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Efectis Nederland-Report

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**Determination of the behaviour of a concrete slab
with loaded fischer anchors, type FNA II 6 x 30 M6
A4 or type FNA II 6 x 30 A4 (Aisi 316 rvs A4),
under RWS (Rijkswaterstaat) fire conditions**

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This report is issued by the TNO company Efectis Nederland BV (previously TNO Centre for Fire Research). TNO decided, in response to international developments and requests by customers, to collaborate with two European Egolf partners, both highly experienced in fire safety: the Norwegian Sintef/NBL and the French CTICM. Thus, through scaling up, a more comprehensive service of high quality and a wider range of facilities can be offered. In order to achieve this, the fire safety related activities of the partners involved have been privatised in this collaboration. With respect to TNO this has lead to the privatisation on the 1st of July of the activities of the TNO Centre for Fire Research via the establishment of the company Efectis Nederland BV.

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1 Introduction

In some cases tunnels of reinforced concrete have to be protected against fire. To ensure that the anchoring of the protection or service installations is able to withstand the high temperatures associated with fire while maintaining its function, fire tests must be conducted. The anchors mentioned in this test report have been tested under load.

2 Subject

Loaded fischer anchors type FNA II (Aisi 316 rvs A4) M6 or type FNA II (Aisi 316 rvs A4).

3 Investigation

Determination of the ability of fischer anchors type FNA II (Aisi 316 rvs A4) M6 or type FNA II (Aisi 316 rvs A4) to maintain their load bearing function for a period of 2 hours in accordance with the Rijkswaterstaat (RWS) time-temperature curve. The tested specimen consisted of a concrete slab with loaded fischer anchors type FNA II (Aisi 316 rvs A4) M6 or type FNA II (Aisi 316 rvs A4).

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5 Place and time of the research

The test was conducted at the laboratory of Efectis Centre for Fire Research in Rijswijk, the Netherlands.

The concrete slab was casted at the beginning of 2005.

The anchors were installed in week 33 of 2006.

The fire test was conducted on the 17th of August 2006.

6 Date and number of the report

November 2006; Efectis report 2006-CVB-R0561.

7 Materials

7.1 Reinforced concrete slab

7.1.1 Dimensions
1450 x 1450 x 150 mm.

7.1.2 Concrete grade
B35

7.2 Anchors

4 fischer anchors type FNA II (Aisi 316 rvs A4) M6 and 4 fischer anchors type FNA II (Aisi 316 rvs A4). The difference between type FNA II (Aisi 316 rvs A4) M6 and type FNA II (Aisi 316 rvs A4) is that the end of the anchor with type M6 is a treaded wire of 6 mm diameter, the type FNA II (Aisi 316 rvs A4) is an anchor with a circular head. Under the heads of both types of anchors stainless steel rings were placed with dimensions 30 x 6.5 x 1 mm. Both anchor types had anchor depths of 30 or 40 mm in the test in the table below the codes and dimensions of the anchors are mentioned:

Anchor	Number of anchors in the test	Anchor depth mm
6 x 30 , 30 mm	2	30
6 x 30 M6 , 30 mm	2	30
6 x 40 , 40 mm	2	40
6 x 40 M6, 40 mm	2	40

7.3 Test related additions

Under the heads of the anchors stainless steel U-profiles of 60 x 60 x 60 x 6 mm were placed in order to transfer the loading to the anchors

7.4 Load on anchors

Each anchor was loaded with a weight of 10 kg during the test.

8 Conditions

8.1 Before heating

The test specimen was placed in the laboratory of Efectis Centre for Fire Research with ambient conditions temperature $20 \pm 10^\circ\text{C}$ and relative humidity $50 \pm 10\%$

8.2 During heating

The test specimen was placed on the furnace for preliminary testing of Efectis Centre for Fire Research and the side with the anchors was heated for two hours in accordance with the Rijkswaterstaat fire curve.

9 Measurements

9.1 Fire test

9.1.1 Conditions

The test specimen was placed on the top of the furnace for preliminary testing of the Efectis Centre for Fire Research with the side with the anchors towards the furnace.

Each anchor was loaded with a weight of 10 kg.

The interior dimensions of the furnace are approximately. 120 x 120 cm.

The time-temperature curve is shown in figure 1.

9.1.2 Measurements

The following aspects were measured and recorded during heating:

- The gas temperatures within the furnace with 3 thermocouples(see figure B1);
- The time to failure of each of the anchors (visual).

10 Observations during heating and after cooling

10.1 During heating

After 90 minutes the weight fell of one anchor type FNA II (Aisi 316 rvs A4) 6 x 30 M6.
After 99 minutes the weight fell of one anchor type FNA II (Aisi 316 rvs A4) 6 x 40 M6.
The rest of the anchors supported their load throughout the test.

10.2 After heating and cooling

After heating and cooling it was visible that the two anchors who lost their load during the test were still embedded in the concrete. The loads fell down because the M6 threaded wire lost it's threads resulting in failure to support the load.

11 Results

After two hours of heating according to the RWS fire curve the fischer anchors type FNA II (Aisi 316 rvs A4) M6 or type FNA II (Aisi 316 rvs A4) anchors were still embedded in the concrete.

Of one anchor 6 x 30 M6, and one anchor 6 x 40 M6 the load fell of because the M6 threads were ripped of the anchors resulting in failure to support the load.

The results are only valid if the anchor depth is at least 30 mm.



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FIGURES

Figure 1 : Rijkswaterstaat time-temperature curve

Figure 2 : positions of the anchoring

Figure 3 : fischer anchors type FNA II (Aisi 316 rvs A4)

Figure 4 : fischer anchors type FNA II (Aisi 316 rvs A4) M6

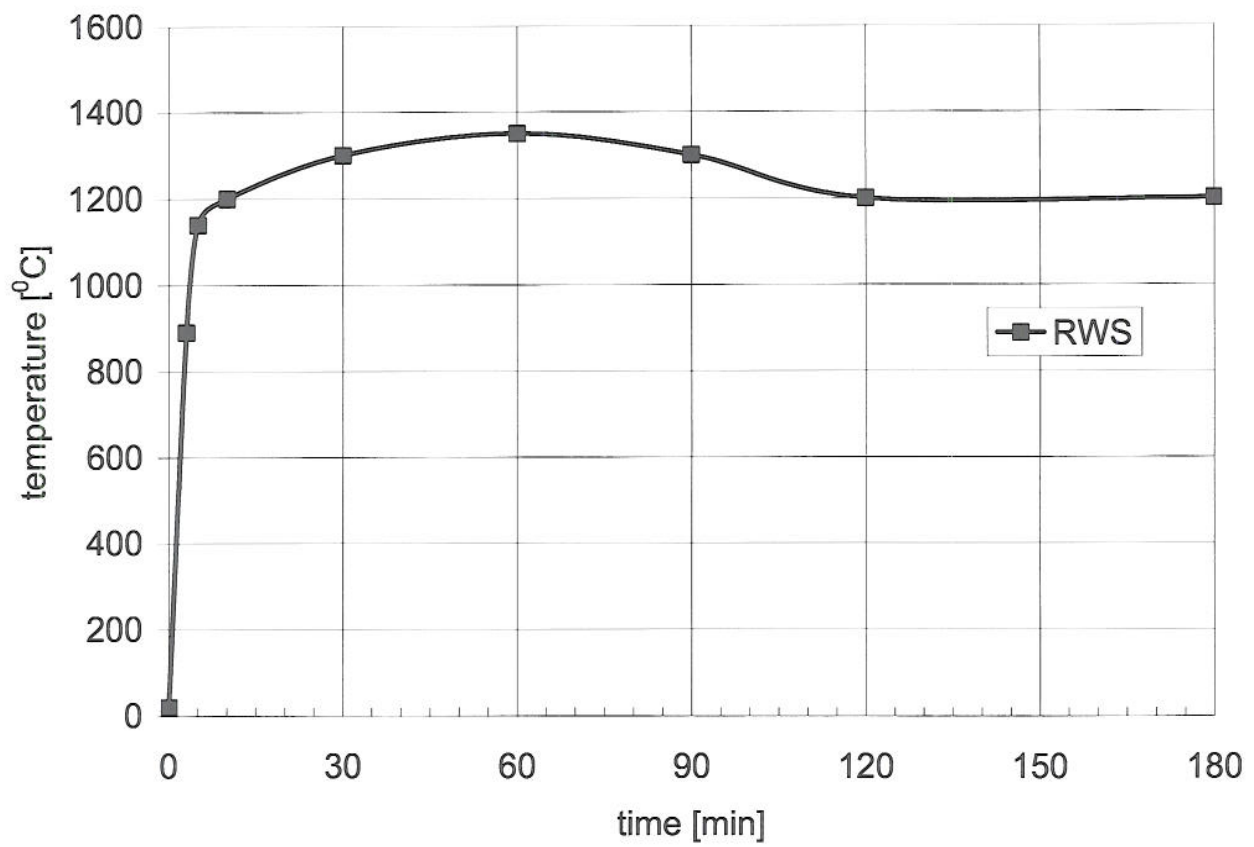
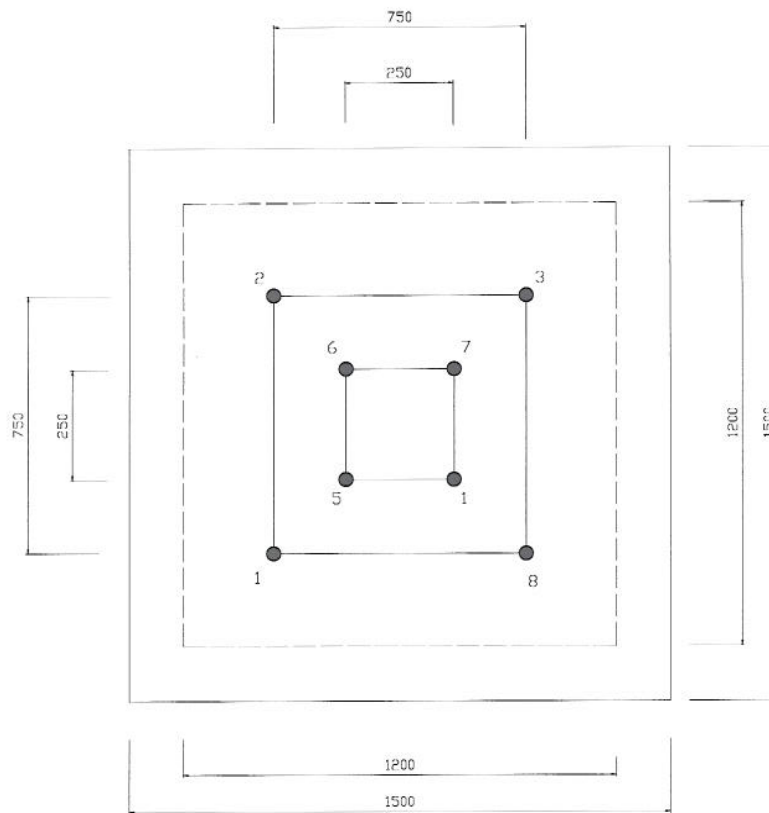


Figure 1 : Rijkswaterstaat time-temperature curve.



1. 6 x 40 depth 40 mm
2. 6 x 30 depth 30 mm
3. 6 x 40 M6 depth 40 mm
4. 6 x 30 M6 depth 30 mm
5. 6 x 40 M6 depth 40 mm
6. 6 x 30 M6 depth 30 mm
7. 6 x 40 depth 40 mm
8. 6 x 30 depth 30 mm

Figure 2 : positions of the anchoring

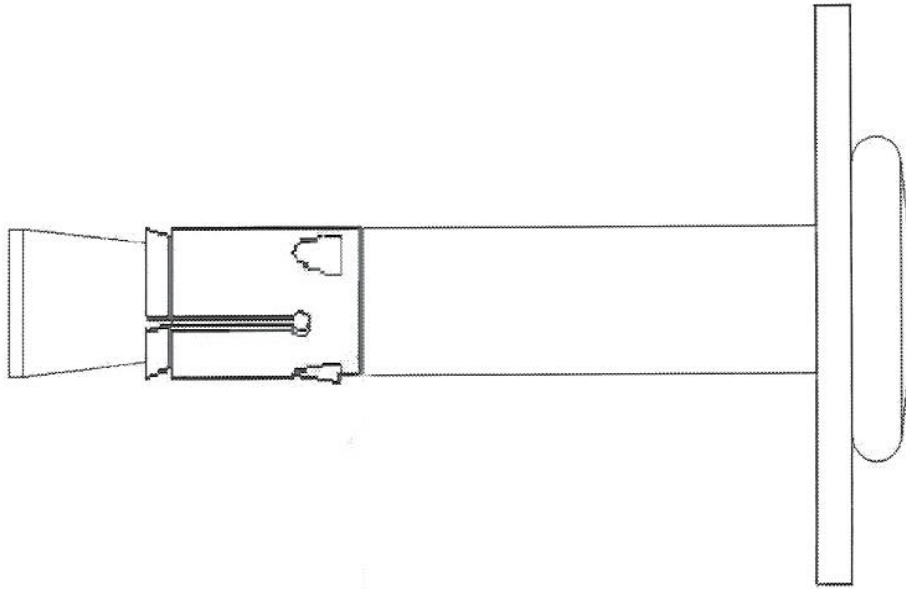


Figure 3 : fischer anchors type FNA II (Aisi 316 rvs A4)

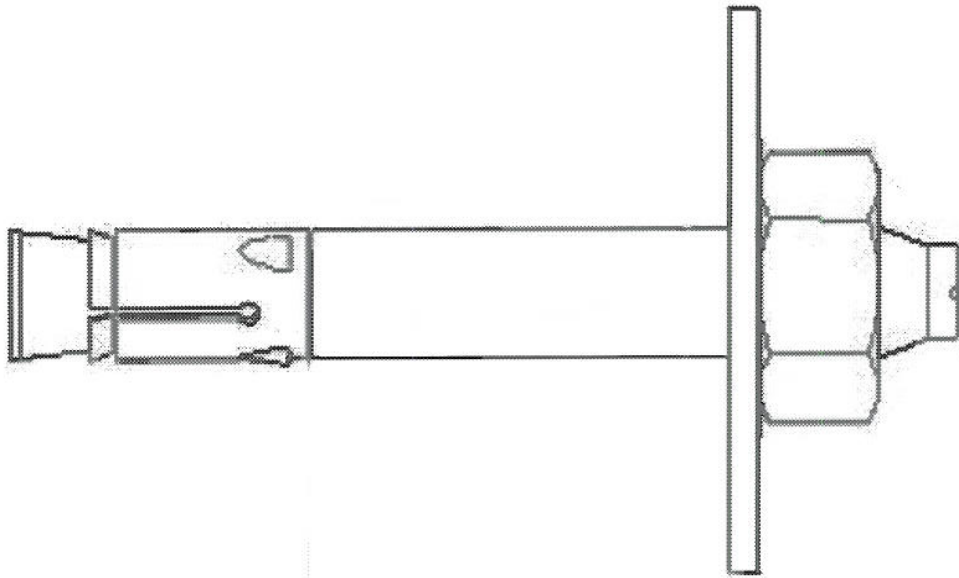


Figure 4 : fischer anchors type (FNA II (Aisi 316 rvs A4) M6

A Observations

During heating

After 90 minutes the weight fell of one anchor type FNA II (Aisi 316 rvs A4) 6 x 30 M6.

After 99 minutes the weight fell of one anchor type FNA II (Aisi 316 rvs A4) 6 x 40 M6.

The rest of the anchors supported their load throughout the test.

After heating and cooling

After heating and cooling it was visible that the two anchors which lost their load during the test were still embedded in the concrete. The loads fell down because the M6 threaded wire lost it's threads resulting in failure to support the load

B Measured gastemperatures

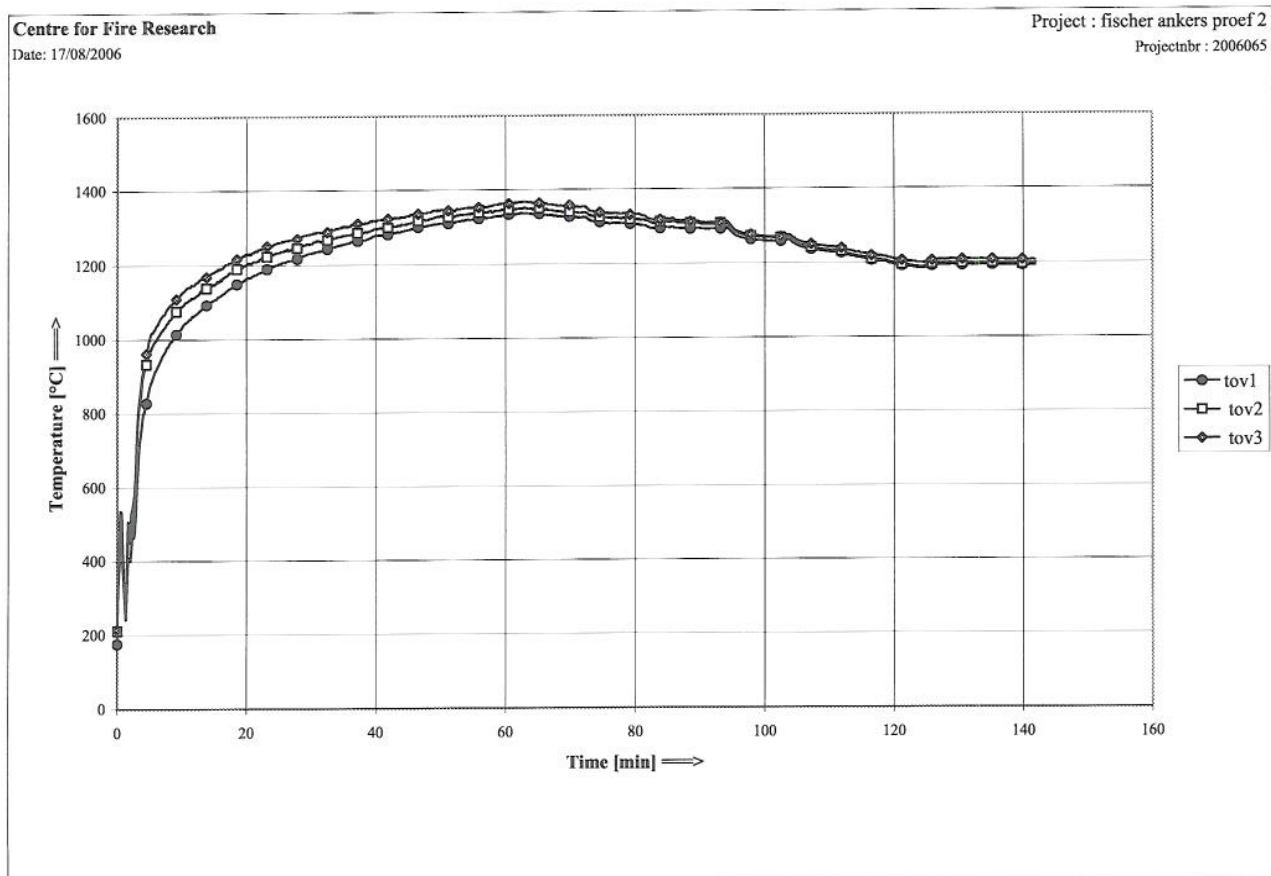


Figure B1 : measured gas temperatures in the furnace

C Photos



Photo 1 : view of the test specimen before the test



Photo 2 : detailed view of one of the anchors



Photo 3 : view of the test specimen after heating and cooling down