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2.3 Arrangement of the hole in the shopping and entertainment center floor slab

In modern conditions of the accelerated pace of urban life, the problem of time shortage is acute. This leads to the integration of cultural and household service institutions into the structure of trade institutions, which is manifested in the formation of shopping and entertainment centers, the potential of which is extremely high: from solving the local needs of consumers to meeting their social and cultural needs. Shopping and entertainment centers are powerful points of social attraction that have become a familiar element of the urban environment. Their success depends directly on the architectural and technological solutions that are conceptually embedded in the project.

A shopping and entertainment center is a multifunctional architectural building, and the integrating link in its structure is a communicative space (an environment that performs the function of communication between elements of functional content). Many works are devoted to the spatial organization of multifunctional entertainment complexes [67, 68].

The authors of the article faced the problem of additional spatial organization of the communicative space in one existing multifunctional entertainment complex in the city of Lviv. With a slight change in the functional content in part of the complex, the issue of additional vertical communication between different levels arose, which involved the installation of additional stairs and an elevator (Fig. 1). The installation of new communications led to an intervention in the supporting structures of the building - an additional opening of 5.16×5.06 m in the existing monolithic floor slab on the 6,200.

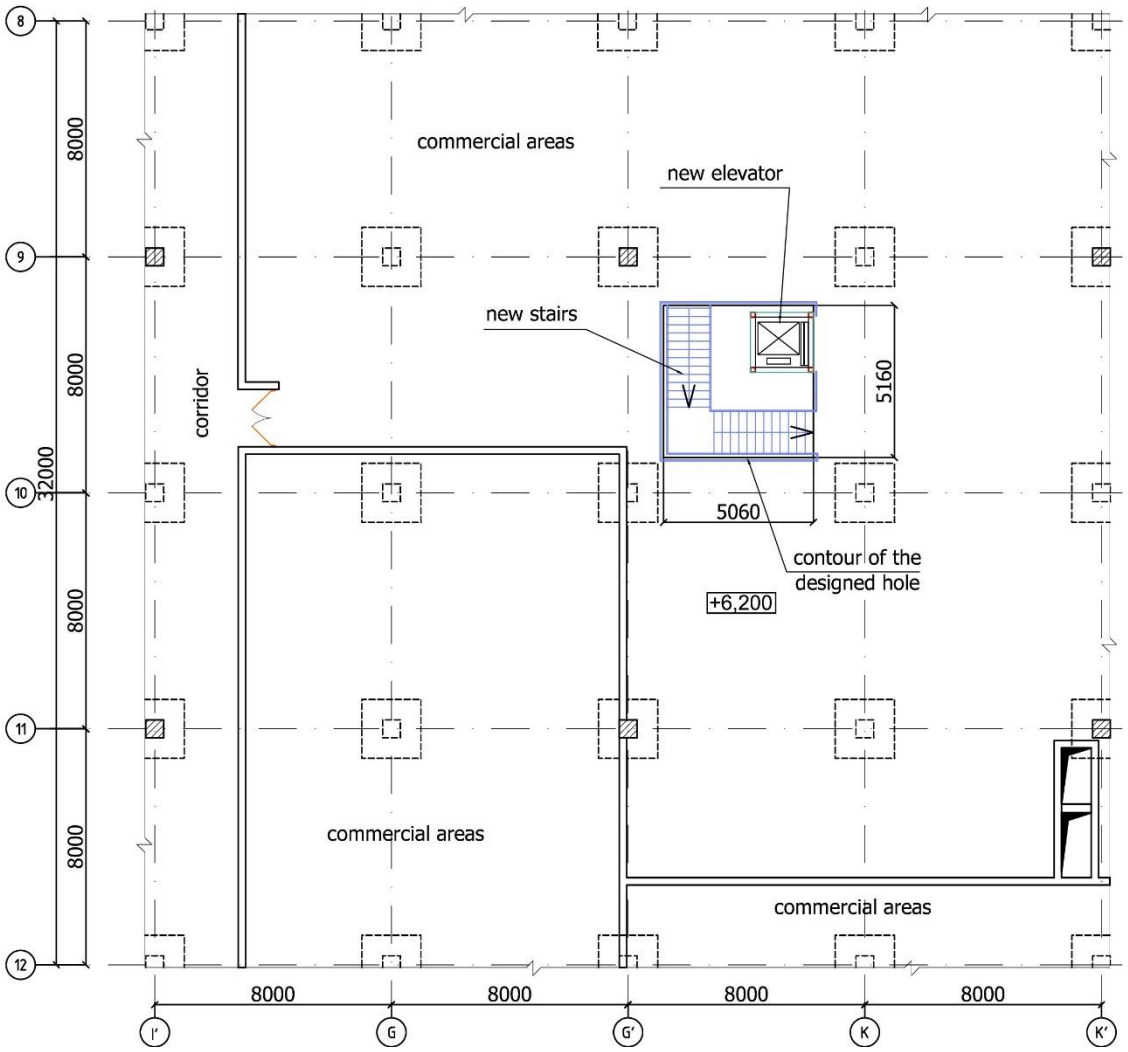

Figure 1. Layout of new vertical communications

The building of the complex, according to the construction scheme, is a frame made of monolithic RC. The column grid of the 1st floor (within the considered area) is 8.0×8.0 m, the 2nd floor is 16.0×16.0 m. Columns with a section of 600×600 mm with capitals. The overlap is monolithic with a thickness of 250 mm (in axes «I'-K/9-11») and 300 mm (on all other sections). Design reinforcement of the floor slab - reinforcing mesh with working reinforcement ∅18 A500C, s=200 mm. The slab is made of C30/35 class concrete. The characteristic value of loads on the floor is adopted as follows: temporary useful - 5.5 kN/m², load from the floor's own weight - 0.3 kN/m²; the load from the self-weight of the floor structures is taken according to the provided drawing of the slab on the 6,200 m, the concentrated characteristic load from the stairs

is assumed to be 3.4 kN at four points. Reliability coefficients are accepted according to regulatory documents [69].

In order to make a decision about the possibility of executing a new hole, a calculation was made in the Lira software complex (Figs. 2, 3, 4).

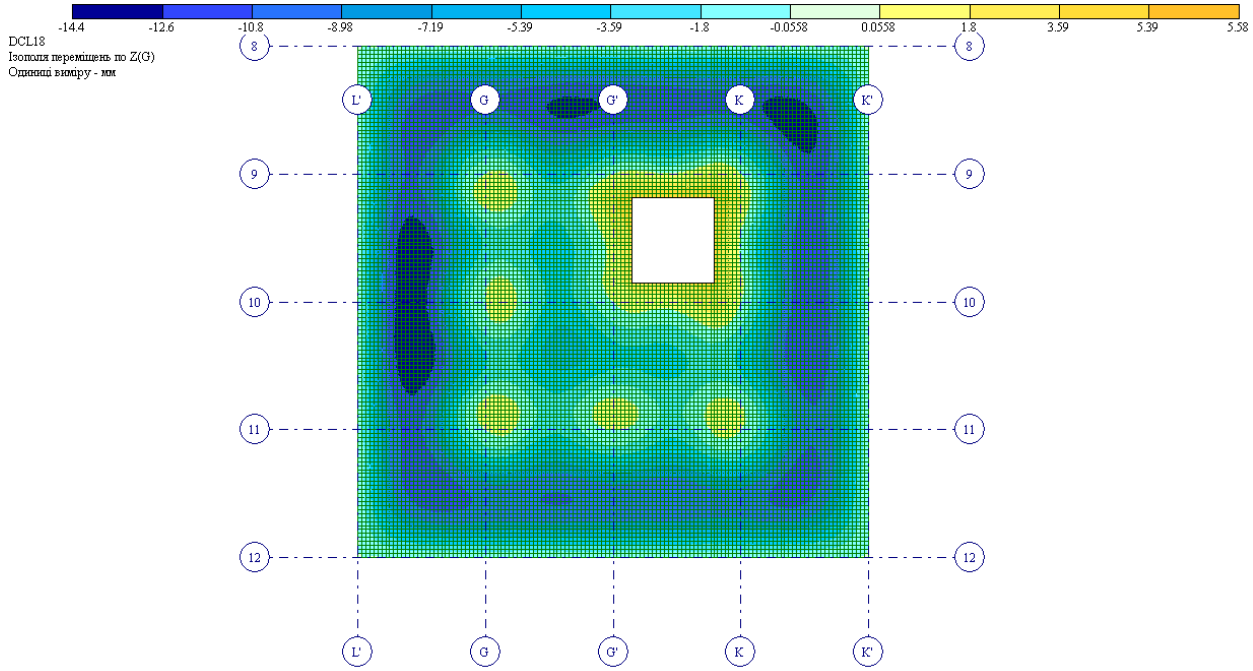

Figure 2. Mosaic of floor slab movements

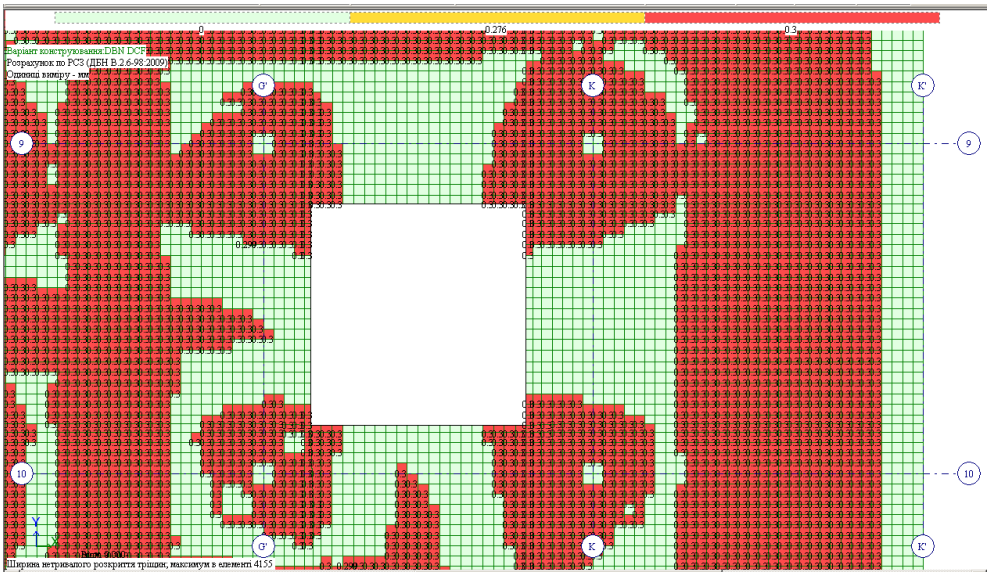

Figure 3. Crack opening width mosaic

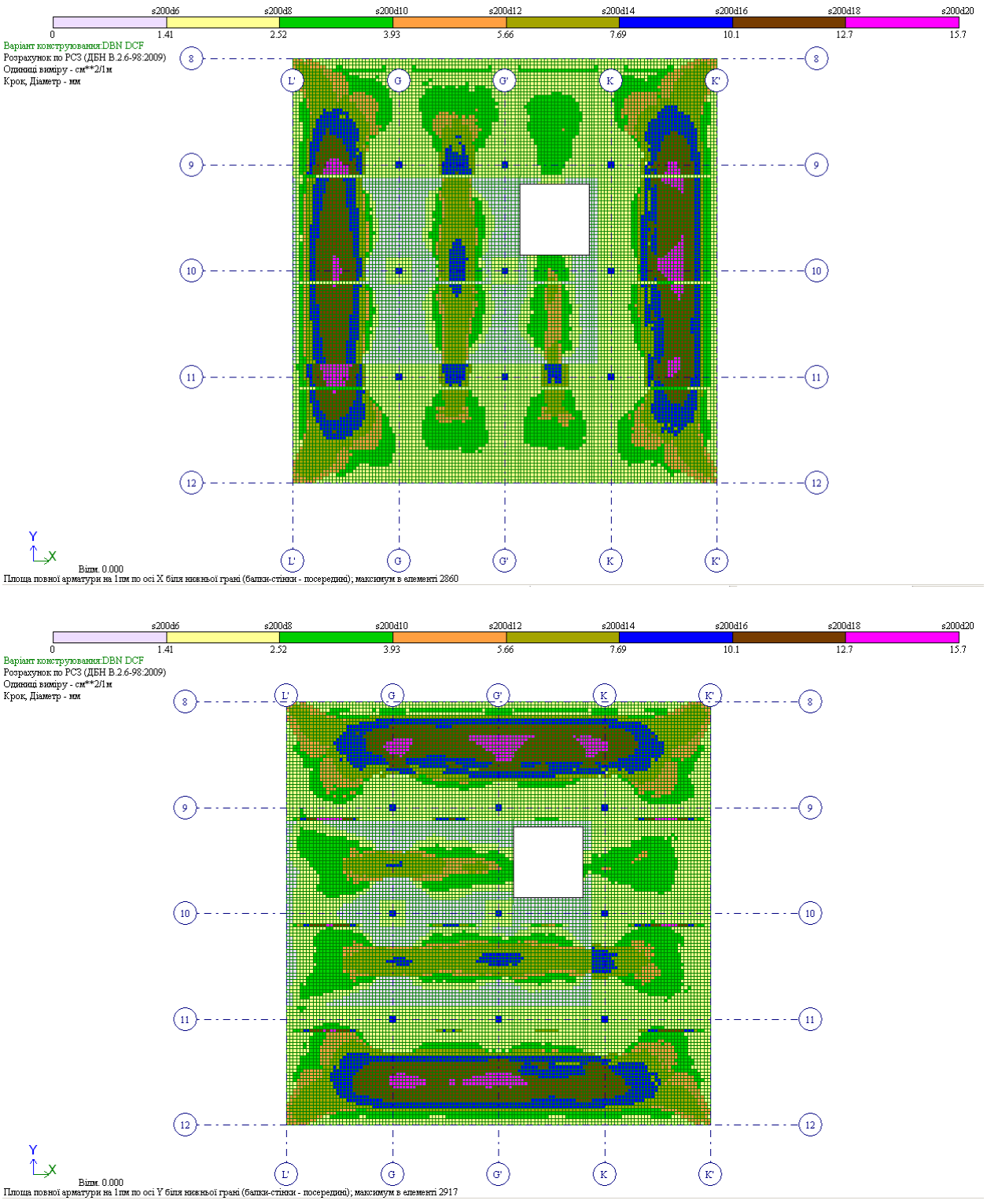

Figure 4. Mosaic of floor slab reinforcement

Based on the calculations, after arranging the slot in the floor slab, for a slab with a thickness of 300 mm, there is not enough reinforcement in the span «K-K'» along the axes «9» and «10» and in the span «8-9» - along the axes «G'» and «K» (15.7-12.7=3.0 cm^2).

As additional reinforcement, it was decided to use carbon composite tapes (CFRP) Sika CarboDur M-1214, which have proven themselves well at other objects [70, 71]. Carbon composite materials are often used when making openings in existing structures (Fig. 5).

Figure 5. Examples of the use of carbon composite materials in the arrangement of holes

Taking into account the physical and mechanical characteristics of the composite tapes, it was determined that in addition, in the spans «8-9/G'-K» and «9-10/K-K'» 9 tapes of 4.2 m length with a step of 1.0 m are needed (Fig. 6, 8). According to Sika technological maps, anchoring of composite tapes can be done with Sika Wrap 230C carbon fiber fabric. Also, from fig. 3, it can be seen that at the corners of the new hole, in the upper part of the slab, excessive cracking occurs. Therefore, it was decided to apply Sika Wrap 230C carbon fiber fabric with a width of 600 mm in three layers for a length of 5.4 m in these places (Fig. 7, 8).

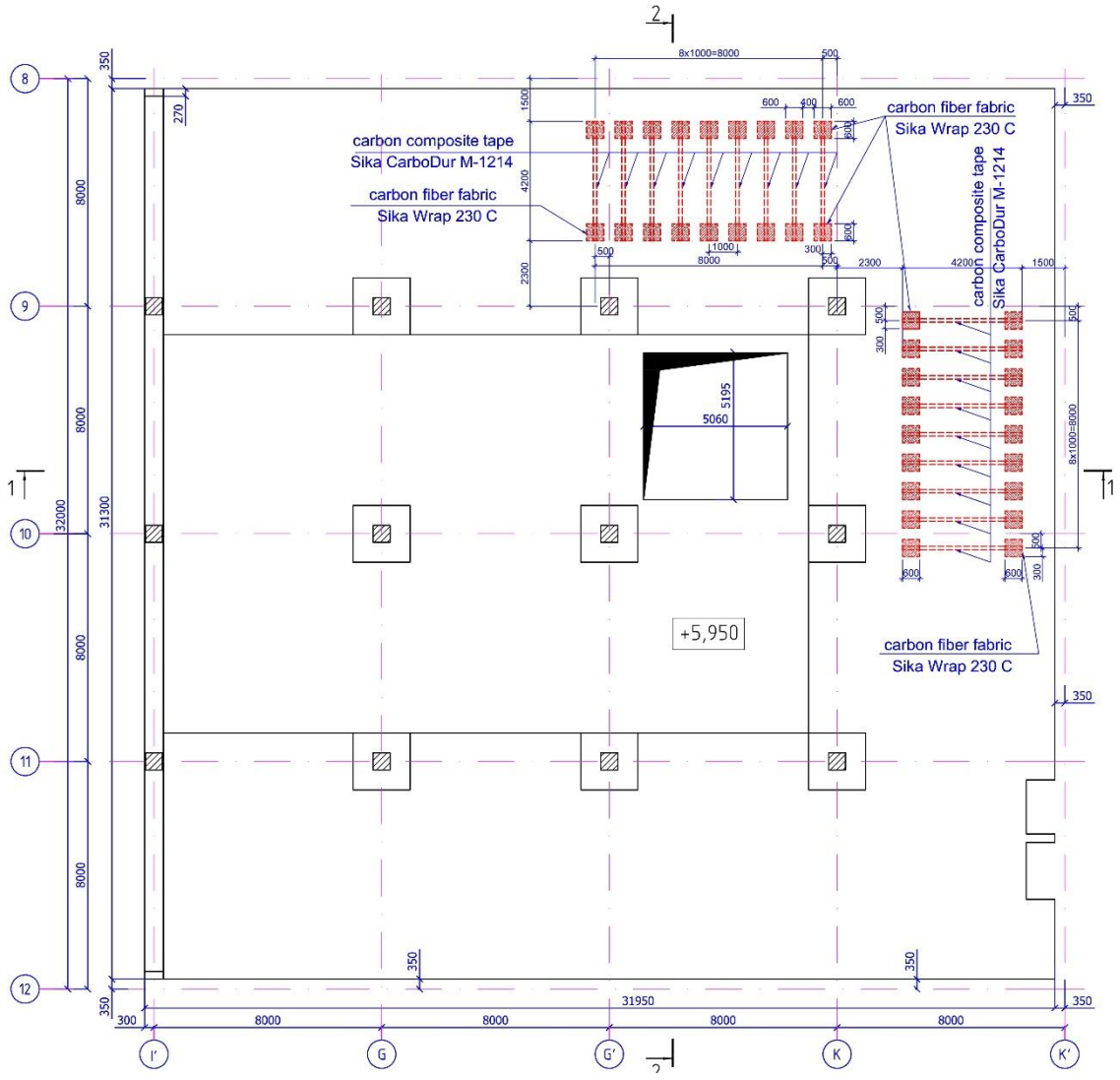

Figure 6. Reinforcement of the plate with Sika CarboDur M-1214 carbon composite tapes (bottom view)

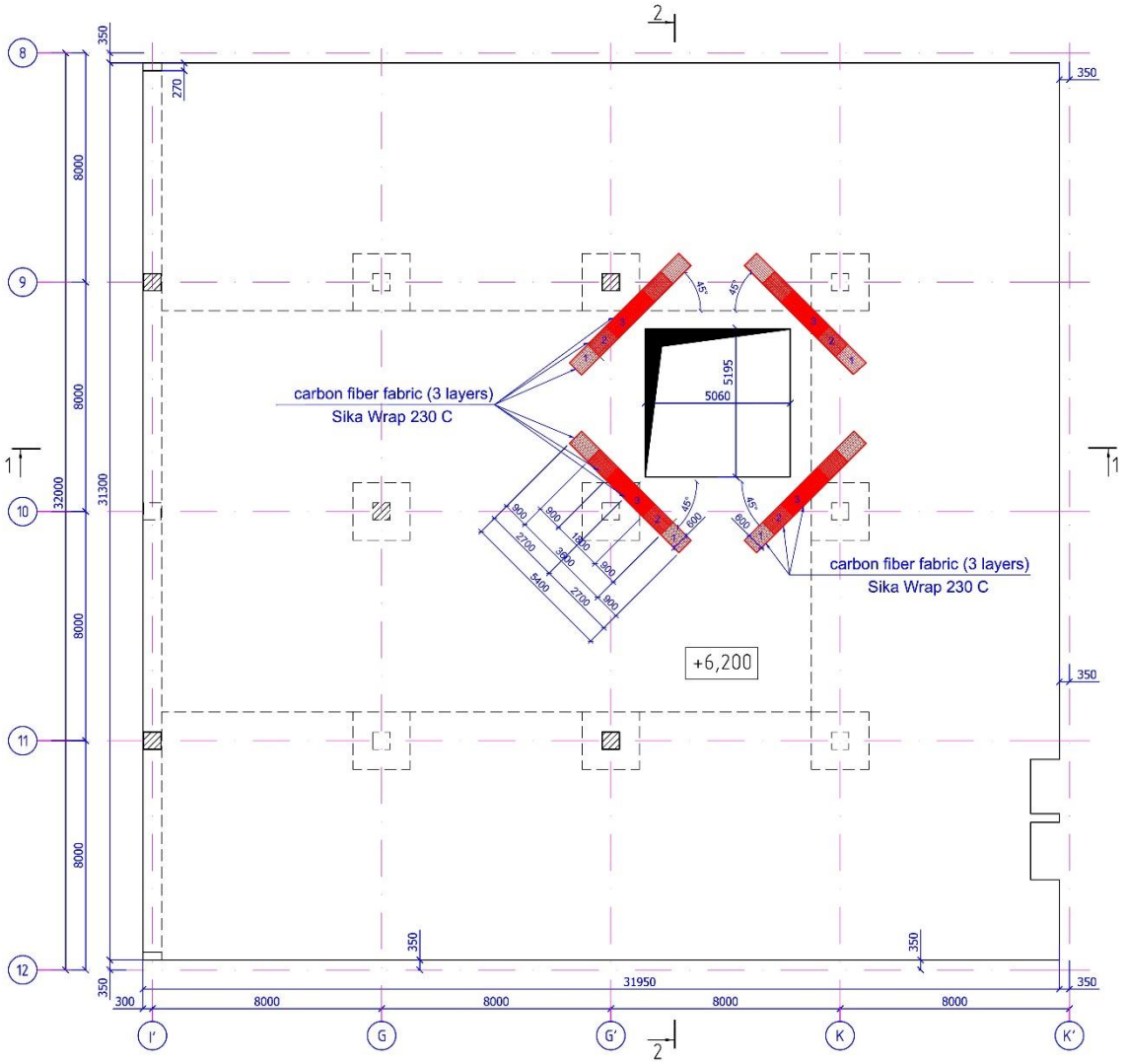

Figure 7. Reinforcement of the slab with Sika Wrap 230C carbon fiber fabric (top view)

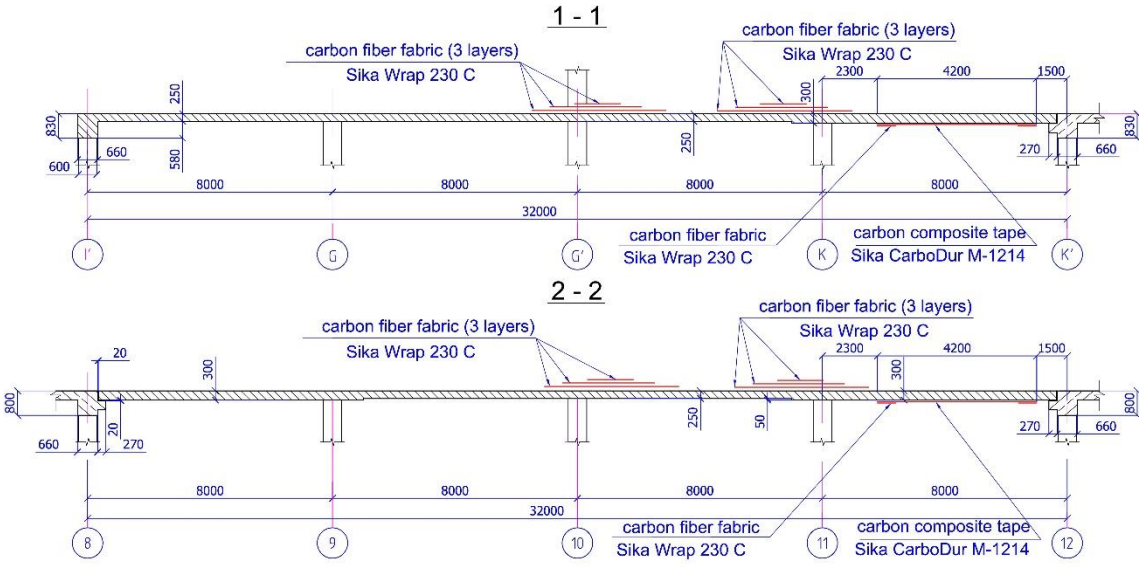

Figure 8. Sections «1-1», «2-2»

Sika CarboDur M-1214 carbon tapes are glued on Sikadur 30 glue. Sika Wrap 230C carbon fiber fabric is glued on Sikadur 330 glue. After gluing the tapes and fabrics, their surface must be covered with protective putty Sikagard 720 EpoCem, which should extend along the contour beyond the edge of the tapes and fabrics by 10 mm.

After the plate is reinforced, the hole is cut. The sequence of cutting the hole is as follows:

- first, a contour measuring 5.38×5.28 m is cut (Fig. 9), which is accordingly increased along the perimeter from the nominal design opening by 110 mm. A RC slab is cut along the contour along with all the fittings;

- then you need to make a contour measuring 5.5×5.4 m (Fig. 9), which is increased along the perimeter from the nominal design opening by 170 mm. Within this contour, only the concrete is removed, and the 60 mm long reinforcing bars of the upper and lower reinforcement of the slab remain.

To ensure the rigidity of the contour and the ability to support the staircase structures, it was decided to frame it with double channels #27 (Fig. 10). To do this, holes are made in the channels of the first row for the passage of the plates' reinforcing rods. Then these channels are installed around the perimeter in the design position and fixed by welding the reinforcement outlets through the washers. The voids between the walls of the channels and the surface of the vertical plane of the slab contour are carefully filled with high-strength SikaGrout - 314 solution. After that, a second row of channels is installed around the perimeter, which are welded to the channels of the first row.

The considered variant of arrangement of a large opening in the existing floor made it possible to solve the problem with the spatial organization of the communicative space in the existing multifunctional entertainment complex. Sika materials have proven themselves to be reliable for this type of reinforcement.

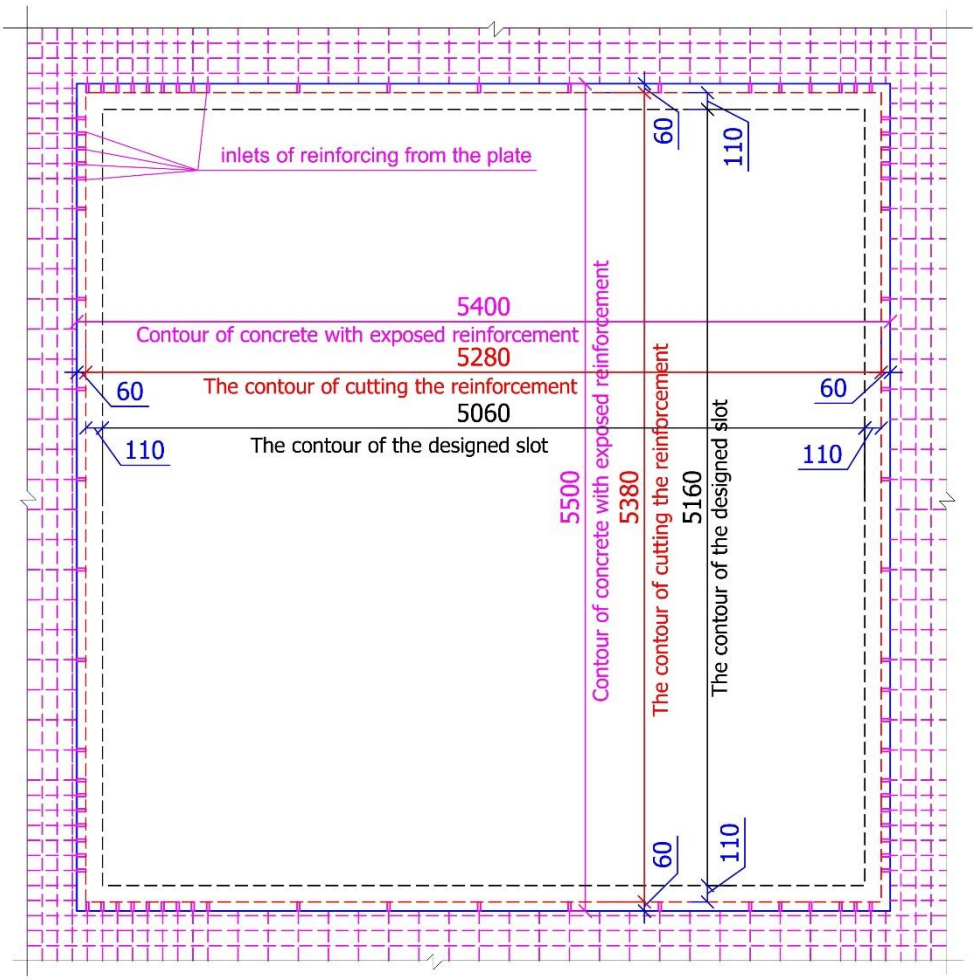

Figure 9. Diagram of the dimensions of cutting a hole in a slab

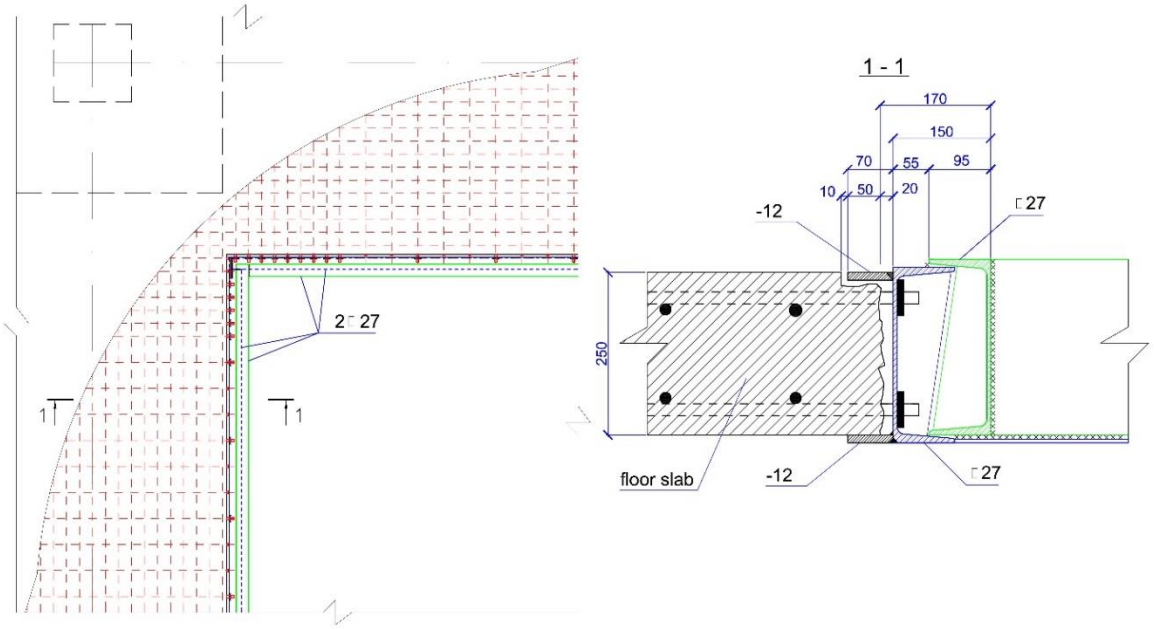

Figure 10. Scheme and assembly of the hole framing device