ZAG

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DEPARTMENT OF FIRE-SAFE SUSTAINABLE BUILT ENVIRONMENT

Fire Laboratory and Fire Engineering

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Member of egolf - European Group of Organisations for Fire Testing, Inspection and Certifications

SLOVENSKA AKREDITACIJA
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LP-005

# TEST REPORT
# 241/22–530–1–EN

FIRE RESISTANCE TEST

of a 200 mm thick semi pre-fabricated lightweight loadbearing concrete ceiling slab

**MARANA EUROPAN**

| | |
|---|---|
| Orderer: | **MARANA d.o.o.,**<br>**Kurtovići 21, HR-21231 Klis, Croatia** |
| Order/contract: | **Offer No. 557/2020/17. 6. 2020** |
| Responsible investigator: | **Simon Grum, mag. inž. str.** |
| Head of laboratory: | **Friderik Knez, univ. dipl. fiz.** |
| Director: | **doc. dr. Aleš Žnidarič, univ. dipl. inž. grad.** |
| Date: | |

The report was internally reviewed and approved by all listed persons, which is confirmed by the electronic signature. Document authenticity check: www.zag.si/pristnost

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Total number of pages: 38; number of annexes: 7.

# Table of contents

# 1. General

| | |
|---|---|
| Product: | 200 mm thick semi pre-fabricated lightweight loadbearing concrete ceiling slab **MARANA EUROPAN** |
| Supplier: | **MARANA d.o.o.**, Kurtovići 21, HR-21231 Klis, Croatia |
| Manufacturer: | **MARANA d.o.o.**, Kurtovići 21, HR-21231 Klis, Croatia |

# 2. Sampling

The test specimen was sampled and delivered by the supplier to the Fire laboratory on 13th March 2023.

Sample No.: P23/044

# 3. Description of the product

All dimensions in test report are in millimetres.

Supplier delivered one 200 mm thick pre-fabricated loadbearing ceiling **MARANA EUROPAN**, of dimensions 2190 × 6800 × 200. In addition to test specimen, one sample of filling element dimensions 675 × 600 × 145 was delivered to the laboratory.

The test specimen was closing the top opening of a combo furnace of dimensions 4000 × 6000 × 4000. The part of the furnace that was not covered by the test specimen was covered with aerated concrete slabs.

## 3.1 Composition of the test specimen

Test specimen was light slab construction made of pre-fabricated elements. The loadbearing of the slab was provided using four main beams, positioned 680 mm apart, with a width of 120 mm and a thickness of 35 mm. Distance between the top and the bottom reinforcement was 160 mm. In the main beam, three reinforcement bars with a diameter of 14 mm and two reinforcement bars with a diameter of 10 mm were placed. The diameter of the top reinforcement bar was 10 mm. In between main beams, filling elements of dimensions 600 × 680 × 150 mm were placed on the beams. On top, top-zone reinforcement mesh Q 196 was placed over the entire surface of the slab. In between filling elements, perpendicular reinforcement Ø8 mm beam bars were placed in top- and bottom-zone. Top surface and all cavities between filling elements were cast with C25/30 concrete (in Annex No. 6 compressive strength test report from 29. 11. 2021). Measured moisture content at the day of the test in the concrete was 1,6 moisture content in % of dry weight. Measurement was made close to the centre of the test specimen with Gann Hydromette HT 85 T.

Filling elements were made of formed KEMOPOR EPS100 blocks (declaration of conformity in Annex No. 6) with a thickness of 125 mm, produced by the company Kamenović d.o.o., that were casted with Keramzit (Liapor) C16/20 concrete with expanded clay aggregate, produced by the company Lias Österreich GesmbH (certificate in Annex No. 6). Keramzit concrete was reinforced over the entire surface of each filling element with 50 × 50 mm grid galvanized mesh with 2 mm diameter bars.

*Details of the test specimen are shown in the documentation provided by the sponsor in Annex No. 6.*

## 3.2 Composition of the supporting construction

Test specimen was positioned on two steel beams HEA 160, of dimensions 152 × 160 × 2180 mm. Over each HEA 160 beam, 25 mm thick ceramic wool was laid in order to protect the supporting construction from heat exposure. In addition to ceramic wool, mineral wool lamellas were placed in the cavity of each beam. Test specimen was laid on top of each insulated beam. In addition to the ceramic wool insulation, rock wool slabs of dimensions 100 × 160 mm were placed in front of each support beam towards the opening in the frame.

The distance between the centres of the supports was 6400 mm.

## 3.3 Sealing materials

Gaps and cavities between the test specimen and the aerated concrete slabs, placed at the sides of the test specimen, were sealed by means of 25 mm thick ceramic wool in such a way that bending of the test specimen was allowed.

## 3.4 Composition of the additional sample panel

The supplier provided one additional sample of filling element dimensions 675 × 600 × 145.

The additional filling element sample had following structure:

- thickness of the sample was 145 mm;
- filling elements were made of formed 125 mm thick KEMOPOR EPS100 blocks, produced by the company Kamenović d.o.o., with a nominal density of 20 kg/m$^3$;
- EPS 100 blocks were casted with 20 mm thick Keramzit (Liapor) C16/20 concrete with expanded clay aggregate, produced by the company Lias Österreich GesmbH;
- Keramzit (Liapor) concrete was reinforced with 50 × 50 mm grid galvanized mesh with 2 mm diameter bars over the entire bottom surface of the filling element ;
- measured moisture content in the concrete was 1,6 moisture content in % of dry weight.

*Details of the test specimen are shown in the documentation provided by the sponsor in Annex No. 6.*

## 3.5 Number of test specimens

The test was performed at the same time on one test specimen.

## 3.6 Applied loading

The 200 mm thick semi pre-fabricated lightweight loadbearing concrete ceiling slab **MARANA EUROPAN** was loaded using 112 weights, each with a weight of 20 kg, equally distributed over the surface of the test specimen. By the request of the sponsor the test load applied on the test specimen surface was 150 kg/m$^2$.

*Details of the distribution of the loading are shown in the drawing in Annex No. 1.*

# 4. Conditioning of the specimen

Before the test the test specimen was for 33 days in the Fire laboratory where the temperature was around 17 °C and relative humidity around 54 %.

# 5. Date of test

25th April 2023

# 6. Testing procedure

The test was carried out according to SIST EN 1363-1:2020 (identical to EN 1363-1:2020) and SIST EN 1365-2:2014 (identical to EN 1365-2:2014).

Representatives of the customer were present at the test.

## 6.1 Test conditions

- the furnace 4000 × 6000 and 4000 deep was oil and gas fired;
- the ambient temperature at the commencement of the test: 17 °C;
- air moisture content at the commencement of the test: 54 %.

## 6.2 Temperature inside the furnace

The temperature inside the furnace was measured by means of ten plate thermocouples NiCr-Ni. These thermocouples extended through the aerated concrete slabs into the burning space to approximately 100 mm from the exposed face of the test specimen. The furnace temperature rise was continuously controlled such that it follows the standard time-temperature curve within the accuracy specified in EN 1363-1:2020:

$$T = 345 \log_{10}(8t + 1) + 20$$

T ..... temperature inside the furnace in °C
t ..... time in minutes

*The sketch of the furnace temperature measuring points is in Annex No. 1.*

*The diagram and the table of the temperatures inside the furnace are in Annex No. 2.*

## 6.3 Preliminary measurements

During the specimen construction the construction details were verified and proved to be in concordance with enclosed documentation.

## 6.4 Overpressure inside the furnace

The overpressure inside the furnace was measured by means of one pressure transducer Furness Controls FCO432, computer and appropriate software. It was controlled by means of three dampers inside the exhaust in such a way that the overpressure inside the furnace 100 mm below the exposed face of the test specimen was approximately 20 Pa. The pressure was measured approximately 0,9 m below the exposed face of the test specimen, so that the target pressure at the measuring location was 13,2 Pa.

*The diagram of the overpressure measuring is in Annex No. 3.*

## 6.5 Temperature rise on the unexposed surface of the test specimen

The temperature rise on the unexposed face of the test specimen was measured by means of 11 thermocouples NiCr-Ni. The thermocouples for surface temperature measurement consist of a 0.2 mm thick by 12 mm diameter copper discs, to which 0.5 mm in diameter NiCr-Ni thermocouples are soldered. The thermocouples were covered with a 30 mm square by 2 mm thick insulating pads of density approximately 900 kg/m$^3$ regarding to standard EN 1363-1:2020. All thermocouples were kept in position by means of inorganic glue.

The temperature rise was measured at the following points on the unexposed face:

*Measuring of the average temperature rise (criteria 140K) and maximum temperature rise (criteria 180K):*

Measuring point No. 1 ..... at the centre of the test specimen;
Measuring points No. 2 to 5..... at the centre of each of the four quarters of the test specimen;

*Measuring of the maximum temperature rise (criteria 180K):*

Measuring points No. 6 and 7 .. ….. in line with precast loadbearing ceiling beams, thermocouple at the centre of a beam, in line with measuring points 2 and 3;
Measuring points No. 8 and 9... ……in line with precast loadbearing ceiling beams, thermocouple at the centre of a beam, in line with measuring point 1;
Measuring points No. 10 and 11…...in line with precast loadbearing ceiling beams, thermocouple at the centre of a beam, in line with measuring points 4 and 5.

*The sketch of the unexposed face temperature measuring points is in Annex No. 1.*

*The diagrams and the tables of the temperature rise on the unexposed face of the test specimen are in Annex No. 4.*

## 6.6 Deflection of the test specimen

Throughout the test the measurements of the deflection of the test specimen with accuracy ± 0.5 mm were made. Dimensions used for calculations were measured directly on the test specimen.

Failure is deemed to have occurred when, after the commencement of the test;

Limiting deflection: $D_{limit} = \frac{L^2}{400 \cdot d} = \frac{6400^2}{400 \cdot 210}$ = 487,6 mm

and

Limiting rate of deflection: $\left(\frac{dD}{dt}\right)_{limit} = \frac{L^2}{9000 \cdot d} = \frac{6400^2}{9000 \cdot 210}$ = 21,7 mm/min

are exceeded, or when measured deflection is greater than 1,5 · $D_{limit}$.

Maximum deflection: $D = 1{,}5 \cdot D_{limit} = \frac{1{,}5 \cdot L^2}{400 \cdot d} = \frac{1{,}5 \cdot 6400^2}{400 \cdot 210}$ = 731,4 mm

*The sketch of the deflection measuring points is in Annex No. 1.*

## 6.7 Deviations from the testing procedure

Due to the furnace error, the furnace burners shut down several times during the testing time. The burners shut down six times; in 21st, 48th, 59th, 75th, 96th and 106th minute. As a result of shut down burners, the standard time-temperature curve (described in Clause 6.2) limits were exceeded. The testing time was extended to cover the period when the furnace temperature was not in the limits, to reach fully valid testing conditions for classification time 90 minutes.

# 7. Observations during the test

## 7.1 Visual observation

| TIME [min] | SIDE | OBSERVATION |
|---|---|---|
| 0 | | The test commenced; |
| 15 | | Smoke leakage at the short edge; |
| 122 | | The test was discontinued on the sponsor's request. |

## 7.2 Deflection of the test specimen

The deflection of the test specimen was measured at three positions. Measuring points I and III were positioned at mid-width of the test specimen at one third of the span length. Measuring point II was positioned at the centre of the test specimen.

The test specimen was loaded for at least 15 minutes before the commencement of the test.

The positive values mean bending of the test specimen into the furnace.

| Time | DEFORMATION ON MEASURING POINT [mm] | | | Remark |
|---|---|---|---|---|
| [min] | I | II | III | |
| / | 0 | 0 | 0 | before the load was applied (*note: at least) |
| / | 1 | 5 | 3 | after the load was applied (*note: at least) |
| / | 1 | 5 | 3 | after the load was applied for 20 minutes |
| / | 1 | 5 | 3 | after the load was applied for 40 minutes |
| 0 | 0 | 0 | 0 | deformations: after the test commenced |
| 1 | 0 | 0 | 0 | |
| 5 | 6 | 9 | 7 | |
| 9 | 17 | 24 | 17 | |
| 13 | 24 | 33 | 25 | |
| 17 | 29 | 38 | 29 | |
| 21 | 33 | 43 | 33 | |
| 25 | 37 | 48 | 37 | |
| 29 | 43 | 58 | 43 | |
| 33 | 52 | 70 | 52 | |
| 37 | 62 | 83 | 61 | |
| 41 | 71 | 95 | 71 | |

| Time | DEFORMATION ON MEASURING POINT [mm] | | | Remark |
|---|---|---|---|---|
| [min] | I | II | III | |
| 45 | 79 | 107 | 80 | |
| 49 | 87 | 118 | 88 | |
| 53 | 93 | 125 | 94 | |
| 57 | 99 | 134 | 101 | |
| 61 | 107 | 144 | 109 | |
| 65 | 110 | 150 | 112 | |
| 69 | 117 | 158 | 119 | |
| 73 | 123 | 167 | 127 | |
| 77 | 128 | 174 | 132 | |
| 81 | 129 | 175 | 133 | |
| 85 | 131 | 179 | 135 | |
| 89 | 138 | 187 | 141 | |
| 93 | 144 | 196 | 147 | |
| 97 | 150 | 204 | 153 | |
| 101 | 153 | 208 | 157 | |
| 105 | 158 | 216 | 162 | |
| 109 | 165 | 226 | 168 | |
| 113 | 170 | 232 | 172 | |
| 117 | 178 | 243 | 180 | |
| 121 | 186 | 254 | 189 | |

## 7.3 Integrity

The integrity of the test specimen was not lost during the testing time.

## 7.4 Insulation

The average temperature rise 140 K on the unexposed face of the test specimen was not exceeded during the testing time.

The maximum temperature rise 180 K on the unexposed face of the test specimen was not exceeded during the testing time.

## 7.5 Load-bearing capacity

The load-bearing capacity of the test specimen was not lost during the testing time.

# 8. Test results

**NOTE:** As described in the Clause 6.7 the testing time was intentionally extended to cover the testing time where the temperature conditions in the furnace was not reached, to achieve fully valid testing conditions for classification time of 90 minutes.

| | | |
|---|---|---|
| INSULATION - **I**: | Average temperature | 90 minutes, no failure |
| | Maximum temperature | 90 minutes, no failure |
| INTEGRITY - **E**: | Sustained flaming | 90 minutes, no failure |
| | Cotton pad test | 90 minutes, no failure |
| | Gap gauge $\phi$ 6 mm | 90 minutes, no failure |
| | Gap gauge $\phi$ 25 mm | 90 minutes, no failure |
| LOADBEARING CAPACITY - **R**: | Maximum deflection | 90 minutes, no failure |

| | |
|---|---|
| Maximum rate of deflection and deflection | 90 minutes, no failure |

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.

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.

# 9. Field of direct application of tested results

The test results are directly applicable to similar constructions where one or more of the changes listed below are made and the construction continues to comply with the appropriate design code for its stiffness and stability. Other changes are not permitted.

## 9.1 Moments and shear forces

The maximum moments and shear forces, which when calculated on the same basis as the test load, shall not be greater than those tested.

# 10. Annexes

1 ..... temperature and deflection measuring points and load distribution (2 pages)
2……..diagram and table of furnace temperature rise (2 pages)
3……..diagram of overpressure in the furnace (1 page)
4 ..... diagrams and tables of temperatures in the test specimen and temperature rise on the unexposed face (4 pages)
5 ..... ambient temperature (1 page)
6 ..... documentation provided by the sponsor (8 pages)
7 ..... 19 photographs (10 pages):

Photo No. 046997d-001: test specimen supporting construction

Photo No. 046997d-002: test specimen laid on the supporting construction

Photo No. 046997d-019: test specimen placed on the test frame and slabs placed at the longer edges

Photo No. 046997d-025: measuring of moisture content in the test specimen

Photo No. 046997d-020: short edge of the test specimen

Photo No. 046997d-027: exposed face before the commencement of the test

Photo No. 046997d-028: exposed face before the commencement of the test

Photo No. 046997d-029: exposed face before the commencement of the test

Photo No. 046997d-050: loaded test specimen at the commencement of the test

Photo No. 046997d-058: 16th minute of the test

Photo No. 046997d-069: 30th minute of the test

Photo No. 046997d-081: 46th minute of the test

Photo No. 046997d-094: 61st minute of the test

Photo No. 046997d-123: 91st minute of the test

Photo No. 046997d-151: 122nd minute of the test

Photo No. 046997d-155: unexposed face at the end of the test

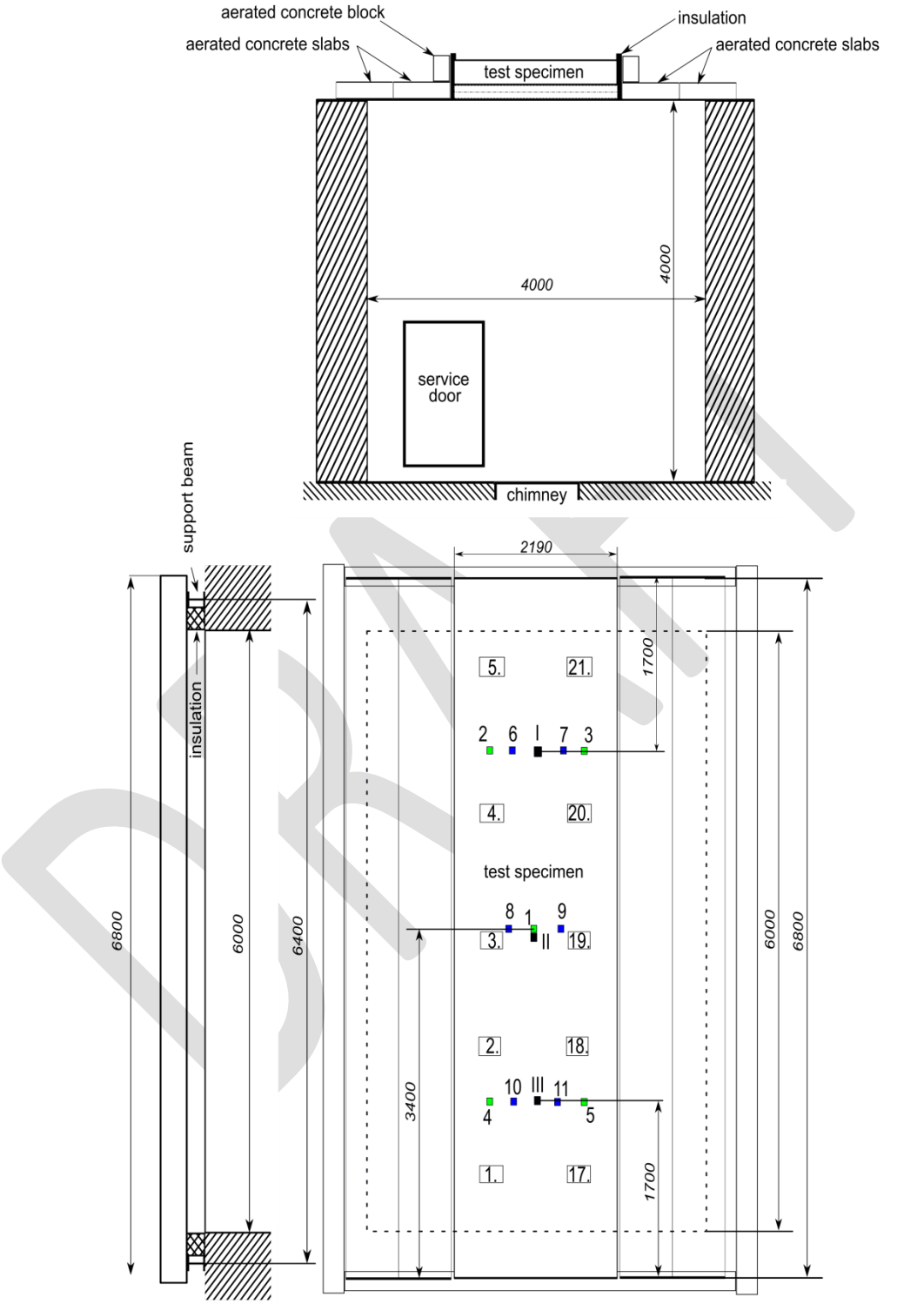
Photo No. 046997d-161: exposed face at the end of the test

Photo No. 046997d-162: exposed face at the end of the test

Photo No. 046997d-163: exposed face at the end of the test

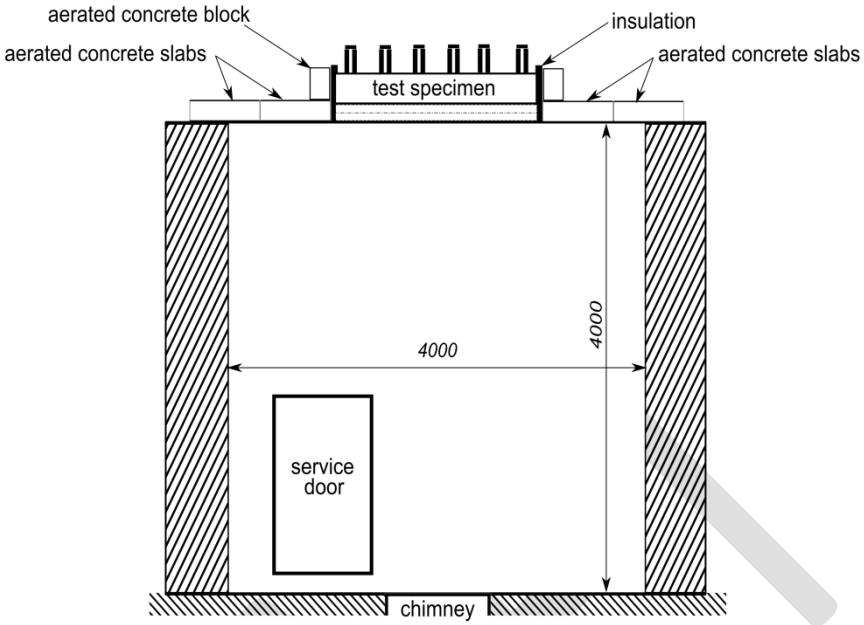
Report was prepared by: Simon Grum, mag. inž. str.

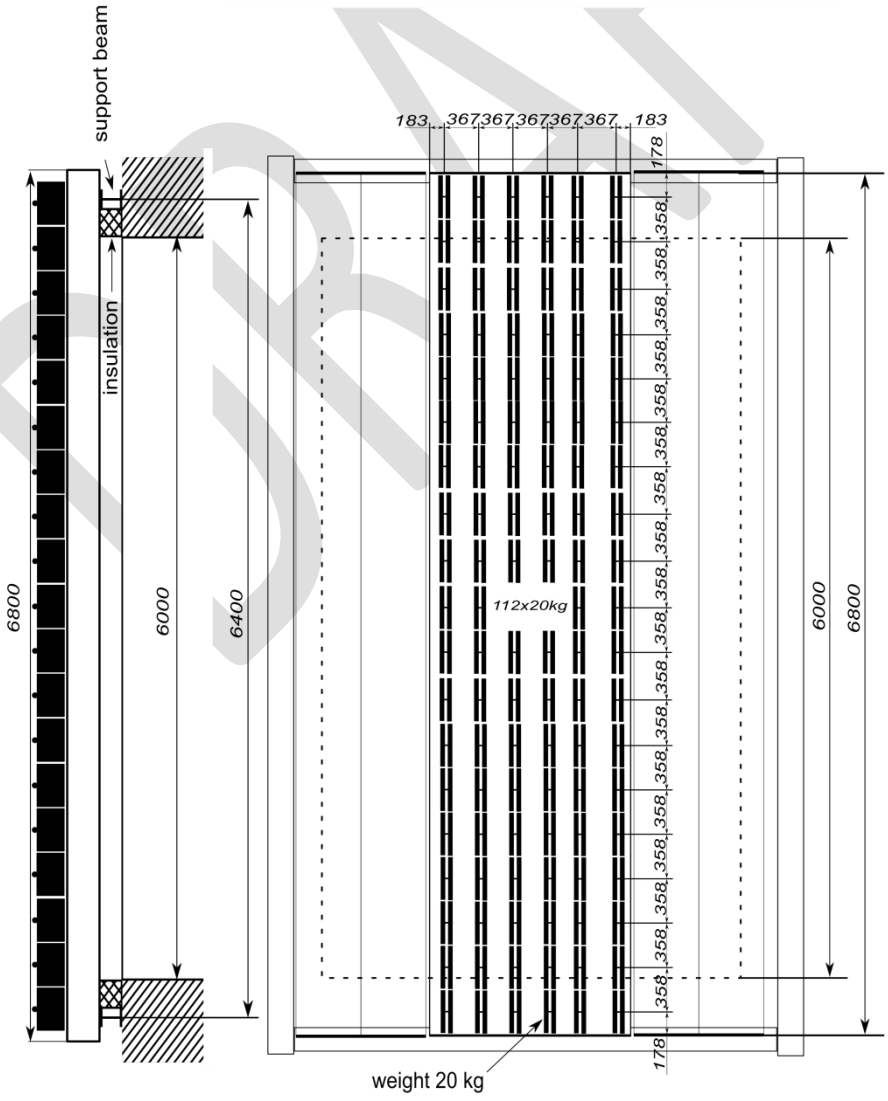
# TEMPERATURE AND DEFLECTION MEASURING POINTS



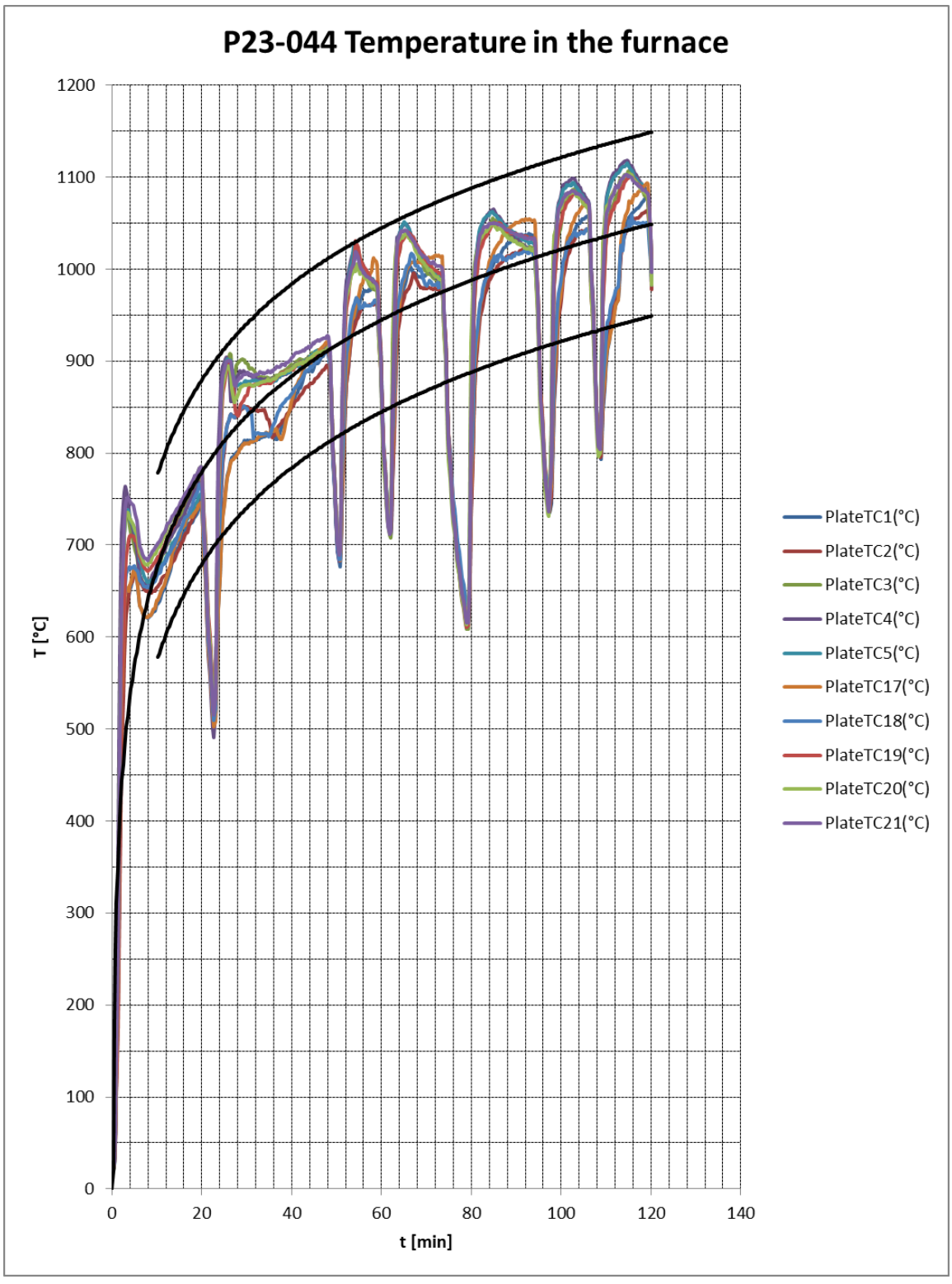

- *Thermocouples for average temperature rise (criteria 140K) and maximum temperature rise (criteria 180K)*
- *Thermocouples for maximum temperature rise (criteria 180K)*
- *Deformation measuring points*
- *Plate thermocouples for furnace control*

## LOAD DISTRIBUTION



## FURNACE TEMPERATURE

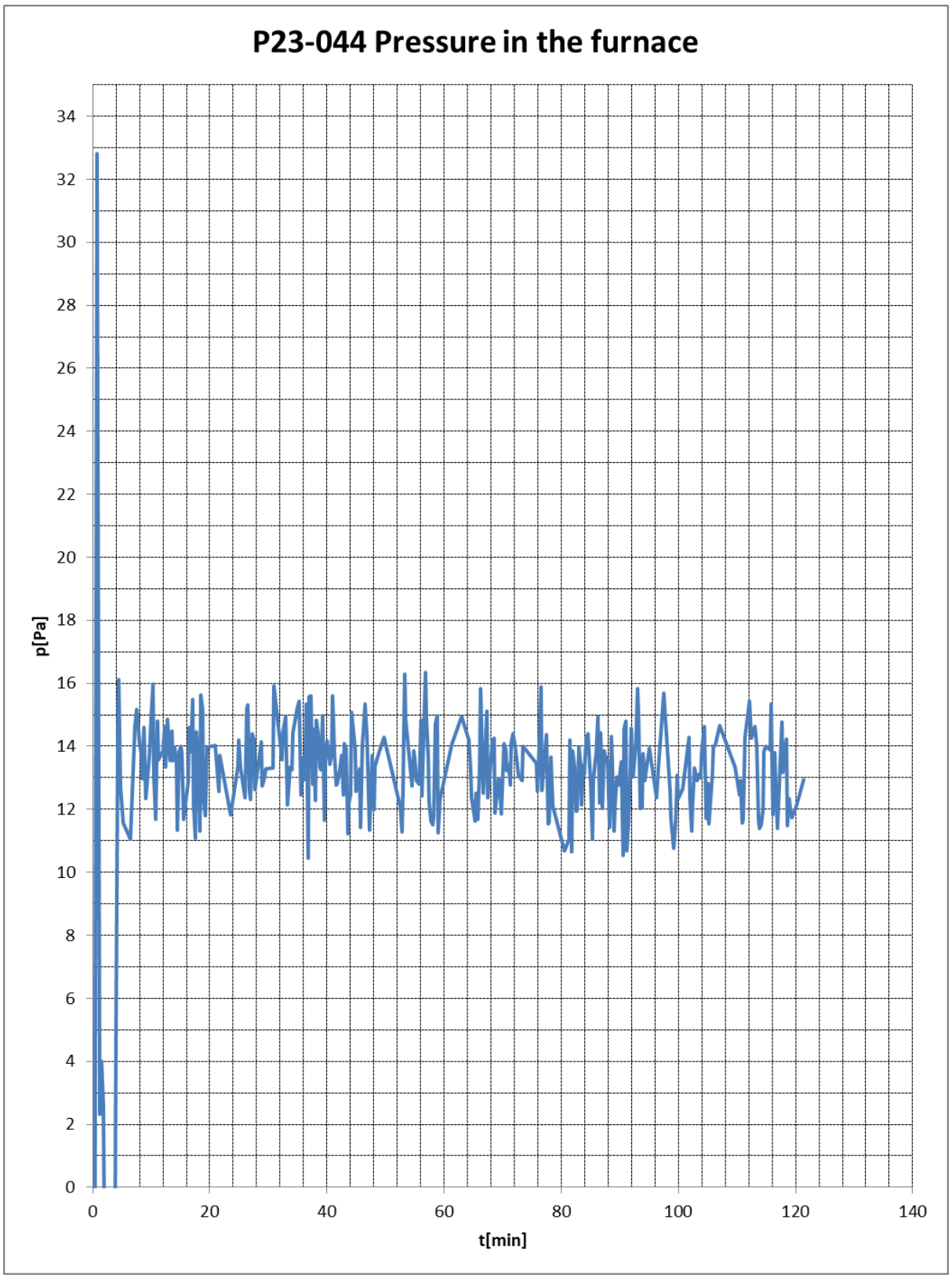



NOTE: The burners shut down six times during the testing time, in 21st, 48th, 59th, 75th, 96th and 106th minute. The testing time was extended to cover the period when the furnace was shut down.

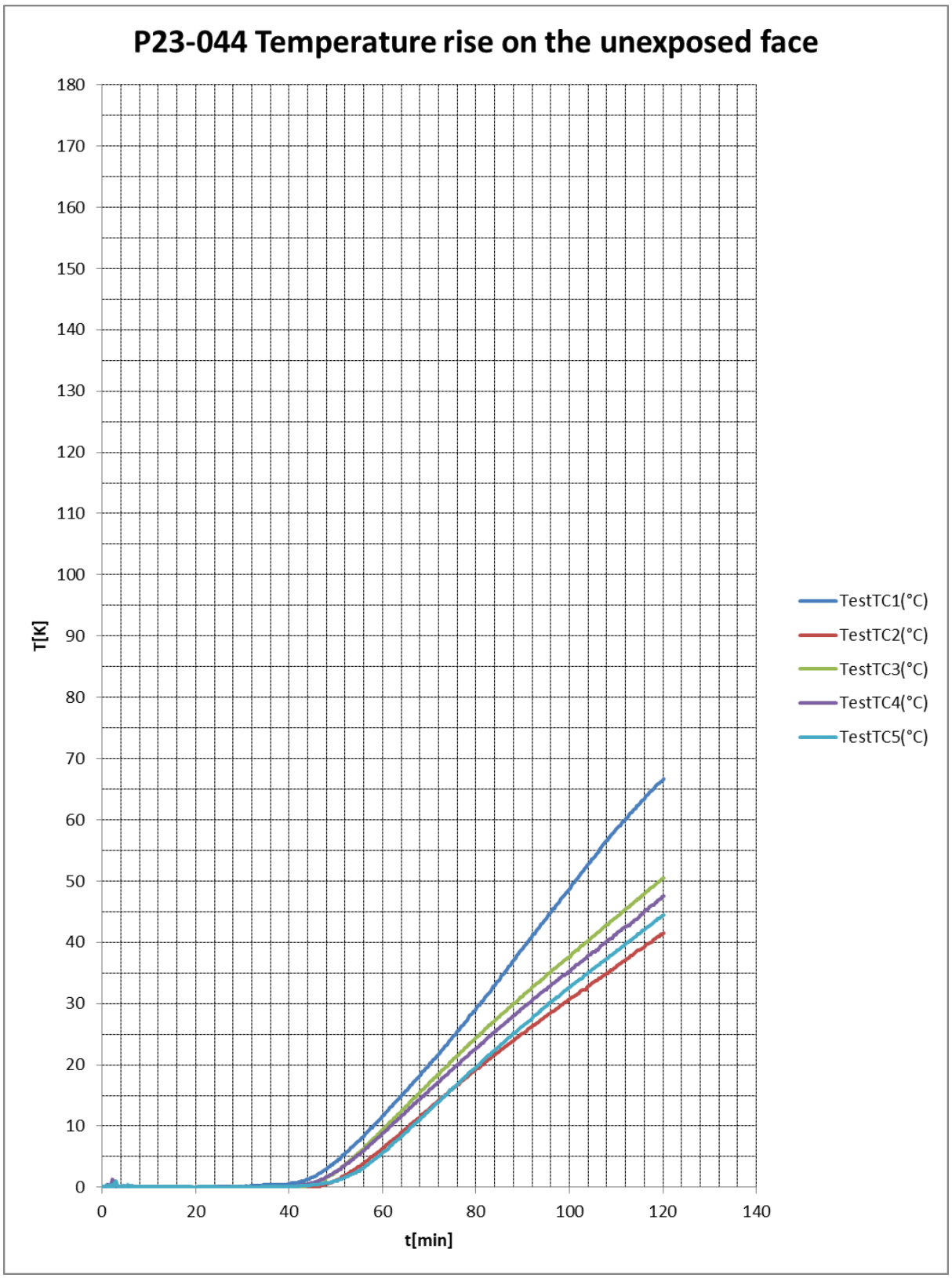
## FURNACE TEMPERATURE

| Time [min] | Requested furnace temp. [°C] | Average furnace temp. [°C] | Tolerance [%] | Percentage deviation [%] |
|---|---|---|---|---|
| 0 | 20 | 20 | | |
| 4 | 544 | 700 | | 28,75 |
| 8 | 645 | 656 | ± 15 | 14,06 |
| 12 | 705 | 689 | ± 14 | 7,95 |
| 16 | 748 | 731 | ± 12 | 5,04 |
| 20 | 781 | 748 | ± 10 | 2,93 |
| 24 | 809 | 753 | ± 8 | 1,05 |
| 28 | 832 | 853 | ± 6 | 1,30 |
| 32 | 851 | 858 | ± 4,8 | 1,22 |
| 36 | 869 | 859 | ± 4,5 | 0,91 |
| 40 | 885 | 879 | ± 4,1 | 0,73 |
| 44 | 899 | 899 | ± 3,8 | 0,65 |
| 48 | 912 | 911 | ± 3,5 | 0,57 |
| 52 | 924 | 915 | ± 3,1 | 0,43 |
| 56 | 935 | 988 | ± 2,8 | 0,87 |
| 60 | 945 | 867 | ± 2,5 | 0,16 |
| 64 | 955 | 1000 | ± 2,5 | 0,49 |
| 68 | 964 | 1011 | ± 2,5 | 0,79 |
| 72 | 973 | 994 | ± 2,5 | 0,88 |
| 76 | 981 | 739 | ± 2,5 | -0,67 |
| 80 | 988 | 795 | ± 2,5 | -1,76 |
| 84 | 996 | 1029 | ± 2,5 | -1,48 |
| 88 | 1003 | 1034 | ± 2,5 | -1,24 |
| 92 | 1009 | 1030 | ± 2,5 | -1,07 |
| 96 | 1016 | 813 | ± 2,5 | -1,97 |
| 100 | 1022 | 1032 | ± 2,5 | -1,84 |
| 104 | 1028 | 1068 | ± 2,5 | -1,58 |
| 109 | 1034 | 828 | ± 2,5 | -2,48 |
| 113 | 1040 | 1047 | ± 2,5 | -2,35 |
| 117 | 1045 | 1083 | ± 2,5 | -2,11 |
| 121 | 1050 | 900 | ± 2,5 | -2,57 |

## OVERPRESSURE IN THE FURNACE



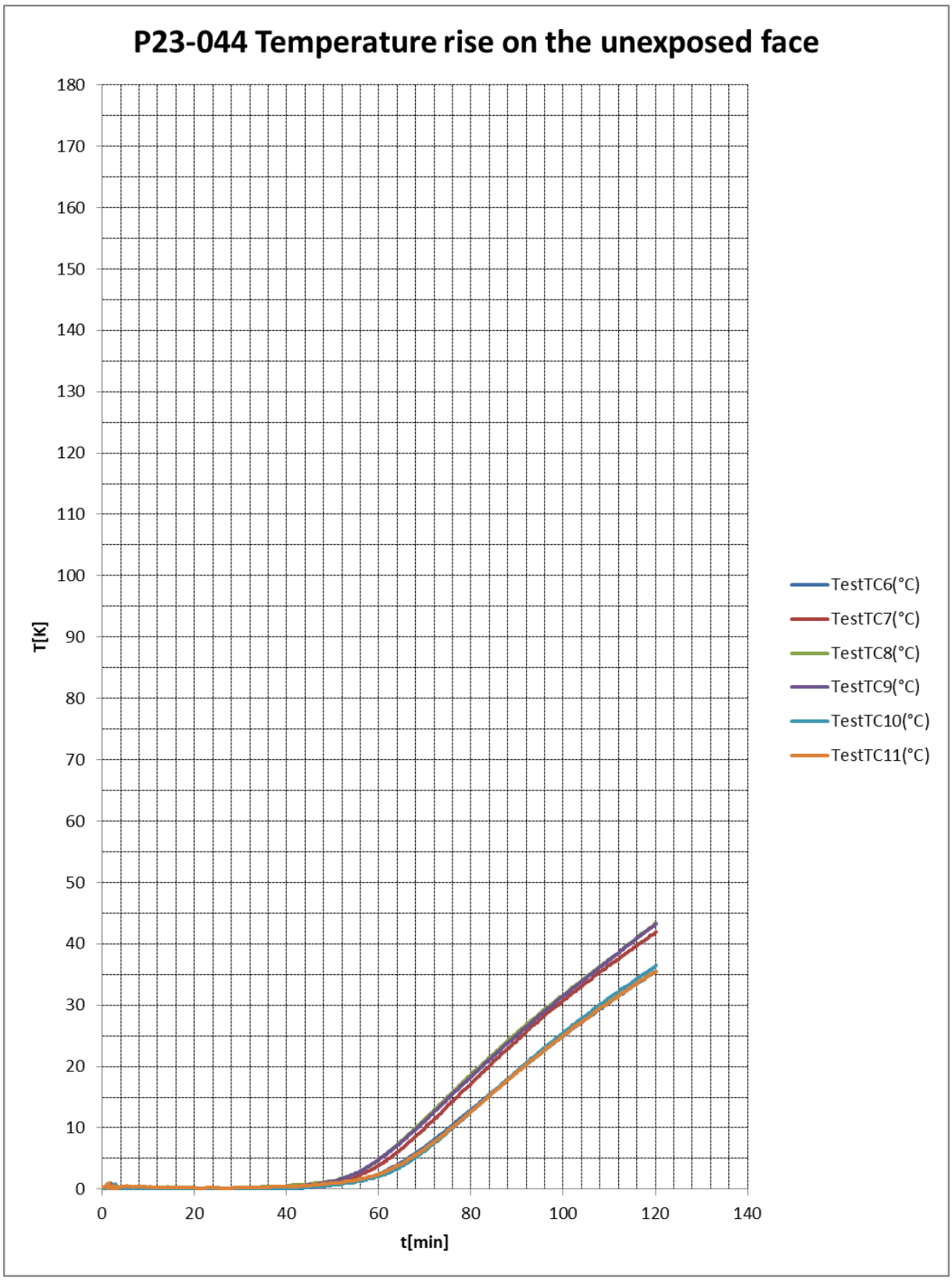
## TEMPERATURE RISE ON THE UNEXPOSED FACE



## AVERAGE AND MAXIMUM TEMPERATURE RISE ON THE UNEXPOSED FACE

| Time [min] | Temperature on measuring points 1 to 5 [K] | | | | | Average temp. [K] | Maximum temp. [K] |
|---|---|---|---|---|---|---|---|
| | TC1(°C) | TC2(°C) | TC3(°C) | TC4(°C) | TC5(°C) | | |
| 0 | 0,2 | -0,6 | -0,4 | 0,0 | 0,2 | -0,2 | 0,2 |
| 4 | 0,2 | -0,6 | -0,3 | 0,1 | 0,1 | -0,1 | 0,2 |
| 8 | 0,1 | -0,6 | -0,4 | 0,1 | 0,1 | -0,2 | 0,1 |
| 12 | 0,1 | -0,6 | -0,4 | | 0,1 | -0,2 | 0,1 |
| 16 | 0,1 | -0,6 | -0,4 | 0,0 | 0,1 | -0,2 | 0,1 |
| 20 | 0,0 | -0,6 | -0,4 | -0,1 | 0,0 | -0,2 | 0,0 |
| 24 | 0,1 | -0,6 | -0,4 | -0,1 | 0,0 | -0,2 | 0,1 |
| 28 | 0,2 | -0,6 | -0,3 | -0,1 | 0,0 | -0,2 | 0,2 |
| 32 | 0,3 | -0,6 | -0,3 | -0,1 | | -0,2 | 0,3 |
| 36 | 0,4 | -0,5 | -0,2 | 0,0 | 0,1 | -0,1 | 0,4 |
| 40 | 0,6 | -0,5 | -0,1 | 0,1 | 0,1 | 0,0 | 0,6 |
| 44 | 1,3 | -0,2 | 0,3 | 0,5 | 0,3 | 0,4 | 1,3 |
| 48 | 3,0 | 0,5 | 1,6 | 1,7 | 0,7 | 1,5 | 3,0 |
| 52 | 5,5 | 2,0 | 3,7 | 3,6 | 1,6 | 3,3 | 5,5 |
| 56 | 8,4 | 4,0 | 6,4 | 6,1 | 3,2 | 5,6 | 8,4 |
| 60 | 11,6 | 6,4 | 9,4 | 8,8 | 5,6 | 8,3 | 11,6 |
| 64 | 14,9 | 8,9 | 12,4 | 11,6 | 8,3 | 11,2 | 14,9 |
| 68 | 18,3 | 11,5 | 15,5 | 14,4 | 11,1 | 14,2 | 18,3 |
| 72 | 21,8 | 14,2 | 18,5 | 17,2 | 14,0 | 17,1 | 21,8 |
| 76 | 25,4 | 16,7 | 21,5 | 20,0 | 16,8 | 20,1 | 25,4 |
| 80 | 29,2 | 19,2 | 24,4 | 22,7 | 19,6 | 23,0 | 29,2 |
| 84 | 33,0 | 21,7 | 27,2 | 25,4 | 22,4 | 25,9 | 33,0 |
| 88 | 37,0 | 24,0 | 29,9 | 28,0 | 25,1 | 28,8 | 37,0 |
| 92 | 41,0 | 26,3 | 32,6 | 30,5 | 27,6 | 31,6 | 41,0 |
| 96 | 45,0 | 28,5 | 35,2 | 33,0 | 30,3 | 34,4 | 45,0 |
| 100 | 48,7 | 30,7 | 37,7 | 35,3 | 32,7 | 37,0 | 48,7 |
| 104 | 52,7 | 32,8 | 40,2 | 37,8 | 35,1 | 39,7 | 52,7 |
| 109 | 57,2 | 35,3 | 43,2 | 40,5 | 37,7 | 42,8 | 57,2 |
| 113 | 60,6 | 37,5 | 45,8 | 42,8 | 40,1 | 45,3 | 60,6 |
| 117 | 64,0 | 39,6 | 48,3 | 45,4 | 42,5 | 48,0 | 64,0 |
| 121 | 67,1 | 41,9 | 50,9 | 47,9 | 44,8 | 50,5 | 67,1 |

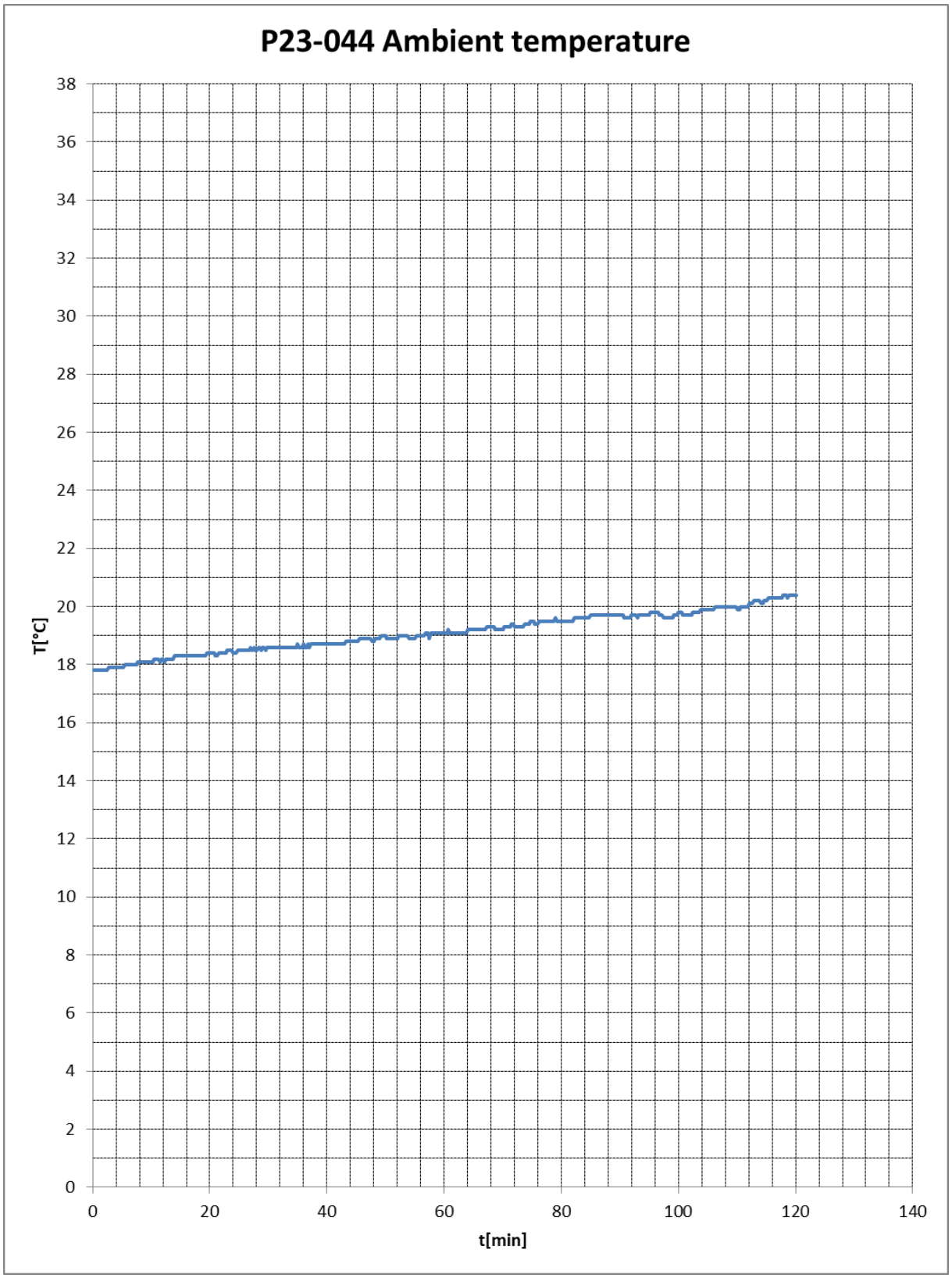
## MAXIMUM TEMPERATURE RISE ON THE UNEXPOSED FACE



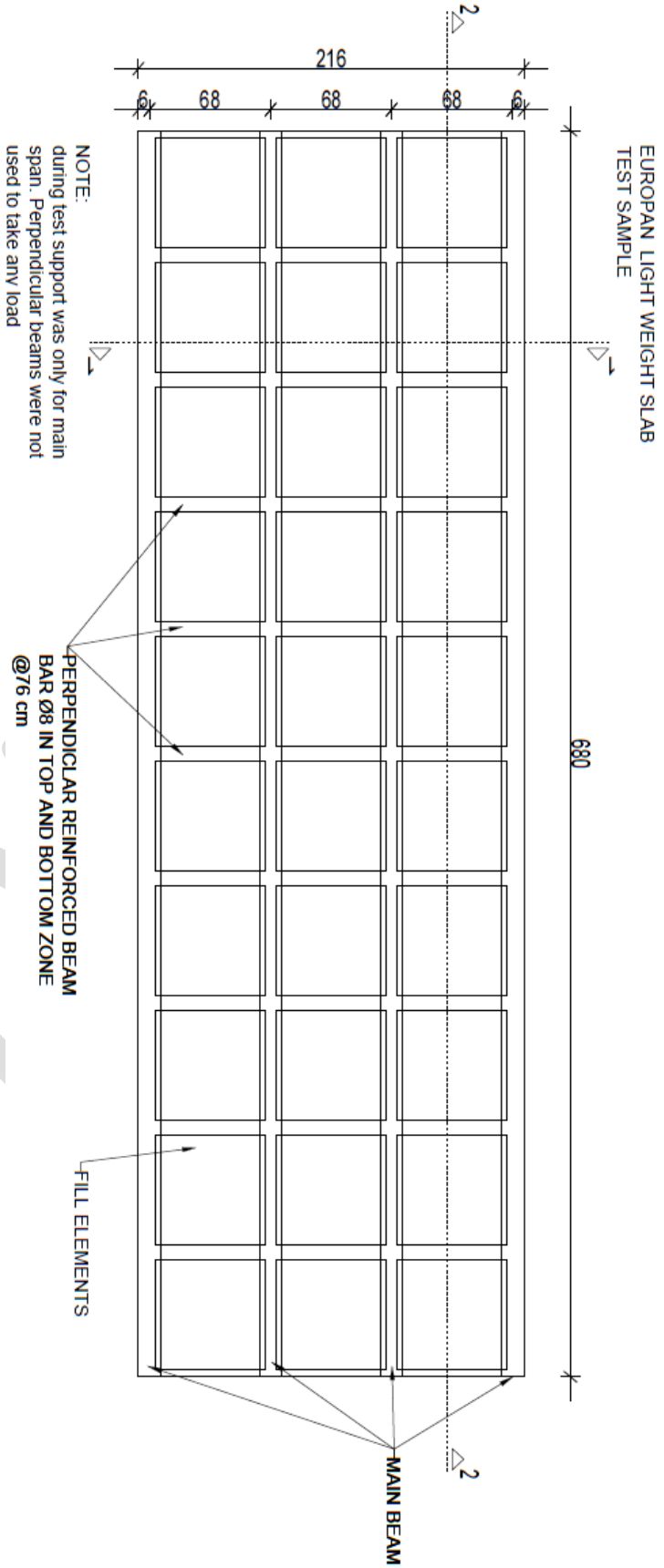
## MAXIMUM TEMPERATURE RISE ON THE UNEXPOSED FACE

| Time [min] | Temperature on measuring points 6 to 11 [K] | | | | | | Maximum temp. [K] |
|---|---|---|---|---|---|---|---|
| | TC6(°C) | TC7(°C) | TC8(°C) | TC9(°C) | TC10(°C) | TC11(°C) | |
| 0 | 0,0 | 0,1 | 0,2 | 0,0 | 0,1 | 0,3 | 0,3 |
| 4 | | 0,0 | 0,2 | 0,0 | 0,1 | 0,4 | 0,4 |
| 8 | 0,0 | 0,0 | 0,2 | 0,0 | 0,1 | 0,4 | 0,4 |
| 12 | 0,0 | 0,1 | 0,1 | -0,1 | | 0,3 | 0,3 |
| 16 | -0,1 | 0,0 | 0,1 | 0,0 | 0,0 | 0,3 | 0,3 |
| 20 | -0,1 | 0,0 | 0,1 | 0,0 | -0,1 | 0,3 | 0,3 |
| 24 | -0,1 | 0,0 | 0,1 | -0,1 | 0,0 | 0,3 | 0,3 |
| 28 | -0,1 | 0,0 | 0,2 | 0,0 | -0,1 | 0,2 | 0,2 |
| 32 | -0,1 | 0,1 | 0,2 | 0,1 | -0,1 | 0,3 | 0,3 |
| 36 | 0,0 | 0,2 | 0,4 | 0,2 | 0,0 | 0,3 | 0,4 |
| 40 | 0,1 | 0,3 | 0,5 | 0,4 | 0,1 | 0,4 | 0,5 |
| 44 | 0,3 | 0,6 | 0,8 | 0,6 | 0,3 | 0,6 | 0,8 |
| 48 | 0,5 | 0,9 | 1,1 | 1,0 | 0,6 | 0,9 | 1,1 |
| 52 | 0,9 | 1,5 | 1,8 | 1,7 | 0,9 | 1,1 | 1,8 |
| 56 | 1,5 | 2,4 | 2,9 | 2,9 | 1,3 | 1,6 | 2,9 |
| 60 | 2,4 | 3,9 | 4,8 | 4,8 | 2,1 | 2,5 | 4,8 |
| 64 | 3,9 | 6,0 | 7,2 | 7,1 | 3,3 | 3,8 | 7,2 |
| 68 | 5,9 | 8,6 | 10,0 | 9,8 | 5,2 | 5,6 | 10,0 |
| 72 | 8,1 | 11,4 | 12,9 | 12,6 | 7,5 | 7,7 | 12,9 |
| 76 | 10,5 | 14,4 | 15,8 | 15,5 | 10,0 | 10,2 | 15,8 |
| 80 | 13,0 | 17,2 | 18,7 | 18,3 | 12,6 | 12,7 | 18,7 |
| 84 | 15,4 | 20,1 | 21,5 | 21,1 | 15,3 | 15,2 | 21,5 |
| 88 | 17,9 | 22,9 | 24,2 | 23,8 | 18,0 | 17,8 | 24,2 |
| 92 | 20,3 | 25,7 | 26,8 | 26,4 | 20,5 | 20,3 | 26,8 |
| 96 | 22,7 | 28,4 | 29,4 | 29,0 | 23,1 | 22,7 | 29,4 |
| 100 | 25,0 | 30,7 | 31,6 | 31,5 | 25,5 | 25,0 | 31,6 |
| 104 | 27,2 | 33,1 | 33,9 | 33,8 | 27,8 | 27,3 | 33,9 |
| 109 | 29,7 | 35,8 | 36,7 | 36,5 | 30,4 | 29,8 | 36,7 |
| 113 | 31,8 | 37,9 | 38,9 | 38,9 | 32,6 | 31,9 | 38,9 |
| 117 | 33,8 | 40,0 | 41,4 | 41,2 | 34,6 | 33,9 | 41,4 |
| 121 | 35,8 | 42,2 | 43,7 | 43,6 | 36,7 | 35,8 | 43,7 |

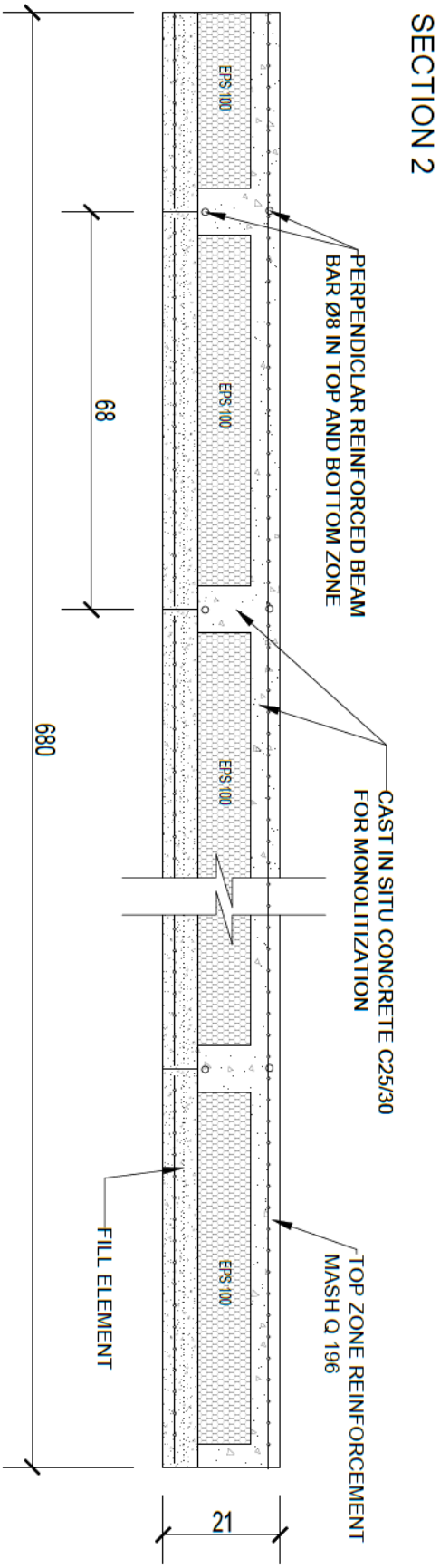
## AMBIENT TEMPERATURE



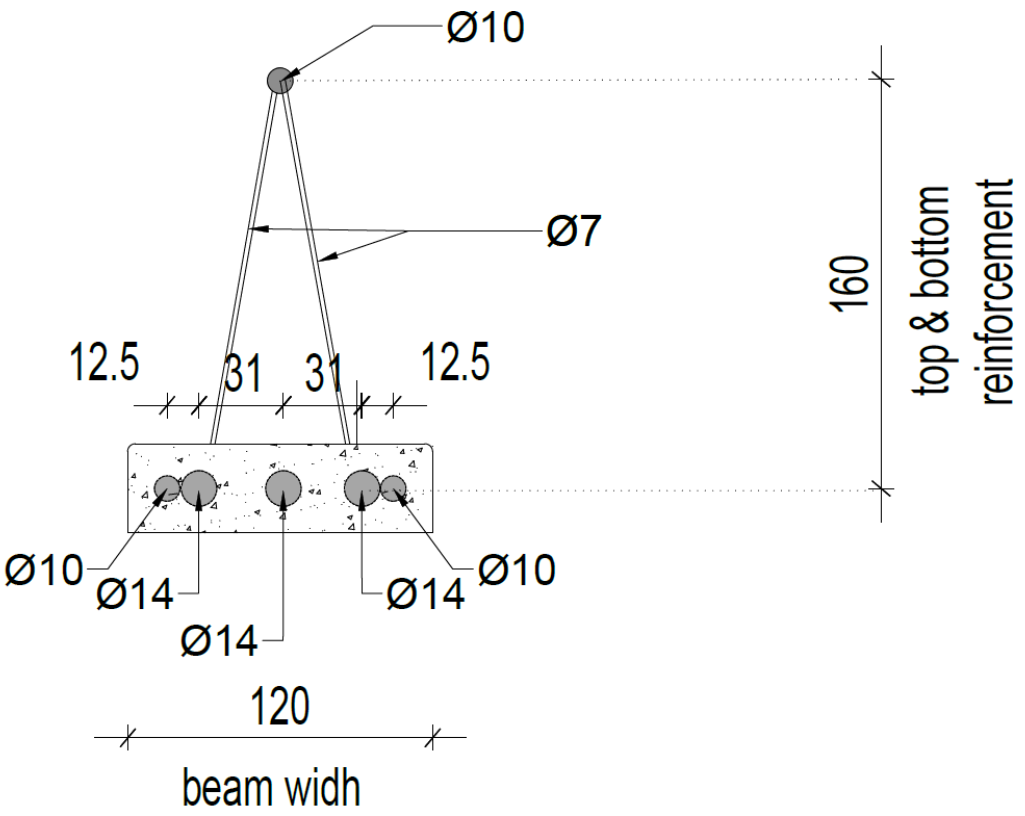
# DOCUMENTATION PROVIDED BY THE SPONSOR

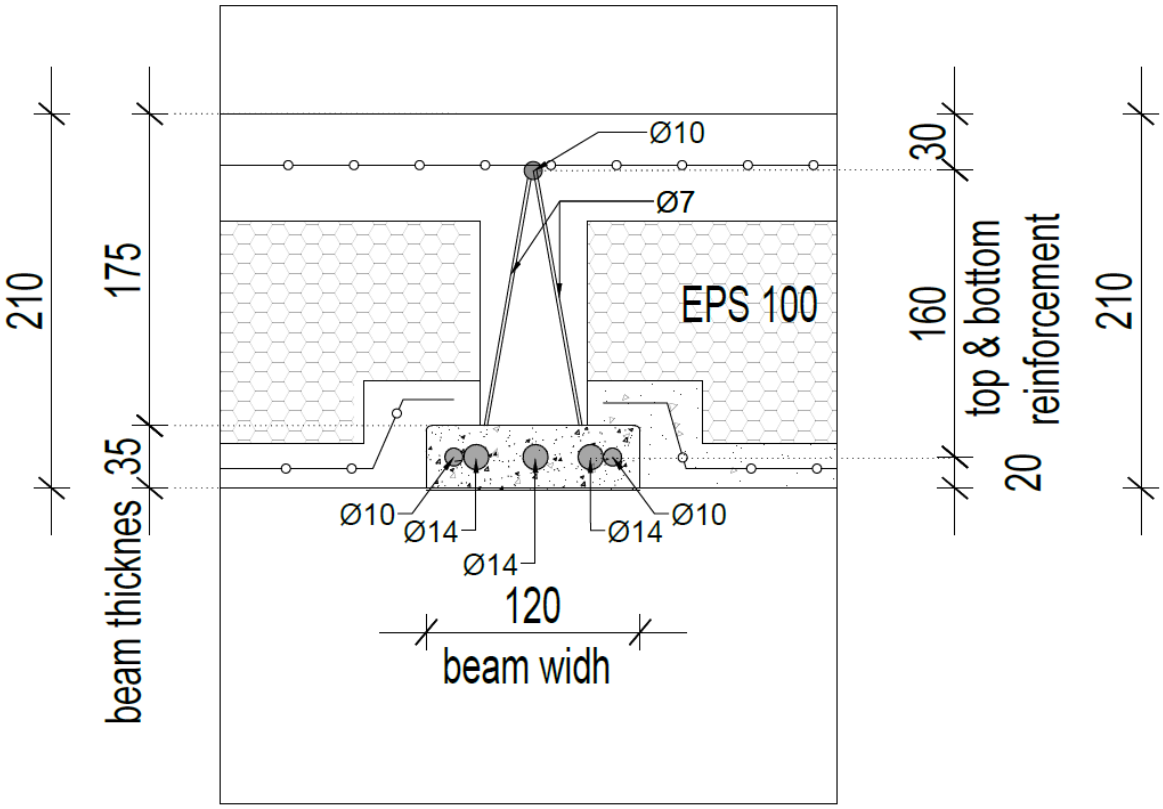


## DOCUMENTATION PROVIDED BY THE SPONSOR

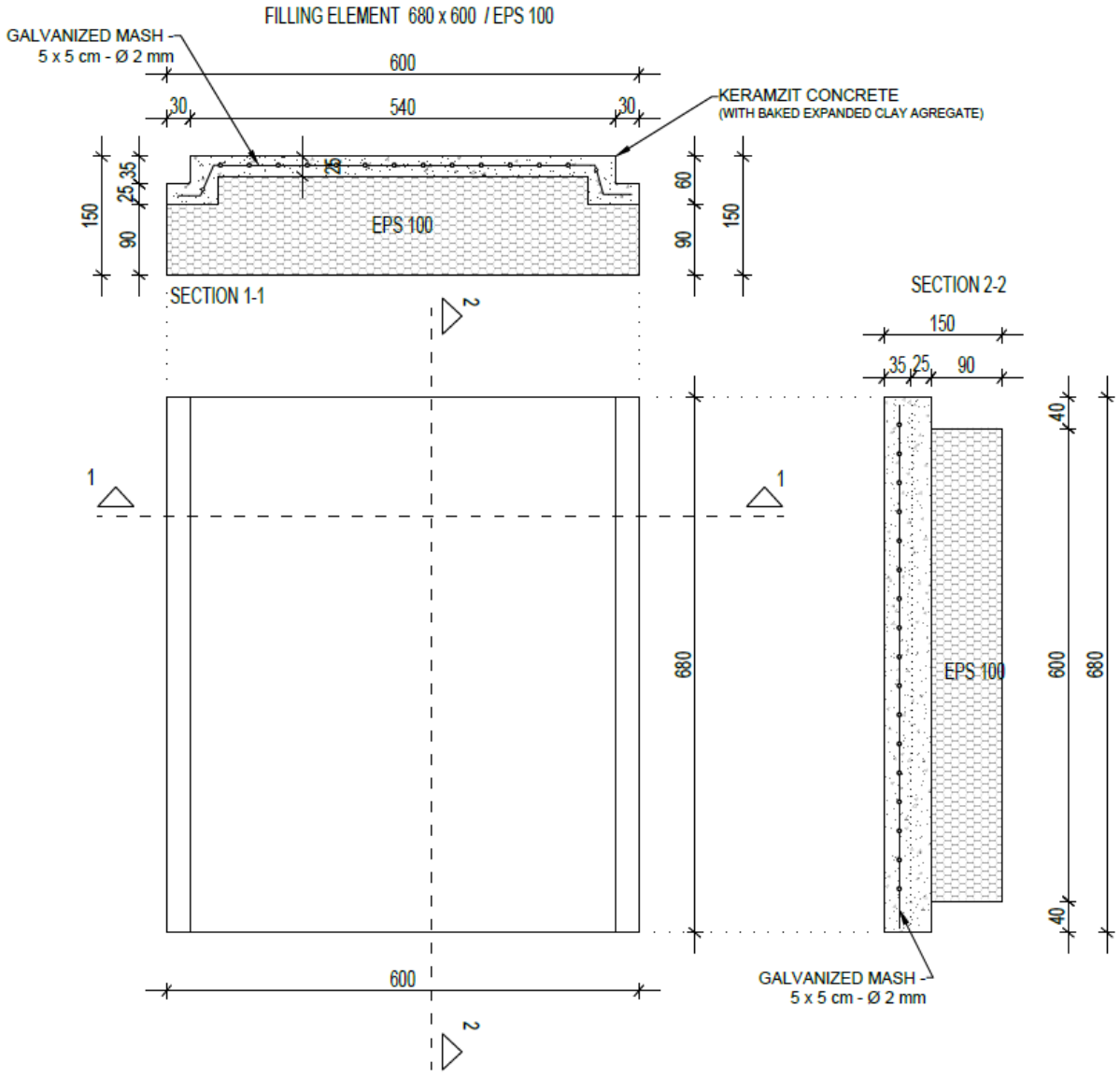


## DOCUMENTATION PROVIDED BY THE SPONSOR



## DOCUMENTATION PROVIDED BY THE SPONSOR



# DOCUMENTATION PROVIDED BY THE SPONSOR

TRIAL d.o.o., Terzićeva 17, Split
OIB:64026545644
Laboratorij: Sv.liberana 48, Split
mob. +385 989844433

**IZVJEŠTAJ O ISPITIVANJU TLAČNE ČVRSTOĆE**

Ob-7/1-3
Izdanje: 4
Revizija 0
12.11.2021.

**Datum izvještaja:** 29.11.2021

**OPĆI PODACI:**

Naziv i adresa naručitelja: MARANA d.o.o., Kurtovići 21, 21231, Klis
Naziv i adresa izvođača: MARANA d.o.o., Kurtovići 21, 21231, Klis
Ugovor/Narudžbenica: /
Građevina: Radni pogon „Marana“ Kurtovići 21, Klis
Građevni proizvod

**PODACI O BETONU**

Mjesto proizvodnje betona: MEGRAM – Sinj
Razred tlačne čvrstoće: C25/30 Tip betona: projektirani beton

**PODACI O UZORCIMA**

Mjesto izrade uzorka: gradilište Uzorkovano prema: normi HRN EN 12390-2
Uzorkovao predstavnik: naručitelja Dostavio predstavnik: naručitelja
Oblik i nazivne dimenzije uzorka: kocka 150*150*150 mm
Njegovanje od zaprimanja: u laboratorijskim uvjetima

| Oznaka uzorka | | Datum izrade (podatak naručitelja) | Konstrukcijski element (podatak naručitelja) | Razred tlačne čvrstoće | Datum primitka | Stanje uzorka po primitku |
|---|---|---|---|---|---|---|
| Laboratorij | Naručitelj | | | | | |
| 1. | 1. | 21.10.2021 | Međukatna konstrukcija – testni uzorak | C25/30 | 24.11.2021. | zaglađena, neoštećena, suha |
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**REZULTATI ISPITIVANJA**

Ispitano svojstvo: Tlačna čvrstoća očvrslog betona prema HRN EN 12390-3;2019
Zasićenost uzorka: Vodom zasićen
Odstupanje od norme: /

| Laboratorij. oznaka uzorka | Datum ispitivanja | Starost (dana) | Obrada ploha (brušenje/ namaz) | DIMENZIJE IZMJERENE (mm) | | | Stanje površine u vrijeme ispitivanja | Oblik loma* | Gustoća ** (kg/m)³ | Sila loma (kN) | Tlačna čvrstoća (N/mm²) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | a | b | h | | | | | fc |
| 1. | 26.11.2021 | 36 | / | 149,8 | 149,8 | 149,9 | zaglađena, neoštećena, suha | Z | 2,33 | 785,1 | 35,0 |
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Napomene:
* Z-zadovoljavajući lom, Nx - nezadovoljavajući lom, x je broj (1…9) prema sl. 1-2 HRN EN 12390-3
**Gustoća izračunata iz mase u zatečenom stanju i volumena iz izmjera, prema HRN EN 12390-7 - nije u području akreditacije.
Izjava: Uzorci su ispitani u skladu s normom, osim navedenog u točki "Odstupanje od norme"

Voditelj laboratorija:
Romeo Bartulović

## DOCUMENTATION PROVIDED BY THE SPONSOR

KEMENOVIĆ

Kemenović d.o.o. hidro i toplinske izolacije · HR 10250 Zagreb - Lučko · Franje Puškarića 104a
tel. 01 6530 812, 6530 813 · fax. 01 6530 814 · www.kemenovic.com · kemenovic@zg.t-com.hr
**MB: 3462935 · Žiro račun: 2360000 - 1101229096 Zagrebačka banka**
Članovi uprave: Dušanka Kemenović, Dragan Kemenović
Trgovački sud u Zagrebu · MBS: 080145720 · Temeljni kapital 850.000,00 kn

### IZJAVA O SUKLADNOSTI

U skladu s člankom 27. Zakona o gradnji ("Narodne novine" br. 175/03 i 100/04), člankom 31. Pravilnika o ocjenjivanju sukladnosti, ispravama o sukladnosti i označavanju građevnih proizvoda ("Narodne novine" br. 1/05),

**KEMENOVIĆ d.o.o.**
**Puškarićeva 104a**
**HR - 10250 Zagreb**

**izjavljuje da je**

toplinsko-izolacijski proizvod od ekspandiranog polistirena trgovačkog naziva:

**KEMPOR EPS 100**

**Oznake: EPS-HRN EN 13163-T1-L1-W1-S1-P3-BS150-DS(N)5-WL(T)3-CS(10)100**

**proizveden u tvornici:**

**KEMENOVIĆ d.o.o.**
**Puškarićeva 104a**
**HR - 10250 Zagreb**

**sukladan zahtjevima norme:**

**HRN EN 13163:2002**

Izjava se daje na osnovu provedenih radnji ocjenjivanja sukladnosti određenih normom HRN EN 13172:2002 i HRN EN 13172/A1:2005 za sustav ocjenjivanja sukladnosti 3 koje je proveo:
INSTITUT GRAĐEVINARSTVA HRVATSKE d.d., Zagreb, Janka Rakuše 1.

Evidencijski broj ovlaštene osobe: 1/05.
Ovlaštenje izdalo Ministarstvo zaštite okoliša, prostornog uređenja i graditeljstva: za radnje početnog ispitivanja tipa: Klasa: UP/I 360-01/05-08/00013, Urbroj: 531-01-06-10 od 22. ožujka 2006.

Direktor:
**Dragan Kemenović, ing. građ.**

**Klasa: 360-02/07-1/4**
**Urbroj: 375-3462935-01-07-4**

**Zagreb, 10. studenog 2007.**

## DOCUMENTATION PROVIDED BY THE SPONSOR

**AMT DER WIENER LANDESREGIERUNG**
**Zertifizierungsstelle für Bauprodukte**
**WIEN - ZERT**

1110 Wien, Rinnböckstraße 15
Telefon: (+431)79514-39385, Telefax: (+431)79514-99-8039
E-Mail: zert.bau@post.wien.gv.at
DVR 0000191

### EG - ZERTIFIKAT
**über die werkseigene Produktionskontrolle**

**1139-CPD-0275/04**
**(3. Neufassung)**

Gemäß der Richtlinie des Rates der Europäischen Gemeinschaften vom 21. Dezember 1988 zur Angleichung der Rechts- und Verwaltungsvorschriften der Mitgliedsstaaten über Bauprodukte - 89/106/EWG - (Bauproduktenrichtlinie – BPR), geändert durch die Richtlinie des Rates der Europäischen Gemeinschaften vom 22. Juli 1993 – 93/68/EWG -, umgesetzt im Land Wien durch das Gesetz über Bauprodukte und die Akkreditierung von Prüf-, Überwachungs- und Zertifizierungsstellen für Bauprodukte in Wien (Wiener Bauprodukte- und Akkreditierungsgesetz – WBAG), LGBl. für Wien Nr. 30/1996 idgF. wird bestätigt, dass die Bauprodukte

**Leichte Gesteinskörnungen**

**(gemäß Angaben im Anhang zu diesem Zertifikat)**

in Verkehr gebracht durch

**Lias Österreich GmbH**
**A-8350 Fehring, Fabrikstraße 11**

und hergestellt im Werk

**Lias Österreich GmbH**
**A-8350 Fehring, Fabrikstraße 11**

einer Erstprüfung der Produkte durch den Hersteller unterzogen wurden sowie einer werkseigenen Produktionskontrolle und zusätzlichen Prüfungen von im Werk entnommenen Proben nach festgelegtem Prüfplan durch den Hersteller unterzogen werden und dass die notifizierte Stelle (Kennummer 1139)

**Amt der Wiener Landesregierung - Zertifizierungsstelle für Bauprodukte**
**A-1110 Wien, Rinnböckstraße 15**

die Erstinspektion des Werkes und der werkseigenen Produktionskontrolle durchgeführt hat und die laufende Überwachung, Beurteilung und Anerkennung der werkseigenen Produktionskontrolle durchführt.

Dieses Zertifikat bestätigt, dass alle Vorschriften betreffend die Bescheinigung der Konformität der werkseigenen Produktionskontrolle, beschrieben im Anhang ZA der Norm

**EN 13055-1:2002/AC:2004**

angewendet wurden.

Dieses Zertifikat wurde erstmals am 18. Februar 2005 ausgestellt. Die vorliegende 3. Neufassung des Zertifikats 1139-CPD-0275/04 ersetzt die 2. Neufassung des Zertifikats vom 04. April 2011 und gilt solange sich die Festlegungen in der oben angeführten harmonisierten europäischen Norm nicht geändert oder die Herstellbedingungen im Werk oder die werkseigene Produktionskontrolle selbst nicht wesentlich verändert haben. Das Zertifikat umfasst inklusive Anhang zwei Seiten.

Der Zeichnungsberechtigte:

Dipl.-Ing. Bernhard Ramsauer

ZERTIFIZIERUNGSSTELLE FÜR BAUPRODUKTE · Amt der Wiener Landesregierung · STADT WIEN · 1

Der Leiter der Zertifizierungsstelle:

Dr. Peter Proßegger
Oberstadtbaurat

Wien, 07. Oktober 2011

2011-0717

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TRIAL d.o.o., Terzićeva 17, Split
OIB:64026545644
Laboratorij: Sv.liberana 48, Split
mob. +385 989844433

**IZVJEŠTAJ O ISPITIVANJU TLAČNE ČVRSTOĆE**

17025 · HAA 1686 TEST

Ob-7/3-1
Izdanje: 5
Revizija 0
7.7.2022

**BROJ IZVJEŠTAJA: LT-2022-304**
**Datum izvještaja: 28.10.2022**

**OPĆI PODACI:**

Naziv i adresa naručitelja: MARANA d.o.o., Kurtovići 21, 21231 Klis
Naziv i adresa izvođača: MARANA d.o.o., Kurtovići 21, 21231 Klis
Ugovor/Narudžbenica: /

Građevina: RADNI POGON MARANA
Građevni proizvod

**PODACI O BETONU (Podaci Naručitelja)**

Mjesto proizvodnje betona: Gradilište
Razred tlačne čvrstoće: C16/20 Tip betona: projektirani beton

**PODACI O UZORCIMA**

Mjesto izrade uzorka: gradilište Uzorkovano prema: normi HRN EN 12390-2
Uzorkovao predstavnik: naručitelja Dostavio predstavnik: naručitelja
Oblik i nazivne dimenzije uzorka: kocka 150*150*150 mm
Njegovanje od zaprimanja: u laboratorijskim uvjetima

| Oznaka uzorka | | Datum izrade (podatak naručitelja) | Konstrukcijski element (podatak naručitelja) | Razred tlačne čvrstoće | Datum primitka | Stanje uzorka po primitku |
|---|---|---|---|---|---|---|
| Laboratorij | Naručitelj | | | | | |
| TM356-1 | 1. | 10.9.2022 | ISPUNA ZA MEĐUKATNU/ KROVNU KONSTRUKCIJU | C16/20 | 27.10.2022. | zaglađena, neoštećena, suha |
| TM356-2 | 2. | 10.9.2022 | ISPUNA ZA MEĐUKATNU/ KROVNU KONSTRUKCIJU | C16/20 | 27.10.2022. | zaglađena, neoštećena, suha |
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**REZULTATI ISPITIVANJA**

Ispitano svojstvo: Tlačna čvrstoća očvrslog betona prema HRN EN 12390-3;2019
Zasićenost uzorka: Vodom zasićen
Odstupanje od norme: /

| Laboratorij. oznaka uzorka | Datum ispitivanja | Starost (dana) | Obrada ploha (brušenje/ namaz) | DIMENZIJE IZMJERENE (mm) | | | Stanje površine u vrijeme ispitivanja | Oblik loma* | Gustoća ** (kg/m)³ | Sila loma (kN) | Tlačna čvrstoća (N/mm²) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | a | b | h | | | | | fc |
| TM356-1 | 28.10.2022 | 48 | / | 149,2 | 149,8 | 149,4 | zaglađena, neoštećena, suha | Z | 1,63 | 497,9 | **22,3** |
| TM356-2 | 28.10.2022 | 48 | / | 151,0 | 150,4 | 149,8 | zaglađena, neoštećena, suha | Z | 1,63 | 457,2 | **20,1** |
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Napomene:
* Z-zadovoljavajući lom, Nx - nezadovoljavajući lom, x je broj (1…9) prema sl. 1-2 HRN EN 12390-3
**Gustoća izračunata iz mase u zatečenom stanju i volumena iz izmjera, prema HRN EN 12390-7 - nije u području akreditacije.
Izjava: Uzorci su ispitani u skladu s normom, osim navedenog u točki "Odstupanje od norme"

Voditelj laboratorija:
Roko Gudelj

## PHOTOS

Photo No. 046997d-001: test specimen supporting construction

Photo No. 046997d-002: test specimen laid on the supporting construction


Photo No. 046997d-019: test specimen placed on the test frame and slabs placed at the longer edges

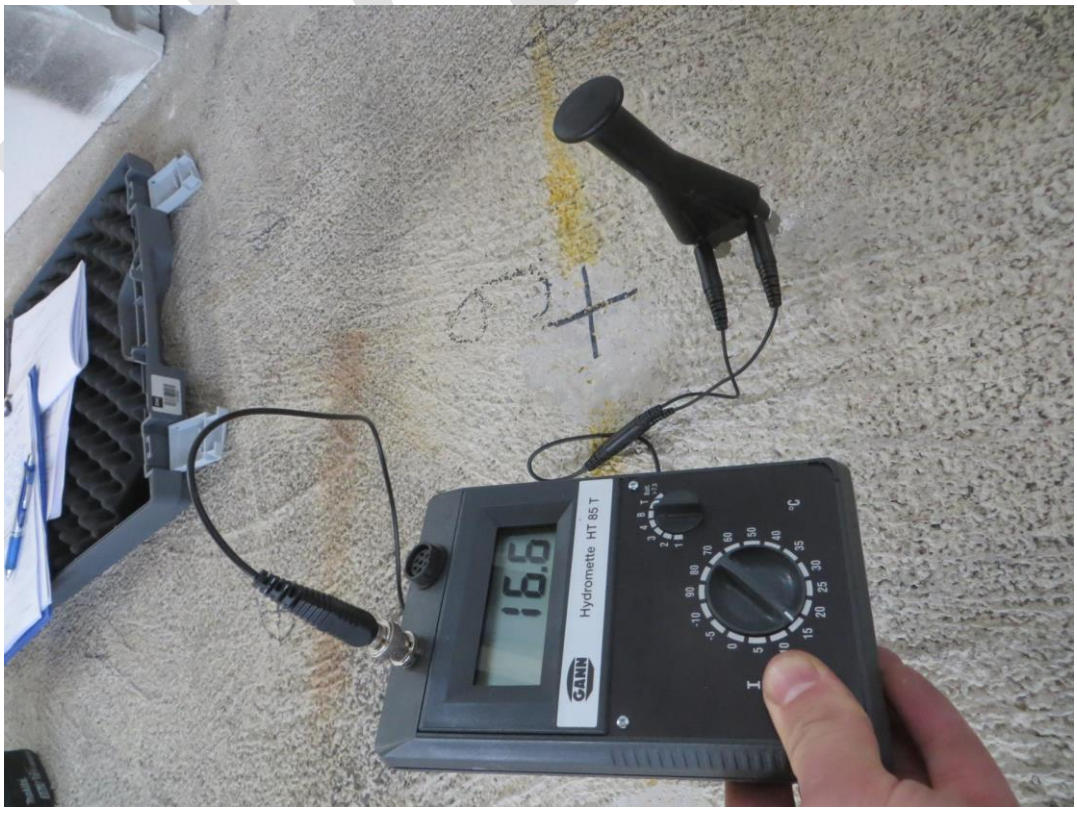


Photo No. 046997d-025: measuring of moisture content in the test specimen

Photo No. 046997d-020: short edge of the test specimen

Photo No. 046997d-027: exposed face before the commencement of the test

Photo No. 046997d-028: exposed face before the commencement of the test

Photo No. 046997d-029: exposed face before the commencement of the test


Photo No. 046997d-050: loaded test specimen at the commencement of the test


Photo No. 046997d-058: 16th minute of the test


Photo No. 046997d-069: 30th minute of the test


Photo No. 046997d-081: 46th minute of the test


Photo No. 046997d-094: 61st minute of the test


Photo No. 046997d-123: 91st minute of the test


Photo No. 046997d-151: 122nd minute of the test

Photo No. 046997d-155: unexposed face at the end of the test

Photo No. 046997d-161: exposed face at the end of the test

Photo No. 046997d-162: exposed face at the end of the test

Photo No. 046997d-163: exposed face at the end of the test