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Efectis Nederland report

2009-Efectis-R0103(E)

Determination of the resistance to fire according to EN 1365-2:1999 of a floor construction consisting of wooden beams with a Lewis® floor on top.
Anticipated fire resistance : 60 minutes

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Project name	Resistance to fire of a wooden floor ceiling construction
Project number	2008770

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A Furnace conditions

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1 Subject

A wooden floor construction which was protected on the underside by 1 layer of gypsum board and on the top side by a Lewis® floor with a 50 mm thick layer of Beamix concrete.

2 Investigation

Determination of the resistance to fire according to EN 1365-2:1999.

3 Sponsor

Reppel B.V.
P.o. Box 102
3300 AC DORDRECHT

4 Place and data regarding the investigation

The investigation took place at the laboratory of Efectis Nederland BV in Rijswijk, The Netherlands.

Mounting of the Lewis floor, the concrete cover and the gypsum boards by the sponsor	Monday the 16 th of June 2008
Fire test:	Monday the 14 th of July 2008

5 Date and number of the test report

March 2009, 2009-Efectis-R0103(E).

6 Investigated construction

6.1 General

Investigated was a wooden floor construction.
For details we refer to figure 1 and the description mentioned below.

6.1.1 *Wooden beams*

- Material : Pinewood
- Cross section : 100 x 200 mm
- Centre-to-centre distance : 500 mm
- Span : 4150 mm

6.1.2 *Ceiling channel on the underside of the floor*

- Type : BPB resilient ceiling channel
- Centre-to-centre distance : 500 mm
- Fixing : grabber screws 25 mm, 2 per beam

6.1.3 *Gypsum boards*

- Type : BPB Gyproc RF 12.5 mm
- Thickness : 12.5 mm
- Number of layers : 1
- Fixing : grabber screws 35 mm, c.t.c. distance 300 mm
- Joints : covered with paper tape and covered with BPB Promix Premium joint mortar

6.1.4 *Lewis® floor*

- Type : Lewis plates
- Overlap between plates : min. 100 mm
- Fixing : the Lewis plates are joint together by self tapping screws Ø 4.2 x 16 mm. The floor is not connected to the wooden beams
- Support : between the Lewis plates and the top of the wooden beams Rockwool of 25 mm thick and 100 mm wide

6.1.5 *Concrete floor*

- Type : Beamix
- Thickness : 50 mm (34 mm over the top of the Lewis plates)

6.2 Method of assembly

- Mounting of aerated concrete frame
- Mounting of the beams
- Mounting of the Rockwool strips on top of the beams
- Mounting of the Lewis plates
- Casting of the concrete floor
- Mounting of the ceiling channels
- Mounting of the gypsum boards

7 Manufacturing of the test specimen

Reppel BV	Lewis floor Concrete floor Gypsum boards
Efectis Nederland BV	Test frame Wooden beams

8 Course of investigation

8.1 Verification of the specimen

During mounting the used materials and parts were verified against the supplied data. Efectis was not involved in the selection of the materials.

8.2 Conditioning

From the moment of installation until the fire test the construction was stored in the laboratory of Efectis Nederland BV with the following conditions:

- Ambient temperature: $20 \pm 5^{\circ}\text{C}$.
- Relative humidity: $50 \pm 10\%$.

8.3 Density and humidity measurements

The density¹ and the moisture equilibrium² of the materials were determined.

Table 1: material properties

Material	Density [kg/m ³]	Moisture content [%]
Wooden beams	392	7.0
Gypsum boards	869	0.6
Concrete floor	2128	1.8

8.4 Fire test

8.4.1 Test conditions

The test was performed under the conditions as specified in EN 1365-2:1999.

The test specimen was heated on one side using the standard fire curve.
The pressure in the furnace that was aimed for was 20 Pa at 100 mm below the floor construction.

8.4.2 Load on the floor

A load of 2 kN/m² was applied on the floor

8.4.3 Measurements

During the heating the following data were measured and registered:

Furnace conditions:

- gas temperatures inside the furnace with plate thermometers, regularly spread over the directly heated surface.
- Pressure in the furnace at measured at 100 mm below the floor construction

Test specimen

- The surface temperatures of the floor construction;
- The deformations of the floor construction

Ambient

- ambient temperature in the laboratory.

The thermocouple positions are given in figure B1.

With a cotton wool pad and calipers the integrity criterion was checked.

¹ Determined before drying

² Determined after drying for 24 hours at 60°C for the gypsum board and 24 hours at 105°C for the wooden beam and the concrete floor

9 Observations

9.1 Observations during heating

See the table below for detailed observations during heating.

Time [min.]	Observations
0	Start of heating
20	Till the 20 th minute of heating the pressure measurement was on the wrong measuring channel. During this time the pressure was monitored at a secondary no registering pressure meter. The pressure was within the limits. After 20 minutes the problem was solved
35	One edge of a gypsum board comes loose
39	Gypsum board deforms and is resting on the plate thermocouples
40	A corner of a gypsum board comes loose
45	The beams near the support color black
49	2 beams can be viewed from below
52	1 gypsum board collapses
54	2 nd gypsum board in the middle collapses
56	More gypsum board are collapsing
77	Temperature rise at TK1=181°C
79	End of heating

The photos in annex C show the construction before, during and after heating.

9.2 Graphs of the results

The measurement results are presented in the form of graphs in annex B and C.

During heating the temperature and the air speed in the laboratory fulfilled the criteria of EN 1363-1:1999.

9.3 Uncertainty of measurement

Because of the nature of fire resistance testing and the consequent difficulty in quantifying the uncertainty of measurement of fire resistance, it is not possible to provide a stated degree of accuracy of the result.

10 Summary

The fire resistance to fire of a wooden floor construction which was protected on the underside by one layer gypsum board and on the topside by a Lewis® floor with a 50 mm thick cover of Beamix concrete has been determined according to EN 1365-2:1999.

Table 2: summary of results

Criterion	Time in minutes from the start of the test till the time a criterion according to EN 1365-2:1999 was reached	
	EN 1365-2:1999	Criterion
a) Load bearing capacity	79	Not exceeded
b) Integrity (E)		
– Cotton wool pad	79	Not exceeded
– Gap gauges	79	Not exceeded
– Sustained flaming	79	Not exceeded
c) Thermal insulation (I)		
– Average temperature rise	79	Not exceeded
– Maximum temperature rise	77	exceeded

The heating was terminated after 79 minutes at the request of the sponsor.

The classification according to EN 13501-2 shall be given in a separate document.

11 Field of direct application

This report details the method of construction, the test conditions and the results obtained when the specific element of construction described herein was tested following the procedure outlined in EN 1363-1, and where appropriate EN 1363-2. Any significant deviation with respect to size, constructional details, loads, stresses, edge or end conditions other than those allowed under the field of direct application in the relevant test method is not covered by this report.

The summary of chapter 10 is only valid for floor constructions with their hardware and materials that are in detail equal to the construction described in this report and that also fulfill the following requirements:

- a) With a height of the plenum of at least 200 mm;
- b) With a centre-to-centre distance of the beams of maximum 500 mm;
- c) With maximum bending moments and shear forced no larger than tested;
- d) With dimensions of the gypsum equal or smaller than tested.

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12 Figures

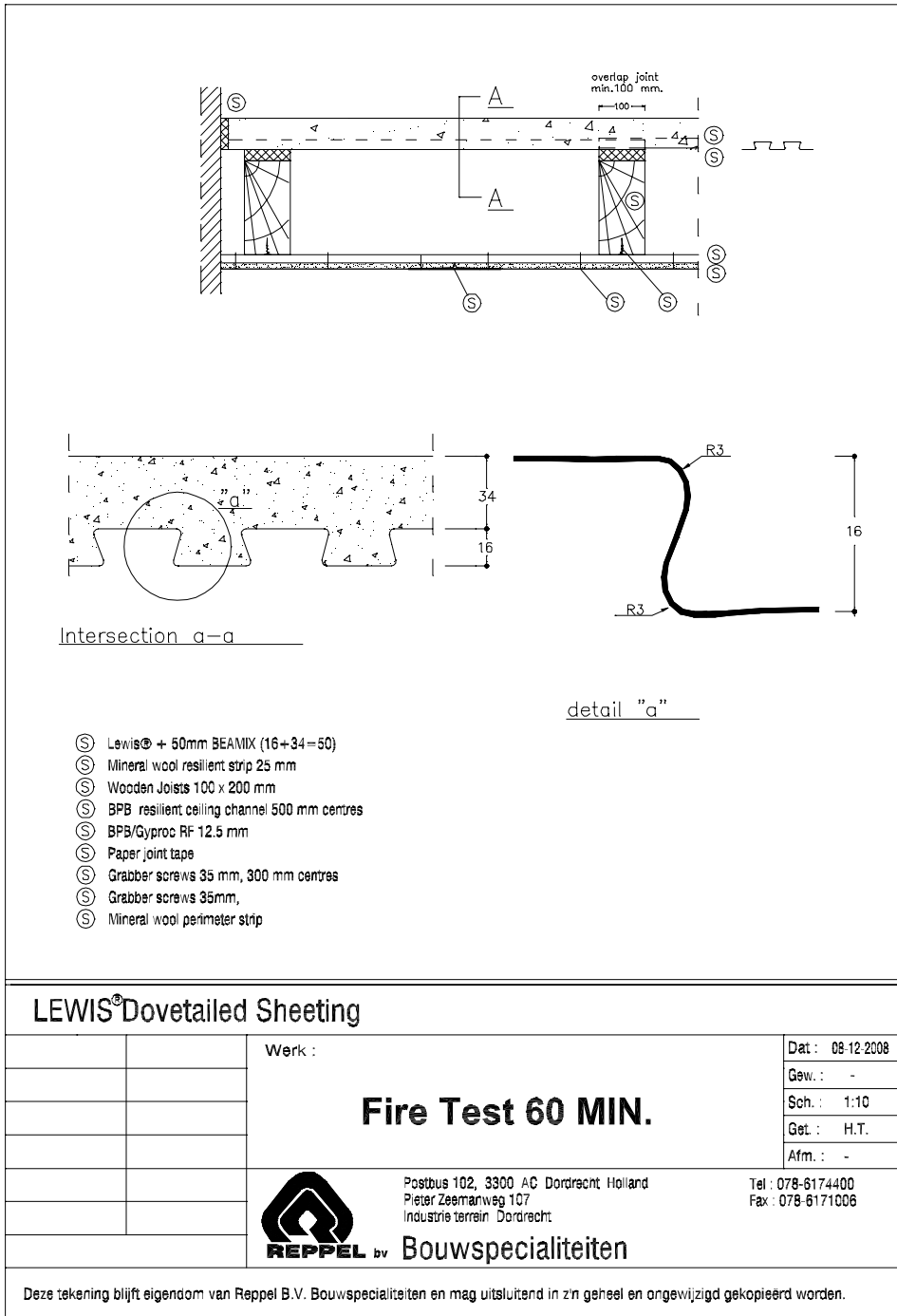


Figure 1: overview of the test specimen

A Furnace conditions

Figure A1 : measured gas temperatures in the furnace

Figure A2 : relative deviation of the furnace temperatures

Figure A3 : ambient temperature in the laboratory during the test

Figure A4 : measured pressure in the furnace

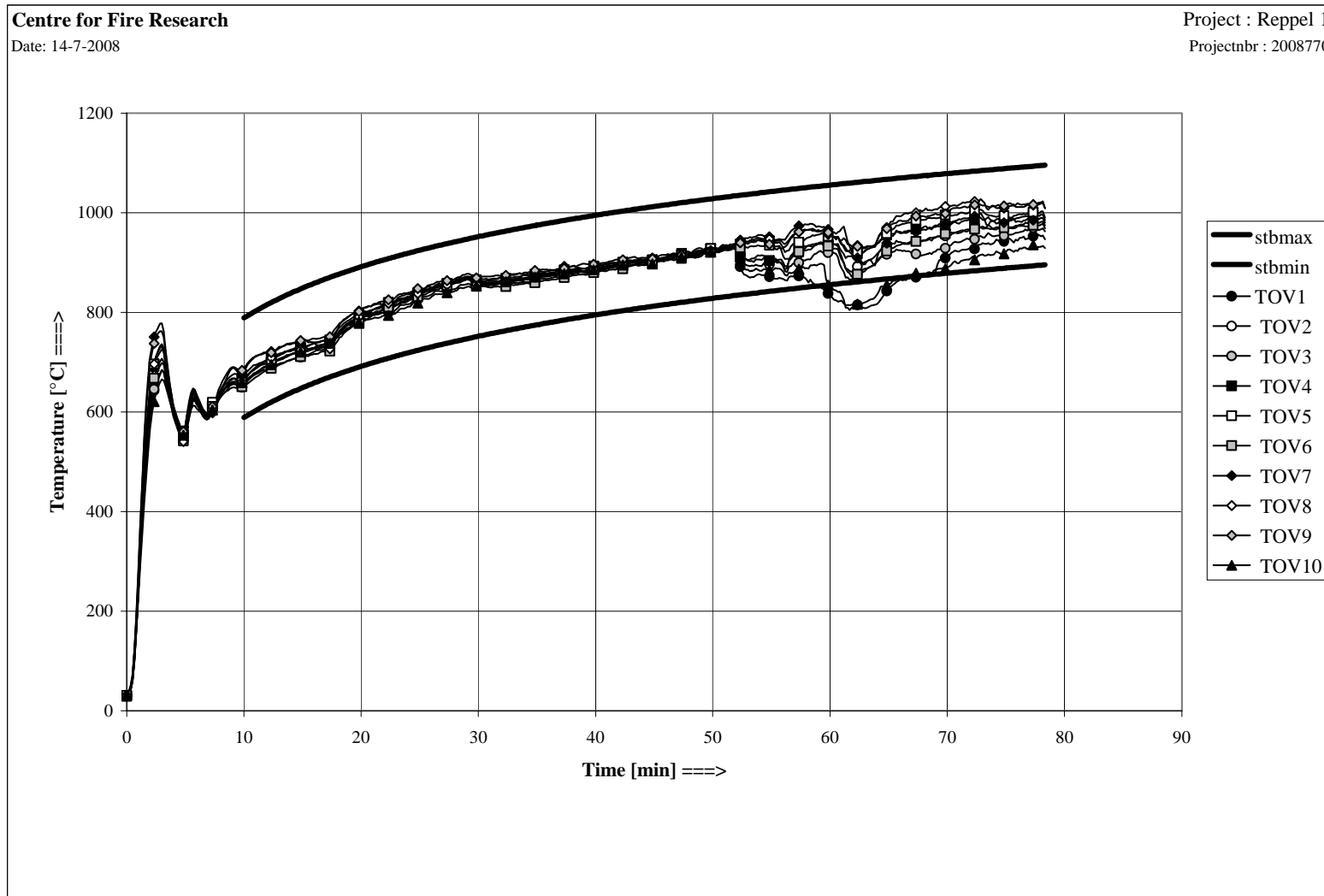


Figure A1 : measured gas temperatures in the furnace

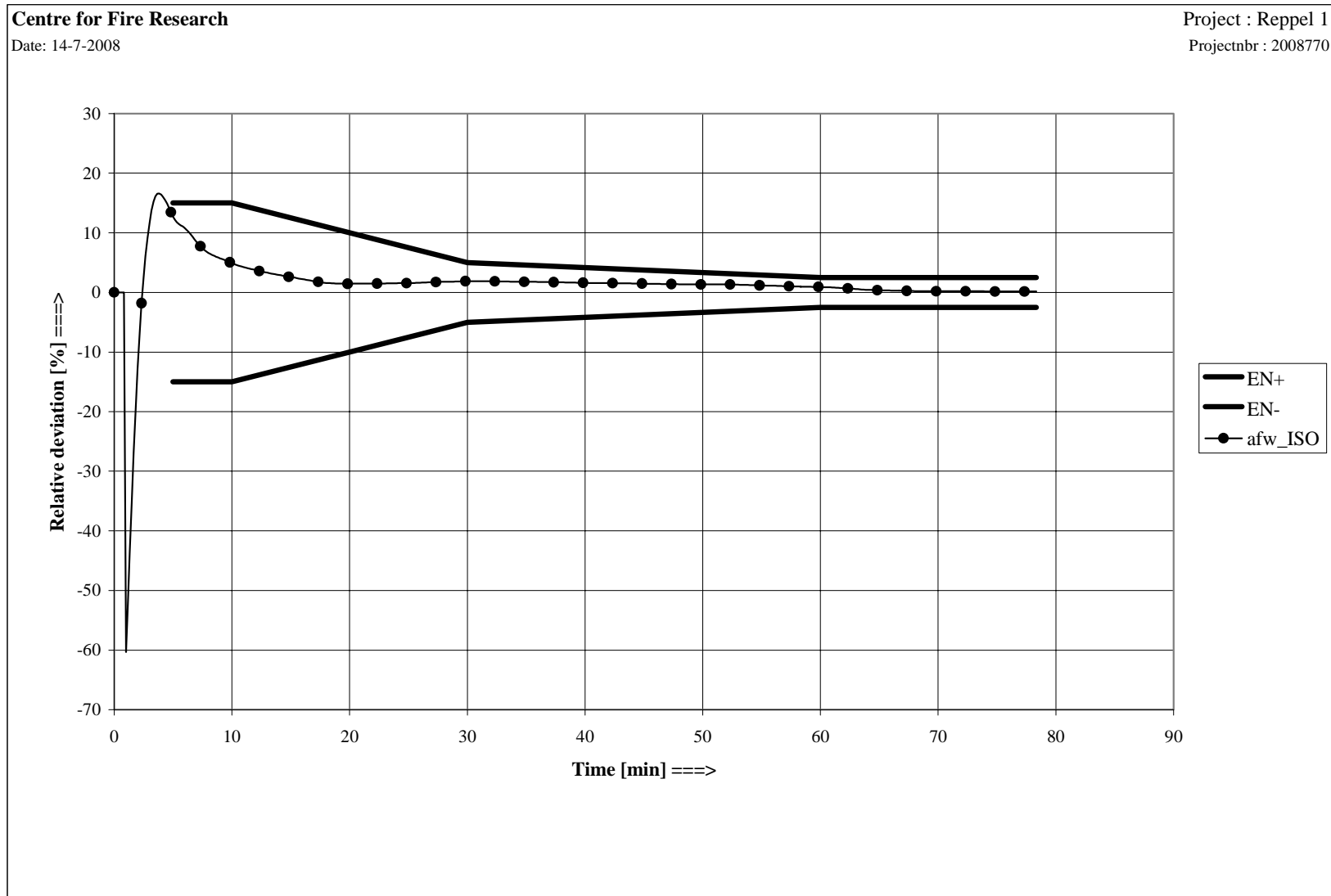


Figure A2 : relative deviation of the furnace temperatures

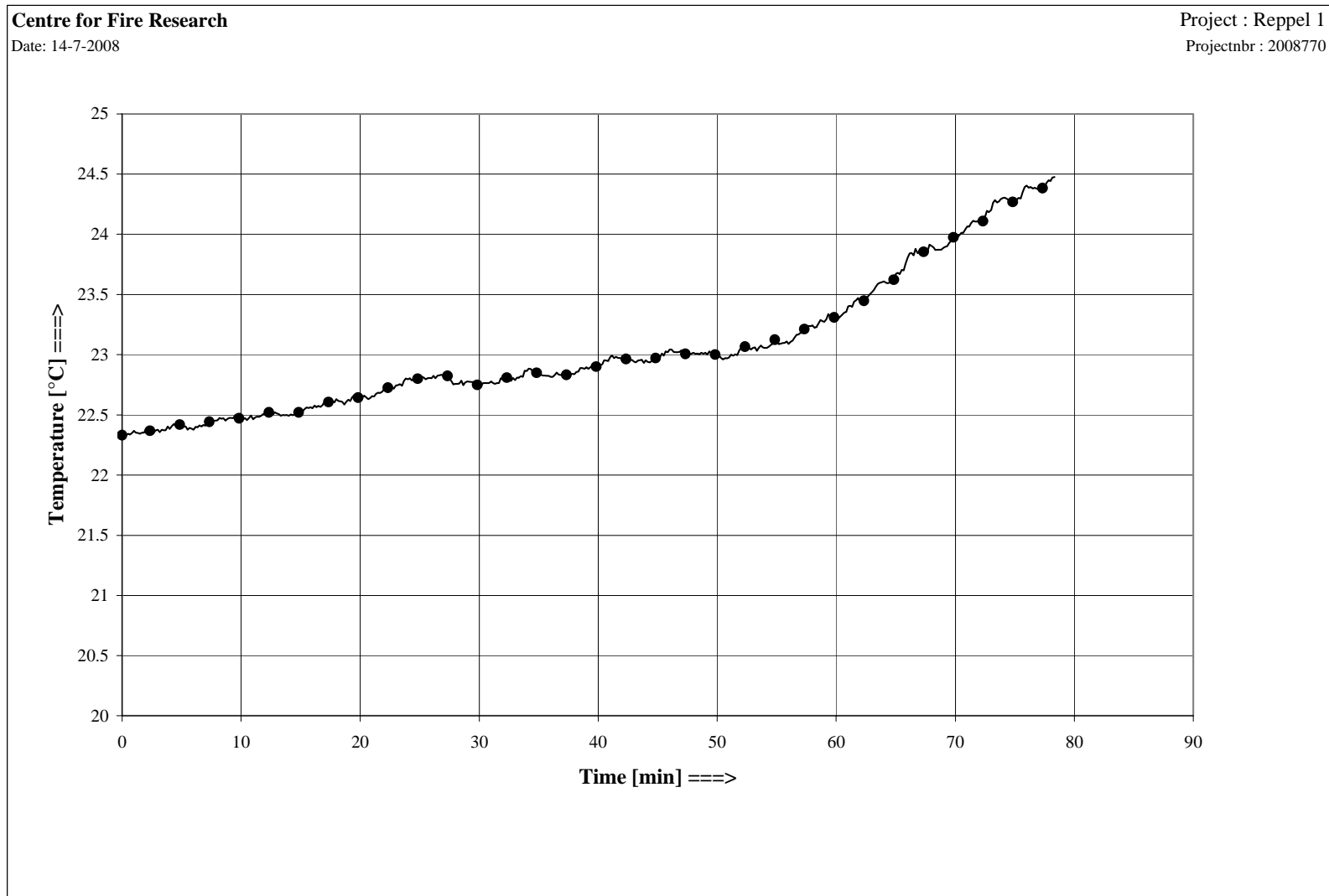


Figure A3 : ambient temperature in the laboratory during the test

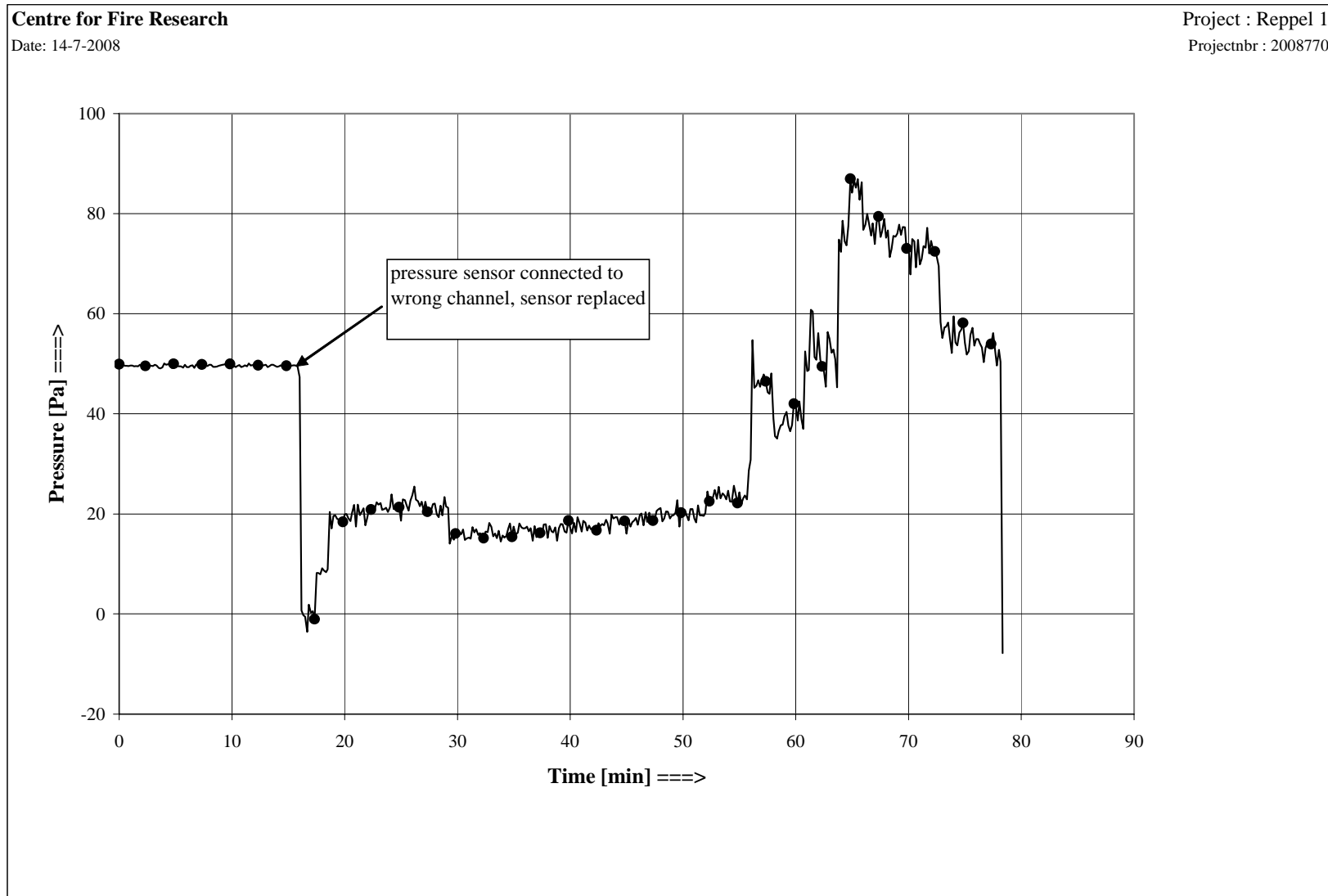


Figure A4 : measured pressure in the furnace

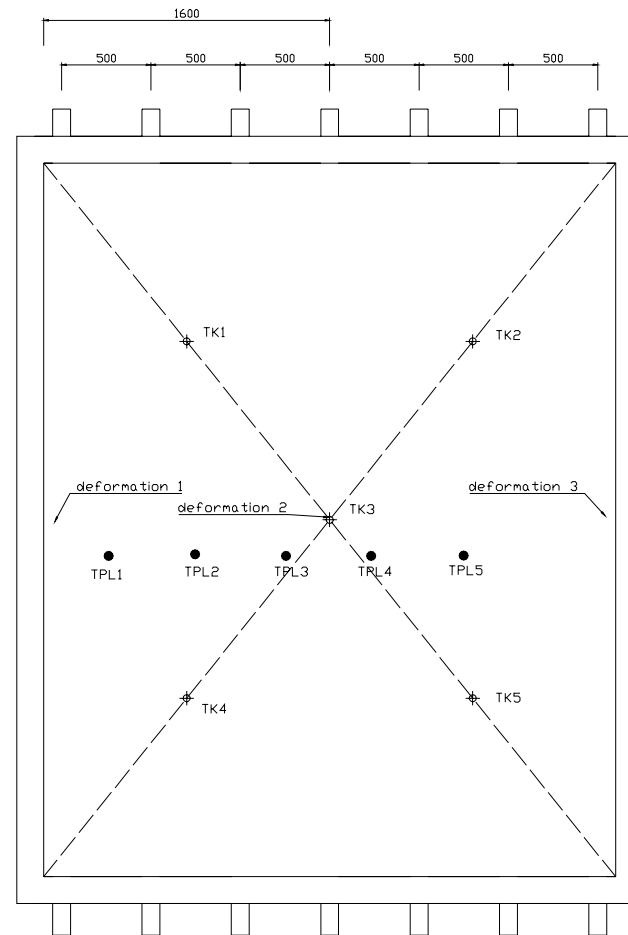
B Positions of the thermocouples and measurement results

Figure B1: positions of the thermocouples

Figure B2: measured air temperatures in the plenum

Figure B3: measured surface temperatures on top of the floor

Figure B4: measured deformation of the floor



TK1-5 are thermocouples on the concrete floor
TPL1-5 are thermocouples in the plenum between the wooden beams

Figure B1: Positions of the thermocouples

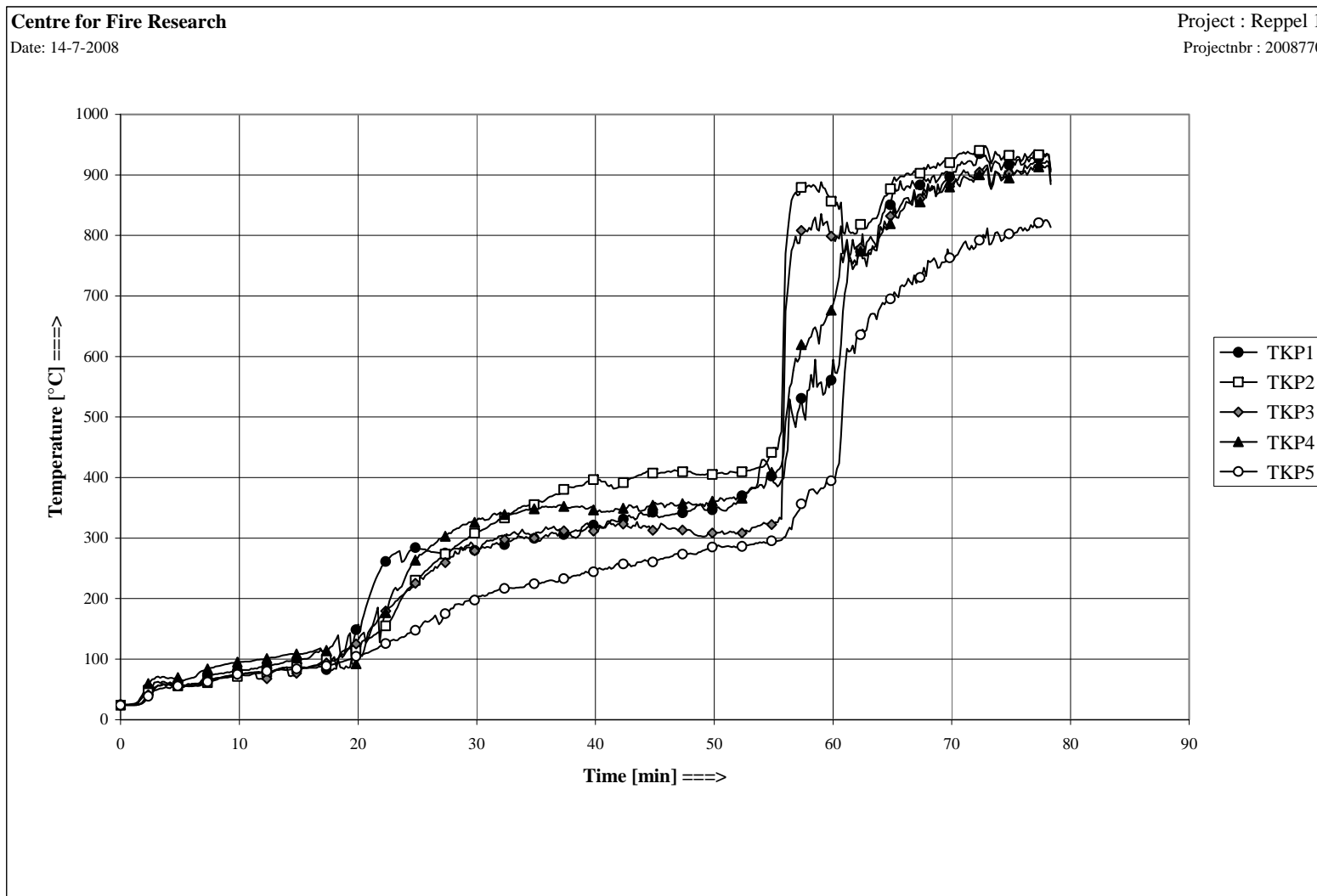


Figure B2: measured air temperatures in the plenum

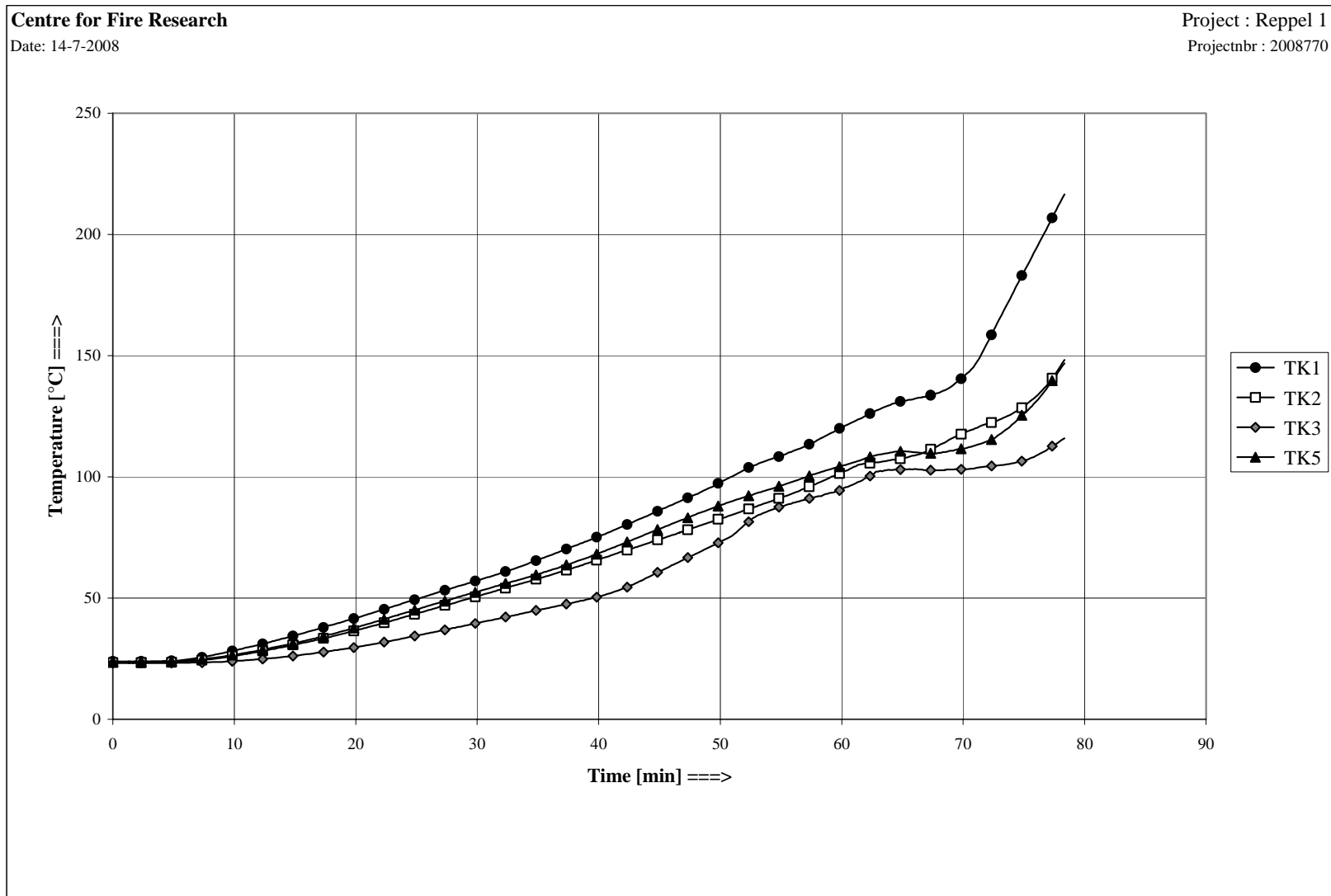


Figure B3: measured surface temperatures on top of the floor

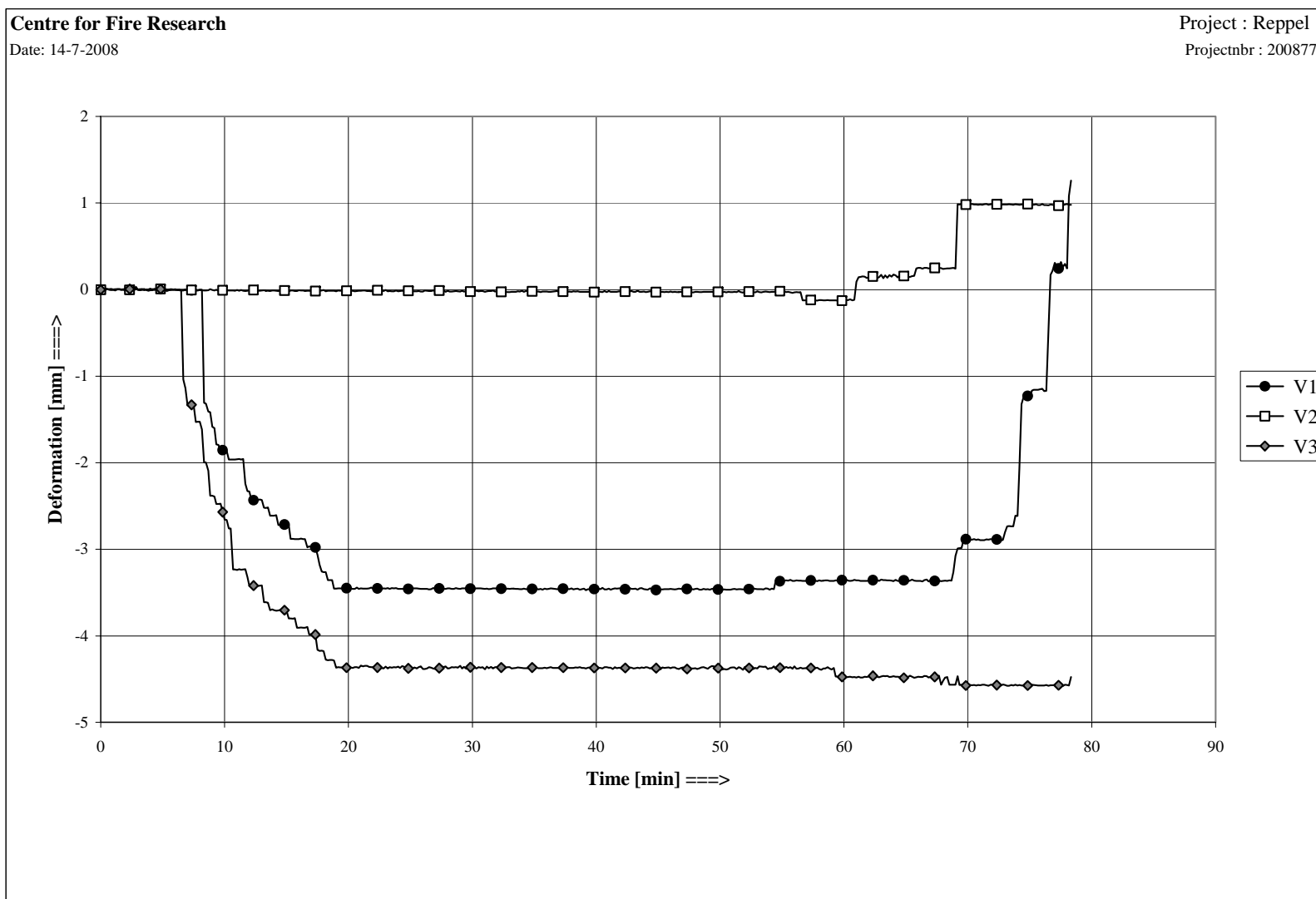


Figure B4: measured deformation of the floor

C Photos

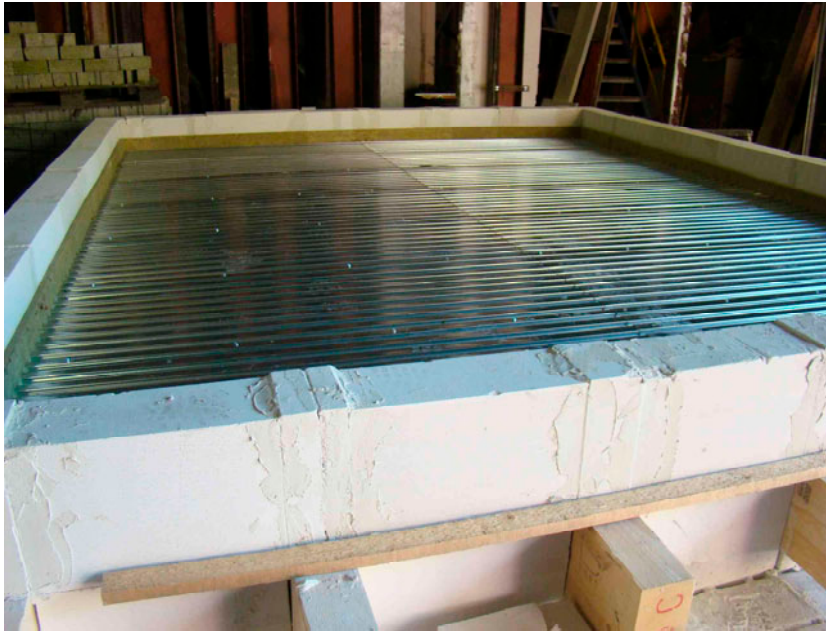


Photo 1: view of the floor before casting the concrete

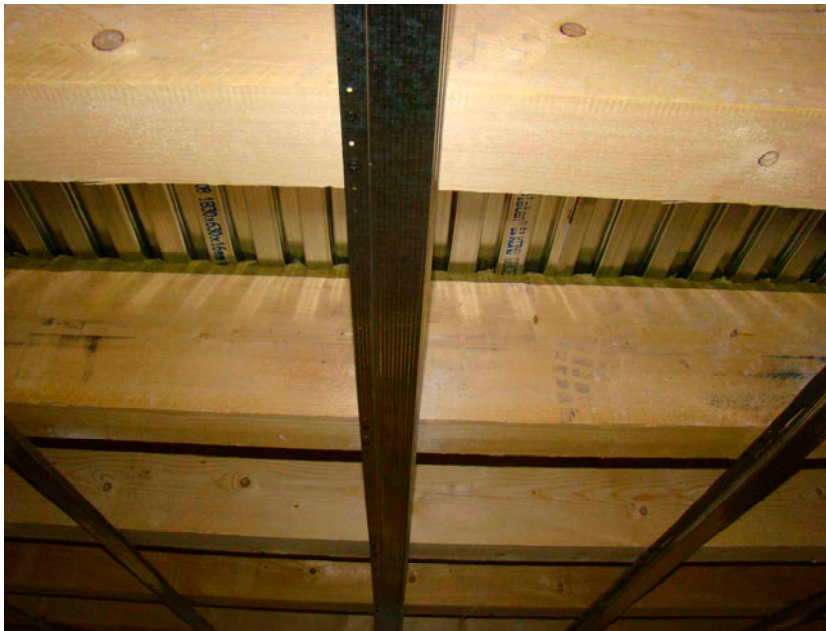


Photo 2 : detail of the mounting of the ceiling channels



Photo 3 : detail of the mounting of the gypsum boards



Photo 4 : view of the construction before the test