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CALCULATING THE STRENTH OF THE LIFTING ASSEMBLY IN NON-FORMING MOULDING SLABS WITH MOUNTING TABS AT THE ENDS OF PRODUCT

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The calculations of the strength of the lifting assembly are made for non-forming moulding slabs with the installation of mounting tabs into the ends of the product. The data are obtained on the strength of the lifting unit, the required diameter of the hinge pin, the length of the anchoring loop.

Non-forming molding technology of hollow floor slabs does not provide for the installation of mounting hinges and fixings. This caused some difficulties when applying such types of slabs due to lack at many construction sites of special traverse equipped with carrying devices for lifting, transportation and assembly. There are various ways to install mounting tabs into such slabs. The peculiarity of these methods is that the mounting tabs are installed into freshly molded products while providing for upper slab plane collapse at loop installation sites.

Study of these problems led to the conclusion about the possibility to make mounting tabs with unilateral anchors and to place them in the slab voids at the ends of products [1, p. 69]. The developed solution to place mounting hinges at the ends of products has been patented. Lifting assembly design is a mounting loop embedded in monolithic concrete in the hollow channel at the slab end (Fig. 1).

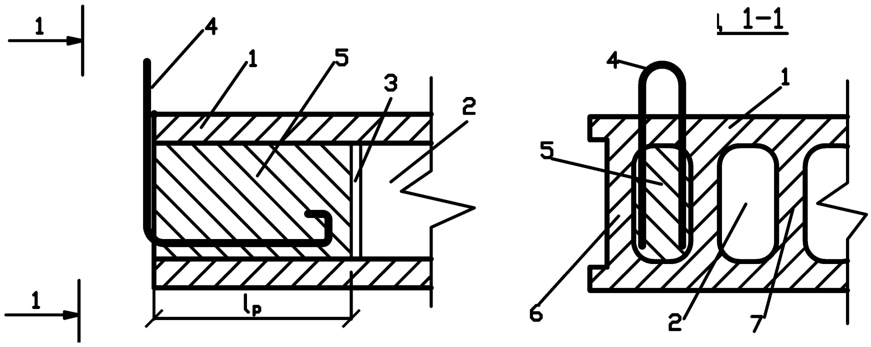

Fig. 1. Installation scheme of one-sided anchor loop:
1 – hollow slab; 2 – void (channel); 3 – partition; 4 – loop with unilateral anchors;
5 – reinforced concrete; 6 – extreme rib; 7 – middle rib

For the application of the developed version of slinging further slab field testing are required with such loops at the ends of products. Before proceeding to full-scale research it is necessary to calculate the strength of the lifting assembly which will include the selection of the diameter of the hinge pin, loop anchoring length calculation and determination of the carrying capacity of the lifting assembly.

Selection of the diameter of the hinge pin is performed by the method described in [2, p. 86]. According to this method, the weight when lifting the structure can be passed to three loops. Load on a single loop, taking into account the maximum allowable angle of sling set 90^0 ($1/\sin 45^0 = 1/0.707 = 1.4$) is equal to:

$$N = G \cdot 1.4 / 3 \tag{1}$$

Weight of a slab as long as 7.2 *m* (a slab of exactly this length is planned to be tested in the future) is equal to 2,640 *kg* (26.4 *kN*), and hence the load on one loop will be:

$$N = 26400 \cdot 1.4 / 3 = 123.2H$$

Given that the dynamic factor when lifting is 1.4 and that efforts are accepted by one branch of the loop, the section will be determined using the following equation:

$$A_s = 1.4 \cdot N / R_y \tag{2}$$

$$A_s = 1.4 \cdot 123.2 / 218 = 0.79 см^2$$

The selected diameter of the hinge pin is 12 *mm*, reinforcement class is S240 (= 1.131 cm^2).

Determination of the length of anchoring loop will be done on the basis of the methods of concrete fracture mechanics [3, p. 13], where, along with the concrete strength the aggregate size, thickness of the product and the distance to the edge or opening, as well as specific designs for strapping are taken into account [3, p. 119]. Seeding depth (anchoring) of a loop [3, p.120] to be lifted (*m*) is determined basing on possible panel destruction due to concrete puncturing:

$$l_{an} = \left[N_n \gamma_d / \left(1.25 \alpha h K_{Ic} \eta \right) \right]^2, \qquad (3)$$

where γ_d – the dynamic factor equal to 1.5; α – lifting loop factor, α = 0.92; h – member panel thickness (0.22 *m*); K_{Ic} – the calculated value of the critical stress intensity factor equal to, determined from table 7.3 [3 p. 120]; η – the coefficient is equal to 1, taking into account the ratio of the distance between the detail and the edge of the product b to the depth of embedment parts l, determined from table 7.4 [3 c. 121], *Nn* – normative load on the item (weight is passed to three loops).

Thus regulatory load on the item will equal:

$$N_n = 26.4 / 3 = 8.8 \kappa H = 0{,}0088 MH$$

Bearing this load in mind, anchoring loop length will be:

$$l_{an} = ((0.0088 \cdot 1.5) / (1.25 \cdot 0.92 \cdot 0.22 \cdot 0.4 \cdot 1))^2 = 0.0169\grave{\imath}$$

Loop termination length is accepted as 250 *mm*, since the length of anchorage must be at least 15*d*, and at least 250 *mm* [4, p. 54].

We define the carrying capacity of the lifting assembly. Mounting loads affecting the loop at the node from the slab in the absence of shear reinforcement (in non-forming moulding slabs only longitudinal pre-stressed reinforcement is provided) are accepted only by the concrete of tension intervoid ribs [5, p. 113]. For sealing of mounting tabs inside hollow channels we initially assume the same concrete as for C25/30 slabs. Sealing concrete function is as follows: to prevent mounting tabs from extension and slipping under the mounting loads [5, p. 114].

Determination of the strength of the load-carrying unit will be done basing on the same procedure used by Belevich V.N. in 2009 for the calculation of the load-carrying unit with spatial loops for slabs made on line «Weiler Italia» [5, p. 115]. Minimum load bearing capacity of the lifting unit can be determined by the strength of concrete of two closest to the loop intervoid ribs on the axial extension from the condition:

$$F = A_{c,eff} \cdot f_{ct} \;, \qquad (4)$$

where F – load on the product lifting assembly; $A_{c,eff}$ – sectional area of concrete of slab intervoid ribs at mounting tab site; f_{ct} – concrete resistance to axial tension of 1.8 *MPa*.

Calculated effective area of the concrete of slab intervoid ribs is conditionally equal to:

$$A_{c,eff} = 2 b_r l_s \;, \qquad (5)$$

where b_r – intervoid rib width, equal to 41 *mm*; l_s – the projected length of the mounting tab according to the calculations performed, equal to 250 *mm*.

Thus the minimum load capacity of the unit will be:

$$F = 2 \cdot 41 \cdot 250 \cdot 1.8 = 36.9 \kappa H$$

Given that the load from the slab is transferred to three loops and, respectively, three lifting units, the total carrying capacity of lifting devices when lifting a slab is equal to 110.7 *kN*. This strength is enough. For testing we use the following calculation results:

- assembly loop $\varnothing$ 12, S240 (A_s =1.131 cm^2);
- planting depth is 250 *mm*;
- loop sealing concrete is C25/30.

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INNOVATIVE MODERNIZATION IN HEATING AND AIR SUPPLY OF LOFT BUILDINGS WITH HINGED VENTILATED FACADE SYSTEMS CONDUCTING LIGHT

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Research refers to the technique of heating and ventilation and is proposed for use in the town- planning industry for energy- and resource- saving of heating and air supply to buildings with modern warm attics and ventilated transparent facade systems.

In all kinds of energy transformation at present because of the imperfection of the technological processes to final consumption is lost over 60% of the potential energy resources used. Energy-saving priorities is of particular significance for countries importers of fuel-energy resources, and the Republic of Belarus. At the State level in recent years adopted a series of measures to enhance the energy saving mode. Developed and approved the State program for energy development and energy conservation for the near term, the Cabinet of Ministers established the Committee on energy efficiency and energy oversight, a number of fundamental decisions aimed at strengthening the work in the national economy for energy efficiency.

The largest consumers of energy in the Republic of Belarus, with its temperate climate after industrial facilities are the engineering systems of buildings, where heat supply and ventilation spent about 35% of all kinds of solid, liquid and gaseous fuels, which is a heavy burden for the economy of the entire national economic complex of the country. On the basis of the above, the scientific and technical development in the field of energy saving are relevant and a priority.

In practice, urban planning widely use attics in buildings. Some functional and structural characteristics can be named: warm, ventilated and cold.

Warm attics are intermediate sectional extraction of 3-d cameras, which offer all of the exhaust channels organized system and exhaust ventilation located within one section of the building, followed by the removal of the warm exhaust air via a separate sectional shaft into the atmosphere.

In ventilated attics exhaust channels are also open in sectional volumes of attics, but instead separate sectional shaft to remove air in the atmosphere through the ventilation openings in the side opposite walls of the attic through cross-ventilation.

In buildings with cool verandas all exhaust pipes separate transit pass through volumes of attics and emit warm air through individual shaft directly into the atmosphere.

When garret buildings for a warm and ventilated attics under the influence of the bias, the pulsating wind pressure due to the difference of the aerodynamic pressures on the windward side and the facade is leeward formation of garret volumes, pressure increase, which is effect of reverse circulation or "rollover" ventilation, exhaust ventilation or completely off or converted into intake with air exchanges and regulated microclimate parameters of ventilated premises. In cold attics organized air exchanges is more resistant, but to all the garrets of buildings the main drawback is the warm exhaust air emission into the atmosphere without prior selection of the heat consumption for heating outdoor cold inlet air heating systems through infiltration.