UDK 624.012.45

USE OF MODIFIED CEMENT-SAND INTERLAYER IN COMPOSITE CONCRETE AND FERROCONCRETE CONSTRUCTIONS

KSENIA KOSTYURINA, IGOR VOROBYEV, ELENA KREMNEVA
Polotsk State University, Belarus

The joint work of layers of reinforced concrete composite structure is provided by the strength of adhesion, which is carried out on the basis of the unity of materials, technological and design activities. In this article, the influence of modified concrete on the strength of joints of composite structures is shown. The purpose of this study is to provide the optimum strength of the adhesion of concretes of a composite concrete and reinforced concrete structures using interlayers modified with the Stahement 2000M.

In view of the widespread use of modified concrete both in monolithic and prefabricated constructions and also in reconstruction, the effect of modifiers on the strength of the contact seam is very important. Investigations of the durable connection of new and old concrete, prefabricated and monolithic, have become widespread both in Belarus and abroad, in the works of scientists in research, design and training institutes [1-9]. On the basis of Polotsk State University for more than 10 years, a number of studies concerning the effect of modifiers on the strength of the contact seam have been carried out. These studies have been carried out using concrete with modified additives ATP, Superplast RT, Stahement F, Stahement 2000M [1, 2, 5]. At this stage, studies are carried out with the HA polymerizer Stahement 2010. The analysis of these works confirms the fact that the introduction of modifiers into the concrete mixture favorably affects the strength of the contact seam compared to the concrete without any additives, and the concentration of the modifier affects the strength of the contact seam. However, for large volumes of work, the use of modifying additives can be very expensive and unpractical, because the cost of modifiers is quite high. A rational solution to this problem may be in the usage of interlayers based on cement systems, including modified interlayers.

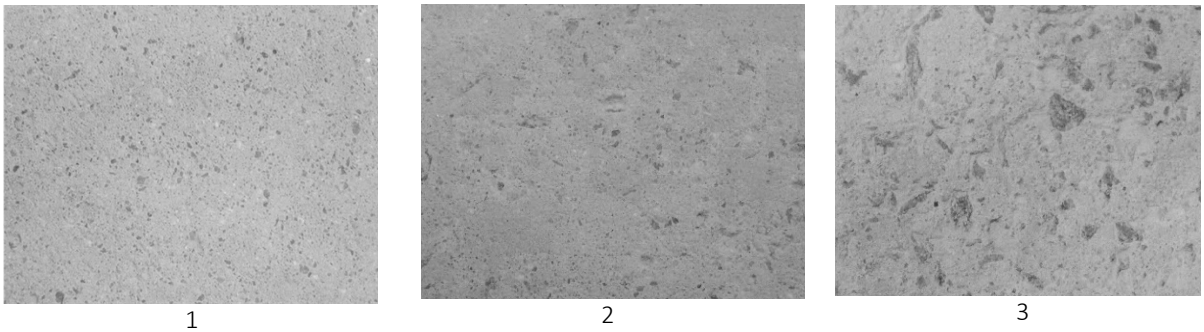
The contact seam generally is a combination of at least two elements, for example, the connection of building-in concrete with old concrete during reconstruction, prefabricated elements with monolithic concrete in prefabricated-monolithic construction, joining sections of monolithic concrete with newly laid in case of monolithic construction, joints in prefabricated buildings. In general, all the works devoted to this topic, consider the presence of only one contact seam. However, with the use of adhesives, impregnations, primers and interlayers, the structure is a system consisting of three layers, with two seams, which solve two main problems: 1) the strength of adhesion of old concrete with interlayer and 2) the strength of adhesion of interlayer with building-in concrete.

In the course of work, on the basis of the Polotsk State University, the influence of the contact surface type on the adhesion strength and the effect of the concrete design class on the strength of the contact seam was studied and analysed. Also some experimental studies concerning the influence of interlayers on the basis of cement systems, including those modified by the hyperplasticizer Stahement 2000M, on the strength of the contact seam of a composite concrete and reinforced concrete structure have been carried out.

Surfaces after treatment were classified in accordance with GOST 13015.0-83 [10], with the assignment of a surface category A5. The average depth of roughness of the surface of the samples was determined in the range from 0.24 to 0.33 mm, using the "sand spot" method. However, due to visual assessment, you can see the difference in the amount of protruding on the surface of the aggregate. It was suggested that the amount of aggregate at the interface would have a different effect on the resistance of the contact seam. Therefore, the sample surfaces were conditionally divided into three categories, depending on the amount of protruding aggregate (Figure 1).

The first group included samples which surfaces did not show the particles of a large aggregate, the second group included samples of a large amount of aggregate on the surface (5-10%), the third group - more than 15%. To reduce the influence of this factor on the test results, we used samples of all three categories in each test series.

The highest values of the strength of the contact seam were observed on samples which adhesion surface was conditionally assigned to group 3 within the category of surface A5, i.e. with the largest amount of filler protruding on the surface.



1 2 3

Fig. 1. The mating surface, depending on the amount of protruding coarse aggregate:
1 – 0-5% of the area of the investigated surface; 2 – 5-10% of the area of the investigated surface;
3 – more than 15% of the area of the investigated surface

The main objective of this study is to study the effects of the presence of a modifying additive in the interlayer and its concentration. To solve this problem, 3 series of G-1-0, G-1-0.4 and G-1-0.7 samples were created. The presence of the hyperplasticizer Stahement 2000M allows to achieve the necessary plasticity of the mixture with the use of less water, thereby increasing the strength characteristics of the elements, and reducing the shrinkage of hardening concrete. Based on the results of the experimental shear resistance, it was concluded that the use of interlayers based on modified cement systems increases the strength of the contact seam by about 40%, depending on the concentration of the additive. The most reliable joint work of composite concrete elements is provided by using a cement-sand interlayer with an additive concentration of 0.7% of the cement mass. The strength of the contact seam of samples with the optimum concentration increased by 1.87 times, i.e. by 46.5% in comparison to samples without an interlayer. From the above reasoning, it can be concluded that the use of a cement-sand interlayer with the use of modifying additives can significantly improve the cohesion of concrete elements.

For a more vivid evaluation of the surface of the adhesion of the samples after destruction, we decided to determine the coefficient of adhering particles of the old concrete on the surface of concrete (k). The coefficient was derived as the ratio of the area of adhering particles to the total area of the bonding surface. The averaged values for the groups of samples are shown in figure 2.

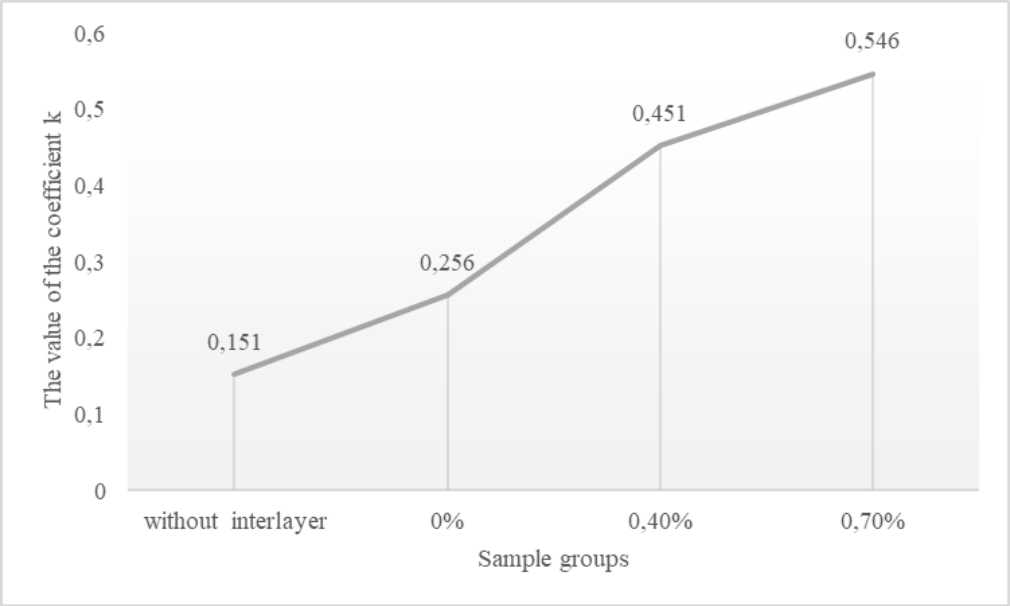


Fig. 2. Change in the amount of adhering particles of old concrete,
depending on the group of samples analyzed

This work was carried out with the aim to obtain qualitative indicators in the study of interlayers based on modified cement systems. However, even at this stage of research, it can be concluded that the use of interlay-

ers based on modified cement systems, in particular the Stachhemant 2000M hyperplasticizer has positive influence on the composite reinforced concrete structures.

Based on theresults of the research, the following conclusions can be drawn:

- the presence of a cement-sand interlayer in the bonding zone of the samples increases the strength of the contact seam by an average of 6% as compared to samples without an interlayer;

- Stachemant 2000M in the interlayer increases the strength of the contact seam by about 40%, depending on the dosage;

- the addition of an additive of 0.7% of the weight of the cement increases the strength of the contact seam by an average of 46.5% compared to samples without an interlayer and by 43% compared to samples with unmodified interlayer;

- the strength of the contact seam can vary within up to 50% for different roughness of the interface surface, within the limits of one surface category (in particular, A5), and therefore in the normative documentation it is necessary to introduce additional gradations of surfaces.

REFERENCES

1. Чикалина, О.П. Об использовании модифицированных бетонов при усилении железобетонных конструкций / О.П. Чикалина, Е.Г. Кремнева // Вестник Полоцкого государственного университета. Сер. В. Прикладные науки. – 2004. – № 6.
2. Калитуха, В.В. Прочность контактного шва железобетонных составных конструкций : автореф. маг.дис. …маг. тех. наук / В.В. Калитура. – Новополоцк, 2017.
3. Гвоздев, А.А. Изучение сцепления нового бетона со старым в стыках железобетонных конструкций и рабочих швах / А.А. Гвоздев, А.П. Васильев, С.А. Дмитриев. – М. : ОНТИ, 1936.
4. Бондаренко, С.В. Усиление железобетонных конструкций при реконструкции зданий / С.В. Бондаренко, Р.С. Санжаровский. – М. : Стройиздат, 1990.
5. Хаменок, Е.В. Контактные швы в железобетонных составных конструкциях / Е.В. Хаменок, Е.Г. Кремнева // Вестник Полоцкого государственного университета. Сер. F. – 2011.
6. Ремонт поврежденных поверхностей бетонных и железобетонных изделий / А. Г. Доля [и др.] ; Донбасская национальная академия строительства и архитектуры, ООО «ВП Мост», ГП «Научно исследовательский институт строительных конструкций». – 2010.
7. Юкневечюте, Я.А. Предложения по расчету усилений изгибаемых и сжатых конструкций, находящихся под нагрузкой, для пособия по проектированию железобетонных конструкций при реконструкции / Я.А. Юкневечюте, В.А. Клевцов, В.М. Богачюнас. – НИИЖБИ, 1980.
8. Торкатюк, В.И. Склеивание старого бетона с новым / В.И. Торкатюк, Н.М. Золотова // Научно-технический сборник. Коммунальное хозяйство городов. – 2002. – № 42.
9. Хаменок, Е.В. Прочность контактного шва железобетонных составных конструкций : автореф. маг. дис. …магистра тех. наук / Е.В. Хаменок. – Новополоцк, 2011.
10. Конструкции и изделия бетонные и железобетонные сборные. Общие технические требования : ГОСТ 13015.0-83 : введ. 01.01.84.