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FEATURES OF COMPOSITE REINFORCEMENT IN CONSTRUCTION

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Reinforcement is a building element used to strengthen and increase the strength of reinforced concrete structures. It plays a compensatory role when forces are applied to the structure. It is most often made of steel, fibreglass or composite materials. Its task is to bind the concrete at all stages of construction. Therefore, it must be flexible, durable and economical.

Fig. 1. Composite reinforcement

Fig. 2. Mesh made of composite reinforcement

The composite reinforcement is made of fibreglass rods wrapped in carbon fibre yarns, which ensures reliable adhesion to the concrete mortar. These rods do not require welding for connection, which greatly simplifies installation.

Advantages of composite reinforcement:

- Lightness: low specific gravity reduces the overall weight of structures.
- Low thermal conductivity: prevents the formation of cold bridges.
- Highly flexible: simplifies transport and installation.
- Durability: high resistance to corrosion and chemical attack.

Despite the presence of periodic ribs, conventional composite reinforcement is characterised by some surface "slipperiness", which is expressed in reduced adhesion (adhesion) to concrete (about 80% of the level of steel reinforcing

bars). To eliminate this disadvantage, composite reinforcing bars are manufactured with a quartz sand finish, which have 100% adhesion to concrete.

Fiberglass (ASP, GFRP), formed by fibres (roving) of glass fibre impregnated with epoxy resin and then cured. It has a light yellow colour (if no colouring pigments are added to the composition) and is characterised by:

– high tensile (tear) strength, up to 10 times stronger than steel rebar by weight (tensile strength up to 700-1200 MPa (for comparison, steel rebar is up to 400 MPa));

– low elasticity - modulus of 45 MPa (200 MPa for steel reinforcement);

– low bulk weight, 4 times lighter than steel (density of ASP is 1.9 g/cm3, steel - 7.85 g/cm^3);

– high corrosion resistance;

– non-conductive (does not form cold bridges);

– non-electrically conductive;

– the coefficient of thermal linear expansion of ASP (9 - 12 x 10 6 K-1) is approximately the same as that of concrete, which prevents its thermal (not frost!) cracking at large ranges of variable temperatures;

– low temperature resistance - only 160 degrees C (determined by the properties of epoxy resins).

The most widespread in the domestic market are fibreglass reinforcing bars (FRP) and basalt reinforcing bars (BRP). They are produced in rods (cables) of limited diameter from 4 mm to 20 mm (FRP (ABP) – 4, 6, 8, 10, 12, 14, 16, 18, 20). Foreign manufacturers can produce rods with a diameter of up to 40 mm (for comparison, steel construction rebar of class A 400C can have a cross section of up to 80 mm).

Fig. 3. Example of composite reinforcement application

Fig. 4. Sand-coated fibreglass reinforcement for better adhesion

The small cross-sectional diameters of composite reinforcement immediately indicate a limited scope of their application - non-critical buildings and structures, their elements operating under relatively low static and dynamic loads.

Table 1

Table of permissible replacements for longitudinal loads

Steel rebar A 400C	Composite reinforcement ASP, ABP
6 A 400C (d = 6mm)< br> 8 A 400C (d = 8mm) 10 A 400C (d = 10mm) 12 A 400C (d = 12mm) 14 A 400C (d = 14mm) 16 A 400C (d = 16mm)	ASP-4, ABP-4 (d = 4mm) ASP-6, ABP-6 (d = 6mm) ASP-8, ABP-8 (d = 8mm) ASP-8, ABP-8 (d = 8mm) ASP-10, ABP-10 (d = 10mm) ASP-12, ABP-12 (d = 12mm)

At the same time, in reinforced concrete structures operating under transverse-elastic stresses (loaded transverse beams, floor slabs, unsupported supports, columns (pillars) with strong wind loads), it is allowed to replace iron reinforcement with composite reinforcement with an increase (twofold) in diameter.

Table 2

Replacement table for transverse elastic loads

Steel rebar A 400C	Composite reinforcement ASP, AB P
6 A 400C (d = 6mm) 8 A 400C (d = 8mm) 10 A 400C (d = 10mm)	ASP-12, ABP-12 (d = 12mm) ASP-16, ABP-16 (d = 16mm) ASP-20, ABP-20 (d = 20mm)

Manufacturers estimate the service life of composite reinforcement to be at least 75 to 80 years.

They have not yet been able to completely replace traditional steel reinforcement in many construction technologies.

The most common applications of composite reinforcement are:

– low-rise suburban and cottage housing construction;

– strip foundations, laying of lightweight (usually foam concrete) walls with longitudinal connections for industrial or commercial buildings (hangars, boxes, warehouses, livestock sheds, etc.);

– in hydraulic engineering construction - in the construction of retaining walls, coastal protection walls, quay walls, dams, and artificial reservoirs (pools, fountains, ponds, sumps, drainages);

– in road construction, for the formation of a strong reinforced roadway, reinforcement of its slopes with reinforcing grids, in retaining walls for landslide (rockfall) protection;

– in plant growing and floriculture - as frame elements for lightweight, cheap greenhouses and hotbeds.

References

1. Бакулін Є.А., Усенко М.В., Бакуліна В.М. Чисельне моделювання посилення сталевого підземного циліндричного резервуару. *Сучасні будівельні конструкції з металу та деревини*. 2024. Вип. № 28. С. 63–74.

2. Yakovenko I., Bakulin Y. & Bakulina V. (2020). Classification methods of civil buildings reconstruction. *Theoretical and scientific foundations of engineering* : coll. mon. Boston : Primedia eLaunch, 2020, pp. 70–96.

3. Клюєв В.В., Бакулін Є.А. Сучасні методи ідентифікації небезпек руйнування будівель, споруд та конструкцій у реальних умовах експлуатації. *Будівельні конструкції. Теорія і практика*. 2024. № 15. С. 86–96. https://doi.org/10.32347/2522-4182.15.2024.86-96

4. Marienkov M.H., Dunin V.A., Margvelashvili N., Farenyuk G.G., Berchun Ya.O. Experimental monitoring and dynamic certification of building structures Наука та будівництво. 2019. Вип. 22(4). С. 33–44.

5. URL: https://polyex.in.ua

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