Test Report

DIN EN 1365-2: 2000-02 in conjunction with DIN EN 1363-1: 1999-10

English translation prepared by Hilti

Original signed version in German language from IBMB/MPA Braunschweig

Document No.:	(3136/2315) – CM from 2nd of Decemer 2005
Client:	Hilti Entwicklungsgesellschaft mbH Hiltistraße 6 D-86916 Kaufering
Order date:	28th of September 2004
Order Ref.:	Mr. Hartmann
Order received:	15th of February 2005
Subject:	Testing the fire resistance of a load-bearing, room closing, 200 mm thick reinforced concrete slab with 100 mm thick Heraklith "Tektalan TK" segmented wood-wool panels; in combination with Hilti IDMS insulating pins with 80 mm retention plates in galvanized zinc-plated steel and Hilti IDMR insulating pins in A2 stainless steel (material number 1.4301) with 80 mm retention plates in galvanized zinc-plated steel, to determine the fire resistance rating for exposure to fire from the underside of the structure.
Test basis:	DIN EN 1365-2: 2000-02 in conjunction with DIN EN 1363-1 : 1999-10
Samples received:	Week 12 of 2005
Tested on:	31th of March 2005
Valid until:	unlimited

This test report contains ….. pages including the title page and 19 annexes.

1 General

The contract provides for the testing of the fire resistance of a 300 mm thick, load-bearing, room closing, heat insulating floor structure according to DIN EN 1365-2 : 2000-02 in conjunction with DIN EN 1363-1 : 1999-10, in particular the determination of the fire resistance rating for exposure to fire from the underside of the structure. The floor structure comprised:

- a 200 mm thick reinforced concrete slab (concrete cover c = 35 mm) of concrete quality ≥ C 20/25
- 100 mm thick Heraklith "Tektalan TK" segmented wood-wool panels in combination with
- Hilti IDMS insulating pins with 80 mm retention plates in galvanized zinc-plated steel and
- Hilti IDMR insulating pins in A2 stainless steel (material number 1.4301) with 80 mm retention plates in galvanized zinc-plated steel.

The test was carried out as specified by DIN EN 1363-1, and comprised a comprehensive description of the installation procedure and test conditions, and specification of the results obtained for the structural component with which this report is concerned. The report does not cover possible deviations from the standard regarding dimensions, structural details, loads, or stress or boundary conditions, except those that are permissible under the test procedure for direct application to similar, untested, floor structures.

Owing to the particular circumstances applying to the fire resistance rating test, and the problems arising from these in quantifying the uncertainties involved in measuring the fire resistance rating, it is not possible to specify a precise uncertainty range for the results.

The Materials Testing Institute Braunschweig (German: Materialprüfungsanstalt Braunschweig) was not responsible for the choice of the test specimen.

2 Description of the test structure

The load-bearing, room closing, heat insulating floor structure to be tested consisted of a 200 mm thick reinforced concrete slab (concrete cover c = 35 mm) to which to a 100 mm thick Heraklith "Tektalan TK" segmented wood-wool panel was fixed using Hilti IDMS insulating pins with 80 mm retention plates in galvanized zinc-plated steel and Hilti IDMR insulating pins in A2 stainless steel (material number 1.4301) with 80 mm retention plates in galvanized zinc-plated A2 stainless steel (material number 1.4301).

The 200 mm thick reinforced steel concrete floor slab having the dimensions of 1910 mm x 5000 mm (W x L) was tested in respect of its qualities as a floor element in a horizontal position with line loading according to DIN EN 1365-2: 2000-02. A Heraklith "Tektalan TK" segmented wood-wool panel having the dimensions of 500 mm x 1000 mm x 100 mm (485 mm x 985 mm x 100 mm) (W x

L x H) was fixed to the reinforced concrete slab. The Heraklith "Tektalan TK" segmented wood-wool panels consisted of an approx. 90 mm thick Heralan mineral wool fiber core positioned at right angles to the surface of the slab and covered on both sides with approx. 5 mm thick magnesium impregnated wood-wool cladding. The panel was. The Heraklith "Tektalan TK" segmented wood-wool panels were provided with a rabbet edge having a step width of 15 mm. To fix these, holes (∅ 8.0 mm) were bored through the Heraklith "Tektalan TK" segmented wood-wool panels into the reinforced concrete slab, in which the IDMS or IDMR insulating pins were driven using a hammer. For each segmented panel, six IDMS or IDMR insulating pins (∅ 8.0 mm x 170 mm) and corresponding retention plates (∅ 80 mm) were used. The positioning of the insulating pin dowels is shown in Annex 1.2.

The gap between the floor structure and the wall was stuffed with mineral wool (material class A1 according to DIN 4102-01; melting point > 1000℃).

The test specimen was supported on a side wall of the furnace.

Note that a 50 mm thick Heraklith "Tektalan TK" segmented wood-wool panel was installed additionally on the floor of the fire room. The temperatures measured at the top of the slab are given in Annex 2.7.

Further details on the construction of the floor structure are given in Annexes 1.2 ff. of this report.

3 Test specimen and material properties

The strength and humidity of the test specimen at the time of testing corresponded approximately to the values that pertain in normal use.

The material classification, data on specific weights per m², absolute densities and humidity of the test specimen and the building materials contained in it are given in Annex 1.5.

4 Test layout and performance

The test specimen described in Section 2 was installed by the client's specialists in the form of a horizontal room closure above a fire room having the overall dimensions of 4000 mm x 1910 mm (length x width = L_{exp} x W_{exp}).

The floor slab was loaded by four line loads at right angles to it and positioned at 1/8 l and 3/8 l (l = supported span) from each support. The line loads were applied via four load distribution beams and two hydraulic presses, each with a total load of 39.89 kN, in accordance with the layout given in DIN

1045-1 : 2001-07 for the determination of breaking load (under consideration of the weight of the slab itself and that of the loading equipment).

The fire room was flame heated in accordance with the standard temperature-time curve according to DIN EN 1363-1 : 1999-10, Section 5.1.1. The temperatures in the fire room were measured using six plate thermometers ("plates") with Ni-Cr/Ni-Al thermocouples (type K), □ 1.0 mm, according to DIN EN 1363-1 : 1999-10, Section 4.5.1.1, and positioned at a distance of a = 100 mm from the underside of the heated surface as specified in DIN EN 1365-2 : 2000-02, Section 9.11(a).

During the test, the static overpressure in the fire room on the upper side of the test specimen corresponded to the value given in Annex 2.11.

The temperatures in the layer between the concrete slab and the Heraklith "Tektalan TK" segmented wood-wool panels were measured by 19 thermocouples as specified in DIN EN 1363-1, Section 4.5.1.2. Furthermore, the concrete slab was provided with three sensor cables, each having 5 thermocouples, to measure the temperatures at intervals of 10 mm from the underside of the slab. The sensor cables were situated at intervals of Lexp/4 from one end, where Lexp is the length of the slab. The temperatures on the unheated side of the test specimen were measured by one NiCr-Ni thermocouple, □ 0.5 mm.

Annex 1.2 shows the position of the measurement points.

The vertical deflection of the test specimen was measured at the center as specified in DIN EN 1365-2 : 1999-10, Section 9.3, and shown in Annex 2.9.

A schematic of the test arrangement, the position of the thermocouples in the furnace, the positions of the pressure measurement points and that of the deflection point are given in Annexes 1.1 ff.

5 Test results and observations

The test results for the temperature rise above the initial temperature on the unheated side of the test specimen, and within the body of the specimen, the temperatures in the fire room, the ambient temperature, the deflection of the test specimen, the error function and the differential pressure are shown graphically in Annexes 2.1 to 2.11.

The observations made during the test are shown in Annex 2.12.

6 Summary of the test results and performance criteria according to DIN EN 1365-01 : 1999-10 in conjunction with DIN EN 1363-1 : 1999-10

The test on the 300 mm thick load-bearing, room closing, heat insulating floor structure consisting in the main of a 200 mm thick reinforced concrete slab (concrete cover c = 35 mm) in concrete quality ≥ C20/25 and 100 mm thick Heraklith "Tektalan TK" segmented wood-wool panels in conjunction with Hilti IDMS insulating pins with 80 mm retention plates in galvanized zinc-plated steel and Hilti IDMR insulating pins in A2 stainless steel (material number 1.4301) with 80 mm retention plates in galvanized zinc-plated steel was carried out on 31.3.05 to determine the fire protection qualities according to DIN EN 1365-2 : 2000-02 in conjunction with DIN EN 1363-1 : 1999-10, that is, to determine the fire resistance rating for exposure to fire on the underside of the structure.

The summary of the test results and performance criteria according to DIN EN 1365-2 : 2000-02 in conjunction with DIN EN 1363-1 : 1999-10 for load-bearing, room closing, heat insulating floor structures for fire exposure to the underside of the structure as shown in Table 1 of this report.

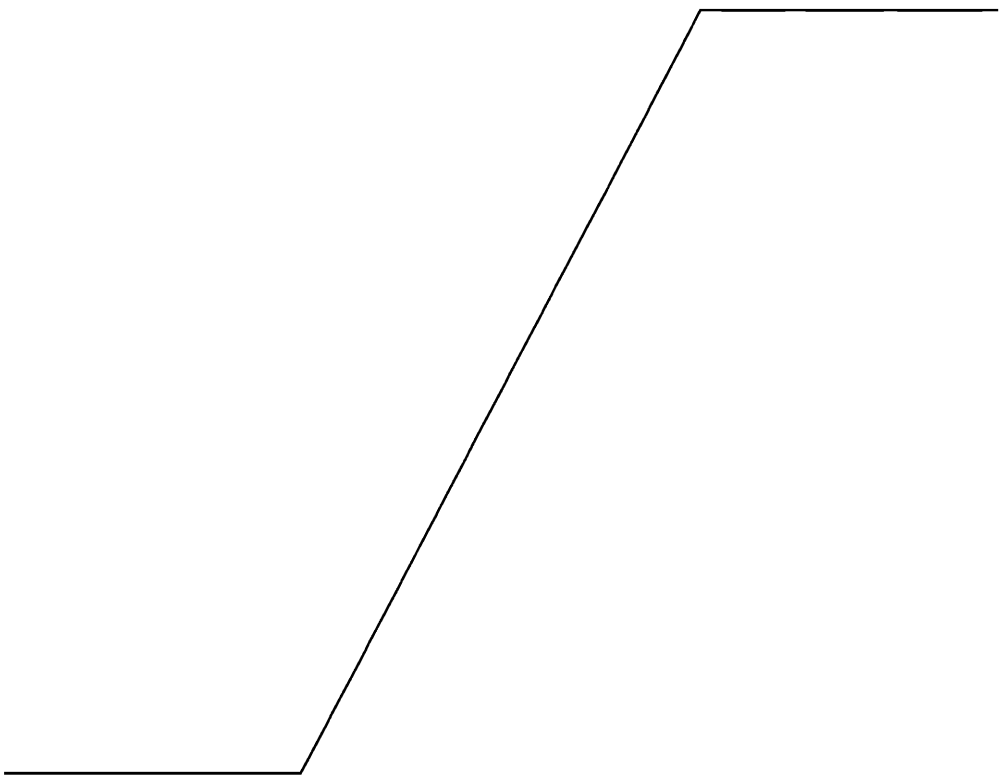

Table 1 **Test results and performance criteria according to DIN EN 1365-2 : 2000-02 in conjunction with DIN EN 1363-1 : 1999-10 for load-bearing, room closing, heat insulating floor structures for fire exposure to the underside of the structure.**

Line	Reference Data according to DIN EN 1363-1: 1999-10 Section:	Description		Test Results Description	Test specimen 1			
1	11.1	Load-bearing capacity	Limiting value for vertical deflection	The limiting value was exceeded after	min.			
2			Limiting value for vertical rate of deflection	The limiting value was exceeded after	min.			
3	11.2	Room closure,	Inflammation of the cotton wadding	Inflammation of the cotton wadding occurred after	min.[1)]			
4		i.e. avoidance of:	Appearance of cracks	A feeler gauge could be pushed through after	min.[1)]			
5			Appearance of flames on the unheated side	Continuous flame penetration occurred after	min.			
6	11.3	Heat insulation[(2)]:		Test duration in minutes	**30**	**60**	**90**	**110**
7		– Temperature on the concrete slab		max. measured temperature: **individual values in K**	0	1	4	7
8		– Temperature between the concrete slab and the segmented wood-wool panel		max. measured temperature: **individual values** in °C:	223 [MP 12]	368 [MP 12]	1029 [MP 12]	1041 [MP 10]
		– Temperature in the sensor cables (with 10 mm concrete cover)			47 [MP 31]	196 [MP 31]	285 [MP 31]	537 [MP 31]
		– Temperature in the sensor cables (with 20 mm concrete cover):			33 [MP 32]	123 [MP 32]	155 [MP 32]	281 [MP 27]
9	5.6	**Other data**		Ambient temperature in the laboratory at beginning of test	20 °C			
10				The ambient temperature rose/fell during the test by max.	0.9 K			
11	5.2.2.1			Pressure in the fire room	according to DIN EN 1363-1 : 1999-10, Annex 2.11			
12	10.4.4			Test duration in minutes	**110[(3)]**			
13				Deflection at center of slab	70.2 mm			
14								

(1) Test unnecessary and therefore not performed
(2) As opposed to the procedure given in DIN EN 1362-2 : 2000-02, a single measurement point only was provided on the unheated side, which showed a maximum temperature rise of less than 7 K
(3) The majority of the segmented wood-wool panels fell into the fire room. From then onwards the concrete slab was unprotected and therefore subjected directly to the heat.

7 Conclusions based on DIN EN 1365-2 : 2000-02 in conjunction DIN EN 1363-1 : 1999-10, and recommendations

The following Table 2 summarizes the main test results based on the performance criteria specified in DIN EN 1365-2 : 2000-02 in conjunction with DIN EN 1363-1 : 1999-10.

Table 2 **Performance criteria in accordance with DIN EN 1365-2 : 2000-02 in conjunction with DIN EN 1363-1 : 1999-10 for load-bearing, room closing, heat-insulating floor structures for exposure to fire on the underside of the structure.**

	Criteria according to the standard	Failure after [minutes]
R	Load-bearing capacity	110 (1)
E	Room closure (continuous appearance of flames, cotton wadding, feeler gauge)	110 (1)
I	Heat insulation	110 (1)

(1) The test was terminated after 110 minutes, since most of the floor panels had fallen off.

On the basis of the test results obtained (see Tables 1 and 2) over the duration of the test from the beginning of flame heating up to the end of the test of 110 minutes, it can be recommended that for the floor structure tested with regard to load-bearing capacity, room closure and heat insulation, and line loads positioned as for the determination of the breaking load (under consideration of the weight of the structure itself and that of the loading equipment (see Section 4)), and exposure to fire on the underside of the structure, it can be recommended in accordance with DIN EN 13 501-2 : 2003-12 that the structure be assigned the fire resistance class **REI 90 or RE 90**.

8 Range of applicability in accordance with DIN EN 1365-2 : 2000-02, Section 13

The test results are directly applicable to similar, untested, floor structures on condition that the following applies with regard to the load-bearing component:

- The maximum moments and transverse loads on the test specimen are not exceeded, the calculation of these being based on the method for determining the permissible load.
- The concrete cover must be $c \geq 15$ mm. For corrosion protection, layout of the reinforcement cage, etc., further evidence of compliance is required.

RR Dr. Ing. Nause
Leiterder Prüfstelle

i.A.
Dipl.-Ing. Maertins
Sachbearbeiter

List of Annexes

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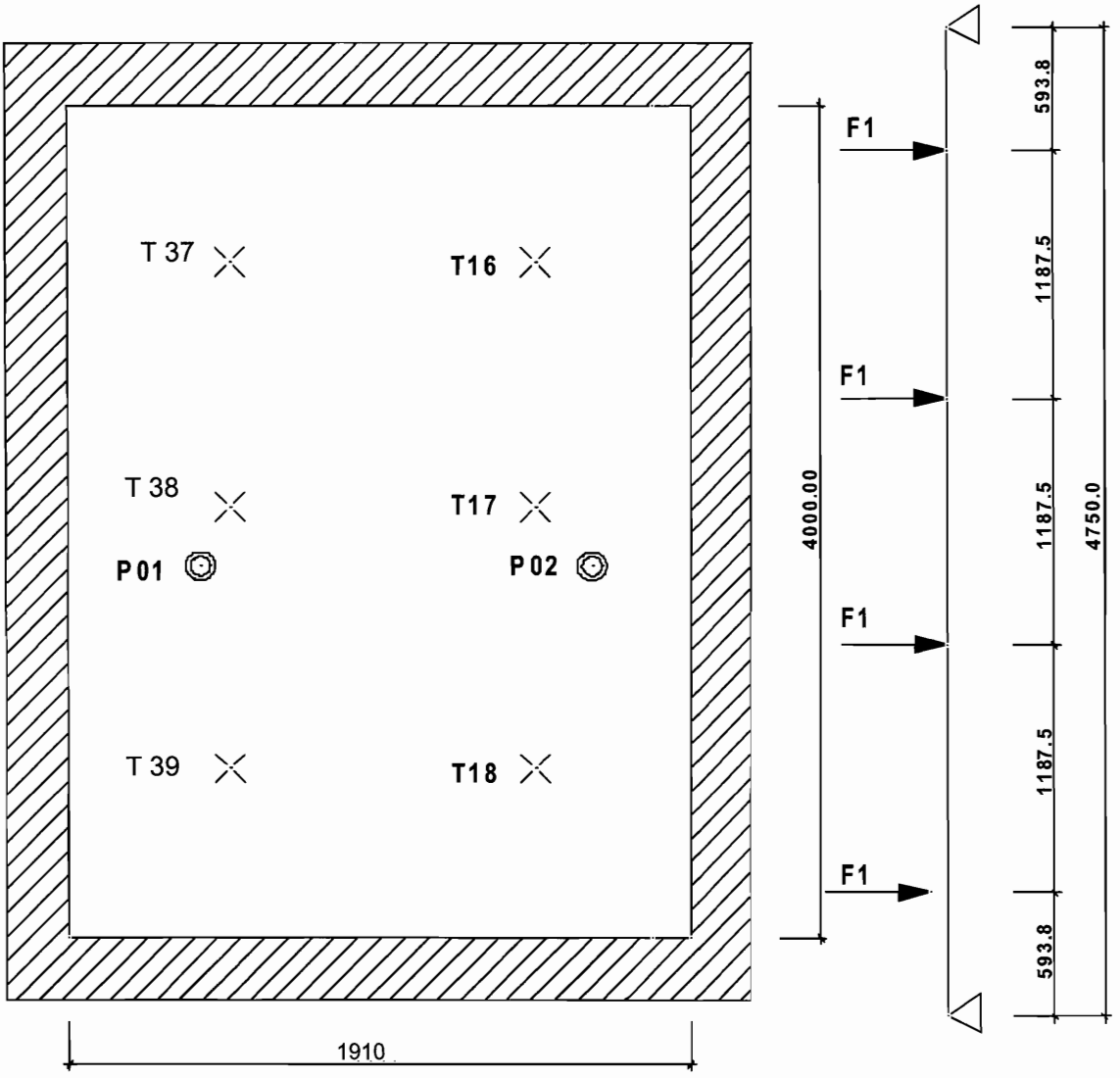
Annex	2.12	:	Observations during the fire test

The drawings in Annexes 1.2 ff. were made available by the client. The design data of the test specimen were verified by the testing institute.

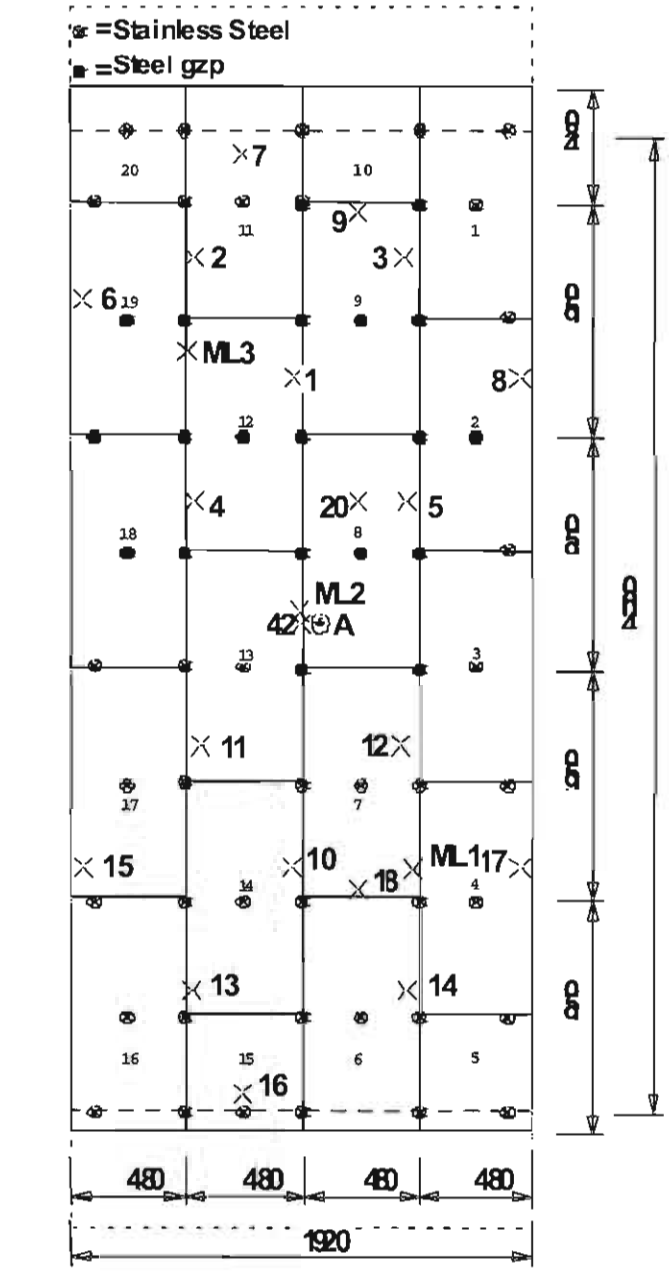


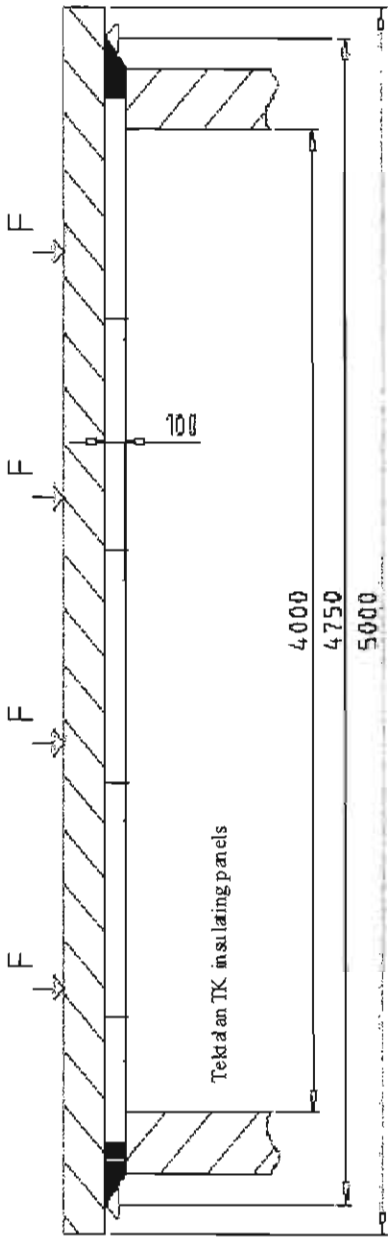
T16-18 + 37-39 Fire room temperature measurement points: plate thermometers ("plates") with Ni-Cr/Ni-Al thermocouples (type K), ∅ 1.0 mm

P01 – P02 Pressure measurement sensor

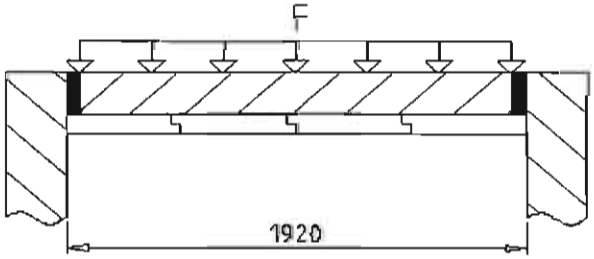
Dimensions in mm

Test arrangement	**Annex 1.1 of Test Report No.(3136/2315) -CM**
Material Testing Laboratory for Architecture Department for Building Materials, Solid Building and Fire Prevention of the Technical University Braunschweig	





Dimensions in mm



◎ A Deflection measurement points

Temperature measurement points, NiCr-Ni ∅ 0.5 mm:

X	1 – 9, 20	Temperature measurement points (°C) pos ition – steel gzp.
X	10 – 17, 42	Temperature measurement points (°C) position – stainless steel A2
X	39	Temperature measurement point (°C) position – ambient temperature
X	ML 1 (21-25)	Temperature measurement points (°C) – Messleiter 1
X	ML 2 (26-30)	Temperature measurement points (°C) – Messleiter 2
X	ML 3 (31-35)	Temperature measurement points (°C) – Messleiter 3
X	19	Temperature measurement point (180 K) – on the reinforced concrete floor (unheated side)

Design and position of the furnace thermocouples, measurement points and loading

Material Testing Laboratory for Architecture
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Annex 1.2 of

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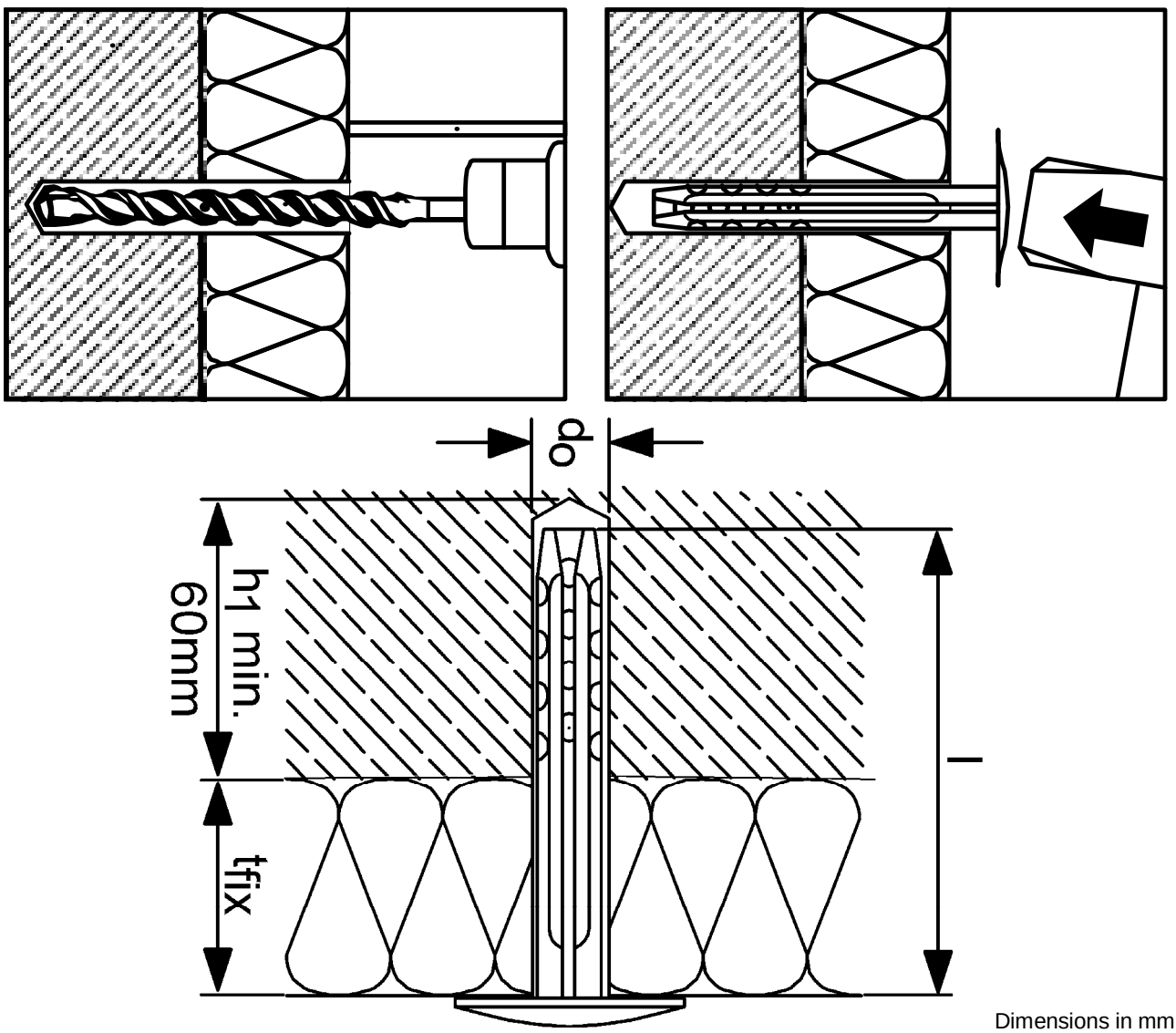

Dimensions in mm

Setting details on IDMS / IDMR Insulating pin

Setting details \ Isolierdorn	IDMS 0/3 IDMR 0/3	IDMS 3/6 IDMR 3/6	IDMS 6/9 IDMR 6/9	IDMS 9/12[1)]	IDMS 12/15
t_{fix} [mm]	0 - 30	30 - 60	60 -90	90 - 120	120 - 150
h_1 [mm]	60				
l [mm]	80	110	140	170	200
t_{fix} [mm]	8				
Drill	TE-CX-8/22				

Installation layout / design data
Hilti IDMS insulating pins / Hilti IDMR insulating pins

Annex 1.3 of

Test Report

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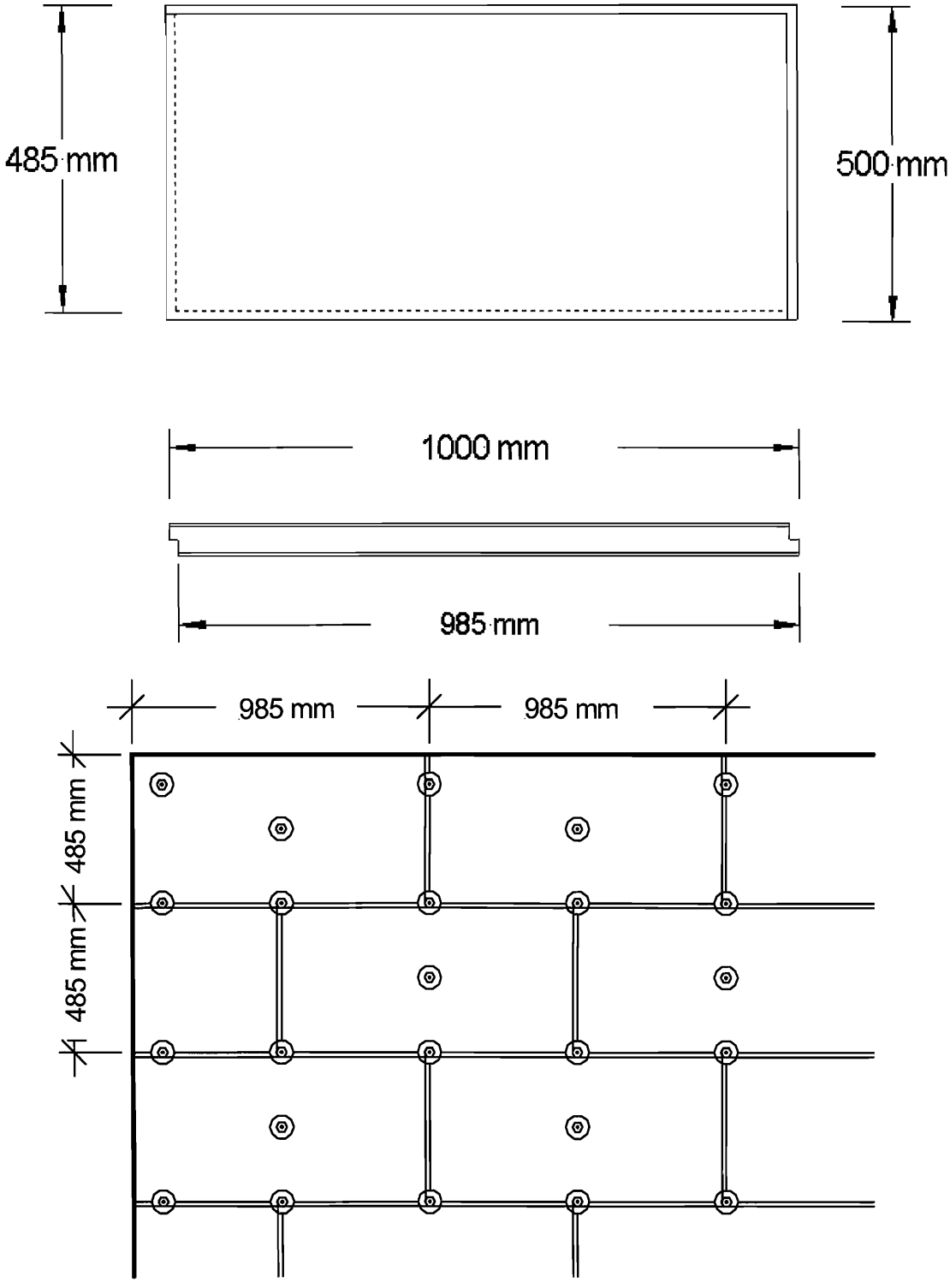
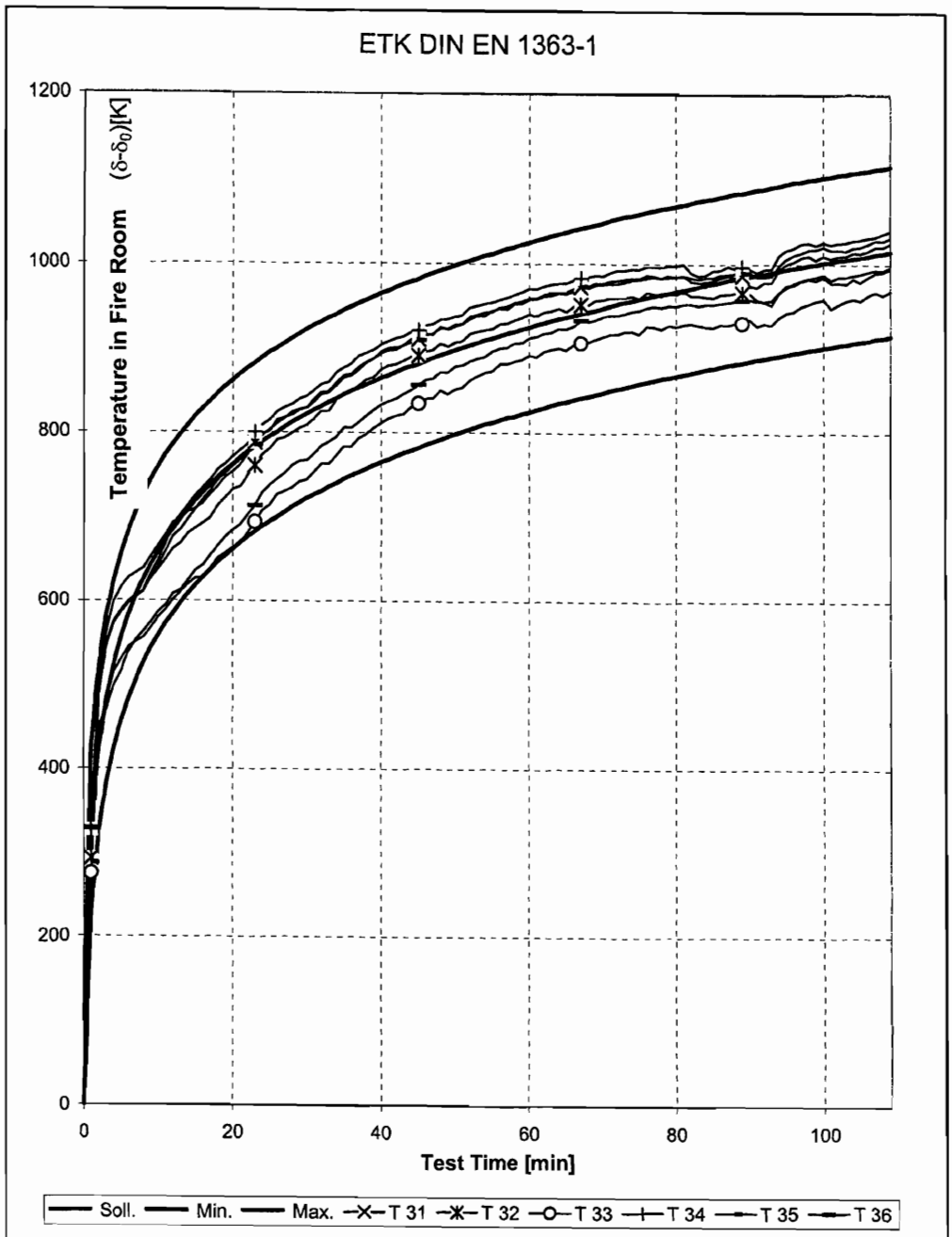


Dimensions in mm

Design data **Heraklith "Tektalan TK" segmented wood-wool panels**	**Annex 1.4 of** **Test Report** **No.(3136/2315) -CM**
Material Testing Laboratory for Architecture **Department for Building Materials, Solid Building and Fire Prevention of the** **Technical University Braunschweig**	

Material	Manu-facturer	Thick-ness	Specific weight at installation time	Absolute density[1] at installation time	Humidity content[2]	Material classification. Certification mark
		mm	kg/m²	kg/m³	% by wt.	
Tektalan TK wood-wool segmented panel according to DIN EN 13168	Heraklith GmbH Simbach	100	16.9	169.2	4.0	**B1:** according to DIN 4102-04 : 1994-03
Reinforced concrete slab B 25 according to DIN 1045	-	200	-[1]	-[1]	-[1]	**A1:** according to DIN 4102-04 : 1994-03
IDMS pin DX51D, material number 1.0226 +Z according to DIN EN 10142	Hilti Entwicklungs GmbH	∅ 6.8 (5.4)	-[1]	-[1]	-[1]	**A1:** according to DIN 4102-04 : 1994-03
IDMR pin A2 stainless steel (material number 1.4301)	Hilti Entwicklungs GmbH	∅ 6.8 (5.4)	-[1]	-[1]	-[1]	**A1:** according to DIN 4102-04 : 1994-03
Pressed retention plate (t = 0.5 mm), DX51D, material number 1.0226 +Z, according to DIN EN 10142	Heraklith	80.0	-[1]	-[1]	-[1]	**A1:** according to DIN 4102-04 : 1994-03

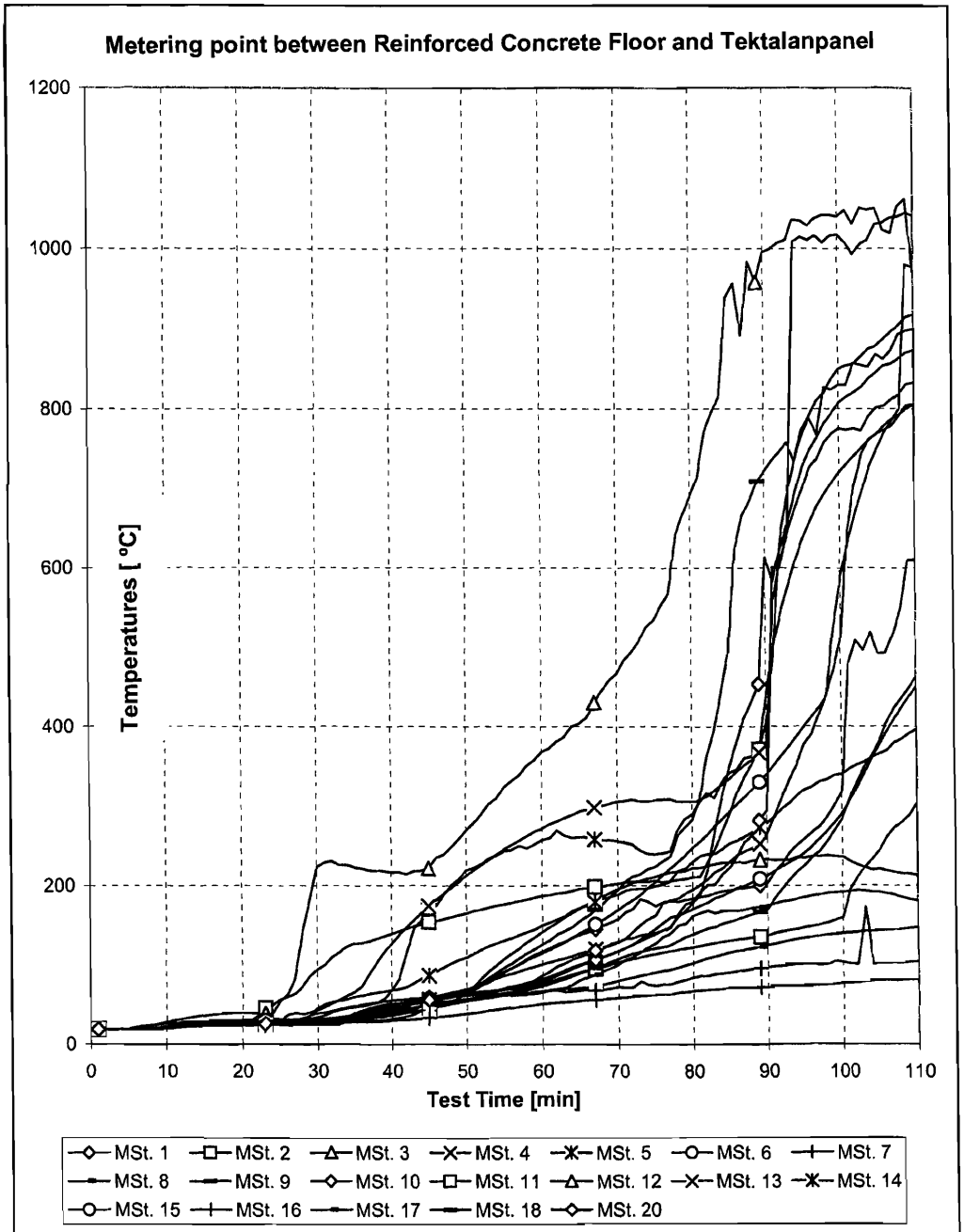
(1) not determined



δ_0 = 19 °C

Date of Test: 31.03.05

Temperature in the fire room Test 1	**Annex 2.1 of Test Report No.(3136/2315) -CM**
Material Testing Laboratory for Architecture Department for Building Materials, Solid Building and Fire Prevention of the Technical University Braunschweig	



End of Flame Impingement after 110 min

Temperature in Test Item	Annex 2.2 of Test Report No.(3136/2315) -CM
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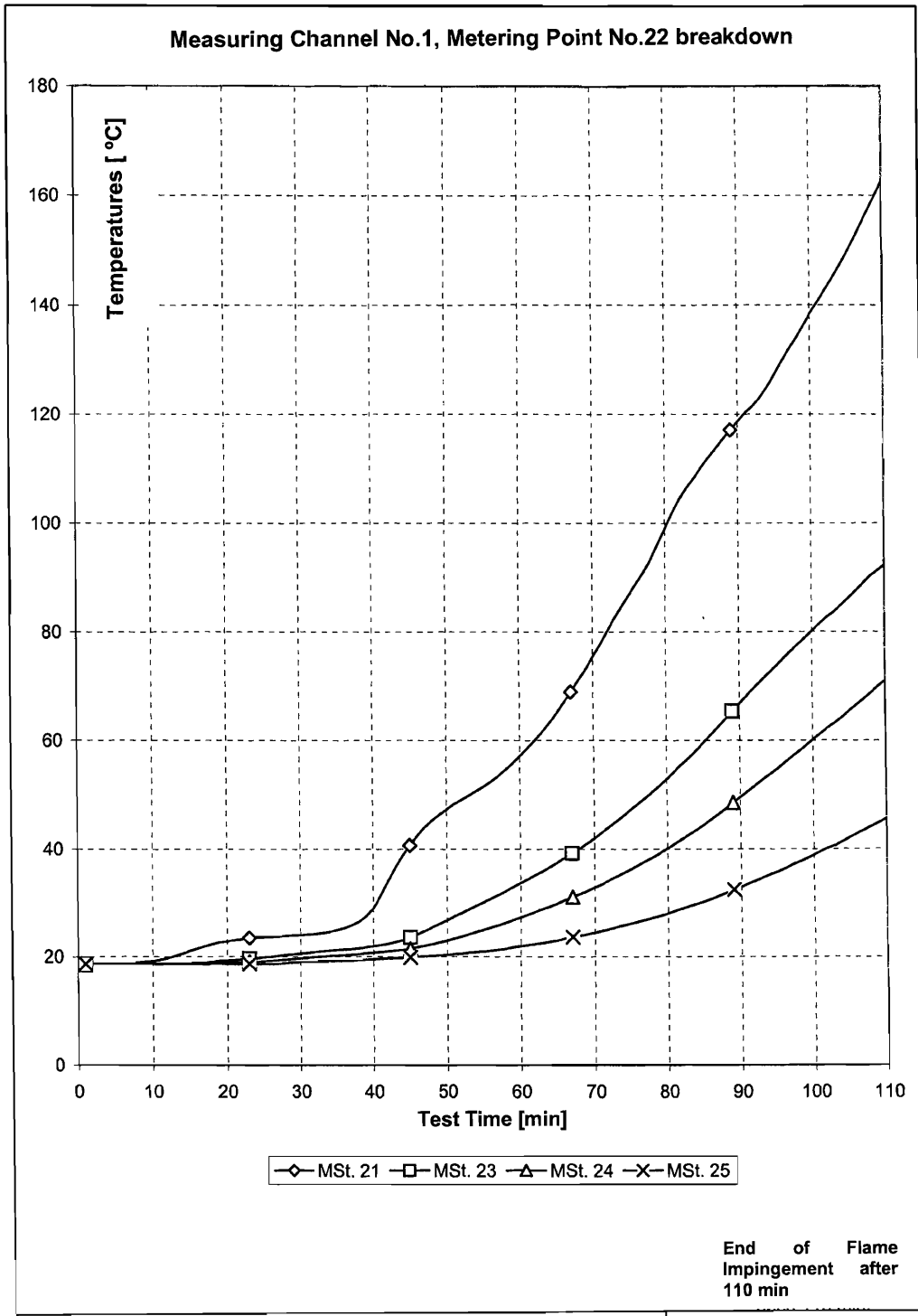

Temperatures in Test Item	Annex 2.3 of
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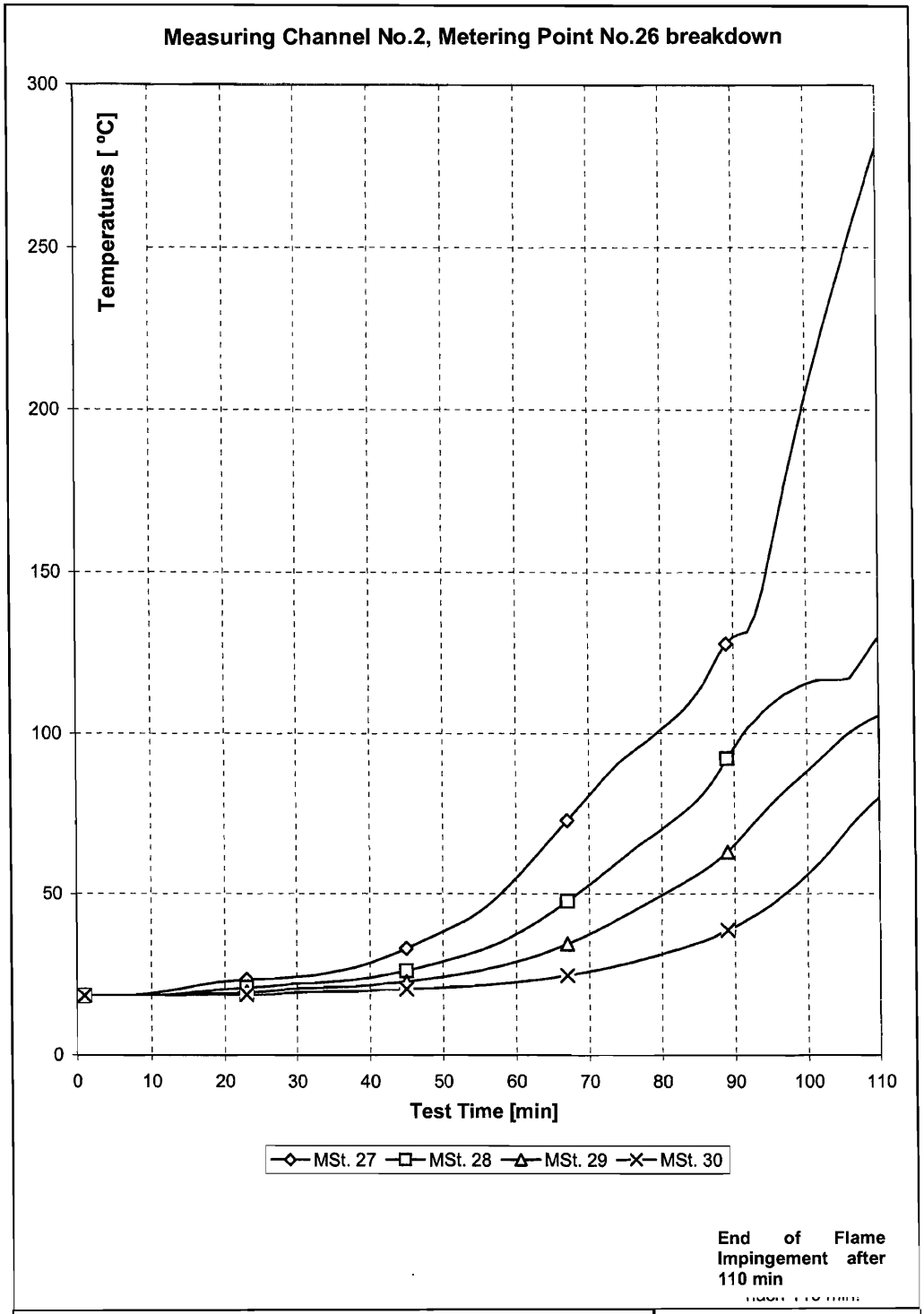

Temperature in the Test Item	**Annex 2.4 of Test Report No.(3136/2315) -CM**
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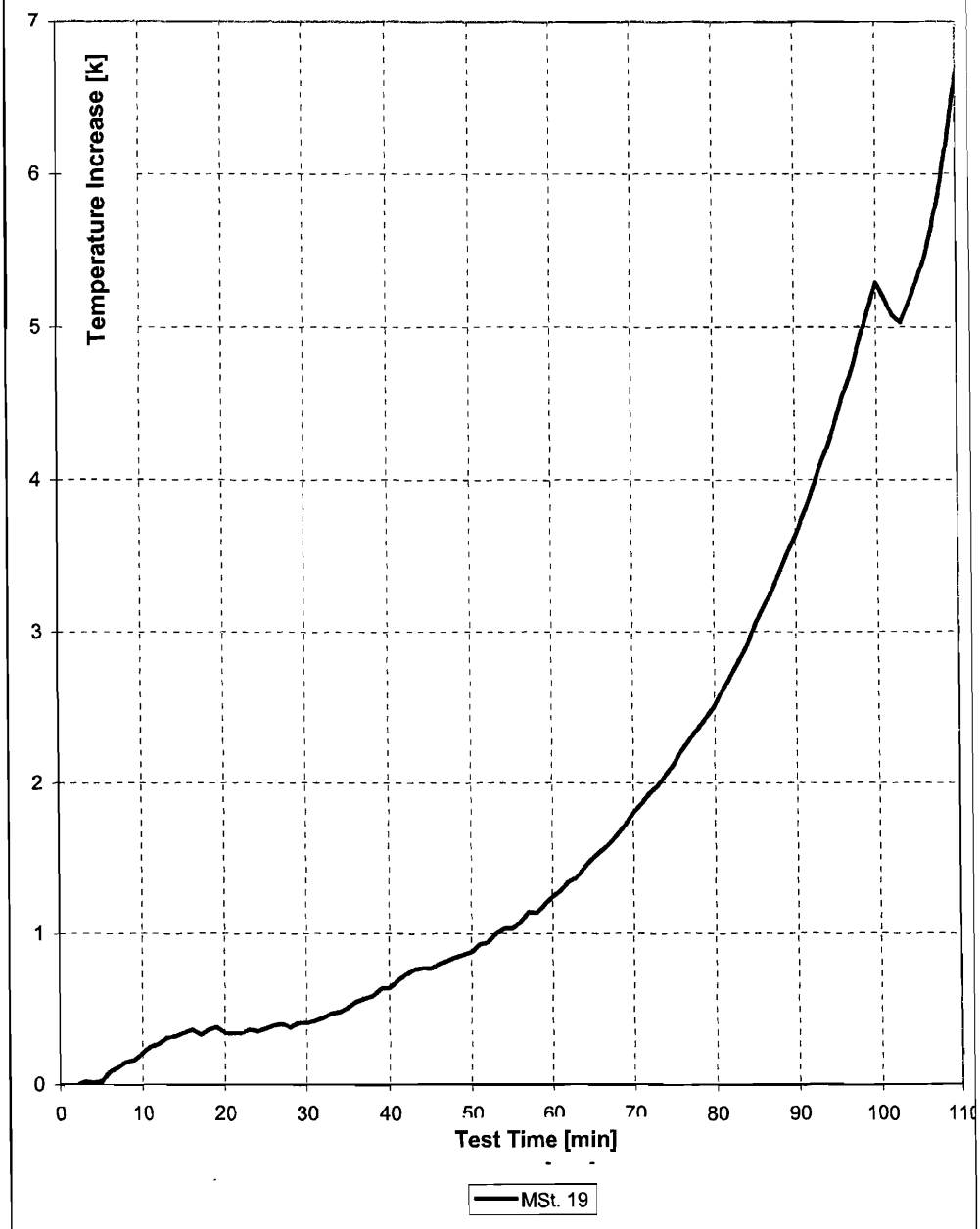
On Concrete Slab



Zeit [min]	30	60	90	110	
Mittelwert	< 1K	1 K	4 K	7 K	
Maximum	< 1K	1 K	4 K	7 K	
Messstelle	19	19	19	19	

End of Flame Impingement after 110 min

Temperature of Test Item

Material Testing Laboratory for Architecture Department for Building Materials, Solid Building and Fire Prevention of the Technical University Braunschweig

Annex 2.7 of

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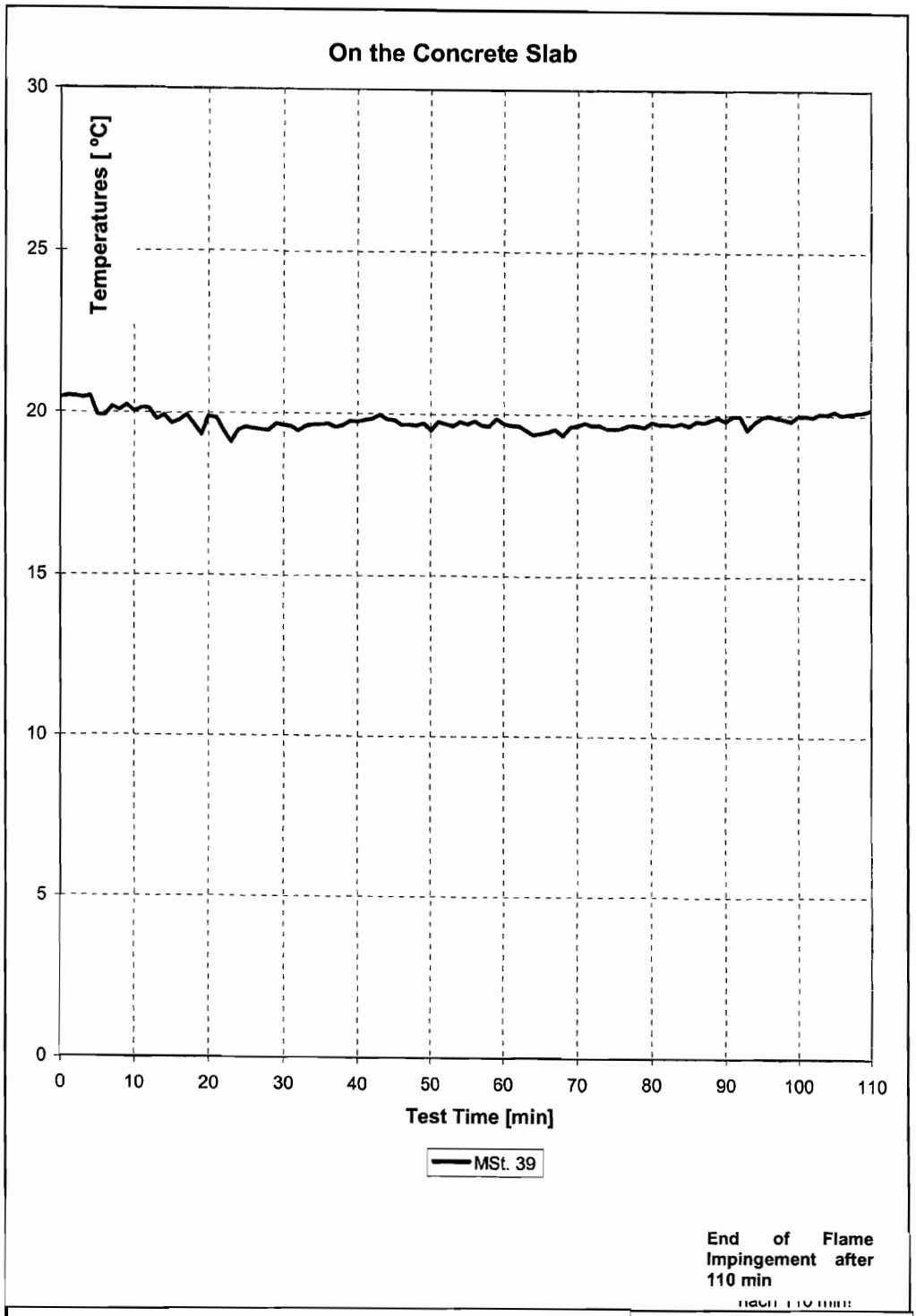

Ambient Temperature	Annex 2.8 of
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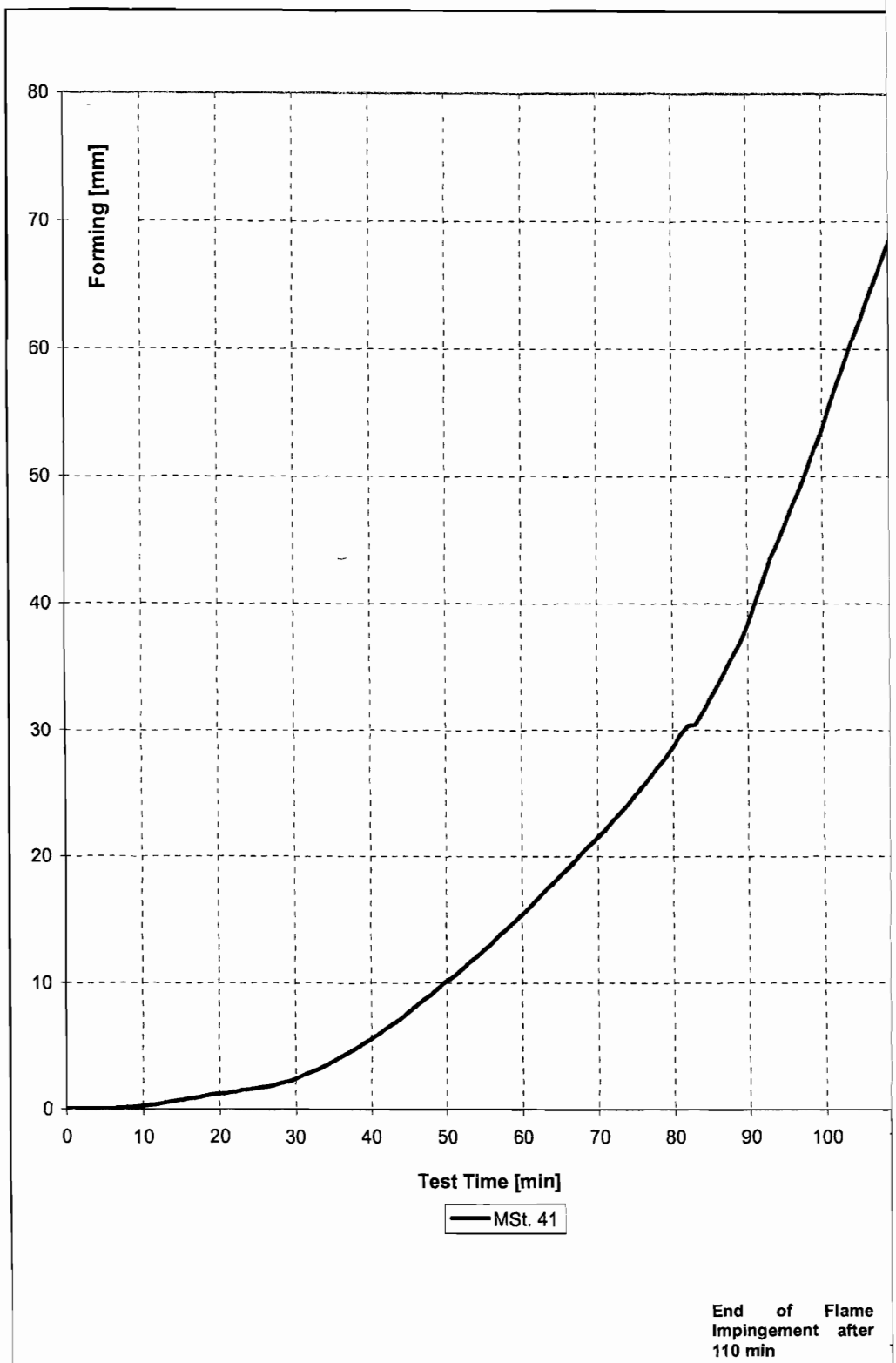
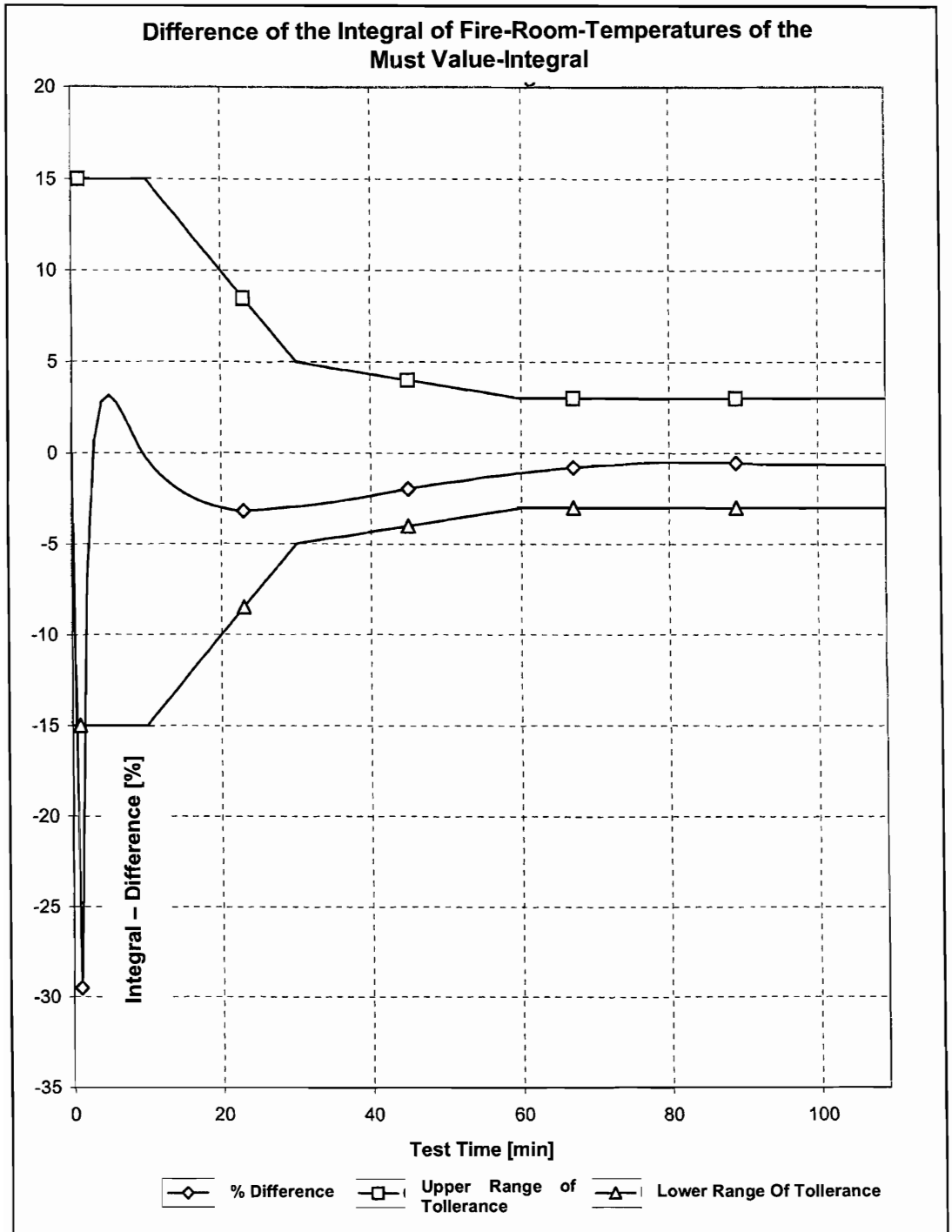
On the Concrete slab



Forming of the Test Item	Annex 2.9 of
Material Testing Laboratory for Architecture Department for Building Materials, Solid Building and Fire Prevention of the Technical University Braunschweig	Test Report No.(3136/2315) -CM



δ_0 = 19 °C

Date of Test 31.03.05

Reporting of the Error Integral	Annex 2.10 of
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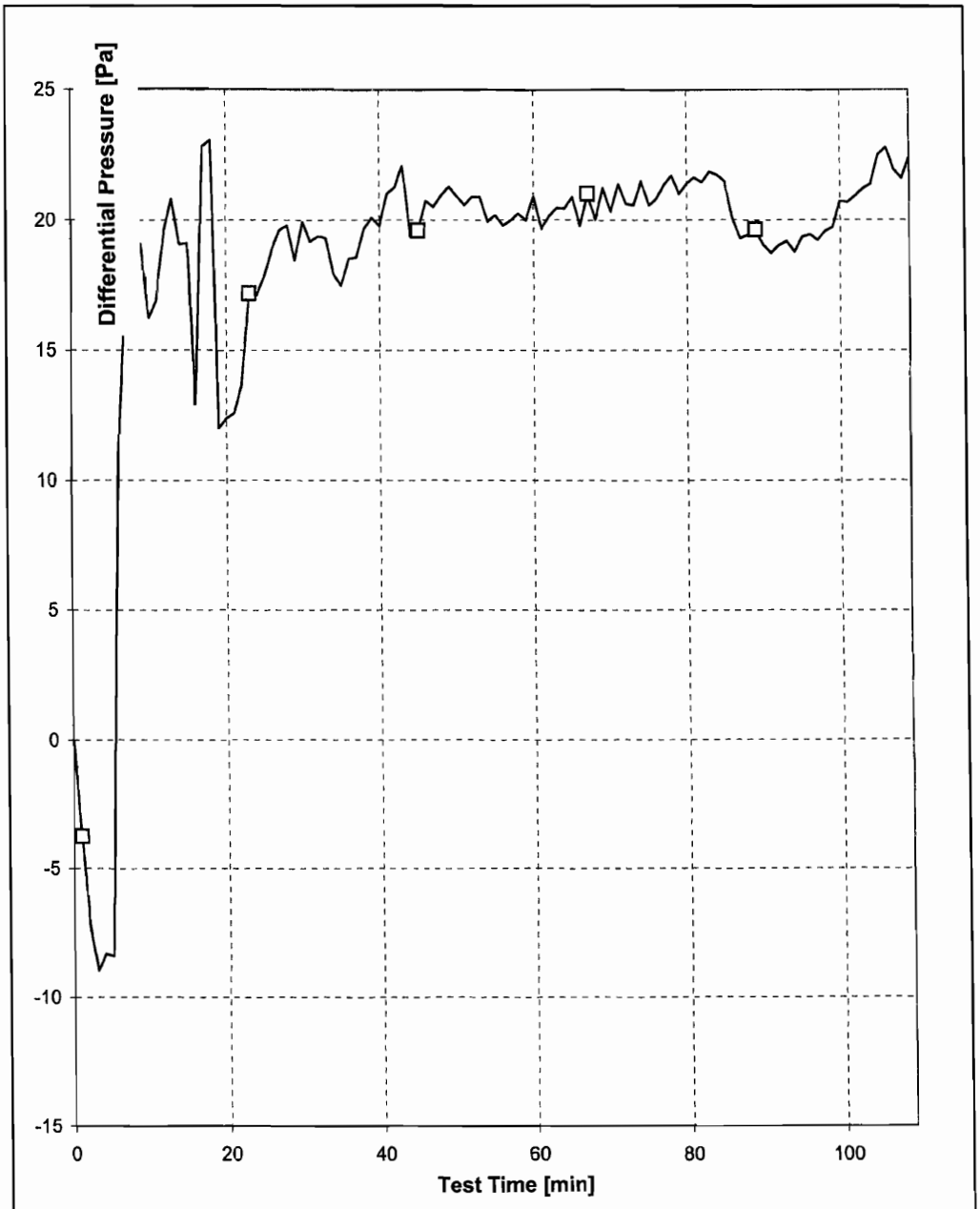

δ_0 = 19 °C

Date of Test 31.03.05

Differential Pressure in the Fire room

Annex 2.11 of

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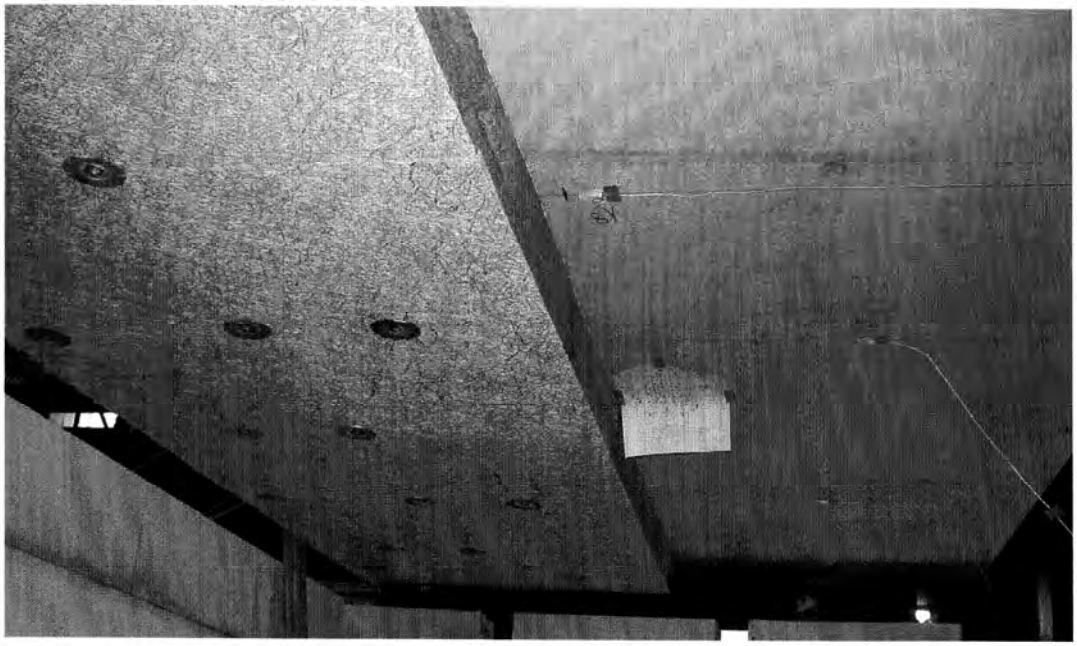
Department for Building Materials, Solid Building and Fire
Prevention of the Technical University Braunschweig

Testing Length (min)	Side *)	Notices during the Fire Test on the 31st of March 2005
2	F	The panels are fading black.
10	F	The plates are drawing in the covering of the sheathing.
13	F	The gap opens up to 3mm.
24	F	The panels are clear again. The plates continued drawing in the covering of the sheathing.
29	F	The sheathing covers the anchor plates.
50	F	The panels are sagging round bodied between the anchors.
71	F	The panel (8) slowly starts to tilt (gap = 3mm).
75	F	The gaps of panel (7), (11) and (15) keep on rupturing.
77		Panel (8) fell down in the Fire room.
83		Panel (7) fell down in the Fire room.
87		Panel (11) fell down partial. Panel (9) is lying on a thermocouple.
93		Panel (6) fell down in the Fire room.
98		Panels (9), (10) and (14) have fallen down in the Fire room.
103		Panel (5) fell down in the Fire room.
110	-	End of flame impingement.

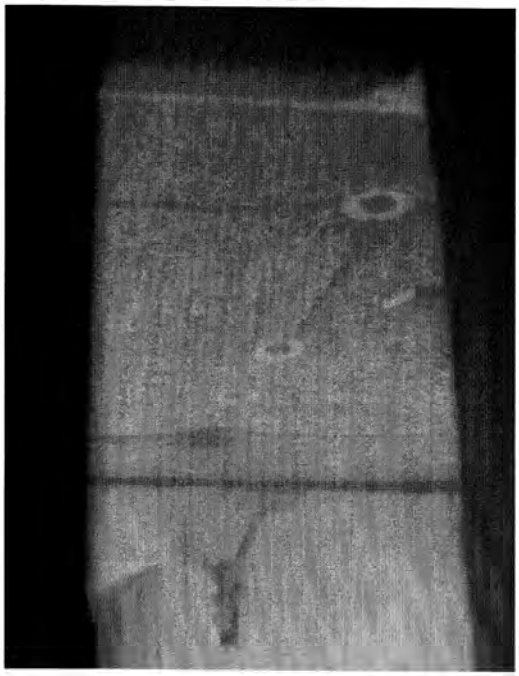
*) F = fire facing site
A = fire averted site

Pictures:1 Day before the Fire test



Photodokumentation	**Annex 3.1 of**
Material Testing Laboratory for Architecture Department for Building Materials, Solid Building and Fire Prevention of the Technical University Braunschweig	**Test Report No.(3136/2315) - CM**

Pictures: During the Fire Test



Pictures: 1 Day after the Fire Test

Photodokumentation	**Annex 3.2 of**
Material Testing Laboratory for Architecture Department for Building Materials, Solid Building and Fire Prevention of the Technical University Braunschweig	**Test Report No.(3136/2315) -CM**