design and construction period, in addition to the choice of structural solutions, it is necessary to develop and improve the methods of calculating the averages, and to take into account how they behave under loads [7,8].

The measures taken will help to take into account as accurately as possible the load-carrying capacity of the selected class of media, and will be compared to other existing technological solutions.

If we look at and analyze the tomyopma and oraiopma, which are widely used in practice, they have different structural forms and are made of different materials.

For reinforced concrete structures, along with walls, a lot of material consumption is required. Approximately 20% of the weight of the building under construction corresponds to the averages, and in the buildings to be reconstructed, this figure reaches 50-60%. This situation means to us that it is important to choose the intermediate structure in the buildings under construction, taking into account the features such as accuracy, uniformity and economic efficiency from the point of view of preparation technology.

The work done in favor of the practice of prefabricated monolithic frame construction in Koyi is also the literature published in the world and in our country.

We present the analysis. We will try to justify the possibility of using this technology in complex climatic and seismically active conditions, along with the introduction of architectural content, giving detailed classification and descriptions. In addition, the reasons why we prefer this particular technology are given. It is based on the fact that the prefabricated monolithic frame of the building works as a half-frame system and has the same positive qualities as a fully prefabricated frame.

One of the urgent issues today is to reduce the cost of construction. The solution to such a problem can be

implemented due to the industrialization of construction. In the case of monolithic construction, the construction period is doubled compared to prefabricated or prefabricated-monolithic construction. For the purpose of industrialization of construction, the relevance of using monolithic constructions in complex conditions, including seismic effects on a large scale [9] has been justified.

In construction, characteristics such as uniformity, durability, noise isolation, and heat resistance, which ensure the required quality of the building, are also of great importance. Precast-monolithic ribbed partitions, the space between the ribbed wall blocks is filled with autoclaved aerated concrete. In this type of environment, aerated concrete serves not only as a filler, but also as a coating at the same time. In a number of articles, the construction of monolithic constructions in the presence of a lifting support structure of industrial and civil buildings, their constructive structures, fields of application, advantages and disadvantages are shown. For the normal development of science in the field of construction, optimal types of constructions that save time and money, as well as having good durability indicators are necessary. In the listed articles, it can be seen that the main indicators and descriptions of composite-monolithic media are processed and summarized with a wide review, analysis and existing information about them.

Calculation methods.

Stresses in statically indeterminate structures are usually determined using the method of strapping systems in structural mechanics. In this method, the calculation is carried out assuming the ideal elasticity of the material and the invariable integrity of the structure. The performance of structures in buckling consists of a linear relationship between stress and displacement as the load increases. However, reinforced concrete structures can exhibit elastic and inelastic deformations, i.e. plastic state. With the distribution of the given force, elastic deformations disappear, plastic deformations remain. Elastic deformations are based on displacements that bring atoms back to the equilibrium state, and plastic deformations are based on non-return to the initial equilibrium state. With the appearance of cracks in reinforced concrete structures, uniformity changes, the correct proportionality of forces and loads is disturbed, that is, internal forces are redistributed. In other words, as the load increases, the ratio between the internal forces in different sections of the structure changes. It follows that the results obtained in the calculation of statically uncertain reinforced concrete systems according to the strap stage do not correspond to the actual bearing capacity of such systems.

Therefore, today, the "limit balance method" is widely used in the calculation of static uncertain structures [1]. The method takes into account plastic deformation of materials and redistribution of forces caused by other factors. According to the content of the method. At a certain value of the load, the cracks in the mild steel tensile reinforcement reach the yield strength. Plastic deformations in steel increase, and a zone of local large deformations occurs in the elongated reinforcement in reinforced concrete structures. This zone is called "plastic hinge". The difference between a plastic hinge and an ideal hinge is that it has a constant moment equal to the limiting value:

$$M=R_s \cdot A_s \cdot z \quad (1)$$

where, R_s is the calculated resistance of the reinforcement in the plastic joint to stretching,

A_s – the area of the extended armature in the plastic hinge,

z – the shoulder of the internal couple force in the plastic joint is found by the following formula:

$$z= h_0 - 0{,}5 \cdot x \quad (2)$$

this on the ground x – the height of the compressed zone in the plastic hinge. As the load decreases, it freezes.

Real with plastic properties constructions shows multiple static nonionic systems. Therefore, all structures will have an additional bearing capacity reserve. In contrast to static definite systems, static indeterminate systems can carry additional loads due to internal forces when the stresses reach the yield point in the most dangerous sections. The moment of the structure immediately before failure is considered, that is, the moment when the conditions for the balance of internal and external forces reaching the limit values are still fulfilled. This is the reason why the calculation method is called "Limited equilibrium method".

$$M_{ex} \leq 0.5 \cdot M_{is} + M_{if} + 0.5 \cdot M_{is} \quad (3)$$

M_{ex} –external standard load moment;

Mis –internal stresses at the support moment;

Mif –moment of internal stresses in the medium.

It can be seen from the equation that the load-carrying capacity of a statically indeterminate structure does not depend on the value of the relationship between the base and intermediate moments and the sequence of plastic hinges. The sequence can be

defined freely, it is only necessary to observe the equilibrium equation.

When considering a statically defined, freely supported beam close to failure, the reinforcement of which has reached the yield limit, a branch with large local deformation – a plastic hinge – appears in it. The number of such branches can be different, for example, in a beam that is tightly clamped on both sides, they can be three – on both supports and in the span. This means that the bearing capacity of the beam is completely exhausted, that is, the given system breaks down. The value of the force generated by the plastic hinge in the beam is called the limiting force.

With a plastic hinge attached to the beam clamped at the supports, it is precisely this clamping that prevents the turning of its parts. Therefore, as long as the load continues to increase, that is, until plastic branches appear and excess connections are broken, the plastic joint does not break. In a statically uncertain system, the appearance of a plastic hinge is redundant is equal to and means that the static uncertainty of the system decreases by one level [10].

Loss of geometrical invariance of the system can occur only with the appearance of those three plastic hinges – both at the base and in the span. We can see the sequence of redistribution of bending moments under the influence of force F_0 (in the figure shown P-load) in the example of a beam with two supports (Fig. 1).

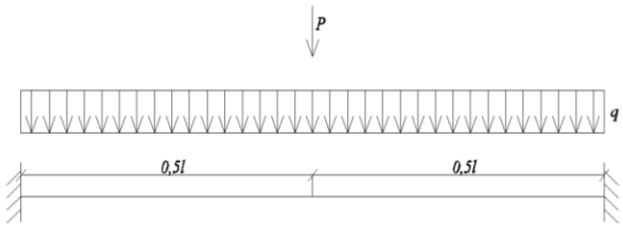


Figure 1. The calculation scheme of the beam with an external load.

We must not forget that the calculation using the limit equilibrium method can be applied only to structural elements made of plastic materials that allow plastic deformations at the most stressed points. This method is also used to calculate the bearing capacity of the element in terms of fire resistance.

Since the light block precast concrete perimeter in question usually rests on the walls, which are made of studs and other materials, it is necessary to make a reinforced concrete belt around the perimeter. During the construction of the inter-floor partition, this belt is protected from twisting by loading with the walls of the next floor. This means that the torsion of the cross-section of the beam and the direct beam in the supporting zones is equal to zero, and its edges are locked together [11].

The loads used in the calculation were obtained based on KMK 20.13330.2016 [4]:

1. Constant loads :

−weight of floor / roof coverings (floor covering , warm floor and roof – 3 options);

−average weight (t/b bulk weight and gas block weight);

2. Short-term loads (long-term):

−transverse curtain walls (150 mm);

−longitudinal curtain walls (100, 120, 150 mm);

3. Short-term loads (short-term):

temporary loads evenly distributed among the spaces (attic rooms: apartments, offices, corridors, halls).

Test-experimental work was carried out by making changes to the types of structures presented for use in the conditions of Uzbekistan. Figure 2 shows the state of the prefabricated monolithic construction type that we propose and called "KOSON-N" before pouring concrete.

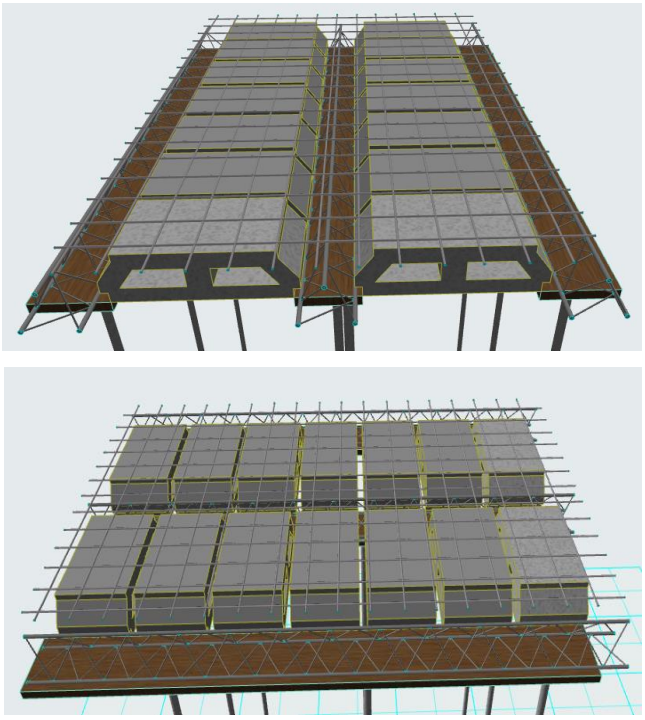


Figure 2. "KOSON-N" intermediate view before concrete placement.

When calculating the "KOSON-N" spacer system, we applied and tested the above-mentioned limit equilibrium method in the conditions of formation of plastic hinges between supports and spacers [5-8]. The result of the test showed us that if the standard load on the media is not less than 600 kg/m², it was 850 kg/m² in our experience.

3. Conclusions

Today, prefabricated monolithic types of structures are being developed and used in the world: Photoderm (Austria), Teriva (Poland), Rektolight (France), Ytong (Sweden), Mapko-Econ 1, Marko-Standard 2, Marko-Universal 3, IJ-670 (Russia). In Uzbekistan, it is possible to close complex geometric shapes in conditions of increasing weight of prefabricated monolithic partitions during construction, without resorting to excessive construction technologies for assembly. This makes it convenient to replace such structures not only in new construction, but also in weakened wooden and other partitions of buildings that have served their service life. Most often, prefabricated monolithic partitions in halls serve as the best option for use in the reconstruction of buildings, including the restoration of historical structures.

Prefabricated monolithic spans are a constructive type in new construction, providing high indicators of load-bearing capacity, impact resistance, sound insulation and thermal conductivity of spans.

The factors constraining the widespread use of prefabricated monolithic superstructures are that these structures have not yet been sufficiently studied and design standards for them are collapsing. Strength tests and necessary calculations are performed to develop a method for calculating prefabricated monolithic supports.

Calculation methods for prefabricated monolithic formwork are based on deformation models, it should be borne in mind that the structural material is heterogeneous, deformability is physically heterogeneous, work with cracks, subsidence and displacement of reinforced concrete.

The criteria for fire resistance of prefabricated monolithic formwork require clarification by conducting special experiments.

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