

Fire resistance of anchorages in masonry

1. General Information

On the research project „fire resistance of anchorages in masonry“ was worked by the Technical University of Kaiserslautern in the period of January 2016 to January 2018. The project was supported and financed by Deutsches Institut für Bautechnik (DIBt).

2. Motivation and purpose

In some cases requirements for the fire resistance of anchorages in masonry are made. It is state of the art to execute fire tests to determine the fire resistance of an anchor system. At the moment rules and standards of testing and evaluation are not sufficient to get comparable results for testing institutes and assessors.

The aim of this research project is it to give the scientific basics for the evaluation of fire resistances of anchorages in masonry. In the framework of this research only chemical anchor systems were considered. The definition of boundary conditions for testing and a proposal for the required test program was part of the work. Furthermore the research should give detailed information about the evaluation of test results of fire tests. For this purpose the loadbearing behaviour of anchorages in solid and hollow bricks under fire exposure was investigated. Therefore theoretical considerations, fire tests and transient thermal simulations were made.

3. Results

Because of the amount of options for combination of masonry materials and formats an overall statement concerning the fire resistance of anchorages in masonry is difficult. Therefore generally a differentiation in solid and hollow bricks and furthermore in the different failure types was made.

The loadbearing behaviour of injection anchors in solid bricks is comparable with the behaviour in concrete. Tests can confirm that the temperature-dependent load bearing behaviour is not affected by the base material for high temperatures (>100°C). The calculation concept known by injection anchors in concrete under fire exposure can be transferred to masonry. In the tests made in the framework of this research no brick failure occurs. However brick failure is imaginable for small brick types in combination with big anchor diameters and should be investigated. The knowledge about steel failure of anchorages under fire exposure can be transferred on anchorages in masonry without restrictions.

There are many different types of hollow bricks, they differ in material, format and position of hollows, this properties have an influence on the loadbearing behaviour of anchorages. Therefore is at the current state of the art the execution of fire tests necessary to determine fire resistance loads for anchors in hollow bricks. The fire resistance loads are only valid for the tested configuration of anchoring material, brick type and format, anchorage depth, anchorage diameter and mortar type. The tests executed for this research shown that the load capacity of anchors in hollow bricks reduces highly under fire exposure. Generally bond failure is the decisive failure type.

4. Conclusion

On the basis of the available test results a procedure for the testing and evaluation of anchors in masonry in case of fire was determined. With the help of transient thermal analysis and fire tests the research gives new information about the load bearing capacity of anchors in masonry in case of fire. With the research results fire resistance loads can be calculated for anchors in solid bricks with a flexible embedment depth. But the confirmation of calculation results with the help of fire tests is still necessary. The fire tests has to show also that stone failure is not the decisive type of failure. Information about the testing and evaluation of test results on anchorages in hollow bricks are included too.