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Joint Operation of a Cross member with Multi-Hollow Floor Slabs

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Annotation: The article presents the results of testing a reinforced concrete crossbar and a fragment of a ceiling with prefabricated multi-hollow slabs for a short-term load. The bearing capacity and deflections of beams are compared without and taking into account joint work with hollow-core slabs. Nowadays, when designing multi-storey frame buildings, their staged erection, and, accordingly, loading is not taken into account in the calculations. In addition, in monolithic reinforced concrete frames, the joint work of prefabricated multi-hollow reinforced concrete slabs with crossbars is not taken into account. This is explained by the fact that the experimental data on taking into account the joint operation of crossbars with multi-track slabs is not sufficient. To evaluate the joint operation of crossbars with multi-track slabs, an experimental study of the model of a prefabricated-monolithic crossbar on the auction of short-term loads was carried out.

Keywords: reinforced concrete, crossbar, multi-hollow slab, short-term load, bearing capacity, camber.

The construction of multi-storey frame buildings is carried out according to a staged scheme. At the same time, as the number of floors increases, the design scheme of the system changes. The loading of the frame in this case is mainly carried out by constant loads from the own mass of the structures, also according to the staged scheme [1-3].

At present, when designing multi-storey frame buildings, their staged erection, and, accordingly, loading is not taken into account in the calculations. In addition, in monolithic reinforced concrete frames, the joint work of prefabricated multi-hollow reinforced concrete slabs with crossbars is not taken into account. This is explained by the fact that the experimental data on taking into account the joint operation of crossbars with multi-track slabs is not sufficient.

To evaluate the joint operation of crossbars with multi-track slabs, an experimental study of the model of a prefabricated-monolithic crossbar on the auction of short-term loads was carried out.

Two series of floor models with prefabricated multi-hollow slabs were made on a scale of 1:4.

In the first series, samples were made and tested - reinforced concrete crossbars with a section of 100x100 mm and a length of 1460 mm. The scheme of reinforcement of a reinforced concrete crossbar is shown in Fig.1. The samples are made of heavy concrete class B20 and steel longitudinal reinforcement 2∅8 A400. As a transverse reinforcement 2∅2 Vr410 is used.

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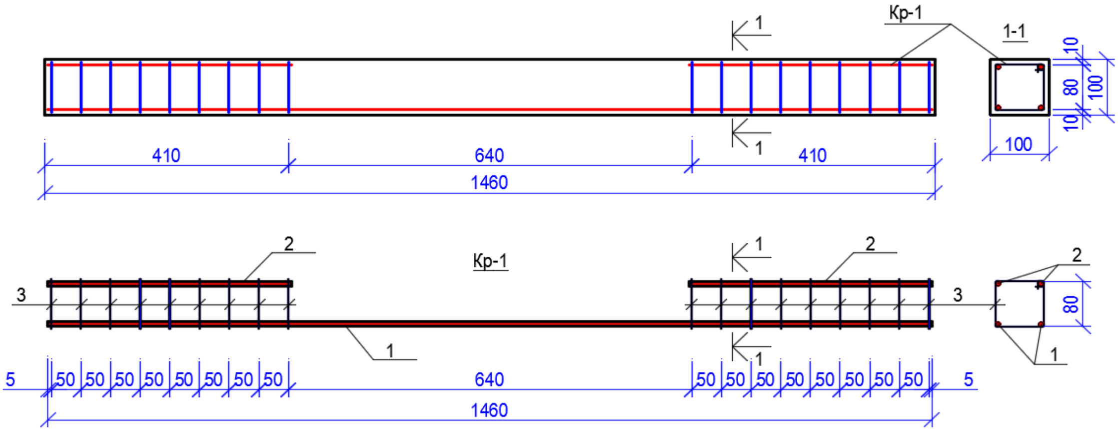

Fig.1. Reinforcement and frame type K-1

In the second series, floor models with prefabricated multi-hollow slabs were made and tested. Hollow-core slabs are made of fine-grained B20 class concrete on a scale of 1:4 (Fig. 2). The slab was reinforced with Vr-1 class reinforcement with a diameter of 3 mm.

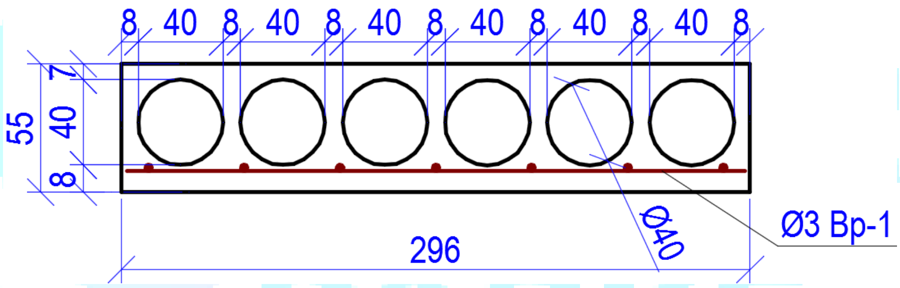

Fig.1. Cross section and reinforcement of a hollow core slab

Fig.3. Crossbar formwork

Fig.4. Hollow core formwork

To assess the strength and deformation characteristics of concrete, auxiliary samples were made and tested - cubes, prisms. These samples were stored with the main samples under laboratory conditions at normal temperature and humidity. Auxiliary samples were tested in accordance with the requirements of GOST at the age of concrete 28 days.

In each series, three samples were made and tested.

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Samples of the first series (crossbars) were tested by two concentrated forces (Fig. 5). The load was transferred by a hydraulic jack. Loading was carried out in steps. Before the formation of cracks, the load in each stage was 0.05P, where P is the breaking load. After the formation of cracks - 0.1R. Samples were brought to destruction. When testing crossbars, the own mass of the plates was taken into account as an external load.

Samples of the floor model were also tested by two concentrated forces (Fig. 6). Loading was carried out in the same way as for crossbars.

Fig.5. Beam testing

Fig.6. Floor Model Test

During the test, the moment of crack formation and their development, deflections of samples in the middle of the span, deformations of tensile reinforcement and concrete of the compressed zone were recorded. The parameters were measured by dial gauges with an accuracy of 0.01 mm.

Schemes of crack formation in the samples are shown in Figs. 7 and 8.

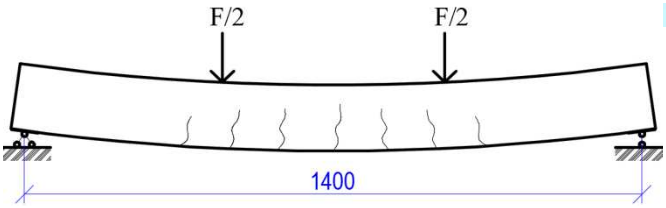
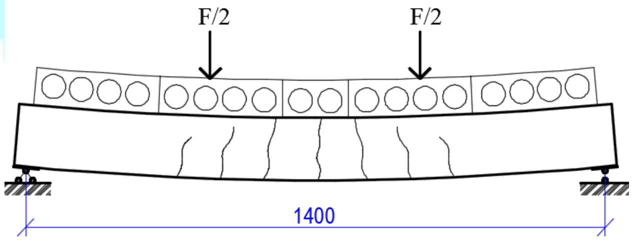


Fig. 7. Scheme of cracks in samples first series



Rice. 8. Scheme of cracks in samples second series

Rice. 9. Types of cracks in tested samples

The "M - f" dependence for the samples of the first and second series is shown in fig. 10.

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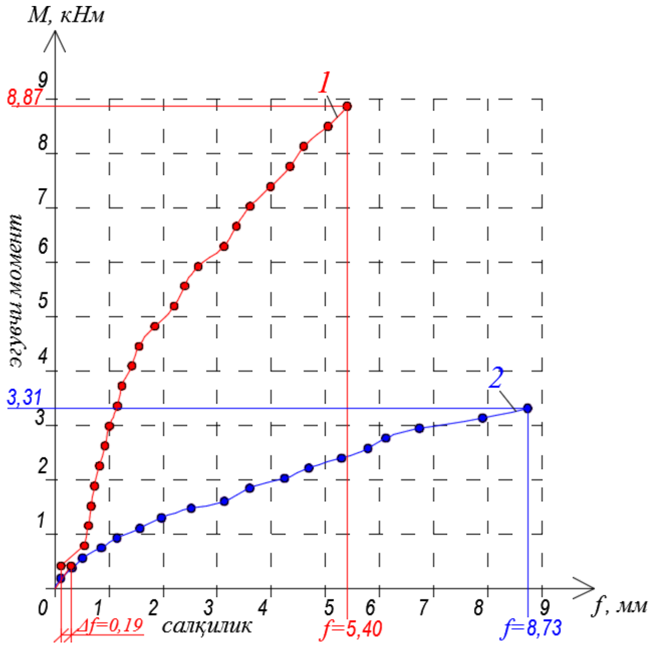

Fig. 10 Dependence "M - f":

1. without taking into account the joint work of the plate;
2. Considering the joint work of the plate

The test results are given in the table below:

Indicators	Without taking into account joint work	With taking into account joint work of the slab	Relationships of indicators without taking into account and taking into account joint work
M_{cr},кНм	2,57	6,29	6,29/2,57=2,45
M_u,кНм	4,04	10,33	10,33/4,04=2,56
f, мм	8,73	5,4	8,73/5,4=1,62

Conclusion

1. Taking into account the joint work of multi-hollow reinforced concrete floor slabs with crossbars greatly influenced the moment of crack formation. The crack resistance of a prefabricated monolithic reinforced concrete crossbar increased in 2.45 times;
2. Taking into account the joint work of multi-hollow reinforced concrete floor slabs with crossbars also greatly influenced the bearing capacity of the prefabricated monolithic crossbar. The bearing capacity of the prefabricated monolithic reinforced concrete crossbar increased by 2.56 times.
3. The deflections of the prefabricated-monolithic crossbar decreased by 1.62 times.

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