Application Centre for Concrete and Construction (ACB²)

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Abstract

In support of the Construction Engineering Research Group (CERG) and the regional construction industry, Hasselt University is investing in a new structural laboratory in which mechanical tests of construction elements and full structures up to a size of 2 storeys can be performed. The facility, called the Application Centre for Concrete and Construction (ACB²), will provide opportunities towards the full-scale mechanical testing of structures and its individual components and will act as a catalyst for further development of the research group CERG and the construction industry through fundamental research, contract research and academic service research.

Keywords: Structural laboratory, reaction wall, reaction floor, structure mechanical testing.

1 History

The early idea of the construction of the research facility dates back about 10 years ago. With the existing industrial expertise in terms of prefab construction elements and the growing importance of continuous innovation, the need for a research facility in support of the regional construction industry in Belgian Limburg became evident. Furthermore, with the closure of the Ford manufacturing site in Genk, a major economical agent was lost. The local economical ecosystem had to evolve to support efficiently the regional industries. Additionally, with the integration of the department of civil engineering from the former XIOS university college as new Faculty of Engineering Technology of Hasselt University in 2012 and the consequent founding of the Construction Engineering Research Group CERG in 2014, the need for a research facility able to support high level academic research as well as contract research in collaboration with the industry became a necessity. Hasselt University, together with its industrial partners and supported by the regional and provincial authorities, launched in 2015 the design of a new state-of-the-art structural laboratory under the designation of Application Centre for Concrete and Construction (Applicatiecentrum Beton en Bouw - ACB²), with the aim of providing a strong link between fundamental research conducted in civil engineering at Hasselt University and the general construction industry and its partners.

2 Infrastructure

The ACB² laboratory has been designed in order to complement existing testing infrastructure in the area together with matching the needs of the local construction industry in terms of missing testing possibilities. This led to the definition of the two main relevant and specific features of the facility, namely a strong floor design to allow the testing of long beam elements, possibly up to 40 m long, and two reaction walls allowing testing full scale vertical elements or structures up to two levels in a realistic configuration. These elements are provided with a steel “meccano” able to assemble the testing rig with the maximal flexibility.

2.1 Reaction walls

The width of the two orthogonal reaction walls is 8 and 4 meters with a total height equal to 7 meters. They are made of a full 120 cm thick concrete wall horizontally stiffened by two thinner transverse walls. They are also post-tensioned in order to maximize their strength and stiffness, by a Freyssinet system with active bars. As a result, these walls are able to accommodate a bending moment at their base equal to 5000 kNm/m and a horizontal shear resistance of 1000 kN/m.

Figure 1 shows the 4 meter wide reaction wall after concrete hardening and before the post-tensioning prestress load is applied.

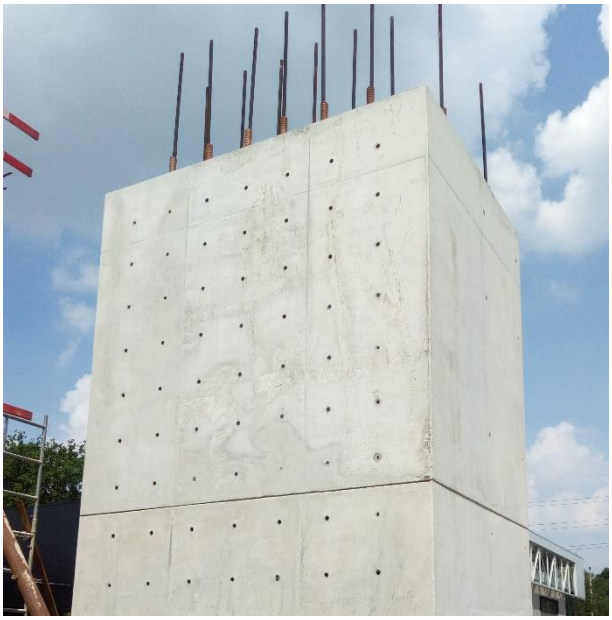

Figure 1: Reaction wall during construction

2.2 Strong floor

The strong floor consists of a 70 cm thick concrete slab with a maximum bending capacity of 1000 kNm/m and a punching resistance of 6000 kN/m². An anchor point grid of 50 by 50 cm is implemented in the reaction floor to anchor the "meccano" elements. Each individual anchor point has an anchor pull-out strength of 500 kN.

Figures 2 and 3 illustrate the reinforcement lay-out in the reaction floor and the reaction floor and walls after concrete hardening and prestressing of the walls.

Figure 2: Reaction floor reinforcement lay-out and anchor point grid.

Figure 3: Reaction floor and walls after prestressing

3 Testing equipment

In order to take the best advantage of the strong floor and reaction walls, the facility also comprises the necessary hydraulic systems and measurement devices, from which the most :

- Hydraulic system: 2 x 160 kW pumps
- Hydraulic jacks with a maximum capacity of 800 kN (uni- and bidirectional), to be extended in a near future to dynamic actuators with a capacity up to 2000 kN.
- Various load and displacement measurement devices
- DIC system

4 Acknowledgements

The project has been designed and realized on behalf of Hasselt University by a design team comprising the architecture offices BEL and D'Hoore en Vanweert and the design offices UTIL, Deltha and Greisch. The execution is carried out by Reynders (Group Eiffage)