Loop-Free Tie-Down Node with an Anchor Rod-Dowel for a Hollow-Core Floor Slab of Formwork-Free Shaping

Mirzaev Pulat, Umarov Kadir, Mirzaev Shavkat

Abstract. When designing buildings and structures for various purposes, the specialists should find new decisions for the possibility of using structures made using the long-line formwork-free technology, including hollow-core floor slabs, namely: installation without free lengths of reinforcement, lifting without the tie-down loops, joint units with other structure elements, configuration of sections with new geometrical parameters. As the hollow-core slabs of formwork-free shaping are produced without tie-down loops, the problems of installation and transportation of these slabs are discussed. Examples of tie-down nodes installation in the slabs produced by the formwork-free shaping technology were considered in the paper, with the justification of the complexity of their installation in such slabs and the increased metal consumption. The aim is to reduce the laboriousness of rigging work and to provide a gripping device for a hollow-core slab of formwork-free shaping when removing it from a long-line pallet, storing, loading and installing this slab during the construction process. A constructive-technological decision was proposed for a tie-down node installed in the slab body without the use of a tie-down loop and having only an anchor rod-dowel through which the tie-down of a slab could be directly done without the use of traditional tie-down loops. The node was designed with reduced metal consumption and does not change the technology of manufacturing hollow-core slabs of formwork-free shaping. The theoretical basis for calculating the bearing capacity of the proposed tie-down node, installed in a hollow-core slab of formwork-free shaping was determined and summarized. It was revealed that the bearing capacity of the proposed tie-down node installed in the body of a hollow-core slab, under the action of lifting loads, depends on the splitting force of concrete protective layer located above the anchor rod-dowel of this node (all things being equal). The theoretical data of the study were validated by full-scale tests of slabs with tie-down nodes installed in their body, carried out in accordance with the proposed structural-technological development. The operational suitability of the proposed tie-down nodes with an anchor rod-dowel for the hollow-core slabs of formwork-free shaping and the possibility of their implementation at other enterprises of the country having production lines for long-line formwork-free shaping were stated. A tie-down node with an anchor rod-dowel, proposed to be installed in a hollow-core slab of formwork-free shaping, can be used in other reinforced concrete structures produced by the technology of long-line formwork-free shaping. A patent for a utility model has been received for the development of a loop-free tie-down node for a hollow-core slab of formwork-free shaping.

Revised Manuscript Received on June 22, 2020.

***** Correspondence Author

Mirzaev Pulat*, Professor at the Department of "Building Structures" of the Faculty of "Construction of Buildings and Structures" of the Tashkent Institute of Architecture and Construction, Tashkent, Uzbekistan. Email: pulatmirza@mail.ru

Umarov Kadir, the Chief Engineer of the "GEO BETON TRUST" Reinforced Concrete Products Plant, Tashkent, Uzbekistan.
Email: Kadir-umarov@mail.ru

Mirzaev Shavkat, Director of the Innovation Center at the Tashkent Institute of Architecture and Construction, Tashkent, Uzbekistan. Email: shavkatmirza@mail.ru

Keywords: Loop-free tie-down node; Hollow-core slab; Formwork-free shaping; Rod-dowel; Load-bearing capacity; Tests.

I. INTRODUCTION

The conversion of plants manufacturing precast concrete slabs in the Republic of Uzbekistan to the production of prestressed hollow-core slabs using formwork-free shaping technology allows increasing their output, improving the quality up to the European level compared to the morally and physically obsolete aggregate-flow technology [1, 2]. The formwork-free technology for the manufacture of reinforced concrete structures has evident technological advantages. Their widespread implementation depends on the country's research and design organizations. A feature of prefabricated hollow-core floor slabs of formwork-free shaping is their reinforcement by high-strength prestressed reinforcement without connecting devices (with adjacent building structures in the floor slabs) and tie-down units. In this regard, some of the problems for the implementation of such slabs in construction in seismic regions of our country have been solved [3, 4, 5]. The technology of formwork-free shaping of hollow-core slabs does not include the installation of tie-down loops in the slab, since it is not possible to install these loops on the long-lines before concrete is supplied, since the concrete spreader moving along the long-line not only feeds concrete, but also forms the voids and the upper flange of the slab. The disadvantage of hollow-core slabs of formwork-free shaping is the absence of tie-down loops, which leads to the problems when lifting and installing these slabs, reduces the construction work safety. During installation and lifting of such slabs without tie-down loops, special load-gripping devices are used. The use of such devices in construction presents certain difficulties, since it requires the creation of a fleet of lifting devices and the workshops for their maintenance [6]. In the construction trusts and firms of the country there are no such devices. Loop-free tie-down with the use of load-gripping devices, significantly saves steel consumption, and allows solving many issues in design and use of lifting loops in the slab [7]. However, the competitiveness of load-gripping devices when installing hollow-core slabs of formwork-free shaping is low, since the fastening with a hook and loop is a universal and simple operation in technological process.

In this regard, during the transition of precast concrete production enterprises to the technology of long-line formwork-free shaping, it became necessary to develop the tie-down nodes in the slab body considering their manufacture using this technology. In [6, node B fig. 2; 8, fig. 3], a tie-down node for a hollow-core slab of formwork-free shaping with crosswise loops was proposed. Its design presents two reinforcing bars intersecting at an angle of 90° located at the mid-height of the floor slab cross-section. The rods of the crosswise loops are inserted into the entire length of freshly formed body of the long-line concrete block through its side face (the configuration of the block section is a hollow-core slab section). At the rods intersection on the upper flange of the slab (above the void), a groove is formed through which the rods are gripped by the hook of the harness tie-down (Fig. 1).

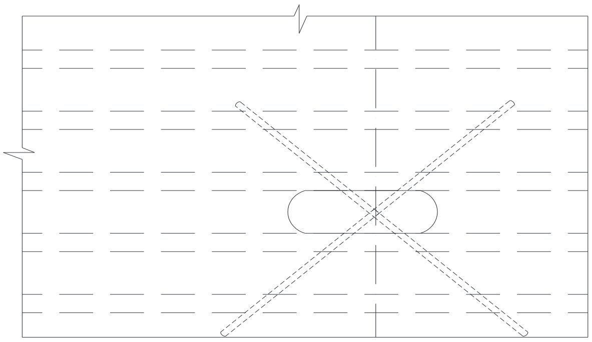

Fig. 1. Installation of crosswise loops in a hollow-core slab of formwork-free shaping [6 node B fig. 2; 8, fig. 3]: 1 - crosswise loops of reinforcing bars; 2 - a groove in the upper flange of the slab through which the crosswise rods are gripped at their intersection point (in the void) by the hook of the harness tie-down

A tie-down node in a slab with crosswise loops was proposed in the patent for invention [9]. The difference of this tie-down node from the one given in [8] is in the technology of the tie-down node installation in a slab. Design solution of the tie-down node in the prefabricated slab of formwork-free shaping was presented in [10 - Fig. 3)]. A groove was formed on the upper flange (by concrete collapse above the void of this flange), through which a loop grip made from the bent reinforcing rod was placed in the void. The partitioned off area of the void, representing the future body of the tie-down node, was filled through the groove with concrete mix, so that the loop could be gripped with a tie-down hook (Fig. 2). The tie-down nodes installation [8, 9, 10] is a complicated process, and these nodes have increased metal consumption and manufacture difficulties.

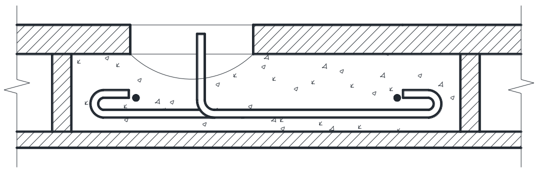

Fig. 2. Tie-down node with a loop for the tie-down, installed in the slab void – a proposal [10, fig. 3]

A tie-down node in a slab of formwork-free shaping was proposed in [11; fig. 2]; it contains at least one anchor and a lifting loop installed along mutually intersecting planes (Fig. 3). There, the closed lifting loop proposed in [12] was used. It is a modification of traditional lifting loops recommended by the Technical Specifications TP94-2003 "Tie-down loops of prefabricated concrete and reinforced concrete structures, design, calculation and testing." NIIZHB. Moscow. 2003. The lifting loop and the part of the anchor are concretized in the slab with secondary filling concrete, and the rest of the anchor is placed in the slab body (primary filling concrete). In this decision, a tie-down node consisting of an anchor and a lifting (tie-down) loop is complicated, which increases the slab metal consumption. The test results for construction loads on the slabs with tie-down nodes installation were not presented.

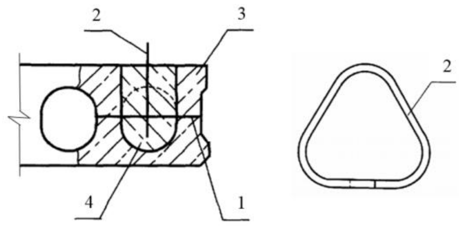

Fig. 3. Tie-down node proposed in [11, fig. 2]: 1 - an anchor connecting the primary-filling concrete (slab concrete) and the secondary-filling concrete (concrete for filling the void on the tie-down node); 2 - closed lifting loop; 3 - primary filling concrete; 4 – secondary filling concrete

A tie-down node where the anchor part of the lifting loop is installed in the void of the slab end section (Fig. 4) was considered in [13; fig. 4].

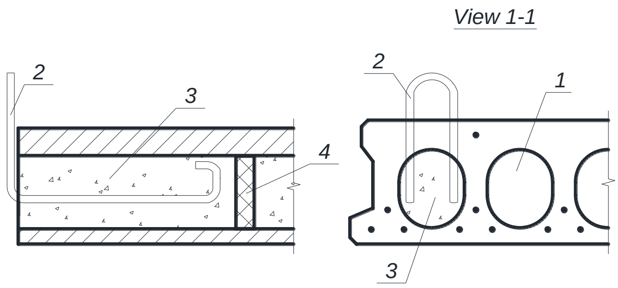

Fig. 4. Structure of a node with a tie-down loop in a hollow-core slab of formwork-free shaping, proposed in [13; fig. 4]: 1 – a void; 2 - tie-down loop with one-sided anchors; 3 - monolithic concrete; 4 - plug insert (polystyrene)

Analyzing the tests results of construction loads on hollow-core floor slabs using such loops at the slab ends, the authors of [13] in the conclusions noted that additional studies on the work conducted would be carried out.

The aim of the work is to simplify the tie-down (the gripping) of a hollow-core slab of a formwork-free shaping when removing a slab from the long-line pallet for storage, transporting it to the construction site, installing the floor slab into the building under construction. To do this, it is necessary to install a tie-down node in the slab that has a simplified arrangement, low metal- and labor-consumption, high reliability and does not prevent the technological process of slab manufacturing.

II. METHODOLOGY

II.1. Methods for determining the strength of the slab tie-down node and its interpretation

To strap a hollow-core slab of formwork-free shaping, a loop-free tie-down node with one anchor was offered; it is a smooth rod 350 mm long, made of A240 class hot-rolled reinforcement, through which it is possible to directly strap the slab without using traditional tie-down loops (Fig. 5).

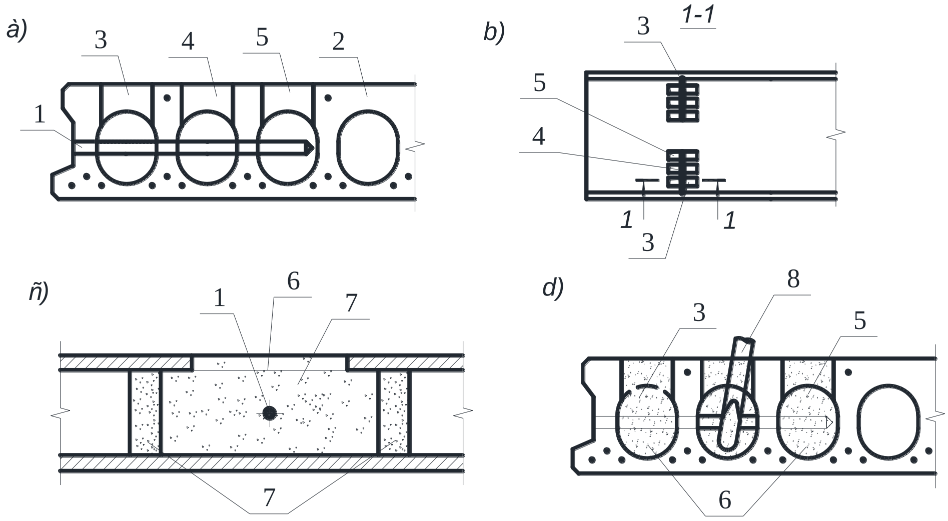

Fig. 5. Loop-free tie-down node installation in the body of a hollow-core slab of formwork-free shaping

The pointed end of anchor 1 is inserted to the entire length into the freshly formed body of the concrete block 2 on the long-line through its side face, intersecting three ribs and three voids (fig. 5, a). Anchor 1 insertion into the freshly shaped concrete block 2 does not complicate and interfere with the technological process of slab manufacturing. The grooves are formed on the section of anchor 1 insertion into concrete block 2 (on the upper flange), they are associated with the formwork-free shaping technology: 3 - above the end void, 4 - above the first intermediate void, 5 - above the second intermediate void (fig. 5, b).

Parts of anchor 1 located in the end and second intermediate voids are embedded in concrete of class B30 through grooves 3 and 5 (figs. 5, c and d). Prior to concreting the free lengths of anchor 1 in the voids, polystyrene plugs 7 are installed to prevent concrete mix spreading in the voids (fig. 5, c). Through the groove 4, the slab strapping is carried out by hook 8 of the load harness through the middle part of anchor 1 located in the first intermediate void (fig. 5, d).

The design scheme of the rod-anchor embedded in the slab concrete body can conditionally be represented in the form of a rod-dowel, which is under the impact of transverse force caused by construction loads (fig. 6).

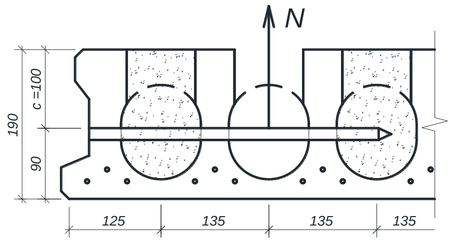

Fig. 6. Design scheme of rod-anchor operation of the proposed tie-down node in a hollow-core slab of formwork-free shaping

In connection with the design scheme, the authors in [14] argued that there are two types of exhaustion of the dowel lateral resistance:

- the first type is the reaching of steel yield strength of the rod-dowel and crushing of concrete above it;
- the second type is the concrete cracking over the rod-dowel in its length section (in tie-down node section).

Further, the authors mentioned the following dependence cited in [15], [14, formula 4; 6] to determine the load-bearing capacity of a rod-dowel corresponding to the node failure under simultaneous concrete crushing and reaching the yield strength of steel rod [15], stating that this formula satisfactorily describes the load-bearing capacity of the dowel in the first form of exhaustion of the dowel lateral resistance.

$$D_u = K \cdot {d_b}^2 \sqrt{f_{cc} \cdot f_{sy}}, \qquad (1)$$

D_u − is the bearing capacity of the rod-dowel;
d_b − is the diameter of the rod;
f_{cc} – is the compressive resistance of concrete;
f_{sy} −is the yield strength of the rod-dowel steel.

Preliminary calculations conducted according to formula (1) given in [15] showed the inapplicability of this formula for determining the bearing capacity of a tie-down node with an anchor rod-dowel installed in a slab due to the low height of the slab. This formula applies to the case when the anchor rod-dowel is installed in a structure with a powerful concrete block, which causes the destruction of the tie-down node as a result of reaching the yield strength of steel and crushing of concrete above the dowel. As experiments [16] showed, for $c \geq (6-7)d_b$ (where c is the thickness of the concrete protective layer), the exhaustion of the dowel lateral resistance comes from the yield strength of steel of the rod-dowel and crushing of concrete.

The authors in [14] noted that the thickness of concrete protective layer "c" is the key parameter on which the second type of exhaustion of the dowel lateral resistance depends - on crushing of concrete.

In [17], to determine the load-bearing capacity of the rod-dowel, which depends on the crushing force of concrete protective layer, a formula (given below) was proposed for the lengths of anchoring into concrete of the rod-dowel equal to 200 ... 400 mm.

$$D_{cr} \approx 5.0 \cdot f_{ct} \cdot c \cdot d_b \cdot \frac{c}{0.66c + d_b}, \quad (2)$$

where 5 is an empirical coefficient;

f_{ct} – is the normative tensile strength of concrete;

$c = 100$ mm is the concrete protective layer (see Fig. 6);

d_b –is the diameter of the rod-dowel.

II.2. Methods for assessing the bearing capacity of a tie-down node of a slab under testing

The load-bearing capacity of a tie-down node in the slab was determined in accordance with Technical Specifications TP94-2003 "Tie-down loops of prefabricated concrete and reinforced concrete structures, design, calculation and testing." NIIZHB. Moscow. 2003. The force acting on the tie-down node should meet the condition

$$N \leq N_{s,ult}, \quad (3)$$

where N is the force of construction loads acting on the anchor rod-dowel of the tie-down node;

$N_{s,ult} = D_{cor}$ –is the limit force perceived by the anchor rod-dowel (the resistance of the anchor rod corresponding to the concrete protective layer splitting (see formula (2));

Force N was determined by the formula

$$N = G \cdot \gamma_d \cdot \gamma_a \cdot \gamma_f \cdot \gamma_{ad}, \quad (4)$$

where C is the force of the proper weight of the product;

γ_d is the dynamic coefficient under lifting and installation, assumed to be 1.4;

γ_a is the coefficient accounting for the increase in force acting on the anchor rod-dowel when the load harness deviates from the vertical line at angle α from 0° to 45°, assumed to be equal to: 1,0 – at $\alpha = 0^\circ$; 1,4 – at $\alpha = 45^\circ$. At intermediate values of angle α, the values of γ_a are taken in linear interpolation (the deviation of load harness from the vertical line by angle α more than 45° is not allowed).

γ_{ad} is the coefficient accounting for the product suction (adhesion) to the long-line pallet at the first lifting of the product;

γ_f is the load safety factor.

In tests on the bearing capacity of the tie-down node of the slab, the control load C_{cont} is taken equal to force N. The value of control load C_{cont} includes the load from the proper weight of the product (a slab) per one tie-down node.

The tests on the loop-free tie-down nodes consisted in slab lifting by gripping hooks of anchor rods of these nodes. The slab was additionally loaded in such a way as to ensure the force in anchor rods of tie-down nodes equal to the required control load in bearing capacity. The slab with additional load, gripped by the anchor rods of all four tie-down nodes, was lifted 6 times until it was completely separated from all support points. Each time the slab was lifted, the dwelling lasted for 10 minutes, and then it was gradually lowered until the load harness relaxed. With each dwelling of the slab under the load, the locations of tie-down nodes were inspected.

With preliminary calculations according to the methods given in subsections II.1 and II.2, the diameters of reinforcing rod-dowels in the tie-down nodes (Fig. 5) of slabs were taken as: Ø20A240 - for slabs of a length up to 6.0 m; Ø22A240 - for slabs of a length from 6.0 to 7.2 m.

The tests of the loop-free tie-down nodes under lifting loads were conducted on two slabs: the first one of 5.9 m long under unified load of 800 kgf/m^2; the second one of 7.2 m long under load of 600 kgf/m^2.

Concrete strength of tested slabs and tie-down nodes sealing were determined on the day of testing with a Silver Schmidt sclerometer of the PCN type (the shock-pulse method) and with the ONIX-OS device with an electronic unit (to determine the strength and grade of concrete by shear test method).

III. RESULTS AND DISCUSSION

The results of tests on bearing capacity of tie-down nodes arranged in hollow-core floor slabs of formwork-free shaping are given in the table. No cracks were observed in tests in the tie-down nodes and no strains in the anchor rods-dowels of these nodes. After testing the tie-down nodes on lifting loads, the slabs were tested for control operational loads. These slabs have passed the load bearing tests.

Based on the research results, the following conclusions were made.

1. The proposed tie-down nodes installed in hollow-core slabs of formwork-free shaping (Fig. 5) passed the control tests for lifting loads; no damage was observed in these nodes.

Table. Tests results of tie-down nodes of a slab

Slab length, m	**Concrete strength of a slab, MPa**	**Concrete strength of tie-down node embedding, MPa**	**Proper weight of a slab, kN**	**Total load bearing capacity of all four tie-down nodes (4·D_cr)-according to formula (2), kN**	**Control load C_{cont} on a slab (under its proper weight), kN**
5.9	28.8	24.7	20.46	72.08	53.14
7.2	31.2	27.3	24.92	77.48	58.73

2. Formula (2) given in [17] can be used in calculating the bearing capacity of tie-down nodes installed in hollow-core slabs of formwork-free shaping, the constructive decisions of which are similar to the decisions of the proposed tie-down node. 3. Since the bearing capacity of a tie-down node depends on the anchor rod-dowel location along the section height of the hollow-core slab of formwork-free shaping, that is, on the thickness of concrete protective layer "c" (see formula (2)), it is recommended to install the anchor rod-dowel in the tie-down node as low as possible from the top flange of the slab, so there would be a possibility to grip it with the hook of the load harness.

IV. CONCLUSION

1. According to the results of design-technological developments of a loop-free tie-down node with an anchor rod-dowel (Fig. 5) for hollow-core floor slabs produced using the technology of long-line formwork-free shaping and the pilot testing at the enterprises of the JV "BINOKOR TEMIR-BETON SERVIS" "GEO-BETON TRUST» the operational suitability and the possibility of implementation of the product at country enterprises of similar production were established.
2. The loop-free tie-down node with an anchor rod-dowel, proposed to be installed in a hollow-core slab of formwork-free shaping, can be used in other reinforced concrete structures produced by the technology of long-line formwork-free shaping.
3. A utility model patent was obtained for the proposed design-technological development of a tie-down node with an anchor rod-dowel for a hollow-core slab of formwork-free shaping [18].

REFERENCES

1. Goncharova M.A., Ivashkin A.N., Costa A.A. Selection and optimization of concrete compositions for the production of hollow-core slabs of formwork-free shaping. Construction materials. Moscow. No. 3 (2017). P.35-38.
2. Yumasheva E. N., Sapacheva L. V. House-building industry and the social control of time. Construction materials. Moscow. No. 10 (2014). P. 3-11.
3. Mirzaev Pulat, Mirzaev Shavkat. Optimization of Geometrical Parameters of Hollow-core Slabs by Formwork-free Shaping for Construction in Seismic Areas. International Journal of Recent Technology and Engineering (IJRTE). ISSN: 2277-3878. Volume-8. Issue-6. March. (2020). P. 4973-4977.
4. Mirzaev Pulat, Umarov Kadir, Mirzaev Shavkat. Anti-seismic bracing in a hollow-core slab of formwork-free shaping for the possibility of creating a rigid disk in a building floor slab. International Journal of Recent Technology and Engineering (IJRTE). ISSN: 2277-3878, Volume-9 Issue-1, May 2020. P. 1409-1413.
5. Mirzaev Pulat, Umarov Kadir, Mirzaev Shavkat. Strength Calculation Features and Tests Results on Bearing Capacity and Operational Serviceability of Hollow-Core Floor Slabs of Formwork-Free Shaping in Seismic Areas. International Journal of Recent Technology and Engineering (IJRTE). ISSN: 2277-3878, Volume-9 Issue-1, May 2020. P. 2219-2225.
6. node B, fig. 2]. Barkov Yu. V., Zakharov V.F. Crosswise loops for reinforced concrete hollow-core floor slabs of formwork-free long-line shaping. Housing construction. Moscow. No. 10 (2008). P. 24-27.
7. Pachesa A. V., Barauskas Ya. A. Improvement of loop-free tie-downing of prefabricated structures. Concrete and reinforced concrete. Moscow. No. 4 (1984). P. 45-46.
8. fig.3]. Barkov Yu. V., Golofast S. I., Zakharov V. F., Smirnov L. Yu. Hollow-core building product and the method for its manufacture. Patent for invention RU 2 204 665 C1 (05/20/2003).
9. Anferov V. A. Hollow-core building product and the method for its manufacture. Patent for invention RU 2.263 748 C1. (10/11/2005).
10. fig. 3]. Degotkov O. V., Krivikov A. N. Hollow-core building product and the method for its manufacture. Patent for invention RU 2 313 639 C1 (12/27/2007).
11. fig. 2] Serbinovsky A. V., Pesotsky E. A., Pinevich S. S. Reinforced concrete hollow-core slab of long-line formwork-free shaping. Utility Model Patent RU 65 917 U1. (March 27, 2007).
12. Shashin A. F., Kalinichev N. N., Minkin B. R. Closed lifting loops in the products built from heavy concrete. Concrete and reinforced concrete. Moscow. No. 9 (1986). P. 5-6.
13. fig. 4]. Grinev V.D., Popkov Yu.V., Gil A.I. Hollow-core reinforced concrete slabs with modified lifting loops. Bulletin of Polotsk State University. Applied Sciences. Series F. Construction. No. 16 (2011). P. 67-70.
14. formula 4.6]. Ashkinadze G.N., Sokolov M.E., Martynova L.D., Lishak V.I. (USSR), Tassnos F., Tsukantas S., Plainis P., Skarpas A. (Greece). Reinforced concrete walls of earthquake-resistant buildings: Research and design basics. Moscow: Stroyizdat. (1988). 504 p. - ISBN 5-274-00212-5.
15. Rasmussen B. H. Strength of transversely loaded boltsand dowels cast into concrete. Laboratoriet for Bygningastatik, Denmark Technical University, Meddelelse. vol. 34. № 2, 1962.
16. Utesher G. and Herrmann M. Vesushe zur Ermittlung der Tragfahig Keit in beton eingespannter Rundstahldollen aus nichetrostondem austenitischem Stahi. Deutscher Ausschuss fur stahlbeton, Heft 346, Berlin, 1983, p 49-104.
17. Gustafsson P. J. and Hillerborg A. Improvements in concrete design achieved through the application of fracture mechanics. NATO ARW: Fracture Mechanics in concrete. Northwestern University, September, 1984.
18. Mirzaev P.T., Umarov K.S., Mirzaev S.P., Shukhratkhodzhaev Zh.M. Hollow-core slab of formwork-free shaping. Utility Model Patent UZFAP01501 (05/29/2020).

AUTHORS PROFILE

Dr. Mirzaev Pulat, Professor of the Department of Building Structures of the Tashkent Institute of Architecture and Construction, graduated from the Tashkent Polytechnic Institute with a degree in Industrial and Civil Engineering. He has graduated from the post-graduate school of the Kiev Civil Engineering Institute and defended a dissertation on the study of the deformability of prestressed expanded claydite-concrete flecxible elements under prolonged load. He is the author of 36 papers published in scientific-practical journals of Uzbekistan and other CIS countries, has 3 papers published in the Scopus database journals and 7 patents. Scientific supervisor of 4 state grant projects and 12 innovative projects developed by order of departments and individual enterprises. Areas of scientific and innovative activity: safety and reliability of buildings structures in seismic areas; introduction of reinforced concrete and composite concrete structures of a new generation to the construction in seismic areas; assessment of the technical condition and anti-seismic strengthening of buildings and structures. He is the supervisor of a normative document development at a republican level - town-planning norms and rules of ShNK 2.03.14-18 “Concrete structures with composite polymer reinforcement”. He is the winner of the Republican contest "Best teacher of a higher educational institution of Uzbekistan" in the nomination "The best teacher-researcher" (2015).

Dr. Umarov Kadir, the Chief Engineer of the “GEO BETON TRUST” Reinforced Concrete Products Plant, has graduated from Kiev Motor and Road Institute in specialty “Bridges and Tunnels”. After post-graduate course in the Tashkent Automobile Road Institute he defended his thesis on the problem of activation of cement-water suspension in the technology of heavy concrete production. He graduated from the International Business School at Tashkent State University of Economics under the program "Market Economics" (Manager's course). He is the author of 36 scientific papers, has 12 patents for inventions and utility models. His areas of scientific and innovative activity cover methodological foundations of concrete mix preparation with mechanical activation and chemical modifiers. He is the project manager of the State program for technological development of concrete plants No. 1 and No. 2 in Tashkent, JV “BINOKOR TEMIR-BETON SERVIS”, “GEO BETON TRUST” plant producing reinforced concrete long-length bridge structures. He has Certificates: “Integrated Quality Management System. ISO 19011: 2002”, 2017; “Environmental Management. ISO 14001: 2004”, 2018; Environmentally-friendly Manufacturing/Kaizen, 2018. Safety Engineering. OHSAS 18001: 2007, 2018".

Mirzaev Shavkat, Director of the Innovation Center at the Tashkent Architecture and Construction Institute. He has graduated from the Tashkent Institute of Railway Transport Engineers with a degree in Construction of Buildings and Structures and the magistracy of the Tashkent Architecture and Construction Institute, the department "Building Structures" - specialization "Design of buildings and structures". He is the author of 9 papers published in scientific-practical journals, including 3 papers published in the Scopus database journals; has 4 patents, participated in 2 international conferences.

He participated in the development of 2 state grants and 2 innovative projects commissioned by enterprises. He is one of the executives on the development of a normative document of a republican rank - urban planning norms and rules of ShNK 2.03.14-18 “Concrete structures with composite polymer reinforcement”. He has a certificate qualifying him as a specialist in the practical application of the LIRA software package in “Calculation of buildings and structures using LIRA PC for experienced users” and a certificate for the additional professional program “Calculation of high-rise buildings in seismic areas taking into account progressive destruction. Theoretical foundations and practical implementation". He is the manager of many large-scale projects for construction and reconstruction of buildings and structures, carried out under a special license.