BRE Tecnical Consultancy

Structural Integrity Division

CLIENT REPORT:

Moisture/Temperature cycling tests On the Cintec remedial wall tie

for: Cintec Ltd.,
Factory Road, Newport, S. Wales NP20 5FA

by S K Arora

November 1990

Enquiry Number 02831

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NTRODUCTION

This report gives results of pull-out tests on Cintec Harke remedial tie embedded in a clay brick, having been subjected to accelerated moisture/temperature cycling over a period of three months. The object of the exercise was to test the long term performance of the tie anchors under conditions of wetting by rain of the external walls of a structure into which they would be incorporated followed by drying.

THE ANCHOR SYSTEM

The literature supplied by the manufacturers of the system, Messrs Cavity Lock Systems Ltd. of Newport, Gwent, describes Cintec-Harke replacement wall tie as a cementitious anchor. The standard design is a long stainless steel hollow tube of 8mm O.D.[1] x 1mm thickness provided with a mesh polyester fabric sleeve or a 'sock' of required diameter at each end. A specially designed cementitious grout is injected into the socks through the tie under pressure in predrilled position(s) in the cavity wall requiring replacement tie(s). The pressure is maintained until the inflated socks are hard and the grout milk with bonding agents are driven out to give good bond between the inflated sock and the background material. The grout is a Presstec or S.T.M.A. grout[1].

EXPERIMENTAL DETAILS

The anchor used in the pull-out tests was a special design of 165-175mm long 8mm O.D. x 1mm stainless steel hollow tube, with an 85mm long sock provided at one end only which would inflate to a diameter of approximately 22mm. The background material chosen for the test specimens was a flat faced solid wire-cut facing clay brick of 212mm x 100mm x 65mm size. The anchor sock was embedded through one of the 212mm x 65mm faces to its full depth, with the steel tube coming out through the other face. Three spare specimens were also prepared with the anchor sock embedded to a lesser depth of around 60mm, with the remaining part providing a bulge of anchor material into a reamed out hole of 40mm diameter. This was done to test a situation where a positive re-entrant tension fixing is to be provided in a wall, in case the grout to brick bond fails.

The specimens made with the said brick supplied by BRE were prepared by the manufacturers at their own premises and delivered to BRE three days later.

The test programme assumed that a masonry wall in reality would be exposed to rain such as to saturate it fully with water at least once a year. Trials were made to ensure wetting of the brick in a water tank to saturation followed by drying in an electric oven heated to 40°C($\pm$2°C) temperature, to a constant weight. A half hour soak in a water tank followed by a minimum of two days of drying was found sufficient to meet the requirements.

The BRE contract stipulated 20 pull-out tests on brick/anchor specimens, five each to be tested at: seven days cure after construction of the specimens, and then after 10, 20 and 40 cycles of wetting/drying of the specimens. A further three specimens of 60mm embedment length referred above

were also tested after 40 wetting/drying cycles.

The pull-out testing was carried out on a standard Universal Testing machine with a maximum load capacity of 20 Tonnes, calibrated to BS 1610: 1985 Grade 2. The test brick was placed in a small restraining rig made out of a rectangular hollow steel section designed to hold the brick firmly along its 'anchored' face. A side load of about 3.5 N/mm^2 pressure was applied on the bed faces to simulate condition of confinement of the brick in a real wall. Vertical restraint was provided by small wedge strips keeping the top surface of the brick tightly parallel against the upper part of the frame.

TEST RESULTS

Clay brick

For the clay brick used, trial tests indicated a water absorption after a 1/2 hour soak of 15.0%, which approximates the full saturation value after a 24 hour soak of 17.5% for the same brick. Its compressive strength was indicated to be 43.3 N/mm^2.

Brick/anchor specimens

The pull-out values obtained in the 20 standard and three extra tests carried out are tabulated below.

Tie Pull-out values in KN

Specimen No.	After 7 days cure	Number of wetting/drying cycles		
		10	20	40
1	10.45	7.56	10.45	9.10 (9.79)
2	12.23	10.23	10.23	11.00 (6.23)
3	10.68	8.45	10.23	10.00 (8.01)
4	10.45	10.68	10.90	12.90
5	10.90	10.68	8.45	9.79
Mean	10.94	9.52	10.10	10.56 (8.01)
c.o.v. %	7.00	15.00	9.00	14.00 (22.00)

Note:- The bracketed values are for the three extra tests involving anchors of the limited embedment length of 60 mm.

A one way analysis of variance of the tabulated values for the 20 standard tests has shown that the wetting/drying treatment given did not affect the pull-out performance of the tie in the background material tested in any significant way. Mean pull-out value for these specimens was 10.28 KN. Regression analysis of the data (for a linear as well as polynomial fits) further confirmed a lack of a significant correlation between the pull-out performance and the wetting/drying treatment given.

The failure of the system tested was typically by a pull-out of the steel tube from the anchor grout (Figure 1), sometimes accompanied by splitting of the brick in the plane of the anchor.

As to the three extra specimens, the mean pull-out value of 8.01 KN, when compared with the corresponding value given for the standard specimens, suggests that the apparent deterioration in performance was only due to the reduced length of embedment of the anchor. The failure here was typically by a rupture of the anchor grout at the interface between the embedded part to the bulging part, accompanied by a pull-out of the steel tube again (Figure 2).

CONCLUSIONS

1. The experiments show that the pull-out performance of the test anchor/clay brick combination tested would not be affected adversely in any significant way in the conditions of exposure to rain simulated in the manner described.

2. The failure of the standard specimens was typically by pull-out of the steel tube from the anchor grout.

3. The pull-out performance of the anchor/brick system tested appears to be directly proportional to the length of embedment of the anchored sock.

REFERENCE

1. Private communication, Mr Owen/Mr James, Messrs Cavity Lock Systems, Factory Road, Newport, Gwent.

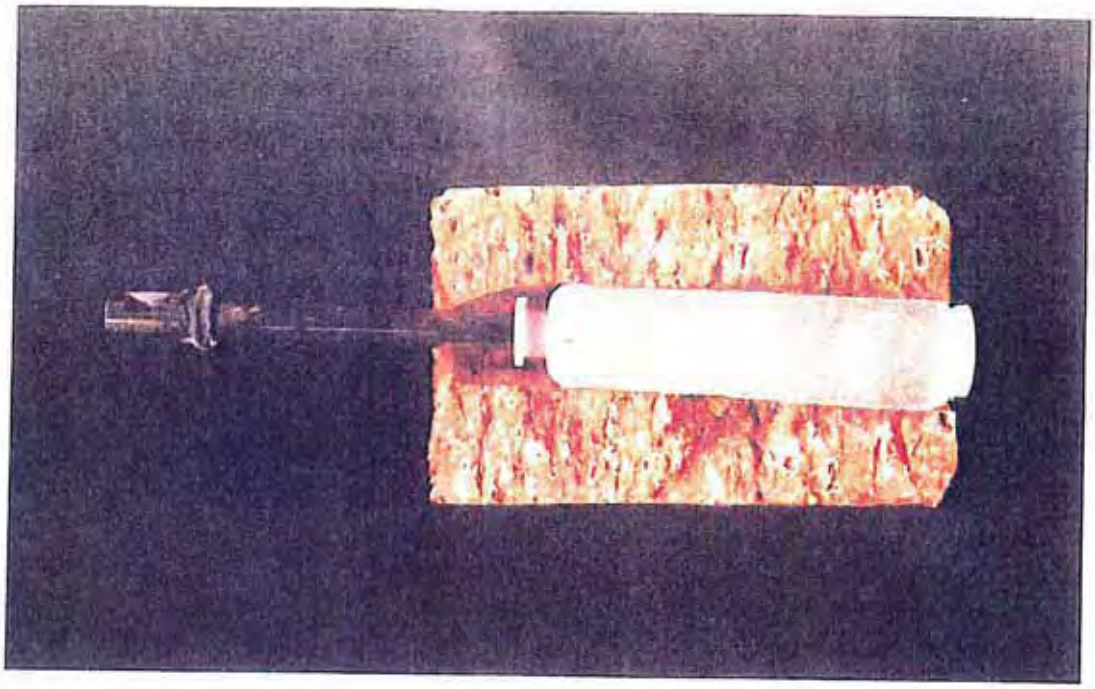

FIGURE 1 TYPICAL FAILURE MODE FOR THE STANDARD SPECIMEN

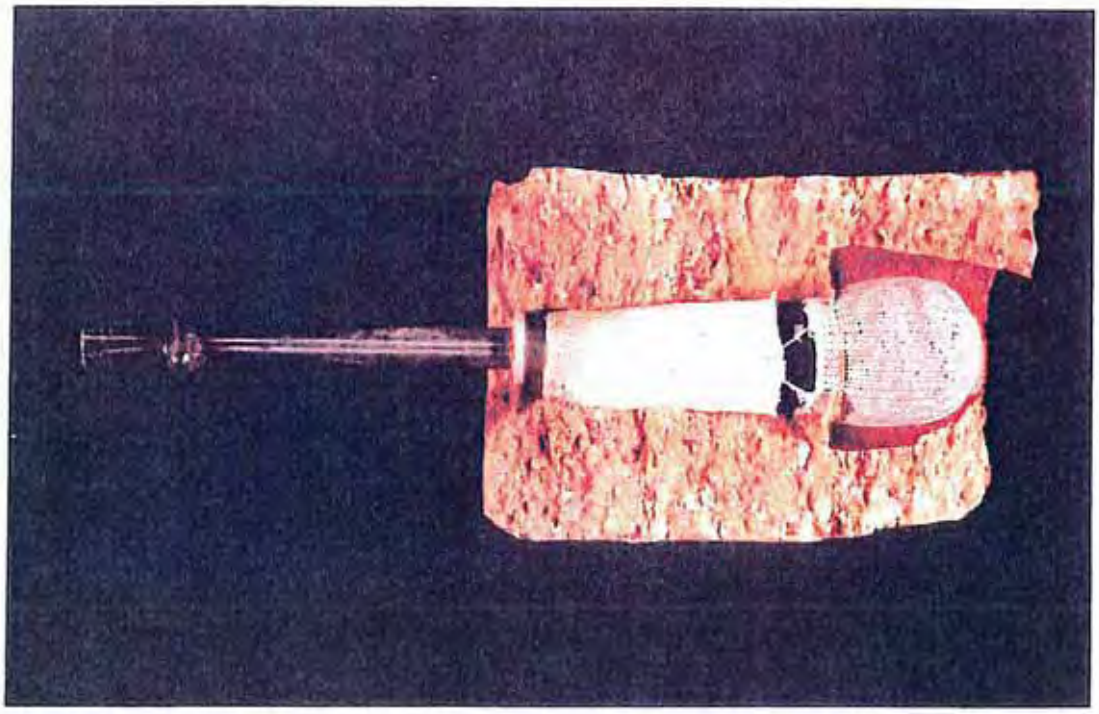

FIGURE 2 TYPICAL FAILURE MODE FOR THE EXTRA SPECIMEN

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Mr. J. Dymmock
Cavity Lock System
Factory Road
Newport
Gwent
NP9 5FA

your reference

our reference BRE/67/50/1

date 23/11/93

Sent by FAX to : 0633 246110

Dear John

Fire testing of Cintec's remedial cavity wall ties.

In the latest test in our fire test rig with a static dead load on each tie of 1.3kN your tie survived a two hour test without failure of any of the three replicate samples.

All three samples are now placed in the upper half of the wall and would have reached several hundred degrees in the part of the tie nearest the fire face.

This indicates that this tie system can, when installed using the correct techniques, be recommended for repair work to buildings having a fire period requirement of up to 2hrs.

Yours sincerely

R.C.de Vekey

Head of Masonry Structures Section, Structural Design Division, Geotachnics and Structures Group

BRE

Fire Test for Wall Ties

by Mr D Chehal & Dr R.C de Vekey
Technical Director, Centre for Masonry Construction, Construction Division

FULL TEST DATA IS AVAILABLE ON REQUEST

Unpublished paper from BMS meeting November 1993

A FIRE TEST FOR WALL TIES

D Chehal and Dr. R C deVekey

SUMMARY

A diverse range of connectors, termed wall ties, restraint ties or cavity connectors, are used in industry to link cladding masonry to either inner leaves of load bearing masonry or to frames of timber, concrete or steel. Their function is to support the cladding and transfer loads arising from wind, impacts, seismic events etc. to the main structure of the building. Many of these connectors have fixing mechanisms or structural components that are made from heat sensitive materials such as resins, plastics and low-melting alloys. Other products use mechanical devices that might be affected by thermal expansion of the components. However, until now, no widely publicised tests have been carried out on the performance of masonry cavity connectors exposed to fire conditions. Under the terms of the EC Construction Products Directive, CEN standards are being drafted for the specification of cavity connectors and resistance to fire is one of the essential requirements for which performance tests are required. Eventually fire performance data will be necessary in order to design in accordance with the forthcoming CEN Code of Practice. The successful application of performance evaluated products will reduce the risks to the public attempting to escape from burning buildings, and to the fire fighting services dealing with the fires. Therefore, BRE has initiated such tests to assess the behaviour of cavity connectors under the effects of fire. In the future it is hoped that the test methodology described in this paper can be extended to other products such as general fixings, support angles, and hangers and straps.

To be presented at the Autumn 1993 meeting of the British Masonry Society, at British Ceramic Research Ltd. Stoke on Trent, 9th - 10th November 1993

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Report on the Uni-directional Freeze-thaw Performance of Cintec Masonry Anchors

To EN772-Part 22 [Methods of Test for Masonry Units] - Part 22
[Determination of freeze-thaw resistance of Clay Masonry Units]

Prepaired for CINTEC NORTH AMERICA

September 2001