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THE USE OF INTERLAYERS IN COMPOSITE CONCRETE STRUCTURES**ANTON SEMENOV, ELENA KREMNEVA**

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In the article the factors influencing the strength of the contact joint of composite structures are considered. The feasibility of using interlayers based on modified cement systems was noted. Proper joint operation of structures is ensured by the triunity of material, technological and constructive factors.

Ensuring the joint operation of layers of concrete and reinforced concrete in composite structures is an important issue not only in precast-monolithic and monolithic construction, but also in the reconstruction and technical re-equipment of buildings and structures. The joint work of the layers of reinforced concrete composite structure is ensured by the adhesion strength, which is carried out on the basis of the unity of materials, technological and design activities.

The Material aspects include the type of binder, the composition of the concrete mixture and the use of various types of modifiers, as well as the use of various impregnations and primers.

The technological aspects are mainly reduced to the formability of the concrete mix, the wetting of the surface of old concrete, surface preparation methods, as well as the measures for the care of concrete.

The constructive aspects are reduced to an increase in the actual area of the contact joint, which can be achieved by the arrangement of holes and grooves, anchor protrusions and snakes, or through the device of different-shaped keys, which is taken into account in the design calculations by entering a coefficient for various types of surfaces, according to [1].

Recently, modified concrete is widely used in new construction, during reconstruction and technical re-equipment, as they allow not only to reduce energy consumption and cement consumption, but also to reduce labour intensity of placing concrete due to partial or complete exclusion of concrete consolidation. This is primarily due to the work in cramped conditions. The use of modifiers allows to increase the quality of concrete works [2].

The use of modifiers in concrete to improve adhesion and increase the strength of the joint of old and new concrete is an established fact that has a sufficiently large and convincing material in the field of research [2-9]. As for the use of interlayers and primers, this issue has not received sufficient coverage. Today, there is a large number of modified additives, and all of them are widely available and contribute to reducing energy and labor costs. For large volumes of work, the use of modifying additives can be very expensive and not expedient, since the cost of modified concrete is higher than that of ordinary concrete. The layers, in turn, are distinguished by the following characteristics: firstly, they create a kind of buffer zone between old and new concrete and can solve the problems of shrinkage reduction, secondly the amount of modifier in the interlayer may be less than in the structure and there is a substantial saving.

It should be noted that in ordinary composite structures there is one contact joint, while in the arrangement of layers it is necessary to ensure the adhesion strength of two contact joints: the first contact joint is between the interlayer and the old concrete, the second one is between the interlayer and the new concrete, figure 1 [3].

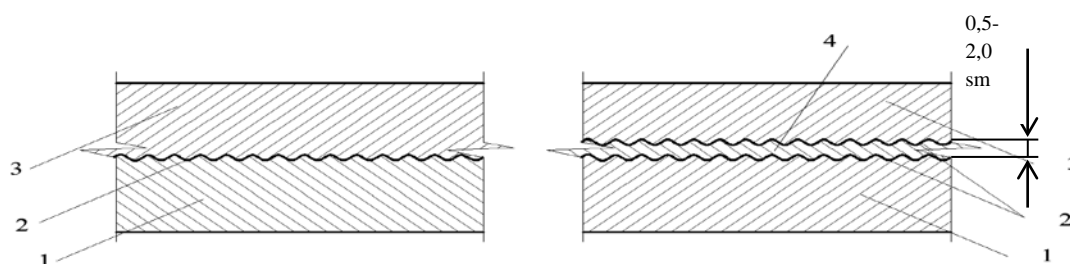


Fig. 1. The presence of one and several contact joints in a design with an interlayer and without it:
1 – old concrete; 2 – contact joint; 3 – grouting concrete; 4 – interlayer

A lot of researches on the contact joints and cohesion of old concrete with new one have been carried out both in the Republic of Belarus and abroad [2–9].

A lot of studies are known with application of cement mortar, cement paste and cement to the surface of old concrete. According to the results of K. Hager and I. Neinning's works [10], the cement powdering over the wetted surface reduced the adhesion strength, while the application of cement mortar sharply increased the adhesion resistance. Based on the results of K. Hager's work, the graph presented in figure 2 is constructed.

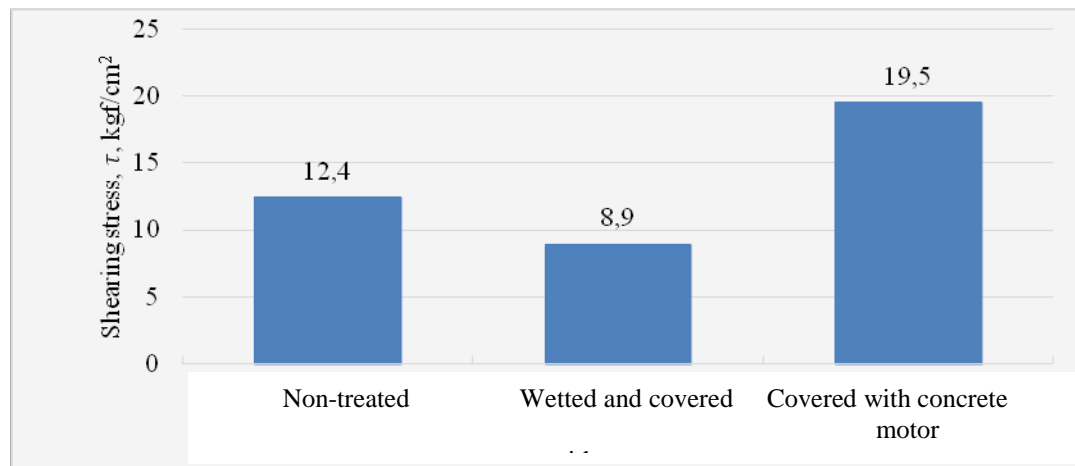


Fig. 2. Change of the shearing stress due to on the type of coupling surface

On the basis of Polotsk State University, a study was conducted to examine the effect of the modifying additive Stakhament 2000M on the layer and its concentration [3]. The change in the strength characteristics of the layer with different concentrations of the super plasticizer is shown in figure 3.

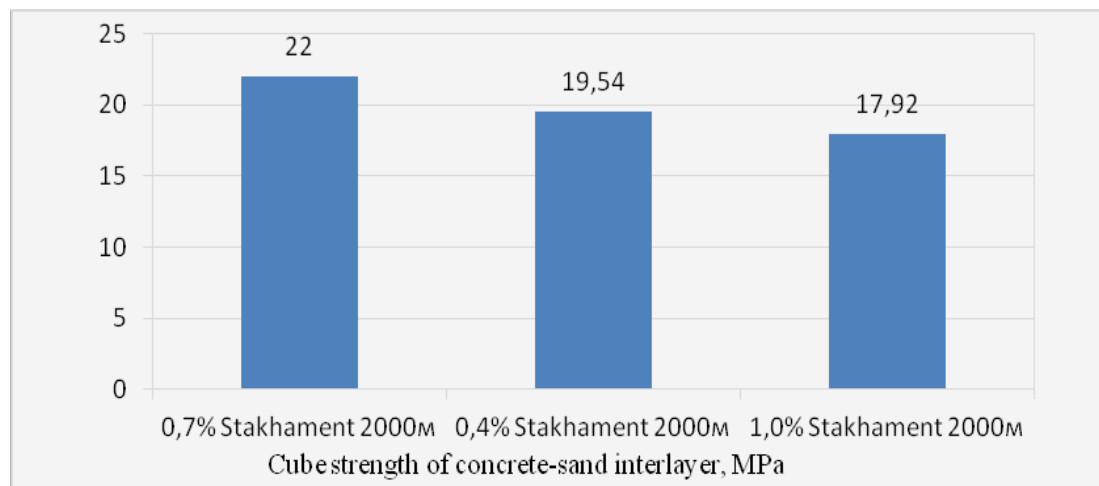


Fig. 3. Changes in the strength characteristics of a cement-sand interlayer, depending on the amount of additive

The influence of different modifier concentrations on the strength of the contact joint is shown in picture 4.

As it can be seen from [3], the use of interlayers based on modified cement systems increases the strength of the contact joint to almost 40%, depending on the concentration of the additive (fig. 4).

Today, Polotsk State University has been conducting the research on the strength of contact joint using the interlayer of the following composition: cement, sand, water, dolomite powder and the additive $Al_2(SO_4)_3$. This composition is selected due to the fact that dolomite powder replaces part of the cement and thereby saves it, and $Al_2(SO_4)_3$ in its turn leads to an increase in the strength of the interlayer.

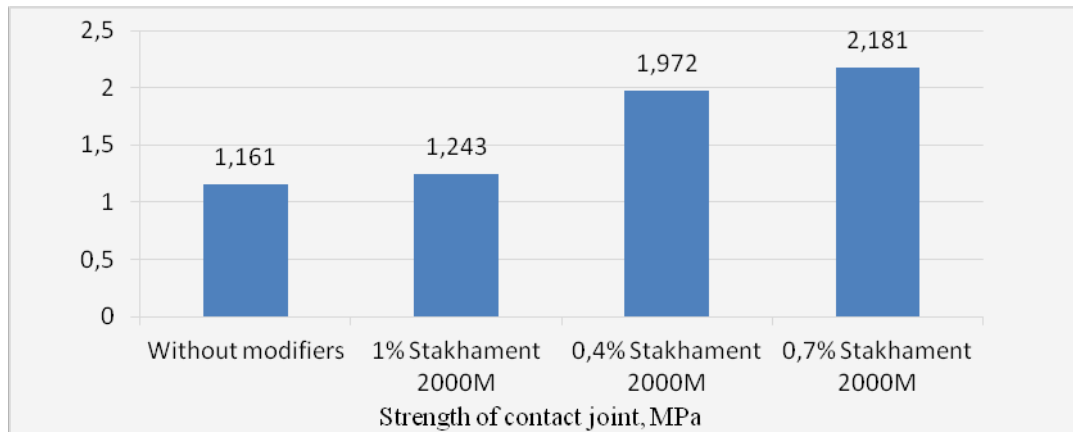
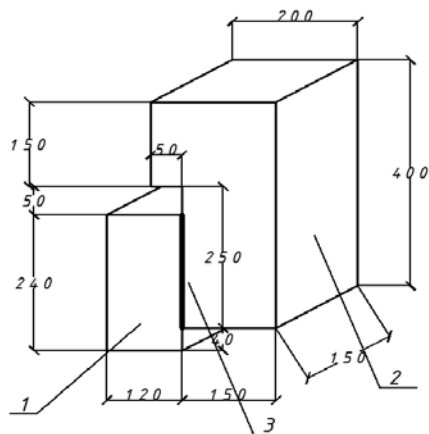


Fig. 4. The effect of the super plasticizer Stakhament 2000M on the strength of the joint

A test rig has been prepared and a test circuit has been selected. The scheme of the composite structure with the interlayer is shown in figure 5.



1. Old concrete
2. Grouting concrete (new concrete)
3. Interlayer

Fig. 5. The scheme of composite structure with interlayer

Based on the above-mentioned material, the following conclusions can be drawn:

- investigation of contact joints in composite structures remains relevant and has not been thoroughly studied;
- strength of the contact joint depends on various factors, the main of which are the conditions of laying new concrete, methods of compaction, maintenance of freshly laid concrete, processing of the interfaced surface of old concrete, the composition of the concrete mixture, etc.;
- the use of interlayers provides an opportunity to save labour and energy resources;
- interlayers have a positive effect on the strength of the contact joint, since shrinkage is reduced;
- it is necessary to develop new compositions of interlayers, using dolomite powder and other components.

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