TECHNICAL REPORT

RECOMMENDATIONS FOR JOB-SITE TESTS OF METAL INJECTION ANCHORS FOR USE IN MASONRY

TR 053

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Contents

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1 GENERAL

The recommendations in this Technical Report (TR) are only valid for metal injection anchors with a European Technical Assessment (ETA) on basis of EAD 330076-00-0604 [1].

The recommendations apply to tests of metal injection anchors in masonry units of clay, calcium silicate, normal weight concrete, light weight concrete, autoclaved aerated concrete (AAC) to be carried out on construction works.

The characteristic resistances given in the ETA for use in solid masonry are valid for the base material and the bricks which have been used in the tests or larger brick sizes and larger compressive strength of the masonry unit.

The characteristic resistances given in the ETA for use in hollow or perforated masonry are valid only for the bricks and blocks which have been used in the tests regarding base material, size of the units, compressive strength and configuration of the voids.

In the absence of national requirements, the characteristic resistance of the injection anchor may be determined by the following so-called "job site tests", if the injection anchor has an ETA with characteristic values for the same type of base material (e.g. clay, calcium silicate, lightweight aggregate or autoclaved aerated concrete) as is present on the construction works.

Furthermore, job site tests for use in solid masonry are possible only if the injection anchor has an ETA for use in solid masonry and job site tests for use in hollow or perforated masonry are possible only if the injection anchor has an ETA for use in hollow or perforated masonry.

This characteristic resistance to be applied to an injection anchor should be determined by means of tests carried out on the construction work with a centric tension load acting on the injection anchor. These tests may also performed in a laboratory under equivalent conditions as used on construction work

Execution and evaluation of the tests as well as issue of the test report and determination of the characteristic resistance should be supervised by the person responsible for execution of works on site and be carried out by a competent person.

The number and position of the injection anchors to be tested should be adapted to the relevant special conditions of the construction work in question and, for example, in the case of blind and larger areas, be increased such that reliable information about the characteristic resistance of the injection anchor embedded in the base material in question can be derived. The tests should take account of the unfavourable conditions of practical execution.

2 ASSEMBLY

The injection anchor to be tested should be installed (e.g. preparation of drill hole, drilling tool to be used, drill bit, type of drilling hammer or rotation, thickness of fixture) and as far as spacing and edge distances are concerned be distributed in the same way as foreseen for the intended use.

Depending on the drilling tool, hard metal hammer-drill bits or hard metal percussion drill bits according to ISO 5468:2006 [2] should be used.

The cleaning process of the drill hole should follow the manufacturer's installation instruction using the corresponding tools.

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3 EXECUTION AND EVALUATION OF TESTS

3.1 General

The characteristic resistance may be determined by pull-out tests according to 3.2 or proof-load tests according to 3.3. The characteristic resistance F_{Rk1} or F_{Rk2} has to be equal to or smaller than the characteristic resistance F_{Rk} which is given in the ETA for the same kind masonry (bricks or blocks).

The test rig used for the tests should allow a continuous slow increase of load recorded by calibrated measuring equipment.

The load should act perpendicular to the surface of the base material and be transmitted to the injection anchor via a hinge. The reaction forces should be transmitted to the base material such that possible breakout of the masonry is not restricted. This condition is considered as fulfilled if the support reaction forces are transmitted either in adjacent masonry units or at a distance of at least 150 mm from the injection anchors.

In absence of national regulations the partial safety factors for the resistance of the injection anchor may be taken as γ_M = 2,0 for use in autoclaved aerated concrete and γ_M = 2,5 for use in all other masonry units.

3.2 Pull-out tests

3.2.1 Execution of pull-out tests

The load should be progressively increased so that the ultimate load is achieved after not less than about 1 minute. Recording of load is carried out when the ultimate load is achieved.

3.2.2 Evaluation of the results of the pull-out tests

If the number of pull-out tests is equal to or more than 15, the characteristic resistance N_{Rk1} is obtained from the measured values of N_1 as follows:

$$N_{Rk1} = 0{,}5 \cdot N_1 \leq N_{Rk,ETA} \quad (3.1.a)$$

with: N_1 = mean value of the five smallest measured values at the ultimate load

$N_{Rk,ETA}$ = characteristic resistance N_{Rk} given in the ETA for the same kind of masonry

If the number of pull-out tests is smaller than 15, the characteristic values are to be determined as a 5 %-fractile taking into account the β factor, given in the ETA for the base material under consideration.

Example with 10 tests:

$$N_{Rk1} = N_{Rm} \cdot (1 - 2{,}57 \cdot v) \cdot \beta \leq N_{Rk,ETA} \quad (3.1.b)$$

with: N_{Rm} = mean value of the ultimate load of the 10 tests

v = coefficient of variation of the ultimate load

β = factor to consider the different influences of the product, given in the ETA

$N_{Rk,ETA}$ = characteristic resistance N_{Rk} given in the ETA for the same kind of masonry

The minimum number of pull-out tests is 5; with 5 tests the following equation has to be used:

Example with 5 tests:

$$N_{Rk1} = N_{Rm} \cdot (1 - 3{,}4 \cdot v) \cdot \beta \leq N_{Rk,ETA} \quad (3.1.c)$$

For shear loads it can be assumed:

if $V_{Rk,ETA} \geq N_{Rk,ETA}$: $V_{Rk1} = N_{Rk1} \leq V_{Rk,c}$ according to TR 054 [3], 4.2.2.5

if $V_{Rk,ETA} < N_{Rk,ETA}$: $V_{Rk1} = N_{Rk1} \cdot (V_{Rk,ETA} / N_{Rk,ETA}) \leq V_{Rk,c}$ according to TR 054 [3], 4.2.2.5

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3.3 Proof-load tests

3.3.1 Execution of proof-load tests

The minimum number of proof-load tests is 15.

The load should be progressively increased until the proof load N_p is achieved.

$$N_p \geq 0{,}8 \cdot N_{Ed} \cdot \gamma_M \cdot 1/\beta \qquad (3.2)$$

with: N_p = load N_p for the proof load tests

N_{Ed} = design value of action ($N_{Ek} \cdot \gamma_F$)

γ_M = partial safety factors for the resistance
γ_M = 2,0 for autoclaved aerated concrete,
γ_M = 2,5 for all other masonry units

β = factor to consider the different influences of the product; given in the ETA

3.3.2 Evaluation of the results of proof-load tests

If visible movement or displacement of the injection anchors does not occur in all tests under the proof-load, then an estimate for the characteristic resistance N_{Rk2} may be obtained as follows:

$$N_{Rk2} = 1/0{,}8 \cdot N_p \cdot \beta \leq N_{Rk,ETA} \qquad (3.3)$$

$N_{Rk,ETA}$ = characteristic resistance N_{Rk} given in the ETA for the same kind of masonry

N_p = see Equation (3.2)

β = factor to consider the different influences of the product; given in the ETA

For shear loads it can be assumed:

if $V_{Rk,ETA} \geq N_{Rk,ETA}$: $V_{Rk2} = N_{Rk2} \leq V_{Rk,c}$ according to TR 054 [3], 4.2.2.5

if $V_{Rk,ETA} < N_{Rk,ETA}$: $V_{Rk2} = N_{Rk2} \cdot (V_{Rk,ETA} / N_{Rk,ETA}) \leq V_{Rk,c}$ according to TR 054 [3], 4.2.2.5

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4 TEST REPORT

The test report should include all information necessary to assess the resistance of the tested injection anchor. It should be given to the person responsible for the design of the fastening. The following information is necessary e.g.:

Name of product

Construction work

Building owner

Date and place of tests

Test rig

Type of structure to be fixed

Masonry (type of brick, strength class, all dimensions of bricks and mortar group if possible);
Visual assessment of masonry (flush joints, joint clearance, regularity);
Thickness of plaster layer or intervening layer (e.g. insulation), if existing

Injection anchors

Cutting diameter of hard metal hammer-drill bits

Type of used drill method (hammer drill, impact drill, core drill)

Cleaning process of the drill hole in detail

Results of tests including indication of value N_1 or N_p; mode of failure

Tests carried out or supervised by; Signature

5 REFERENCE DOCUMENTS

As far as no edition date is given in the list of standards thereafter, the standard in its current version at the time of issuing the European Technical Assessment is of relevance.

[1] EAD 330076-00-0604: Metal injection anchors for use in masonry

[2] ISO 5468:2006: Rotary and rotary impact masonry drill bits with hardmetal tips - Dimensions

[3] EOTA: Technical Report TR 054:2016-04 Design methods for anchorages with metal injection anchors for use in masonry

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