



## Load bearing capacity of plastic anchors in full block masonry stones considering properties and composition of the material

Load bearing capacity of plastic anchors in masonry stones has not been intensively analyzed so far. Since there is no further experience, the knowledge gained on concrete constructions is transferred for the use on full block masonry stones. But not only compression strength has an influence on the load bearing behavior of plastic anchors, many other material properties might be important, too. The high ranges of variation in first tests indicate that beneath the compression strength, there must be further parameters that are important for the load bearing behavior and should be considered for the design of plastic anchors.

A test program was developed to quantify these parameters and to get a possibility to take them into account for the design. The test results are supposed to give an exploration about the correlations between mechanical, physical and chemical properties of the stones and the load bearing capacity of plastic anchors.

Since most of the stones used in Germany are made of limestone and clay bricks, these two stones should be analyzed. The stones were produced by two manufacturers for clay bricks and two manufacturers for limestone. From each manufacturer, stones with the origin of three different batches were tested. So, overall the test program comprehended stones produced in twelve different batches.

The anchor tests consisted of tension tests according to ETAG 020. The tests were conducted in single stones. Plastic anchors of the sizes M8 and M10 with different embedment depths produced by various manufacturers were used. The stones are tested to analyze their mechanical, physical and chemical properties and to find out the parameters concerning the load bearing capacity of plastic anchors. Mechanical properties are compression strength, bending and splitting tensile strength as well as the static modulus of elasticity. Using the same test members as for compression strength and splitting tensile strength the bulk density of the stones was measured by drying, measuring and weighing the test members. The particle density was analyzed on special tablets formed by powder of the stones with the method of gaspycnometry with helium. When the bulk density and the particle density are known, the value for the porosity of the stones can be calculated. This value is also necessary for the analysis of the geometry and distribution of the pores in limestone. For this analysis special thin sections were produced. With a scanner these thin sections can be digitalized and the pores can be analyzed by special software. The same method is used to determine the percentage, geometry and distribution of the quartz grains which are components of clay bricks and limestone as well. With x-ray scattering techniques the mineral components of the stones can be found out. If the several components are known, it might be possible to find out under which conditions the clay bricks are fired.

The complete test results are described in the test report. The analysis report contains the comparison of the determined load bearing capacity of the plastic anchors with the mechanical, physical and chemical properties of the stones. The diagrams in the analysis report show the correlations between the determined properties of the stones and the load bearing capacity of the stones as well as the consequences of scaling the ultimate loads according to several properties.

In the context of the conducted tests, the correlations between mechanical, physical and chemical properties of masonry stones and the load bearing capacity of plastic anchors should be analyzed.