Full-scale test on a pile supported floor slab – steel fibre concrete only or in a combination with steel

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ABSTRACT: The Ph. D project “Integrated Design and Construction of Industrial Floors” proceeds after the presentation of a Licentiate thesis covering methods to increase the quality of concrete floors, Hedebratt (2004). The aim for further studies is to develop directions for design and construction of pile supported steel fibre concrete, SFC floors. SFC is common in industrial floor slabs. In pile supported floor slabs also a combination of non-tensioned reinforcing bars and steel fibres have been used. Furthermore, neither Swedish nor European or any other known design guidelines cover steel fibres as the only reinforcement in pile supported floors or structural members. A common engineering advice is to disregard the ground support. The scope is to investigate the possibility to consider steel fibre only design solutions in a safe way and to compare it with a combined solution and as a reference performing full-scale tests and to develop design guidelines. The now ongoing test on a column supported deck emulates a half scale of an industrial supported floor slab but may also be considered to be full scale of a structural mushroom floor for small housing.

1 THE OBJECT OF THE TEST

1.1 Modelling a real situation

As the area of fibre concrete still is a rather new material and the design of structures in many cases lack thoroughly practical studies, an important element in the build-up of models, standards and building codes is practical investigations. Silfwerbrand & Hedebratt (2006). Such work have been made in Sweden by means of small scale test of beams and plates but none has been in half- or full scale.

Modelling a pile supported slab with the settling ground support and a real piling showed to hard and expensive to perform. The recycling of material was also a large post. Recycling of the test structure as construction material in a contemplated building after the test was necessary. Hedebratt & Silfwerbrand (2004). The foundation and the second floor of a new private residential building will constitute as test object. The test slab is an elevated suspended floor on columns emulating a pile supported industrial concrete slab on piles.

Possibilities to obtain economical, safe, strong and durable industrial floors with fibre concrete that span over piles has been tempting for many contractors.

Some companies have tested this systems in line of there own interest and also introduced them as own or “patented” suspended floor systems to the market. The real failure load and achieved safety factors and mechanical system are still a question mark in independent practical tests.

1.2 Aims and expected outcome

The aim is to perform a full-scale test of a steel fibre concrete suspended floor where the influence of reinforcement and support conditions are investigated. From the study of a suspended slab that is loaded until failure, short and long term effects expects to appear as results of measuring deflections during loading and unloading. Cracking and material properties from a laboratory survey of the material will be used in back calculations. Load-deflection relationships of the actual slab will be compared with the theoretical slab.

1.3 The test site recycled

To lower the test costs a private builder of a residential house was contacted. The builder had ideas of building a house with low maintenance costs. Together we concluded that the only material that would remain without...
reiterate painting and repair and that would not so ever face problems as decay and formation of mould was concrete. The project’s wish of building and testing a structural fibre concrete slab and the property owners wish to build an everlasting house could have a mutual solution.

The local housing committee gave permission to build a 1½ story house (14.2 m × 12.9 m) with a fibre concrete deck (13.56 mm × 12.13 m) on columns for use as a private home.

A deal were the concrete slabs and columns (piles) are produced and installed by the project and the walls and roofs are produced and installed by the property owner was agreed on. Also the property owner should have the entire responsibility for the concrete slabs after the test was performed, such as safety, repair and disposal. The property owner should in own interest produce architectural design drawing and construct the ground structure in order to fit to the demands of the full-scale test.

2 TEST-SETUP

2.1 Floor slab plan and section of test-setup

Two parameters are varied in the test slab: presence of non-tensioning reinforcement (present at A, not present at B), and the fibre content (strain softening S and strain hardening H).

Two parameters are varied for the loading and support conditions of the slab, also the loading time, representing short or long term conditions on selected parts varies. This would give rigid-, or free supported edges and corners.

The pile spacing is typically divided equally over the side lengths in a real situation: here modelled with prefabricated columns giving a pattern of squares with sides 3.0 × 3.0 m.

A bottom slab is cast to be a rigid footing supporting the above concrete deck.

3 LOADING

3.1 Short term and long term test

Loading loops cast into the top slab and mounted in the bottom slab will serve as loading points. A hydraulically induced force will pull the two load point together during simultaneous measuring of slab deflection. Expected deformation is about 100 mm and expected maximum loading is about 70 kN.

To measure the creep of the top slab in long term (one year) in different configurations of parameters the loading will be by weights. The load should be between 50–90% of tested first crack load.

4 CONCLUSIONS

As the test in the moment of the deadline of the article is in build of phase no conclusions of results could be drawn. The load test will start in March 2008. The expectations are that fibre concrete implemented in structural floor applications also in combination with reinforcement steel would have a interesting future. This test will indicate possibilities.

REFERENCES


