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Efectis Nederland-Report

2006-CVB-R0559

Determination of the behaviour of a concrete slab protected with Promatect-H boards, anchored with 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.

Contents

1 Introduction 3

2 Subject 3

3 Investigation 3

4 Sponsor 3

5 Place and time of the research 3

6 Date and number of the report 4

7 Materials 4
7.1 Reinforced concrete slab 4
7.1.1 Dimensions 4
7.1.2 Concrete grade 4
7.1.3 Instrumentation 4
7.2 Promatect-H boards 4
7.3 Fixation 4

8 Conditions 5
8.1 Before heating 5
8.2 During heating 5

9 Measurements 5
9.1 Density and moisture content 5
9.2 Fire test 5
9.2.1 Conditions 5
9.2.2 Measurements 5

10 Observations during heating and after cooling 6
10.1 During heating 6
10.2 After heating and cooling 6

11 Results 6

Appendices
A Observations
B Measured temperatures
C Photos

1 Introduction

In some cases tunnels of reinforced concrete have to be protected against fire. To ensure that the protection is able to withstand the high temperatures associated with fire and offer sufficient protection to prevent spalling of the concrete, fire tests must be conducted.

2 Subject

Board material, type Promatect-H , thickness 27.5 mm, attached to the concrete with fischer anchors type FNA II (Aisi 316 rvs A4) M6 or type FNA-II (Aisi 316 rvs A4).

3 Investigation

Determination of the temperature development at the interface of concrete and board material during heating for a period of 3 hours in accordance with the Rijkswaterstaat (RWS) time-temperature curve.
The tested specimen consisted of a concrete slab with Promatect-H cladding anchored to the slab with fischer anchors type FNA II (Aisi 316 rvs A4) M6 or type FNA-II (Aisi 316 rvs A4).

4 Sponsor

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5 Place and time of the research

The tests were 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 cladding was installed in week 33 of 2006.
The fire test was conducted on 15 August 2006.

6 Date and number of the report

November 2006; Efectis report 2006-CVB-R0559.

7 Materials

7.1 Reinforced concrete slab

7.1.1 Dimensions
1450 x 1450 x 150 mm.

7.1.2 Concrete grade
B35

7.1.3 Instrumentation
Eight thermocouples were installed on the interface of concrete and board at the locations indicated in Efectis report 2006-CVB-R0560.

7.2 Promatect-H boards

The Promatect-H boards with a thickness of 27.5 mm were attached to the bottom of the concrete slab (side with thermocouples, see figure 2 for the dimensions of the boards and the points of anchoring.

7.3 Fixation

The Promatect-H boards were fixed to the concrete slab in the positions indicated in figure 2 with fischer anchors type FNA II (Aisi 316 rvs A4) M6 or 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 while 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 an anchor depth of 30 mm in 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 ± 10°C and relative humidity 50 ± 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 boards was heated for three hours in accordance with the Rijkswaterstaat fire curve.

9 Measurements

9.1 Density and moisture content

On the date of the test, the density [1] and moisture content [2] of the Promatect-H boards were determined by weighing the boards before and after drying.

Promatect-H boards
Density : 869 kg/m^3
Moisture content : 3.0 %

9.2 Fire test

9.2.1 Conditions

The test specimen was placed on the top of the furnace for preliminary testing of the Efectis Centre for Fire Research with the board side down.
The interior dimensions of the furnace were approximately. 120 x 120 cm.
The time-temperature curve is shown in figure 1.

9.2.2 Measurements

The following aspects were measured and recorded during heating:
- The gas temperatures in the furnace with 3 thermocouples (see figure B1);
- The temperatures at the interface of concrete and cladding with 8 thermocouples (see Efectis report 2006-CVB-R0560).

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[1]) determined before drying
[2]) determined after drying for 24 hours at 105°C

10 Observations during heating and after cooling

10.1 During heating

The test specimen did not show any visible material problems during the heating test.

10.2 After heating and cooling

After heating and cooling the Promatect-H boards were still attached to the concrete by means of the fischer FNA II 6 x 30 M6 A4 or fischer FNA II 6 x 30 A4 (Aisi 316 rvs A4) anchors. When lifting the slab from the furnace part of the Promatect-H boards fell of, see photo 2.

11 Results

After three hours of heating according to the RWS fire curve the fischer FNA II 6 x 30 M6 A4 or fischer FNA II 6 x 30 A4 (Aisi 316 rvs A4) anchors were still in place and were still able to attach the Promatect-H boards to the slab.
At the request of the sponsor the thermal details of the interface temperatures are mentioned in a separate Efectis report number 2006-CVB-R0560.

P.W.M. Kortekaas

Dr. G. van den Berg, M.Sc.

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

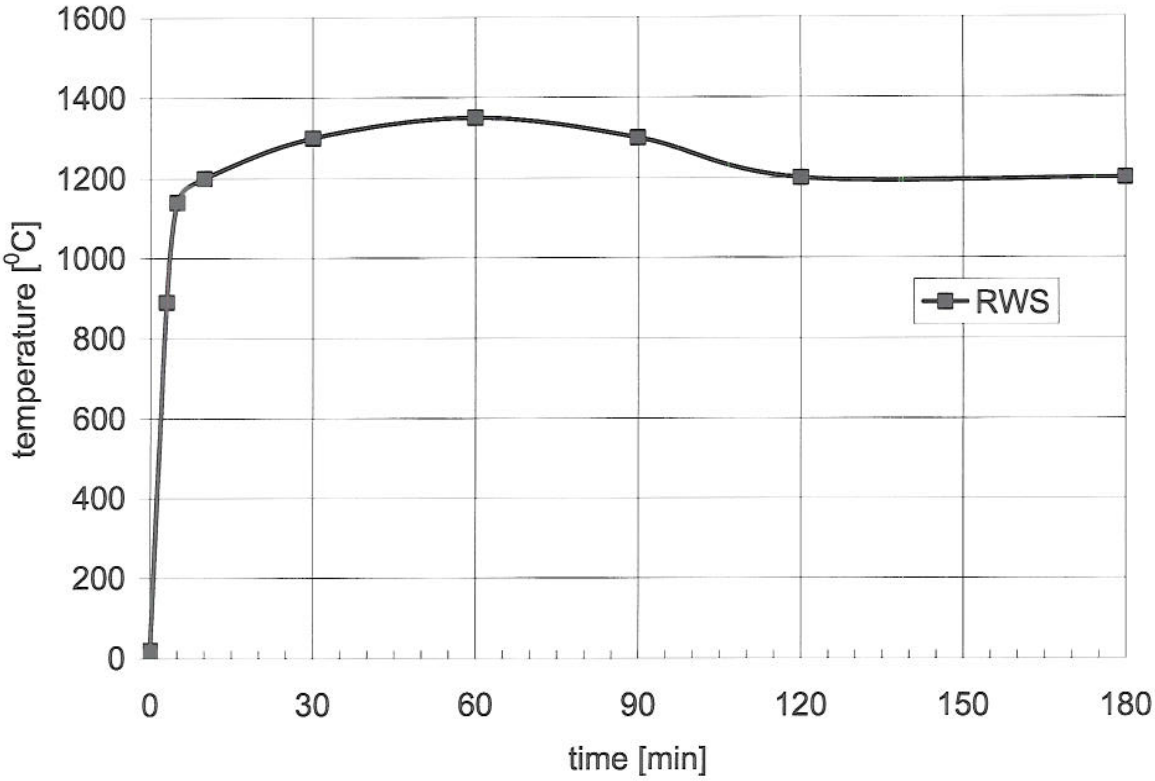
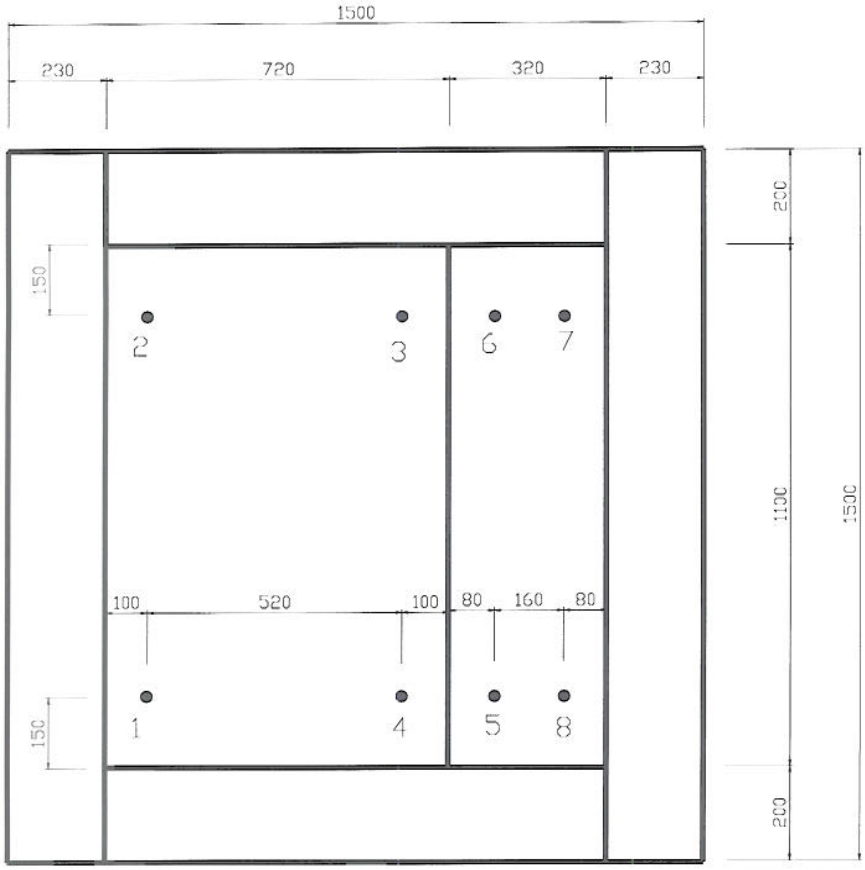


Figure 1 : Rijkswaterstaat time-temperature curve.



Anchors number 1,2,7 and 8 are type FNA II 6 x 30 M6 rvs A4
Anchors number 3,4,5 and 6 are type FNA II 6 x 30 rvs A4
anchor depth of 30 mm in the test

Figure 2 : positions of the anchoring

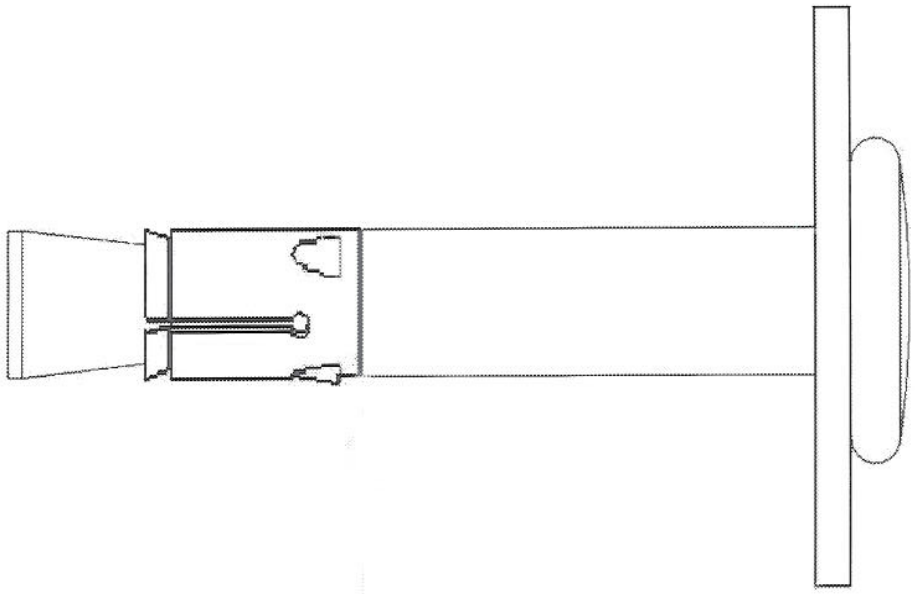


Figure 3 : fischer anchor type FNA II (Aisi 316 rvs A4)

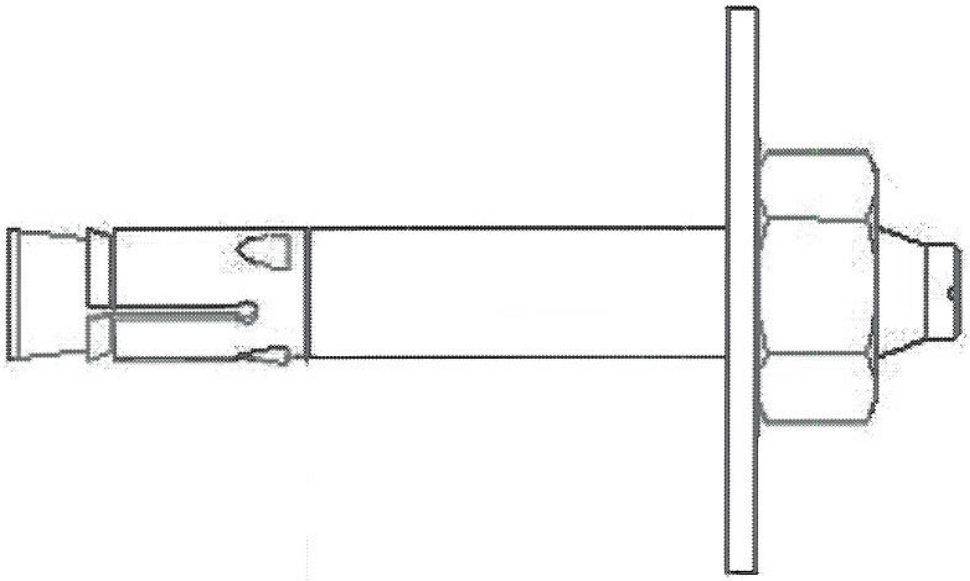


Figure 4 : fischer anchor FNA II (Aisi 316 rvs A4) M6

A Observations

During heating
The test specimen did not show any visible material problems during heating.

After heating and cooling
After heating and cooling the Promatect-H boards were still attached to the concrete by means of the fischer FNA II (Aisi 316 rvs) M6 or fischer FNA II (Aisi 316 rvs) anchors. When lifting the slab from the furnace part of the Promatect-H boards fell of.

B Measured gastemperatures

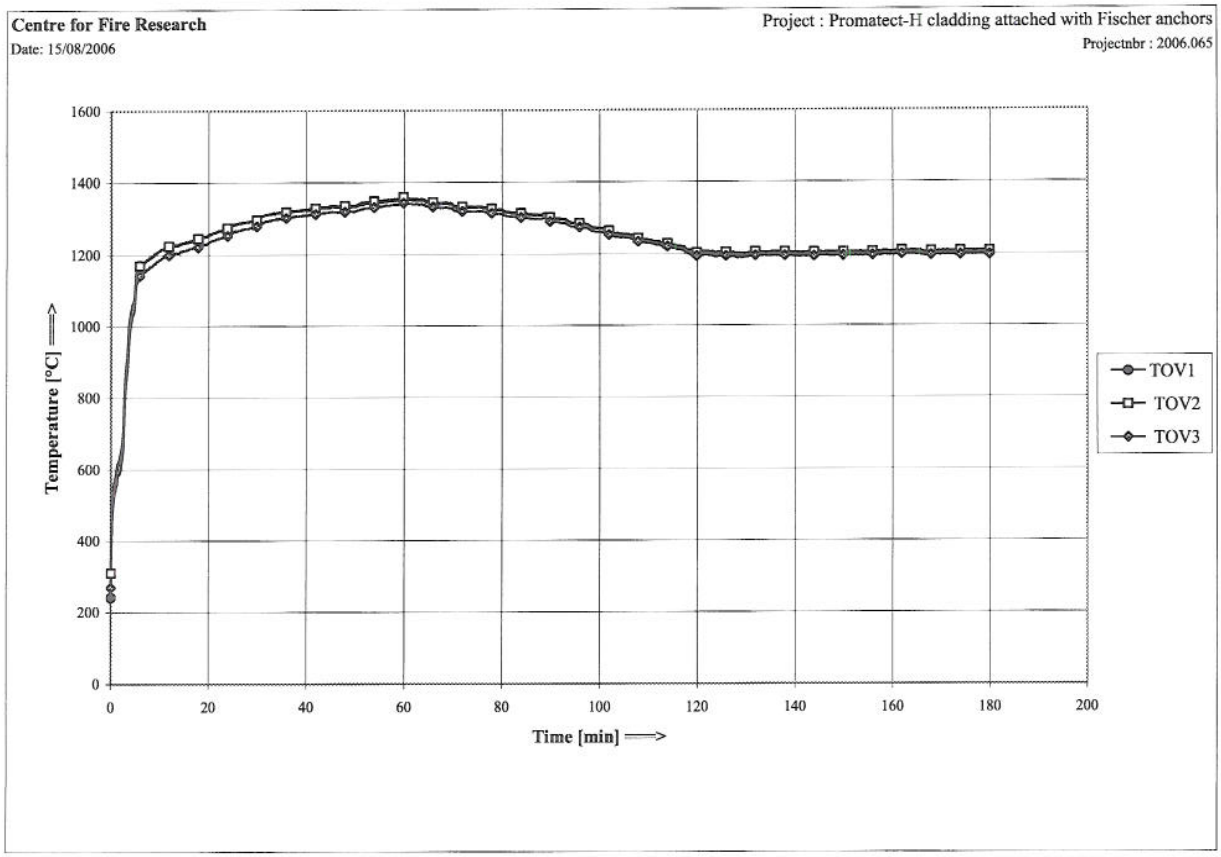


Figure B1 : measured gas temperatures in the furnace

C Photos

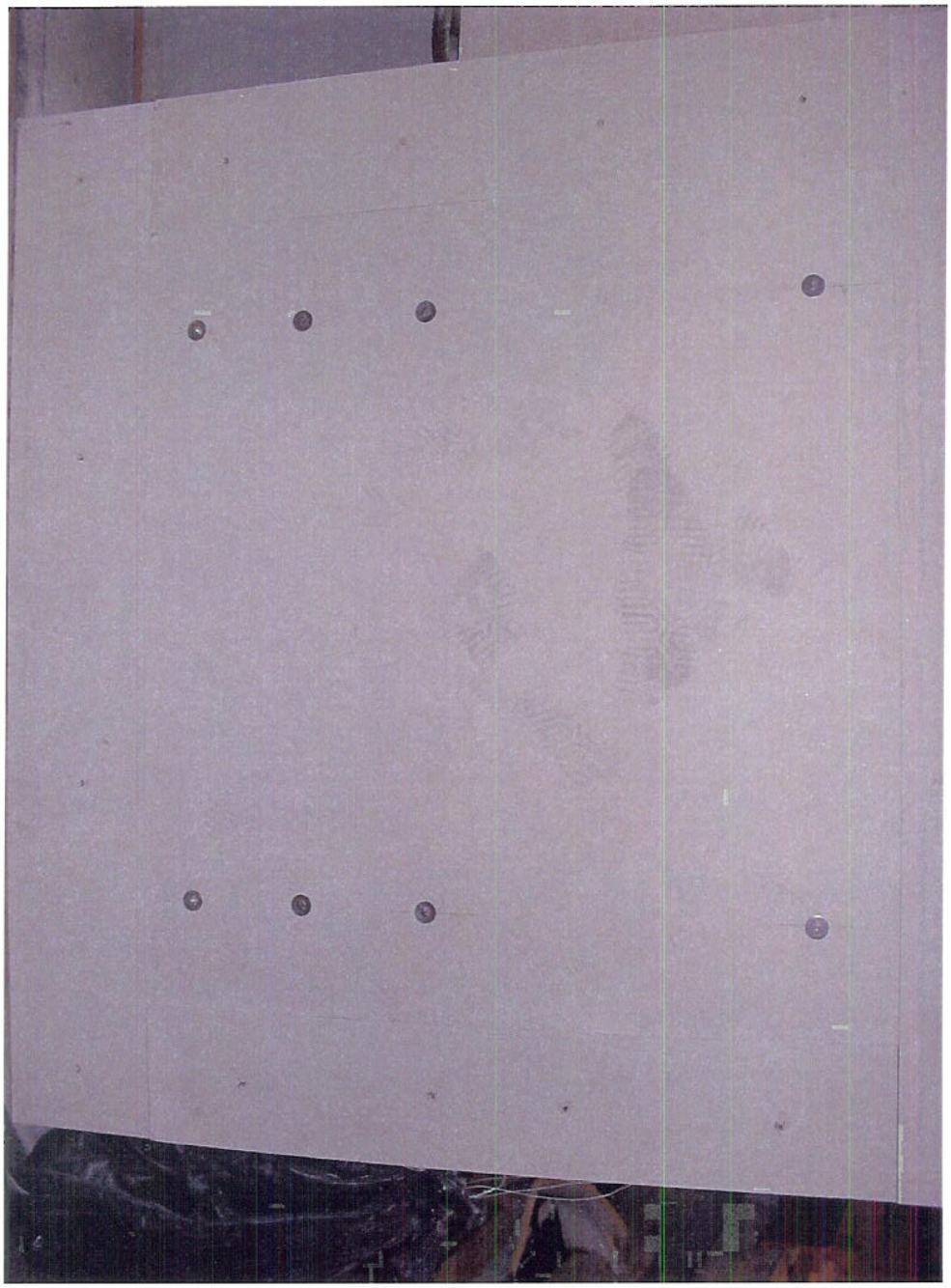


Photo 1 : view of the exposed side before the test