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THE ANALYSIS METHODS OF MASONRY STRENGTHENING WITH
 COMPOSITE MATERIALS AND SCREW RODS

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The review and analysis of Modern methods of strengthening brick walls of buildings with using composite materials, as well as using screw rods from of stainless steel are reviewed and analyzed; features of technology enhancements are considered, there identified the advantages and disadvantages of each of the methods that should be relied upon when deciding on strengthening brick walls of buildings.

Brick is one of the most general construction materials load bearing walls. Successfully applied as in high-rise residential and industrial construction as well in private build up.

The issue of providing constructive reliability and durability of brick walls buildings will always be relevant. But masonry is not the best way works in tension and is very sensitive to shear stress. Therefore, one of the most common type's damage to brick buildings is their cracking.

The most common reasons causing cracks in the stone constructions, according to statistics are [4]:

- Uneven precipitation of bases (65–75%);
- Overload of structures (10–15%);
- Temperature deformations (10–15%);
- Moisture deformations (5–8%); special loads and impacts (2–5%).

Among the traditional ways to enhance brick walls can be distinguished such as:

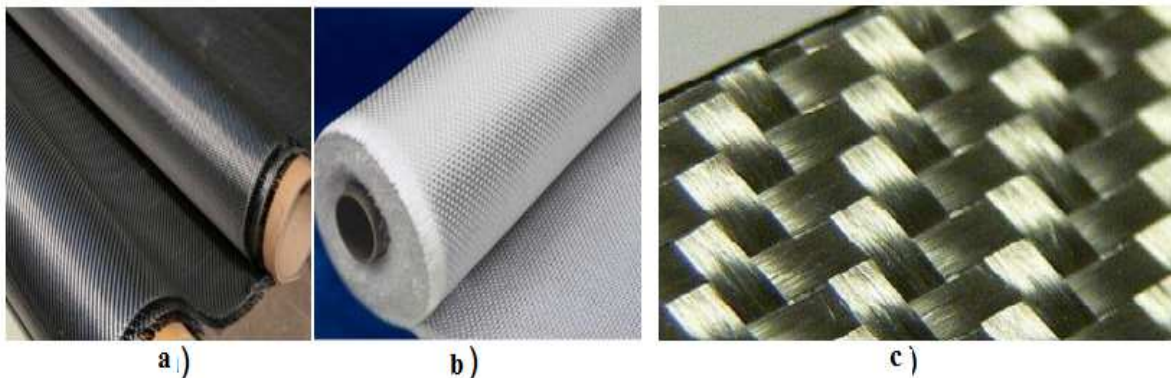
- reinforcement with steel, reinforced concrete clips, clips based solution;
- device metal or reinforced concrete core;
- partial or full replacement masonry elements;
- injection of solution in the cracks of layer

Traditional amplification methods masonry is quite effective; however, in some cases their use is impossible. Most of them are expensive and labor intensive. In addition, after the reinforcement of structures with the help of clips, the aesthetic external changes appearance of the building. Consequently, for repair and reinforce the brick walls of buildings all more use of new technologies and materials. These include [1]

1. External reinforcement of composite mi materials.
2. Application of screw rods from of stainless steel.

Composite materials are fabrics, nets, ribbons, canvases. They consist of reinforcing fibers and binders components. Inorganic and organic fibers can act as reinforcement. Inorganic fibers include carbon plastics, fiberglass plastics, basalt fiber (Fig. 1). To organic fibers include aramid, flax and hem fiber [2, 3].

Abroad given amplification system known as FRP (Fiber Reinforced Polymer) reinforced with polymer fiber. Polymer systems possess high strength, rigidity, and lightness and corrosion resistance.



a. – carbon fiber; b – fiberglass; c – basalt fiber
 Figure 1. – Inorganic fibers of composite materials

To ensure adhesion Composite material with a design as an adhesive using epoxy glue or glue based on micro cement. Epoxy glue is a thermosetting synthetic product consisting of epoxy resin and additional components in the form of a hardener. It has high technological characteristics; however, has a low fire resistance.

It should be noted that epoxy vapor resin and glue entering open areas skin adversely affect human health. In this regard, when working with epoxy glue. It is important to adhere to special security measures.

The glue on the basis of micro cement is more effective in terms of fire resistance and safety of work. The technology of external reinforcement composite materials is the following (Fig. 2, 3):

1. On the cleaned surface of the brick laying after its impregnation and priming is applied epoxy glue or a layer of plaster with a smooth metal spatula layer up to 6 mm thick.
2. Up to the moment of setting of a layer polymeric systems (fabrics, grids) keep within, tape, canvas) in the applied layer of the solution.
3. Next, apply a layer of plaster a minimum thickness of 3 mm, the surface of which is subjected to finishing.
4. Providing high strength reinforcement, if necessary in the protective layer can fit the second element of the system (fabric, mesh, tape, canvas).

Possible gain as bent structures in stretched zones and on in the zone of action of transverse forces, as well as compressed and eccentrically compressed elements [2].

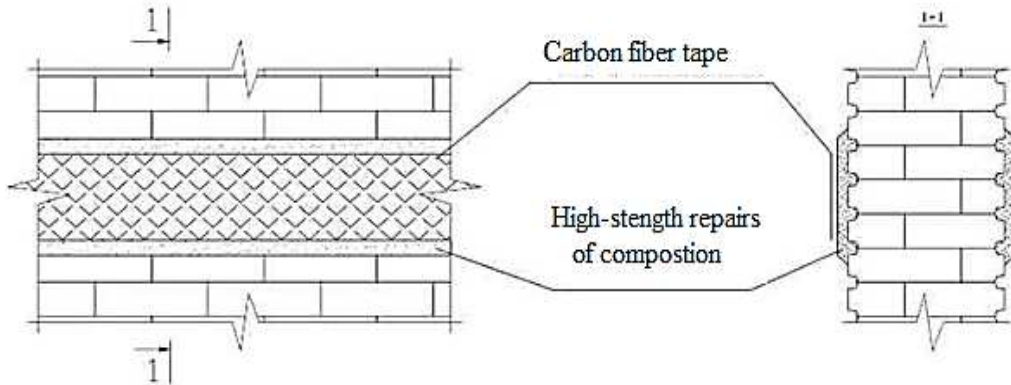


Figure 2. – Strengthening of brick walls with a tape of carbon fibers

From an economic point of view fiberglass are the cheapest polymer fibers. A composite reinforcement material of brick walls and multilayered designs allows us to highlight the following their advantages:

- high values stiffness and strength;
- relatively low density; corrosion resistance;
- the ability to perceive shock loads;
- ease of installation;
- low material weight and how consequence of minimal load on reinforced structures;
- preservation of the architectural appearance of structures.



Figure 3. – Strengthening of brick walls with a tape of carbon fibers

At the same time, the system under consideration has several disadvantages: hygroscopicity composite materials; low fire resistance index of epoxy adhesives (starting from 50 ° C); toxicity of resins entering into composition of epoxy adhesives; possible burns when epoxy glue gets on your skin person; high specific volume.

In the new construction of buildings in quality increase stability and strength of one of the most promising products from polymer composites is composite based reinforcement carbon, glass, and basalt or aramid fiber.

The second effective method of strengthening brick walls of buildings is to strengthen with the help of screw rods from of stainless steel. This method is applied not only to repair and strengthen brick masonry cracking as well as in multilayer structures for interconnecting layer with the outer layer of cladding.

Spiral Flexible made by cold rolling of round stainless wire cross section. In the manufacturing process cruciform creation initially occurs molds from central core and adjacent flat edges of the "wings", then formed screw rod. The surface of the "wings" becomes very hard, at the same time the core keeps spring properties. Further hardening gives "Wings" pressers, and core due to different structure, this hardening is not exposed.

Due to this, tensile strength more than doubled. The technology of pushing through a special matrix in such a way that the "wings" wind up around the core (Fig. 4).

Manufacturing technology includes by a number of production stages, as a result those who turn out the product combining in itself high flexibility and elastic guest [4, 5].

Standard screw connection made of stainless steel 304 or 316. To reinforce brick walls rods of nominal diameter are used 4, 5, 6, 8 and 10 mm. In rare cases, may rods up to 14 mm are used. Standard the length of these rods is from 1 to 10 m. can overlap, bend, and knit together wire.

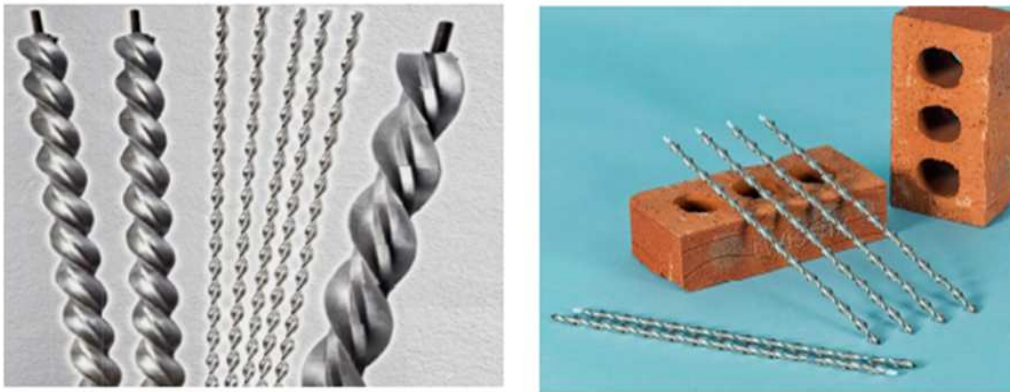
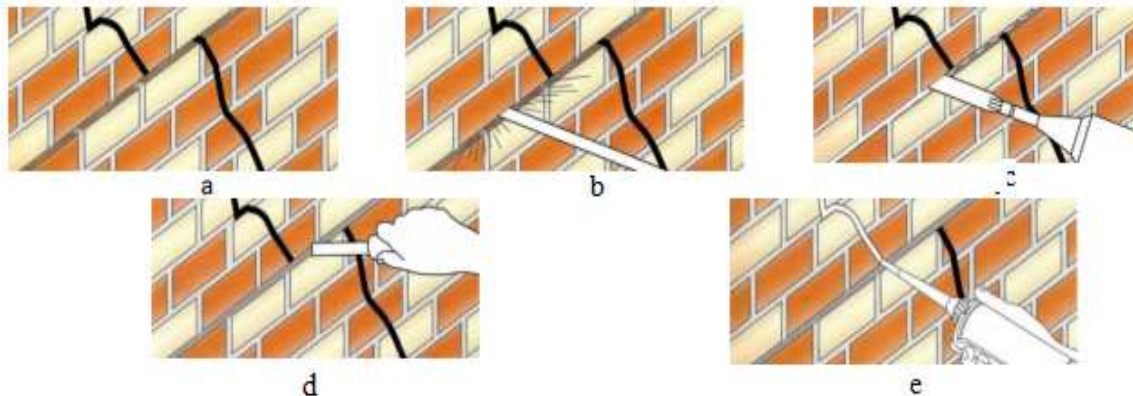


Figure 4. – Screw-down stainless steel rods to strengthen the masonry

The technology of strengthening represents deepening of screw cores in a special solution. The solution is placed in a pre-drilling well with a diameter of 12-16 mm or in a 1 mm wide hole. The solution is placed in the cleaned well with a hand gun. Then, using the applicator or manually laid screw rod. Then cracks are injected (Fig. 5).

A spiral rod and a special solution create a spring effect and, thus, are created small movements of the United edges of the cracks'. As a result, it is provided durability of the brick wall of the building



a – groove device; b – cleaning the groove with compressed air; c – sealing the seam with a special solution; d – installation of the rod; e – injection of cracks

Figure 5. – Technological operations of strengthening the brick wall with screw rods

Adhesive solution is a two-component composition (powder and liquid), has high adhesion to various materials. To prepare the solution, only the ingredients should be used, supplied by the manufacturer (banned add water, cement, sand, plasticizers, etc.).

The spiral edge of the rods provides the ability to also mount them by driving or twisting them into the masonry using a hand-held power tool with a special adapter attachment.

At the base of a hollow brick connection is established using chemical anchors [3].

To advantages of strengthening of brick the walls of the buildings are screw rods:

- high strength, stiffness and elasticity of the material;
- light weight of the material;
- not time-consuming to implement (no mechanized equipment);
- resistance to corrosion; in the presence of external damage there is no need to interfere with the design from the inside;
- preservation of the architectural appearance of structures;
- technological compatibility with all materials.

Disadvantages of this method: high cost of materials; there is a need for skilled workers [3, 4].

Strengthening of brick walls of buildings with composite materials and screw rods are massively used in foreign countries, however, in Belarus they were not yet widely used due to the lack of regulatory framework governing use of these methods.

Thanks to modern technology and materials are effectively eliminated defects and damage in building structures, ensuring safe and operational reliability of the brick walls of buildings.

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