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THE CONSTRUCTION DECISIONS IMPROVEMENT OF ENERGY EFFICIENT FLOORINGS

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A comparative analysis of the main operational characteristics traditional types of flooring structures, which are the most widely used in modern construction was carried out. The most perspective methods of prefabricated monolithic flooring, considering modern tendencies of new technologies, materials, organizational solutions are defined.

The market supply of modern technologies of prefabricated monolithic flooring which characterized by relatively lower indicators of the flooring weight, increased thermal and sound insulation properties are analyzed. The constructive solutions for the prefabricated monolithic flooring by using cellular concrete blocks were improved.

Key words: prefabricated monolithic floorings, cellular concrete blocks, energy efficient, technologies, construction decisions.

Introduction

Today, designing of energy-efficient buildings is one of the most important problem and one of the most perspective direction of engineering science development from the point of view high energy intensity of final construction products. A high cost of turn-key construction in Ukraine depends on significant energy component of the building materials costs.

The cement industry, production of wall materials, enterprises of reinforced concrete products are characterized by high-temperature technological processes. Except that, those enterprises using outdated technologies and equipment with a high level of degree and low efficiency. As we know, the technology of cement burning is characterized by a high-temperature process, approximately 1450–1500^{o}C. It has great impact on specific consumption of energy resources and it's a consequence of the high energy intensity of cement production. We can achieve a high resource efficiency indicators in construction exploitation applying an integrated approach of architectural planning, designing, engineering solutions, taking into consideration the requirements of energy saving.

Implementation of effective structural elements of the construction in terms of cost savings of labor, energy, materials, and as a consequence, financial resources, with increased insulation indicators is the strategic direction of modern construction development.

The ***main idea*** of this paper is the need to determine ways of reducing the cost construction and search most resource-efficient technologies for the structural elements of the construction. Also, an important aspect of this research is improving the design solutions of prefabricated monolithic flooring with using cellular concrete blocks.

The ***main purpose*** of the article is development of constructive solutions, improving technological and designing approaches an energy saving of prefabricated monolithic flooring with the use cellular concrete blocks.

Overview

In modern science much attention is paid to the issues of resources and energy efficient flooring. Thus, V. Shmuckler and M. Pomazan consider the peculiarities lightweight reinforced concrete slabs introduction. They offer use insert from a light material. Today, there are technologies of prefabricated monolithic flooring using ceramic blocks and exclay clamps. So, in the national science the issues of use products made of cellular concrete as elements of the flooring structure are practically not considered.

Most scientific works devoted to the relevance of the use products made of cellular concrete, as a wall material [1] (external wall panels and large blocks of autoclave aerated concrete) full or high readiness for the installation of facades in residential construction.

The results of research

The development of modern construction in terms of energy efficiency and energy saving should take place in a comprehensive way covering various areas of structural elements of a building improvement. First of all, it concerns the introduction of new types enclosing structures that are characterized by an increased level of thermal resistance, according to State Building Codes (SBC) V.2.6-31: 16 "Thermal insulation of buildings" [2]. The new version of this document introduces the improved requirements for energy efficiency and thermal engineering indicators of building structural elements and structures.

The most important constructions in the sphere of designing building is flooring. Flooring - is an internal horizontal bearing protective structure that separates a building into floors and accepts the corresponding load. In addition the flooring must comply with the normative fire, heat and sound insulation requirements. An important aspect of design is the economic importance of construction, and therefore the cost of flooring should not exceed 15-20% of the total estimated construction cost.

Moreover, the construction of such structural elements as flooring significantly affect the durability of the construction and therefore requires the development of new improved existing technology solutions.

Before choosing the type of the constriction for a house, it is necessary to take into account all the advantages and disadvantages of certain types of flooring, which are often used in housing construction (Tabl. 1)[3,4]. The greatest demand for the flooring choice is the usage of finished products - reinforced concrete plates. The reason is explained by the speed of installation and the range of dimensions. The weight of one cubic meter of reinforced concrete plates is about 350 kg. The extrusion products have an even greater weight of about 450 kg. At the same time, the bearing power of such a flooring from 330 to 650 kg/m^2. In some cases, especially when we use modern extrusion technology, the maximum calculated load can make 850 kg/m^2 and in some cases 1000 kg/m^2.

Table 1

General characteristics of some flooring type

Kind of flooring	Advantages	Disadvantages
Reinforced concrete plates	- convenience and speed of the installation; - diversity of dimensions; - do not require installation of lathwork; - the possibility of use for multistorey and individual house;	- require the use of building machinery; - additional thermal and sound insulation is required; - relatively large weight of the product; - high delivery cost; - limited application in non-standard project decisions; - limited installation in compressed conditions; - the need for a reinforsed belt in some cases;
Monolithic flooring	- the possibility of independent installation without the use of construction equipment; - for walls of different shapes; - equal strength along the perimeter;	- relatively long terms of installation; - require the use of lathwork; - heavy weight of the flooring (additional load on the foundation, walls); - the need of reinforcement;
Wooden flooring	- ease of installation; - relatively small weight of the construction; - less cost of the installation; - do not require the usage of construction equipment; - thermal insulation; - environmental friendliness;	- mainly for low-rise buildings; - additional sound insulation is required; - steam and gas permeability; - requires additional material processing; - limited size of the building; - relatively less bearing power;

So, when we deal with a low-rise individual house, the importance of choosing this type of flooring is questionable. In this case, wooden flooring is more often preferred, taking into account the lower cost of the arrangement, but, accordingly, significantly lower than the bearing power of the design within the limits of 200-400 kg / m^2. This material has a number of other disadvantages and exploitaion features that need to be taken into account when choosing the flooring of construction.

With the optimal and most rational choice of flooring, it is possible to achieve high energy efficiency, thermal resistance and necessary soundproof. As it is known the specific gravity of energy saving due to the improvement of enhancing structures (windows, walls, floors) is 25-30% [5, p. 47-48].

The increase of thermal protection properties of flooring be acquired by constant improvement of some constructive, technological, organizational solutions and at the same time using modern building materials with increased heat-insulation properties. Recently, monolithic flooring with the use of exclay blocks, ceramic products which are characterized by a high thermal insulation, sound insulation and relatively lower cost of the installation are especially popular. Moreover, the weight of the prefabricated-monolithic flooring is 30% less than reinforced concrete products. It's reduces the stress on foundation and walls of the construction, and decrease building costs.

Today, much attention is paid to modern technologies of prefabricated monolithic floorings on construction market, among them: the Polish overlap "TERIVA", the Belarusian "DAH", Serbian "SerboCeramika" and Russian – "MARKO".

The peculiarities of the presented flooring methods in technological aspect by organizational and constructive solutions are similar. So, these technologies contain reinforced concrete beams with a spatial triangular reinforcement frame in the form of a light metallic truss, hollow liner–blocks, the required level of strength is ensured by the arrangement of reinforced mesh, which is fixed by a layer of concrete screed (Fig. 1). When the concrete acquires the necessary strength, such prefabricated monolithic flooring accepts the load up to 800 kg/m^2.

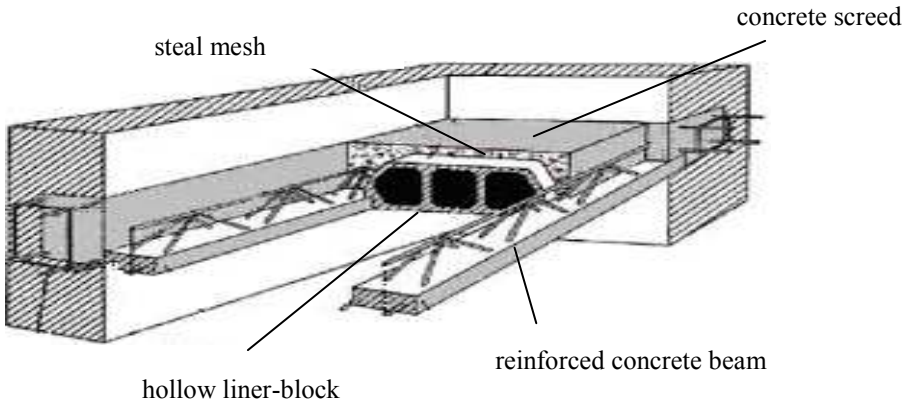

Fig.1 – The scheme of prefabricated monolithic flooring
according to technology "TERIVA" [6, p.28-29; 7]

By the structural-element composition, given methods of prefabricated monolithic flooring that are presented, modify depending on the form and material from which the liner-blocks are made. Thus, technology "TERIVA" uses exclay blocks, the technology "DAH", SerboCeramika implies the usage of special burning ceramic blocks. As we know, the production processes of exclay and ceramic products are characterized by high temperature (the keramzite burning takes place at the temperature of 1100°C and requires the usage of fusible clay), and therefore, an energy intensive process that, in cases of fuel and energy resources economy, lose its relevance.

The increase of requirements of heat and sound insulation enclosing structures of constructions and in conditions of practical need improvement of prefabricated monolithic flooring technologies the authors of this paper, improved the structural and technological approach.

In particular, we suggested the usage of cellular concrete blocks with a density of 300-400 kg/m^3, as a material of liner-blocks. Cellular concrete liner-blocks with dimensions of 320*240*200 mm (Fig. 2) provide the necessary level of thermal insulation and are characterized by sufficient sound insulation of the structure, in accordance with modern high requirements of the thermal engineering parameters of enclosing structures.

The normative parametres of the main characteristics of cellular concrete liner-blocks, are [8]:

– average density – 380 kg/m^3;

– the type of compression strength – B1.5;

– the compression strength 2.0 MPa;

– the flooring volume insulation is about 25-43 dB (living spaces) according to NBC V.1.1-31: 2013 "The Protection of territories, buildings and structures from noise";
– thermal conductivity 0.11 - 0.12 W/(mK).

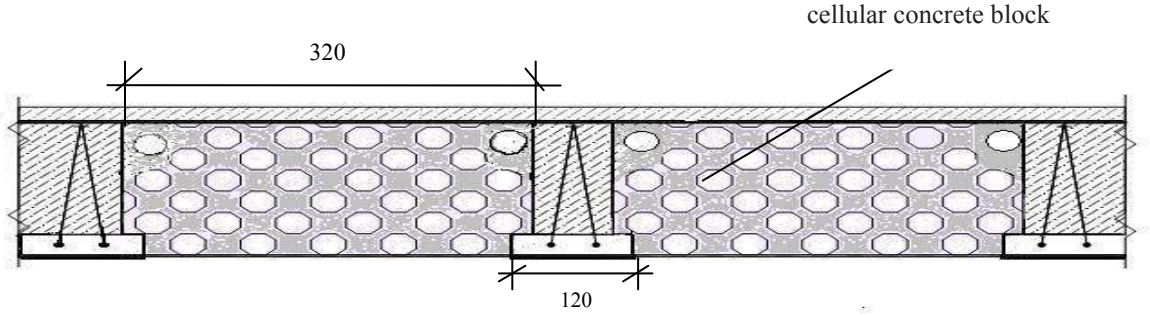

Fig. 2. The schematic picture of prefabricated monolithic flooring
with the usage of cellular concrete blocks

The main direction of increasing resource and energy efficiency of prefabricated monolithic flooring is the usage of a new variety of porous conglomerates – aerated concrete without autoclaved setting. The supply of metered exploitation parameters for such materials is achieved by the usage of artificial precast concrete aggregate and reduction of the mineral material usage. It is known, that natural mineral aggregate and admixture require additional costs for their production and transportation, at the same time, 12 of the existing thermal power plants in Ukraine, on average, annually waste about 10 million tons of ash-slag [9,10].

Using of prefabricated monolithic flooring with cellular concrete blocks in modern construction leads to a significant reduction in their weight. Also this type of flooring reduces load on vertical structures and the foundation of a building.

As a matter of fact the decrease of flooring weight by 30 - 40% leads to the decrease installation costs. In addition, this type of flooring has high thermal and sound insulation compared to traditional reinforced concrete structures. There are cases, when the prefabricated monolithic flooring with the use of cellular concrete blocks are especially important: individual and cottage construction, non-standard architectural forms in places with limited access to specialized building machinery

This kind of flooring is an absolutely complete element of a building, which does not require additional work to ensure the required sound insulation level. Another additional advantage of prefabricated monolithic flooring is that they don't need the usage of lathwork, because special elements of this flooring are being installed on the walls of the building.

In Ukraine modern building production, such types of flooring are rarely used. This is explained by the lack of awareness of the technology of erection of such structures, the operational features of individual components of flooring, the lack of a widely available market supplies for the constituent elements of prefabricated monolithic flooring.

The problems of ensuring the durability of prefabricated monolithic flooring with the usage of cellular concrete blocks with calculated maximum load, significance of deformation processes are insufficiently studied.

Conclusion

– The reseach of the ways to reduce resource capacity and decrease of the construction costs are the most important scientific problems. The large percentage of energy resources in one square meter of final building production promotes the development and implementation of effective methods, technologies and organizational solutions in a building production. Lately at the state level much attention is paid to the problems of energy saving and the implementation of energy efficiency processes in modern construction and building industry.
– A large number of scientific developments and design decisions in the construction industry are aimed at reducing the proportion of reinforced concrete products, which are characterized by high energy intensity and resource consumption in building industry and require additional heat and sound insulation solutions. Rapid development of new building materials, energy and resource efficient

construction technologies for some elements of the house will gradually change traditional engineering solutions.

– Perspective directions for further scientific researches imply the calculation of the bearing load of flooring on the walls and the foundation of the house. Also it is important to determine the organizational and technological steps of the prefabricated monolithic flooring process with the usage of cellular concrete blocks. It is advisable for achieving the necessary performance characteristics of flooring, to conduct the research in order to ensure the common work of separate structural elements in the building flooring.

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УДОСКОНАЛЕННЯ КОНСТРУКТИВНИХ РІШЕНЬ ЗВЕДЕННЯ ЕНЕРГООЩАДНИХ ПЕРЕКРИТТІВ

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Здійснено порівняльний аналіз основних експлуатаційних характеристик традиційних видів конструкції перекриття, що найбільш масово застосовуються в сучасному будівництві. Визначено найбільш перспективні методики зведення збірно-монолітного перекриття, з урахуванням сучасних тенденцій розвитку нових технологій, матеріалів, організаційних рішень.

Проаналізовано ринкову пропозицію сучасних технологій зведення збірно-монолітного перекриття, що характеризується відносно меншими показниками ваги конструкції перекриття, підвищеними теплотехнічними, звукоізоляційними властивостями. Удосконалено конструктивні рішення зведення збірно-монолітних перекриттів із використанням блоків з ніздрюватого бетону.

Ключові слова: огороджуючі конструкції, ніздрюватий бетон, теплозвукоізоляція, енергоефективні перекриття.

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УСОВЕРШЕНСТВОВАНИЕ КОНСТРУКТИВНЫХ РЕШЕНИЙ ВОЗВЕДЕНИЯ ЭНЭРГОЭФФЕКТИВНЫХ ПЕРЕКРЫТИЙ

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В статье проведен сравнительный анализ основных эксплуатационных характеристик традиционных видов конструкции перекрытия массового использования в современном строительном производстве. Определены наиболее перспективные методики возведения сборно-монолитного перекрытия, с учетом современных тенденций развития новых технологий, материалов, организационных решений.

Изучение рыночного предложения современных технологий возведения конструкции сборно-монолитного перекрытия, отвечающим повышенным показателям теплозвукоизоляционным характеристикам. Усовершенствованы конструктивные решения технологии сборно-монолитных перекрытий с использованием блоков из ячеистого бетона.

Ключевые слова: ограждающие конструкции, ячеистый бетон, теплозвукоизоляция, энергоэффективные перекрытия.

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