

Datum
25 augustus 1999

Report concerning the pull-out test performed on uncoated and Zinga coated rebars for

b.v.b.a. ZINGAMETALL

Our File nr: LS/154/180899/Z.M.W

1. Problem:

At the request of Mr. G. WILLEMOT, Zingametall, Eke, Belgium, the Laboratory Soete for Strength of Materials, **Corrosion Department**, applied for a pull-out test on non coated and Zinga coated rebars.

2. Materials:

Three rebars with enhanced adherence $l = 1000 \text{ mm}$ $\phi = 18 \text{ mm}$

One rebar is embedded in concrete in the uncoated condition.

Two rebars were first coated with a Zinga coating of $25 \mu\text{m}$ over a length of 500 mm and subsequently, after 72 hours of drying time, embedded in concrete.

3. Procedure:

The pull out test was performed in accordance with the specifications of the RILEM/CEB/FIP Recommendation RC6-1978 “ Bond test reinforcing steel - 2. Pull-out test “

The rebars were embedded in the centre of concrete cubes with side equal to 10 times the diameter of the rebar. A plastic tube is slipped over the rebar in such a way that only 90 mm of the rebar is in contact with the concrete. The rebar protrudes for about 100 mm on the side where it is in contact with the concrete. The displacement transmitter is also mounted on this side. On the other side of the cube, the rebar protrudes for about 700 mm and the traction force is applied to this side of the rebar.

Together with the three rebar test specimens, five concrete cylinders were manufactured ($\phi = 150 \text{ mm}$ $h = 300 \text{ mm}$). These cylinders are needed for the evaluation of the concrete strength, which should approximate 30 N / mm^2 as close as possible.

The specimens were kept for three days in an air conditioned room at $20 \pm 2^\circ\text{C}$ and minimum 90% relative humidity. After removal of the shuttering, they were kept in an air conditioned room at $20 \pm 2^\circ\text{C}$ and $60 \pm 5 \%$ relative humidity.

After 28 days cure, the pull-out test was performed.

4. Results

4.1. Compression of the cylinders:

The results of the compression test are given in the following table:

Specimen	Compressive strength N / mm ²
1	30,81
2	30,5
3	31,03
4	30,13
5	30,02
Mean	30,5
Standard deviation	0,43

4.2. Pull-out test

The results of the pull-out test are given in figure 1. The measurement was stopped at the moment the maximum force was applied and the displacement increases with decreasing force, this in order to protect the transmitter.

The adhesion force is calculated by the means of the following formula:

$$\tau = \frac{F}{5 \pi d^2} \cdot \frac{30}{f_{cm}} \quad \frac{N}{mm^2}$$

Whereby:

- F: maximum force (N)
- d: diameter of the rebar (18 mm)
- f_{cm}: mean compressive strength of the cylinders (N/mm²)

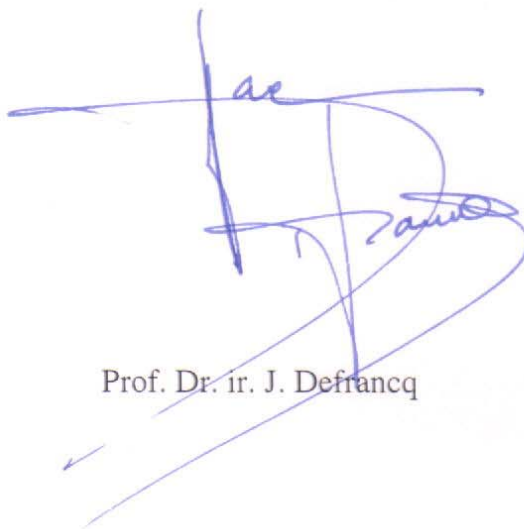
The mean values are summarised in the table below:

Specimen	F (N)	τ (N/mm ²)
Reference	97.800	18,90
Zinga Average	88.115	17,03

5. Conclusion:

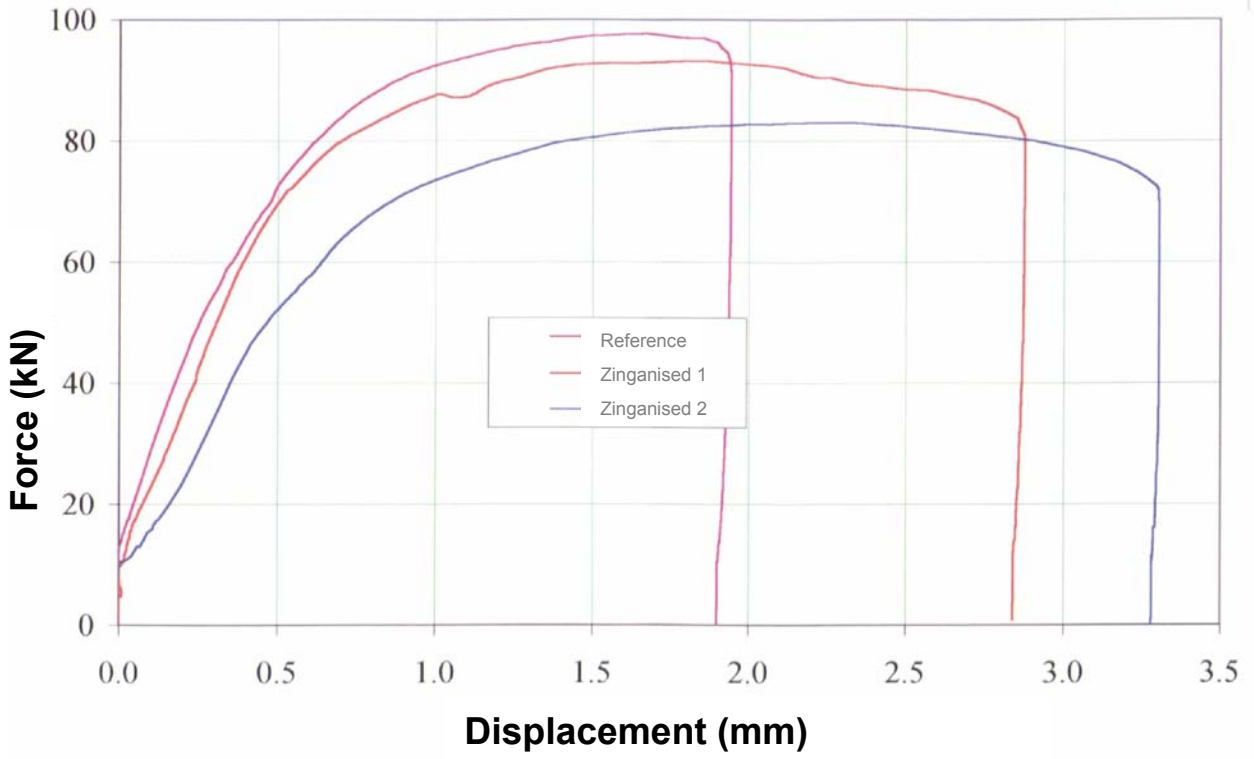
The results indicate that, within a reasonable variation on the results of the measurements, the adhesion to concrete of rebars coated with Zinga is not adversely affected compared to the adhesion of non coated rebars.

Ghent, August 25th 1999

A handwritten signature in blue ink, consisting of several overlapping loops and lines, positioned above the typed name.

Prof. Dr. ir. J. Defrancq

Pull-out test



Figur 1.