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INFLUENCE OF HETEROGENEITY OF THE REINFORCING BARS IN THE CROSS SECTION ON THE TESTIMONY OF PORTABLE HARDNESS

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It is considered one of the most important trends in the field of inspection and quality control of existing structures.The basic methods for determining the class of reinforcement in concrete examination of buildings and structures. The possibility of using portable hardness in practice. Attention is paid to methods for treating the side surface of reinforcement stem. Experimental data showing the unevenness of reinforcement strength readings across the section depending on the depth of cut. Theconclusionsabouttheneedforadditionaltesting.

Today the development and improvement of methods and tools for monitoring the technical state of reinforced concrete structures of existing buildings and structures is one of the most important areas in the field of quality control of materials and products.

A detailed examination of reinforced concrete elements of buildings and structures a priority is to determine the parameters of the steel reinforcement. The most difficult and the most important in the performance of testing calculations is to establish a reinforcement belonging to a particular class, and thus assigning it specific strength qualities.

There is a fairly large number of methods of control parameters of the strength characteristics of reinforcement.However, not all of them allow you to reliably and accurately determine the required parameters. Some methods are hardly applicable because of the difficulties that accompany their use, while others are outdated.

The basic method of determining the strength of reinforcement is considered a test of samples in tension in accordance with GOST 12004.However, it has a major drawback: when it must extract using test samples, which necessitates partial structural failure, and hence to its weakening.Sampling the complexity is very high, as well as the complexity and carrier recovery element capability.

Actual and perspective are considered non-destructive methods to determine the strength of the steel through the dependence of the "strength-hardness".This method to date the subject of many research and experimental work.The fundamental relationship for steel is reflected in GOST 2276-77 "Metals and alloys. The method of measuring the Brinell portable hardness strength static action" and GOST 9013-59 "Metals. The method of measuring the hardness of Rockwell". To apply these methods, a large number of portable devices that allow you to determine the hardness of the steel in the field.The above measuring apparatus implemented by various methods such as:

- the dynamic series TEMPO units (Shore analog measurements) Ultrasound;
- series devices MET-U (Vickers) static;
- Equostat (Rockwell), and others [1].

In the dynamic method is defined indirect characteristic - the ratio of the velocity at impact and rebound of the indenter from the specimen surface. The measured parameter in the ultrasonic method is the oscillation frequency of the indenter during its introduction into the sample at a certain depth under the action of a constant force.In static indentor hardness measurement method slowly and continuously pressed into the surface of the test sample with a certain force.

When using these methods is not necessary to extract samples which greatly reduces the volume of work as compared with the method of reinforcement class by testing samples of the tensile and bearing capacity to restore the damaged element.

It should be noted that the use of any of the non-destructive testing methods requires compliance with a number of requirements to the measurement site, and its surface:

— measurement of the minimum area for the use of the dynamic method must be at least 10 mm and ultrasonic - not less than 5 mm;

—roughness of the surface to be measured with most methods of hardness measurement (both portable and fixed devices) must not exceed 0.32 mkm (Ra) [2].

To achieve the above requirements, you can perform with the help of processing rebar surface abrasive discs mounted on angle grinders (LBM). To get the desired size and area roughness is recommended to further refine the surface by appropriate nozzle angle grinders.

Also, do not ignore the fact that the properties and structure of the surface layer of steel can be changed during their processing. Generally, these changes are due to the influence of two factors: high temperature and hardening due to plastic deformation of the surface layer of the metal.

The same effect on the hardness readings provides the depth of cut surface, as the cross section of the reinforcing bar hardness is not uniformly distributed, close to a value above the sample surface, as compared with the other readings.

Thus, the use of portable devices with low penetration depth of the indenter (static, ultrasonic) can provide measurement results with significant differences from the truth. Therefore, to expand the scope of portable hardness testers on the side of the reinforcing bar is necessary to investigate the effect of treatments on the reinforcing steel and choose the optimum slice thickness.

In order to determine the depth of the cut affect the readings of portable hardness tester based on the Polotsk State University tests were conducted on samples of class S800 diameter 10, 12, 14 mm. It was selected for the six samples of each diameter.

Constant K5U instrument was used to determine the hardness of the metal. Hardness measurements were performed pre-polished samples on the lateral surface.To identify the hardness depending on the size of the cut, the samples were made thin sections of different depths. The thickness of the shear layer was administered – 1 mm, 2 mm, 3 mm diameter and 10.12 mm 1, 2 mm, 3 mm, 4 mm for diameter 14.

The averaged values of experimental results are shown in Table 1.

Table 1 – Average hardness readings static depending on the depth of cut

Classreinforcingsteel	S800									
Diameteroftheshaft	10			12			14			
Slicethickness	1 mm	2 mm	3 mm	1 mm	2 mm	3 mm	1 mm	2 mm	3 mm	4 mm
Results	38,54	44,5	42,91	29,42	40,58	33,88	44,05	42,69	41,94	37,75
	40,28	41,92	40,28	32,12	38,31	33,32	43,41	39,4	42,72	38,27
	46,03	39,95	46,03	36,29	44,6	40,22	43,04	38,68	41,82	39,72
	44,22	42,89	44,22	34,76	43,89	36,48	42,7	40,52	41,95	40,6
	41,5	42,35	41,5	32,01	36,45	39,56	44,19	41,23	38,31	39,28
	39,62	40,44	39,62	26,91	37,01	41,29	40,45	40,54	41,18	38,77
Theaveragedvalues	41,70	42,01	42,43	31,92	40,14	37,46	42,97	40,51	41,32	39,07

Here is a clear reflection of the change in hardness indices over the cross section of the reinforcing bar.

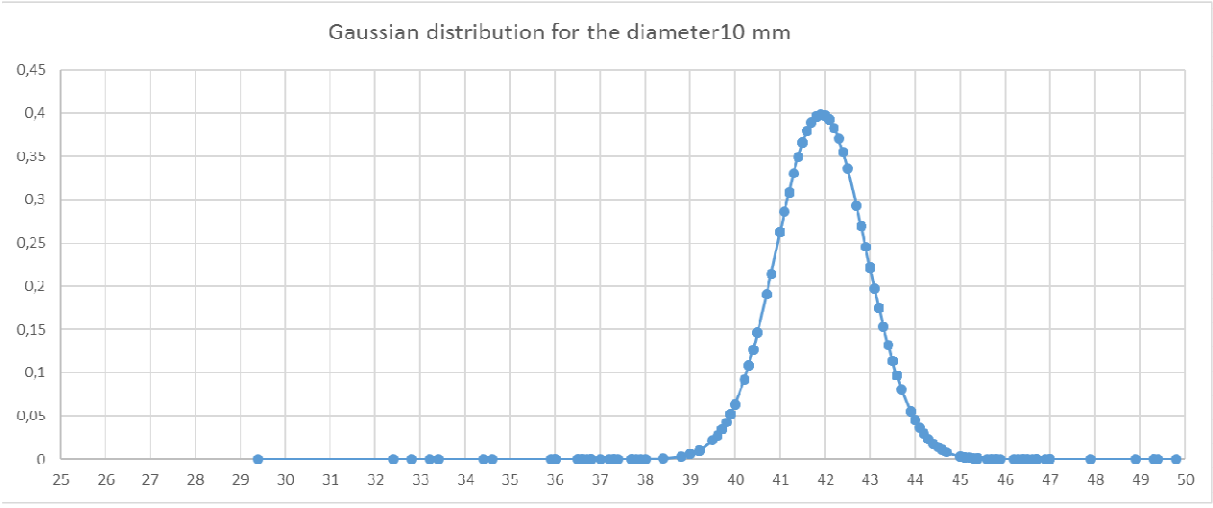

Fig. 1. Schedule changes in the indices of hardness class S800 of reinforcing bars diameter of 10 mm

From the data presented above it can be concluded that for the selected class scatter S800 durometer readings of samples in the cross section of the reinforcing rod is negligible.In this case, this phenomenon is related to the technology of manufacturing of reinforcing bars S800 class. Samples of reinforcing rods for Quality Certificate № 0037618 for diameter 10, № p 2146 for diameter 12 and № 1110 for diameter 14 are rental reinforcing thermo-hardened and comply with STB 1706-2006.The graphs show that the probability of falling hardness values of approximately 10 to 15%.

However, you must make an additional analysis based durometer readings on the depth of cut of the rod surface for of reinforcing bars produced by other technologies and to identify whether there is for them the optimum depth of cut.

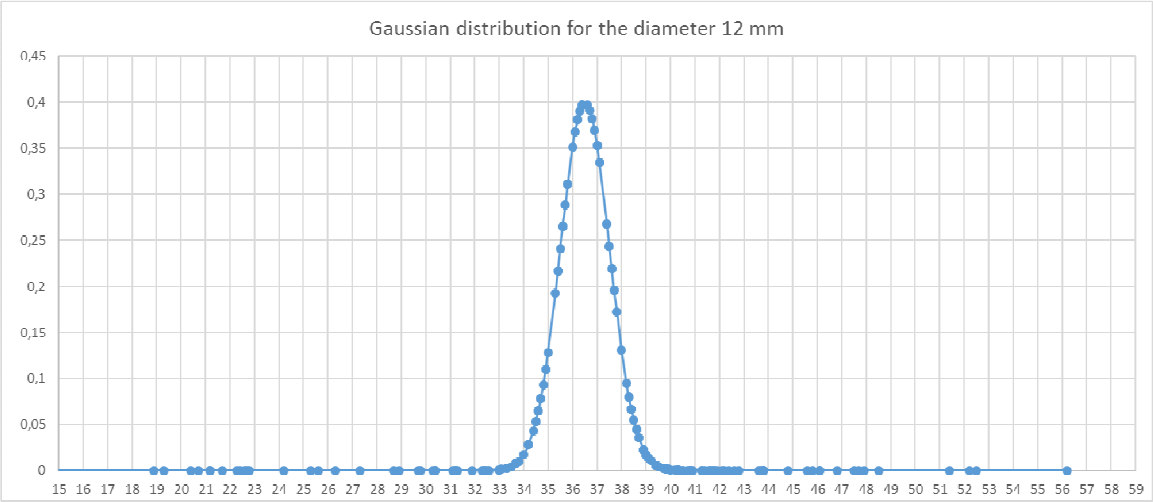

Fig. 2. Schedule changes in the indices of hardness class S800 of reinforcing bars diameter of 12 mm

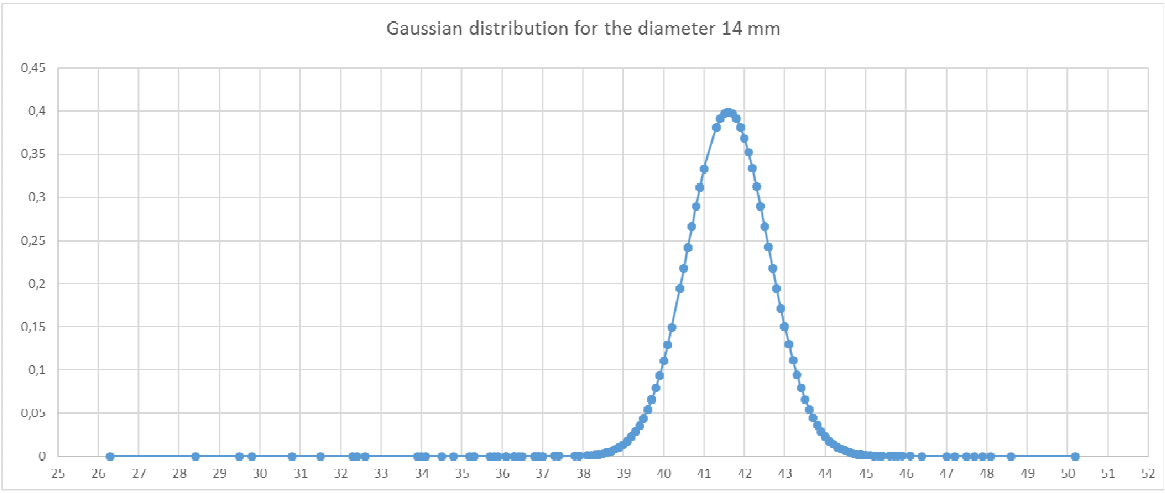

Fig. 3. Schedule changes in the indices of hardness class S800 of reinforcing bars diameter of 14 mm

Taking into account the wide variety of different grades of reinforcing bars, which are found during the examination of existing buildings and structures and their diameters, a more detailed study of the dependence of the depth of the sample cut and its diameter on hardness readings.

Most of the literature indicate dependence "hardness-strength steel", obtained in the study of rolled profiles (channels, I-beams, etc.), used for the construction elements [3]. Easy to use this dependence in the study of rolled sections is caused by a relatively narrow range of strength, a small variety of brands and simple way to improve thermal. All this can not be said of the reinforcing steel of various grades.

For a reliable assessment of the reliability of the proposed method is required to carry out additional experiments, obtained by different technological methods of reinforcement samples (hot-rolled, heat and thermo-hardened), in order to identify the hardness distribution in the cross section of the samples.When the relevant research and development of practical recommendations for the method can be used without sampling, on the surface of the rod directly at the opening portion.

REFERENCES

1. Улыбин, А.В. Применение зависимости «прочность-твердость» при обследовании стальных конструкций с помощью портативных твердомеров / А.В. Улыбин, П.А. Рогозин // Стройметалл. – 2011. – № 4 (23). – С. 25 – 27.

2. Металлы и сплавы. Метод измерения твердости по Бринеллю переносными твердомерами статического действия : ГОСТ 22761-77.
3. Хомич, В.М. Экспериментальное исследование взаимосвязи предела текучести и некоторых чисел твердости строительных сталей / В.М. Хомич, Д.Н. Логвинов // Известия вузов. Строительство. – 1999. – № 11. – С. 133–137.
4. Сталь арматурная термомеханически упрочненная для железобетонных конструкций. Технические условия : ГОСТ 10884.
5. Галкин, Д.С. Определение временного сопротивления стали эксплуатируемых строительных металлоконструкций методами твердометрии при обследовании / Д.С. Галкин, А.Н. Патраков // Вестник ПНИПУ. Строительство и архитектура. – 2010. – № 1. – С. 85–88.
6. Улыбин, А. В. Методы контроля параметров армирования железобетонных конструкций / А.В. Улыбин // Инженерно-строительный журнал. – 2011. – № 1 (27).
7. Металлы. Метод измерения твердости по Роквеллу : ГОСТ 9013-59.