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Adhesion Between Repair Mortars and Concrete

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ABSTRACT

The repair of concrete may be carried out with repair mortars. On this repairs we could profit of the ameliorated properties of repair mortars that we could find in the furnishers of that kind of products. We have studied the adhesion of that repair mortars to the concrete. The repair mortar study is composed of acrylic resins, hydraulic liaints and polypropilene fibres.

First we have studied the need of adhesion coat. In spite of the technical report deliver with the product, says that adhesion coat is not necessary, our tests show that this coat is well necessary. We have made pull-off tests.

We have made also aging tests of specimens concrete/epoxy glue/repair mortar. The specimens haved passed the cycles of ice-thaw, thermic shock and cycles variations of temperature. After this tests we have made the pull-off tests. This tests show that adhesion and repair mortar is not affect by the aging simulate. The ruptures occur always on the concrete with less resistance than standards specimens.

For conclusion we can say that this kind of repair mortars needs an adhesion coat in epoxy in preference. The aging of that mortars is less important than that of concrete.

1.0 INTRODUCTION

The appearing of polymeric materials in the field of civil construction created the possibility of developing original adhesion procedures and had proporcionate interesting works [1].

The first works in concrete had been made with some care, but the increase of the population and the need of reconstruction after the second world war obliged the construction industrials to making more and more works in concrete, they accelerated the cadence of the construction in prejudice of quality [2].

So, in our days, the concrete constructions builded fourty or fifty years ago need repair works [3]. In the same way some more moderns justify, at once, repair works, in cause, in a great part, of the atmosferic polution action on the acceleration of aging process in concrete buildings and your degradation [4].

Repair mortars with cement-polymer mixtures have advantages in the reparations of damaging concrete elements. This products are used in external repairs, like reconstituition of carbonated concrete and the filling of concrete voids. In the places when we have degradation is better to use produts with great durability. The repair mortars due to the presence of resines and polymeric fibres are more resistants to tension and present less porosity what contribute to the increase of durability.

Between the questions we put about repair mortar we have your application (with or without adhesion coat) and your durability. This mean in what measure they can support aggressive actions like thermic shock, ice-thaw and cyclic variations of temperature.

2.0 TESTS
2.1 DESCRIPTION

In order to do our study we use the tests described in [5]. The selected tests were pull-off, ice-thaw, thermic shock and cyclic variations of temperature.

The pull-off test is used to determine in laborarory the resistance to tension of paint or covering coats with t_0 as thickness, applied in a concrete surface dry or wet, by comparison with a reference value (Fig 1).

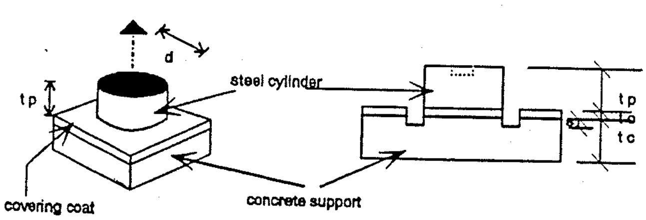

Fig. 1: Pull-off test

The ice-thaw test consists in immerse successively the specimens in salted water at -18 ± 2 °C. The specimens stay one hour in each bath (Fig. 2). The bath begines with immersion in water at normal temperature. All the cycles take 200 hours (100 cycles). The temperature of 20 ± 2 °C is measured in a region near the specimen. The specimens are placed in vertical position (Fig. 3).

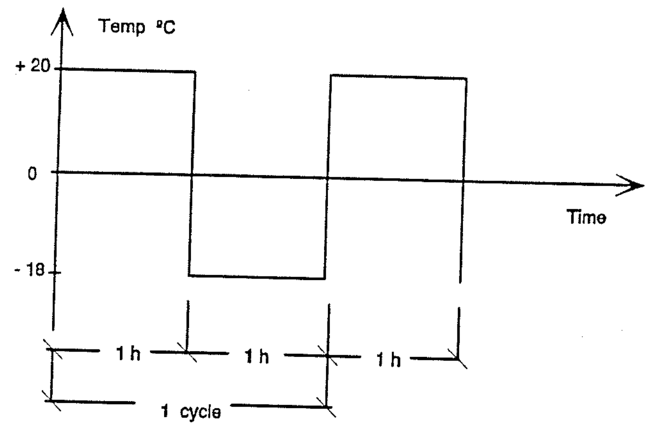

Fig. 2: Cycles of ice-thaw

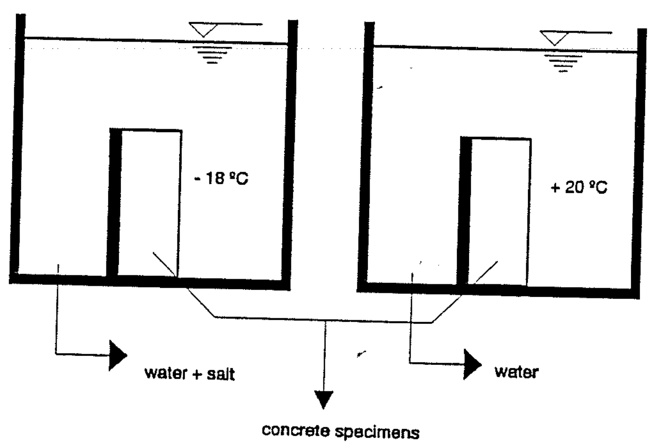

Fig. 3: Placement of the specimens in the ice-thaw test

The tests of thermic shock have a heating phase at 60 ± 2 °C during 6 hours, with relative humidity of 90 ± 2 % and a phase of artificial rain of 10 minutes (flow of 30 to 40 l/min) with water at 10 ± 2 °C of temperature. The thermic shock test has 50 cycles (Fig. 4). In the heating phase, the temperature of specimen surface should reach 60 ± 2 °C the more rapidly that is possibly, the warm air should be mechanically impelled.

During the artificial rain projection, the specimen will be placed in horizontal position on a metallic rail (Fig. 5). The projection tube of water will be placed 30 to 50 cm above the study surface.

The cyclic variations of environmental temperature tests are made with 100 cycles each with variation of temperature between -25 to +55 °C (Fig. 6).

After each test of thermic compatibility the adhesion is valued with pull-off tests in at least five regions of each specimen.

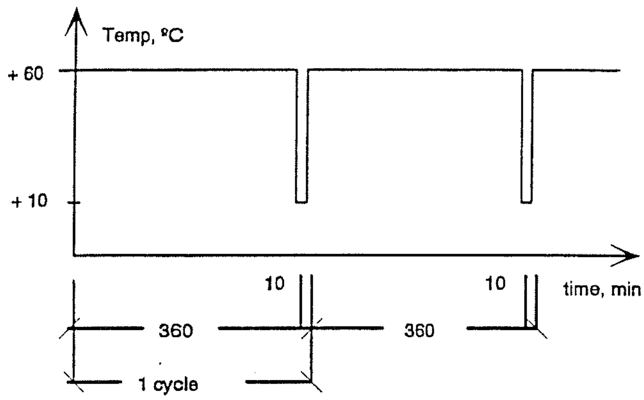

Fig. 4: Cycles of thermic shock

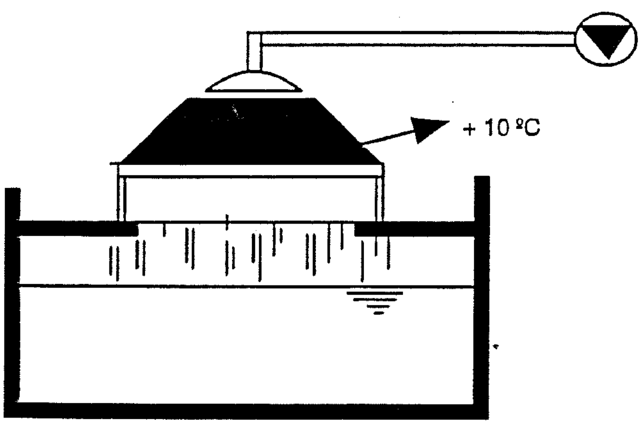

Fig. 5: Placement of the specimens in the test of thermic shock

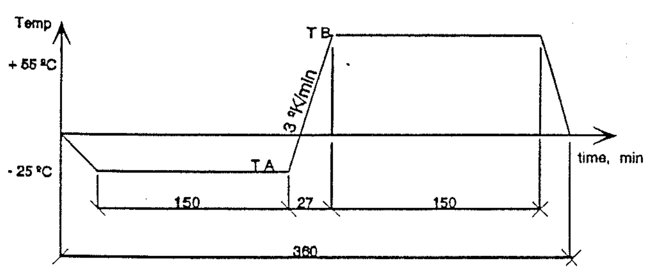

Fig. 6: Test of cyclics variations of temperature

2.2 SPECIMENS PREPARATION

To prepare the specimens we use concrete basis C20/25 with cement type I, 32,5. This basis were made with prismes with 20X20X10 cm^3. The faces when we have applied the mortar had 20X20 cm^2. Before the application of the adhesion coat or repair mortar we rub the concrete with a steel brush to eliminate the cement laitance and open the voids in contact with exterior. After that we take out the power with an air compressed jet. We put the form work to receive the mortar. The form work is metallic and appropriated for this work.

The adhesion coat is composed by an epoxy adhesive. The epoxy adhesive used is commercialized in Portugal. There are furnished two packages, one with the resin and the other with the hardening, the proportions of the mixture are 88 weight parts to 12 weight parts, respectively. The mixture is made with a spatula till we obtain an homogeneous colour. We disperse the adhesive in the specimens with the care necessary to obtain a good soaking.

After that we apply the repair mortar who is constituted by acrilic resins, hydraulic binders, polypropilene fibres and charges. This mortar is presented in two componentes wich had been mixed in the proportions recommended by the producer.

We apply the mortar in the specimens using a spatula. In the specimens without adhesion coat we well press the mortar against the concrete, to avoid the existence of voids. In the specimens with adhesion coat, we put simply the mortar. To finish we smooth the surfaces of the specimens. The thickness of mortar is 3 cm. The specimens obtained (Fig. 7) are maintained 28 days in a acclimatized chamber with 20 °C of temperature and relative humidity higher than 90 %.

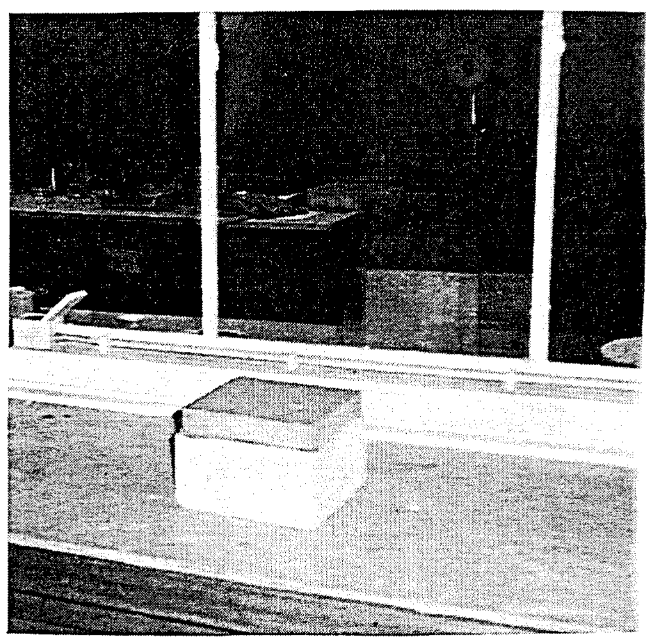

Fig. 7: Specimen with mortar

We have made 24 specimens, 12 with adhesion coat and 12 without adhesion coat. Six specimens (three of each) were aged in the acclimatized chamber, six with thermic shock, six with ice-thaw and six with cyclics variations of environmental temperature.

2.3 PULL-OFF TESTS

After the aged tests the specimens were prepared to the pull-off tests. For that we make a circular hole, with an appropriate machine (Fig. 8). The circular hole have 6 cm of depth. The diameter of the hole is 5 cm.

After that we glue with epoxy the metalic pieces (Fig. 9) wich are going to serve for the adaptation of pull-off machine (Fig. 10).

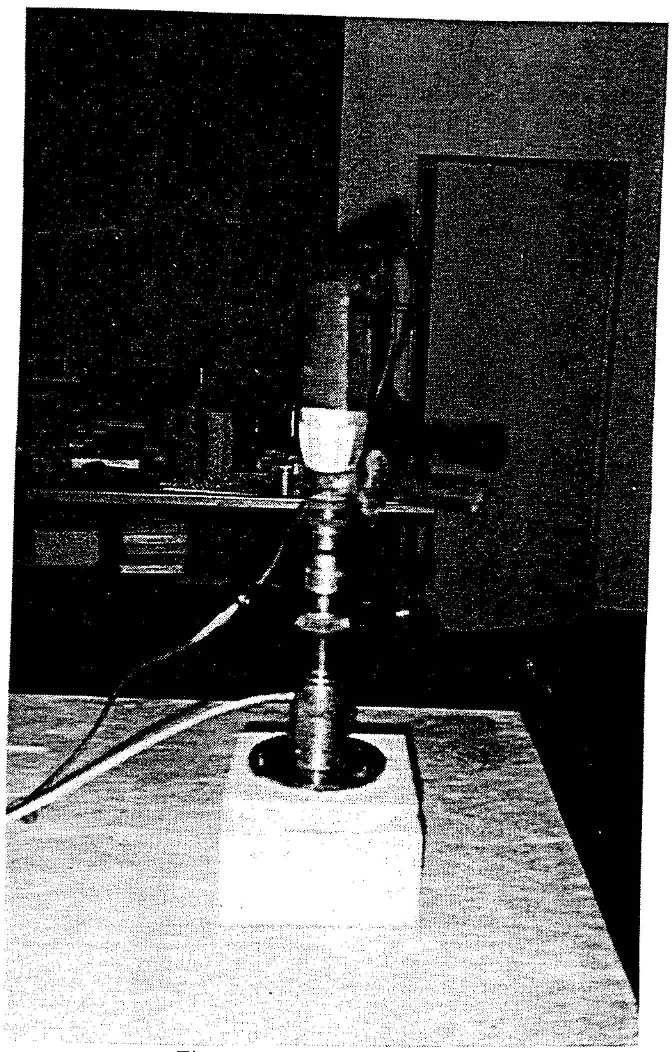

Fig. 8: Making a circular hole

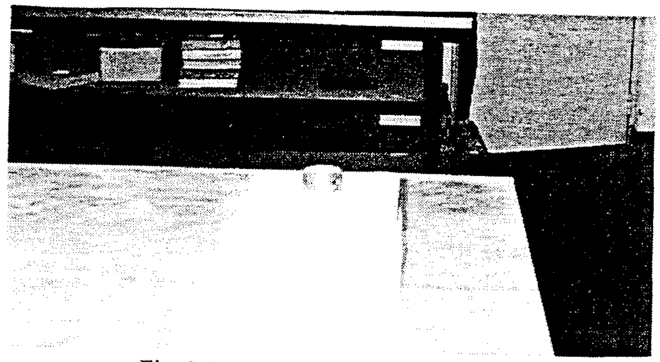

Fig. 9: Specimen with metalic piece

The pull-off tests were made with the application of strengths increasing gradually till the rupture. We register the rupture strength and the kind of rupture.

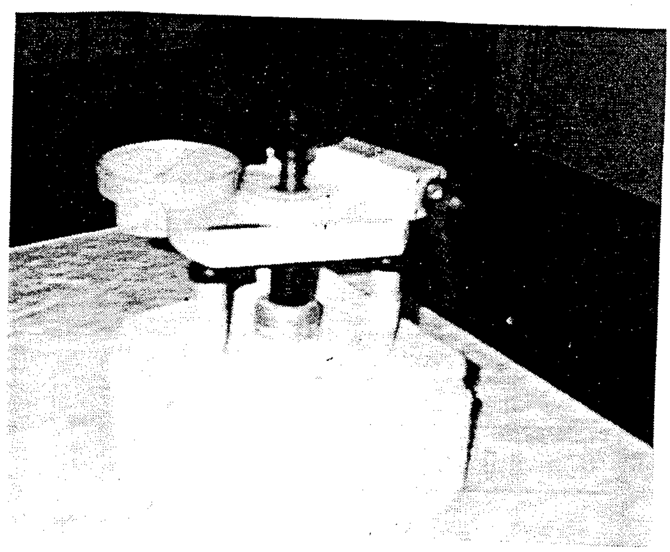

Fig. 10: Pull-off test

2.4 RESULTS

The tests of the specimens without adhesion coat had always the same result, adhesive ruptures with adhesion resistance pratically nulle, except for the pattern specimens. The average resistance of these was 0,4 MPa.

The specimens with adhesion coat presented always concrete ruptures with average resistance (three specimens) reported in Table 1.

Table 1: Pull-off resistance

Type of aging	Resistance (MPa)
normal	2,0
ice-thaw	1,1
thermic shock	2,3
temperature variations	1,2

3.0 CONCLUSION

The first conclusion is that in the specimens without adhesion coat the rupture is always mixte. In the specimens with adhesion coat the rupture is always in the concrete. On the other hand the adhesion resistance is higher in the specimens with adhesion coat. So, in spite of the producer does not suggest, the application of the repair mortar should be preceded with the application of an adhesion coat.

The rupture never appears in the adhesive or in the repair mortar. So we can say that repair mortar and adhesive are more resistants to pull-off tests than concrete.

About aging, we can say that repair mortar and adhesive were not affected. At least the rupture stay in the concrete. The ice-thaw and the cyclics variations of temperature affected the concrete because resistance decrease from 2 MPa to more or less 1,2 MPa. The thermic shock did not affect the concrete. The resistance is even higher after this test. In our opinion this is due to the way how is doing the aging, because in this case the rain fall directly over the repair mortar without affecting the concrete.

4.0 ACKNOWLEDGMENTS

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5.0 REFERENCES

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