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Resource-saving in the operation of a building with a correctly executed waterproofing

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Abstract: The article is devoted to the issues of waterproofing of expansion and technological joints. The necessity of using reliable waterproofing methods during construction is identified and justified. Particular attention is drawn to the shortcomings of existing methods, namely bentonite and hydrophilic waterproofing cords related to installation problems and other technical issues. System installation waterstop for technological joint mating base plate-wall and the repair scheme of the one with using the polyurethane resin are described. Comparison is given of the cost of repairing the technological joint and the installation of a waterstop in new construction. The influence of the construction quality on the further cost operation of the building is revealed.

1. Introduction

The main feature of the current situation in the world is urbanization, which is an increase in the role of cities in the development of society. Cities act as areas of concentration of huge production capacities, concentration of information, innovation and cultural potential, which provide the main part of the growth of national wealth.

The cornerstone in this development is the quality construction of new facilities (factories, houses, warehouses, roads). At performance of each stage of construction according to the technological regulations there will be an increase of durability and reliability of a design.

The most important component of construction is high-quality building materials used in compliance with the technologies and regulations prescribed by the manufacturer. Improving the quality of construction will entail the saving of finance in the future operation.

The quality of products is a consequence of many factors: the quality of personnel, the quality of production organization, the quality of machinery and technology, and the quality of management.

One of the main directions for improving the quality of construction is the waterproofing of buildings and structures.

2. Materials for waterproofing

In structures exposed to water, expansion and construction joints, and cracks should be given increased attention, since more than 99% of all leaks take place through these ones that occupies less than 1% from the entire surface area of concrete. That entails expensive repairs. If you look at the market of building, you can conclude that the main emphasis is on hard waterproofing, which does not



withstand cracking in the body of concrete and roll-bitumen waterproofing, which also has its problems: careful surface preparation, observance of surface moisture, priming.

Technological joints are time gap in concreting, they are created when the construction of a building requires a technological pause in the production of structures. It can be said that this is the combination of the old concrete layer with the new one, which results in the formation of a technological weak point through which leaks can occur in the future.

At the moment, the most common type of waterproofing of technological joint is swelling cords made of hydrophilic rubber and bentonite cords made from modified natural sodium bentonite clay and unvulcanized polymer (butyl rubber). Bentonite and hydrophilic waterproofing cords have the property of swelling and increasing in size when moisture contacts in them, which in theory ensures waterproofing and sealing, even under hydrostatic pressure. In the project, these cords look like a reliable structural element providing reliable waterproofing, but in practice there are many problems such as:

- Surface Unevenness – Profile Setup Problems;
- Fastening of swelling cords data – use of additional elements for fastening: anchors and sealants;
- Problems associated with leaching of bentonite cord with active water inflow (Fig. 1);
- Problems related to the preservation of the geometric dimensions of the swelling cord, made from hydrophilic rubber prior to pouring concrete: dependence on rainfall - when water contacts the cord, swelling occurs, and when pouring concrete on the swollen profile, the latter will return to its initial geometric state after some time and it will leave an empty space, due to this leaks may start.

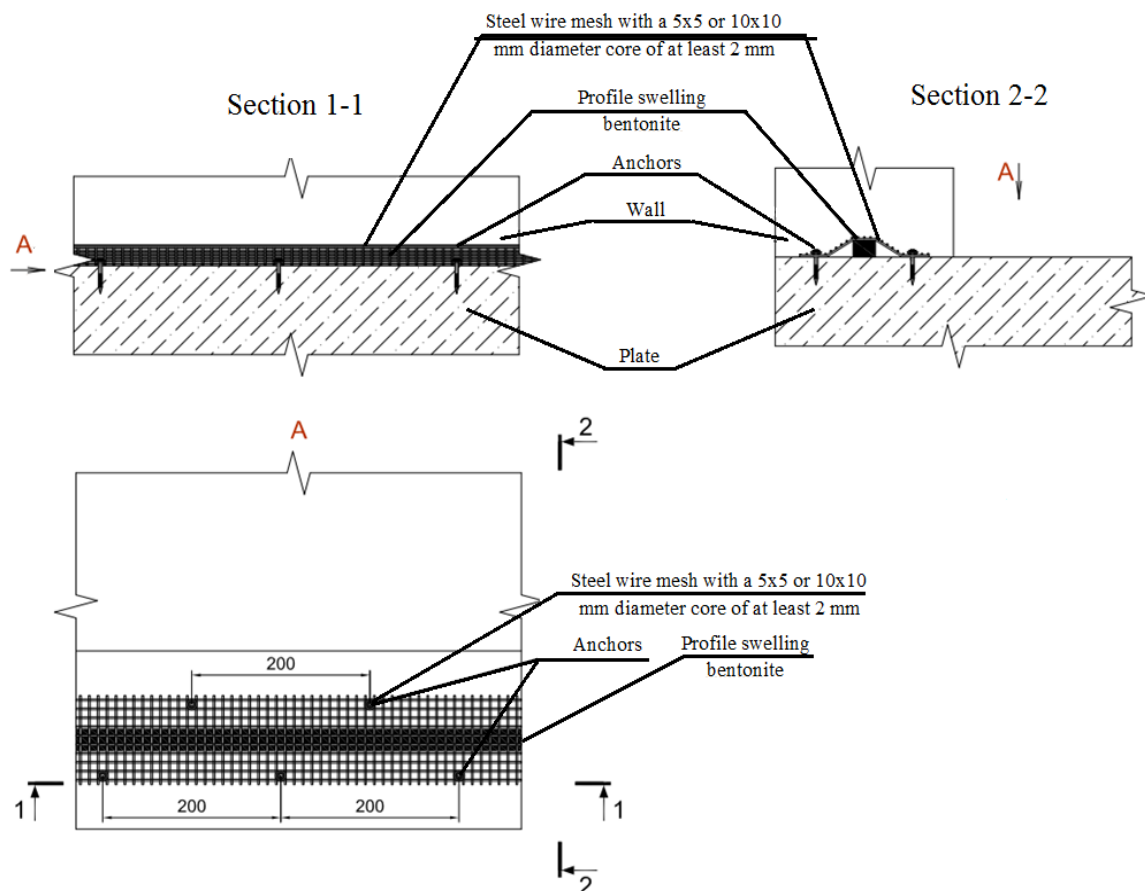


Figure 1. Installation of bentonite cord.

It is also necessary to take into account the most important element of the waterproofing of buildings and structures, namely the sealing of expansion joints. Expansion joint - is designed to reduce the load on structural elements in the places of possible deformations arising from fluctuations in air temperature, seismic phenomena, uneven sedimentation of soil and other influences that can cause dangerous own loads, which reduce the bearing capacity.

Since the cavity of the expansion joint does not require watertightness to the filler, lately the filling material is a sheet of expanded polystyrene which is embedded in the seam when it is formed. Such filling allows free compression and opening of the seam without any stresses of the conjugated elements. At the same time, sealant are used as fillers of the cavity for compacting expansion joints of small sizes up to 30 mm and pasting of roll-bituminous materials with a compensator on the expansion joints. Regularly for contour sealing of all types of joints waterproofing tapes on a polymer basis are used.

A significant problem in the waterproofing of expansion joints is its movement. For example, as the temperature decreases, the joint gap increases, and tensile stresses arise in the sealant material, which must be perceived by this one.

3. Waterstops

To date, there are special materials for technological and expansion joints, namely waterstops. These materials are made of plasticized PVC, can be joined into the system and welded, both with each other - to obtain the required length, and with other ones. Welding is carried out with a thermal knife or a construction hair dryer at a temperature of 185-195°C.

Waterstops when concreting is embedded in the body of each slab. All the waterstops have anchors (or anchor ribs) (Fig.2). Due to these protrusions, the waterstop is firmly retained in the body of the concrete elements. These concrete elements are interconnected through an elastic material - a waterstop, which plays the role of a barrier and prevents the penetration of water into the structure.

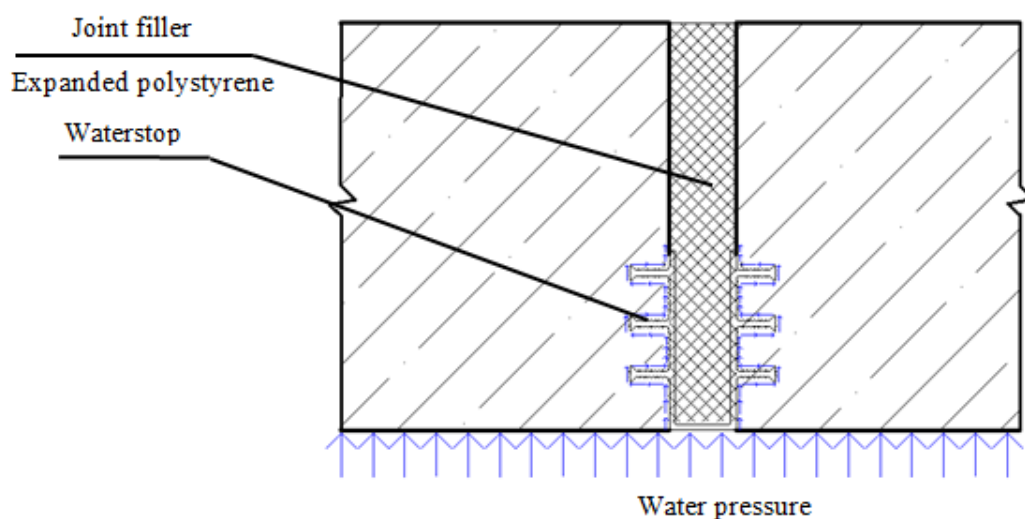


Figure 2. Waterstop in the concrete.

Joint movements are compensated:

- for technological joints - due to the elasticity of the material of the waterstop;
- for expansion joints - due to deformation of the central element of the waterstops (compensator) and the inherent elasticity of the material.

The principle of operation is very simple: due to the different anchors and ribs, these materials lengthen the path of water.

4. Comparison of cost

Now consider the practical part related to finance for waterproofing buildings and structures.

At the beginning examining at the cost of waterproofing of technological joint mating base plate-wall with using a waterstop (Fig. 3).

This waterstop is mounted using special staples (3 pieces per 1 meter), which are attached with a binding wire to the transverse reinforcing bars of the upper belt of the reinforcing cage of the foundation plate or slab. Staples prevent the movement of the waterstop from the design position. The reinforcement frame in the upper part of the outer walls should allow unobstructed placement of the waterstop.

Table 1. Cost of material and installation of waterstops for new construction.

Name	Cost of material	Cost of works	Total
Waterstop for waterproofing technological joint - mating foundation plate-wall	6\$	4\$	10\$

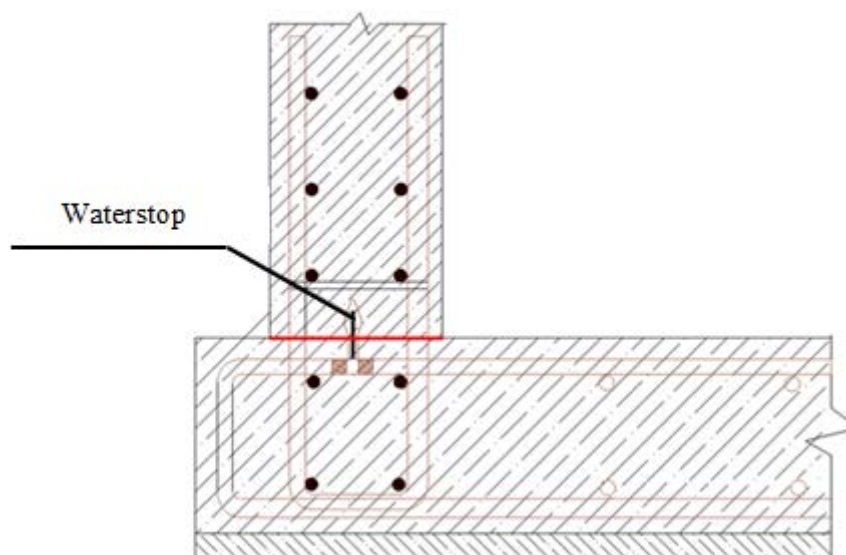


Figure 3. Waterproofing of technological joint mating base plate-wall.

Now consider the cost of repair with polyurethane resins (Fig 4).

The following water penetration technology is used:

1. Break the joint. The dimensions are 30x30 mm.
2. To put the repair material with the formation of fillets. With active water inflow, using fast-setting repair composition.
3. Drill the holes at a distance of 50-70 mm higher in one row parallel to the joint at an angle of 45 under the injection packer. The distance between the holes is 200-250 mm. Depth of drilling 2/3 of the thickness of the wall.
4. Clean the holes from cement dust, dirt and foreign elements.
5. Install injection packer.
6. Pressurize the hydroactive elastic polyurethane foaming resin with low viscosity.
7. Within 15 minutes after the injection of foam is injected with elastic polyurethane resin
8. Remove injection packer.
9. Fill the drill holes with the repair composition.

10. Apply an elastic waterproofing in two layers through a glass net for a width of 300-400 mm along the joint.

Table 2. Cost of repairs, taking into account works and materials.

Name	Cost of material	Cost of works	Total
Injection of a technological joint with active leaks using polyurethanes - mating a foundation slab-wall	44\$	51\$	95\$

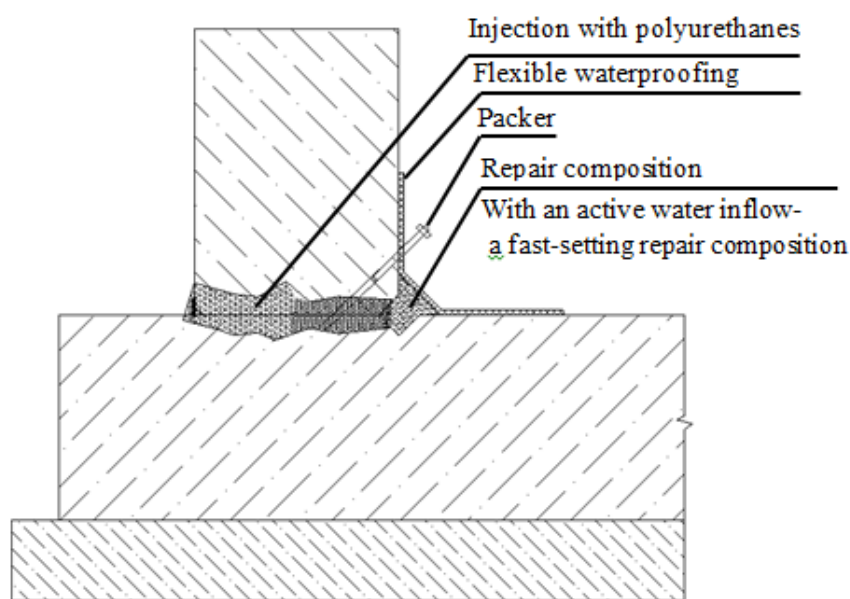


Figure 4. Repair of technological joint mating base plate-wall

The cost is calculated taking into account the exchange rate of the Central Bank of the Russian Federation as of 18.09.2018.

This cost of materials and works is calculated from the average cost for the city of Ekaterinburg (Russian Federation) and does not include overheads and estimated profits.

5. Conclusions

From the foregoing, it follows that the cost of the original waterproofing with waterstop is 9.5 times cheaper than the subsequent repair of this interface without the use of similar elements. These indicators show with certainty that with properly executed waterproofing, resource saving is occurring in the construction industry.

6. References

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