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# EXPERIMENTAL RESEARCH OF RC BEAMS, STRENTHENED BY BONDED AND WELDED STEEL PLATE

*The article deals with the question of experimental research of reinforced concrete beams strengthened in the tensile zone by bonded and welded steel plate.*

*Repairing of reinforced concrete elements is required is required after a damage. Strengthening such building elements is a method to increase their bearing capacity.*

*Depending on the desired load resistance of the structural element, types of the elements and their connections, members can be repaired or strengthened by different methods.*

*So, for repair of reinforced concrete structural elements the advice and adequate method of strengthening of engineers is required.*

***Keywords***: *reinforced concrete beam, strengthening, adhesive-bonded joint, bearing capacity, experimental research.*

## Inroduction

Modern development of the of civil and industrial engineering infrastructure is closely connected with the rehabilitation, reconstruction, technical upgrading, and improvement of labor and living conditions at active enterprises in housing, administrating, and residential buildings.

The necessity of strengthening or renewal of building structures appears not only during the reconstruction or technical upgrading but also as a result of premature corrosion or mechanical deterioration. Loss of serviceableness can appear in the result of the complications or unforeseen by the project changes in the production technology, different damages, defects, etc. This question provokes the high interest to the problem of strengthening and reconstruction of the existing building structures.

Different types of strengthening materials are available in the market.

Examples of these are ferrocement, sprayed concrete, steel plate and fibre reinforced polymer (FRP) laminate. Generally the use of steel plate and FRP are preferred in this field due to their advantages such as easy construction work, minimum change in the overall size of the structure after plate bonding and less disruption to traffic while strengthening is being carried out. With the development of structurally effective adhesives now a day, these has been a marked increases in strengthening using steel plates and FRP laminates [1-3].

## Literature Review

A lot of domestic scientists such as M.S. Zolotov, I.M. Shutenko, O.O. Gvozdev, V.V. Dushin, Y.D. Kuznetsov [4] are devoted their scientific work to the problem of adhesive-bonded joint in construction. Their scientific researching are dedicated to investigation of bearing capacity of adhesive-bonded joint subjected to tension/compression, creep and shear, using acryl-based adhesives.

The scientific researches of strengthening of reinforced concrete elements were performed by such scientists as A.I. Barashikov, S.V. Bondarenko, B.A. Boiarchuk, L.V. Afanasieva, O.B. Golyshev, L.A. Murashko, and others [5].

## Research significance and objectives

In the given article there are considered the next problem:

- to propose the experimental methodology of investigation of increasing the bearing capacity of reinforced concrete beams by epoxy-bonded and welded steel plate in a tensile zone;
- to research the influence of adhesive member on the bearing capacity and deformability of the structural element;
- to compare the results of bearing capacity of beams strengthened by different methods and materials;

## Background

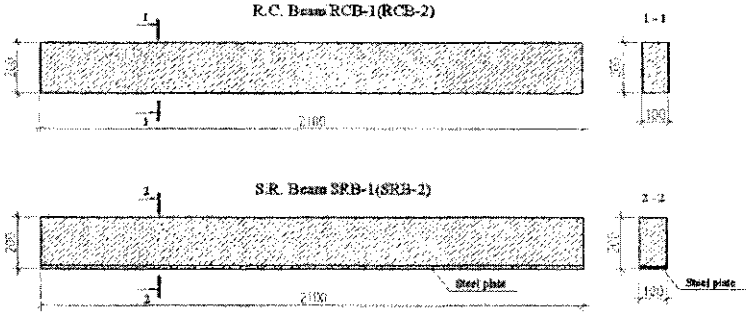
To determine the bearing capacity of the reinforced concrete beams strengthened by epoxy-bonded and welded steel in the tensile zone, as well as its influence the strength and deformability, there were designed and manufactured the following specimens:

- Steel composite elements (beams), using different concrete mixtures of different concrete grade (M350 and M400);
- Standard concrete prisms 100x100x400mm and cubes 100x100x100mm for determination of concrete strength and deformability.

According to the way of the external load application, specimens of each type are divided into series in accordance to the accepted geometrical characteristics of experimental specimens. The specimens of each series are differed one from another by the availability and type of the adhesive-bonded and welded joint. Therefore, the basic factors are: the geometrical characteristics of structure, concrete grade, and adhesive-bonded or welded joint. So, all these distinctions can influence the adhesive joint's bearing capacity value, as well as the strength and deformability of experimental specimens (beams). Total number of specimens, except of prisms and cubes, is 15 pcs.

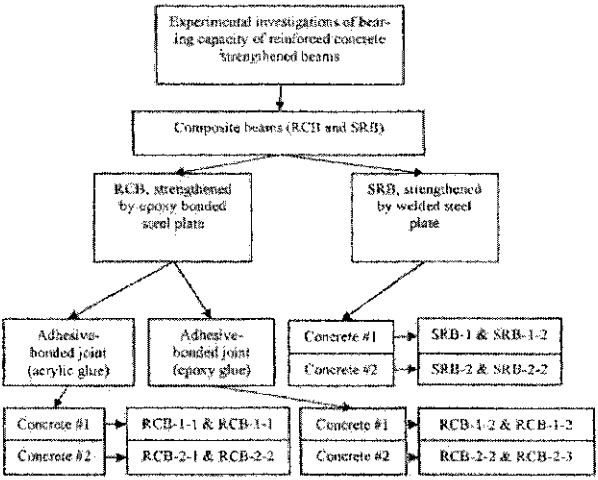
Experimental specimens are represented in a form of reinforced concrete elements (beams), which are strengthened with bonded and welded steel plate in the tensile zone.

All the specimens are filled up with concrete mixture with concrete grade M350 and M400. Experimental specimens are represented in a form of steel composite beams RCB-1, RCB-2, SRB-1, SRB-2. Geometrical characteristics of beams are shown on pic.1




**Pic.1 Specimens of strengthened beams.**

Experimental investigations on determination of bearing capacity of strengthened beams are to be carried out in accordance to the proposed scheme on pic.2.




**Pic.2 Scheme of carrying out of experimental research of RCB and SRB.**

The specimens were manufactured on Industrial-Construction Group «Kovalska».

During experimental investigations procedure it is planned to study the dependence of bearing capacity of adhesive-bonded and welded joint from availability and type of the adhesive, as well as its influence the strength and deformability of experimental steel reinforced concrete beams and the bearing capacity of strengthened beams.

Characteristics of concrete mixture, as strength and deformability of experimental beams, are defined on the result of testing the control cubical and prism specimens. The

specimens for the testing are manufactured by series of 12 pcs in each (6 prisms, and 6 cubes) where 3 cubes and 3 prisms are made from concrete grade 350 and 400.

Specimens are manufactured from one premix of concrete, used during formation of SRB, which have been hardened under the same conditions as beams.

There were used two types of adhesives: epoxy-based adhesive (Sikadur 30), and acryl-based one as ASS-T.

Sikadur 30, SBA is a unique high-modulus 2- component, moisture-tolerant, solvent-free, epoxy resin system available in three application temperature ranges. A unique high-modulus, structural adhesive for bonding hardened concrete for segmental bridge construction. The mixed material has the consistency of paste and is a concrete gray color.

Sikadur 30 is used for structural bonding of post-tensioned precast concrete bridge segments, sealing joints between concrete segments, for use in segment-by-segment erection and supplied in three temperature grades to meet project requirements. [6].

Another adhesive under usage during structure strengthening is the acrylic plastics ASS-T. ASS-T is a high-molecular mixture, which is based on suspension polymer of methylmethacrylate.

During the experimentation there were used the next measuring instruments: strain gauges, monometers for loading value control, and linear variable differential transducers, which record deflections and deformations of the structures.

## Conclusions

The experimental research presented in the article is an attempt to rationalize the data available in the literature focusing on the characterization of existing methods of reinforced concrete beams strengthening.

There were proposed the experimental research of reinforced concrete beams strengthened in the tensile zone by bonded and welded steel plate and research the influence of adhesive member on the bearing capacity and deformability of the structural element.

The given methodology of experimental researches and measurement instruments allow us to receive the necessary experimental data for determination the strength and deformability of strengthened steel reinforced concrete beams systems with the prescribed accuracy, as well as the study the form of fracture of specimens under investigation.

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