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**Fire resistance according to NEN-EN 1364-1:2001
in compliance with NEN 6069:2005 of a Fermacell
wall construction, type 1S21**

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Project name Fire Resistance
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1 Subject

Fermacell wall construction, type 1S21, on both sides plated with fermacell gypsum fiber board.

2 Examination

Determination of the fire resistance according to NEN-EN 1364-1:2001 in compliance with NEN 6069:2005.

3 Contractor and sponsors

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4 Location and date of test

4.1 Location

The investigation took place in the laboratory of the Centre for Fire Research of TNO Build Environment and Geosciences at Rijswijk, the Netherlands.

4.2 Date

The wall construction was assembled on 30 January 2006.
The fire test was executed on 6 February 2006.

5 Date and number of the report

March 2006, 2006-CVB-R0193

6 Test specimen

6.1 General

A non-load bearing Fermacell wall construction, type 1S21, was investigated. It was assembled from steel studs, filled with mineral wool and finished with fermacell gypsum fiberboards. The fixed edge, bottom and head rail were mounted on the concrete test frame.

6.2 Wall construction

6.2.1 *Steel framework*

The framework was assembled from steel profiles and existed of:

- a Dingemans U-stud 75-06 (5)¹, as bottom and ceiling rail, dimensions 78 x 45 x 0,6 mm;
- a Dingemans C-stud 75-06 (4), as mullions, dimensions 75 x 50 x 0,6 mm. The c.t.c. distance of the mullions was 600 mm.

The U-studs and C-stud on the fixed edge were fixed with plugs and screws (Ø 4 x 50 mm) in the test frame. The c.t.c. distance was 800 mm. Between the test frame and the studs were strips of mineral wool with a thickness of 10 mm (7).

The U-studs and C-studs were held together by the gypsum fiberboards. The length of the C-stud mullions was 15 mm shorter than the height of the wall, in order to create expanding possibilities.

In order to simulate the width of the wall in practice, the right-hand side (seen from the cold side) was not attached to the supporting construction. In order to give the free-edge the possibility of deflecting there was a strip of Rockwool (thickness 50 mm) placed between the test-frame and the wall construction.

6.2.2 *Filling and finishing*

Between the C-studs plates of mineral wool (6) (Rockwool 204 (dutch type number), dimensions 1200 x 600 x 60 mm) were clamped.

Fermacell gypsum fiberboards (1) (dimensions 1200 x 2500 x 12,5 mm) were screwed onto the C-studs using fermacell gypsum screws Ø 3,9 x 30 mm (2). The c.t.c. distance was 250 mm.

On the free-edge a whole board was used, while on the fixed edge an edge panel was used. On the cold side a horizontal board (height 500 mm) was placed on the upper side, on the fire side the horizontal plate was placed on the lower side.

The vertical and horizontal joints were covered with a synthetic wire mesh and then filled with mortar.

¹ The numbers between the parentheses refer to the numbers in figure 3.

6.3 Test frame and supporting construction

Test frame

Material: concrete. The inner dimensions of the test frame were: 3000 mm x 4000 mm (h x w).

For detailed information concerning the tested construction is referred to the material list and figures 1 - 3 and the photos in appendix D.

7 Sampling and manufacturing of the construction

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- Test frame
- Delivery of materials
- Mounting and assembling of wall construction

8 Test specimen inspection

8.1 General

The materials and components used were inspected during assembly on the basis of the supplied drawings and data.

8.2 Conditioning

During the period of assembly of the construction until the performance of the fire test, the wall was located in the test laboratory at the Centre for Fire Research with an ambient temperature of 20 ± 5 °C and a relative humidity of 50 ± 10 %.

8.3 Determination of density and moisture content

The results of the density²⁾ and the moisture content³⁾ were:

Material	Density [kg/m ³]	Moisture content [%]
Fermacell gypsum fiber board	1120	1,4
Mineral wool	31,4	0,7

²⁾ Determined before drying.

³⁾ Determined by drying during 24 hours at 105 °C, weighing before and after drying. The drying of the Fermacell gypsum fiber board took place at 60 °C.

8.4 Fire test

8.4.1 Conditions

The fire test was carried out according to NEN-EN 1364-1:2001 in compliance with NEN 6069:2005.

The wall construction was heated at one side using the standard fire curve (see figure B.1 in appendix B).

The targeted overpressure in the furnace was 0 Pa at 0.5 m (20 Pa at 3.0 m) above floor level, see figure B.3.

8.4.2 Measurements

During the heating the following measurements were made:

Furnace conditions:

- The gas temperatures in the furnace using 8 plate thermocouples, evenly spread over the directly heated wall surface;
- The pressure in the furnace.

Specimen:

- The surface temperatures on the unexposed side of the wall using 5 thermocouples;
- The surface temperatures on the unexposed side of the wall next to the edges and joints using 16 thermocouples;
- The horizontal displacement of the wall, in the middle and on the free-edge, measured half way up the wall.

Environment:

- The air temperature in the laboratory outside the furnace.

The positions of the thermocouples on the wall are specified in appendix C.

9 Observations during the heating

After a heating time of 65 minutes the cotton wool of the cotton pad glowed. The cotton pad was held in front of a joint, *End of integrity with regard to the sealing*.

For a detailed description concerning the observations, is referred to appendix A. The photos in appendix D show the wall before and during the test.

10 Measurements

10.1 Measurements

The measurements are presented in appendix B and C.

10.2 Uncertainty of measurement

Due to the nature of fire resistance testing, in which several non-linear effects are present in both the test configuration and the test specimen, which influence each other, it is at this moment not yet possible to give stated degree of uncertainty of measurement.

11 Summary

The fire resistance of a Fermacell wall construction, type 1S21, is determined. The construction is assembled from:

- steel studs with a filling of mineral wool and finished with gypsum fiber boards.

The fire test was carried out conform NEN-EN 1364-1:2001 in compliance with NEN 6069:2005. The results are summarized in Table 1.

Table 1: Summarized results

Criterion	Time measured from the start of the test during which, conform NEN 6069:2005 and NEN-EN 1364-1:2001, the criterion was reached.	
	NEN-EN 1364-1:2001 and NEN 6069:2005	Criterion reached or not reached
a) Integrity <ul style="list-style-type: none"> – Cotton wool pad – Opening gauges – Sustained flaming (> 10 sec) 	65 minutes 67 minutes 67 minutes	reached not reached not reached
b) Thermal insulation <ul style="list-style-type: none"> – Average temperature increase – Maximum temperature increase – Radiation 	65 minutes 65 minutes 67 minutes	reached due to cotton wool pad reached due to cotton wool pad not determined

After consulting the contractor the heating was terminated after 67 minutes.

12 Conclusion

Fire resistance, concerning the separation function, according to NEN 6069:2005 of the investigated wall construction: **65 minutes**.

13 Field of application and conditions

The conclusion formulated in chapter 12 is only valid for wall constructions, which are the same in detail to the investigated construction, including materials and means of assembly used. Also the following conditions have to be met:

- a) The wall is isolated with mineral wool with a thickness of at least 60 mm, a density of at least 30 kg/m^3 and a melting point greater than $1000 \text{ }^\circ\text{C}$.
- b) Mounted in a supporting construction with a minimum density of 2000 kg/m^3 and a floor of non-combustible material.
- c) the maximum height of the wall is limited to 3 m
- d) horizontal and vertical joints cross at a T-junction.
- e) the width of the wall construction has no limitations.



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Figures

Figure 1: Overview test specimen, seen from cold side.

Figure 2: Overview test specimen, seen from fireside.

Figure 3: Cross-section overview of test-specimen

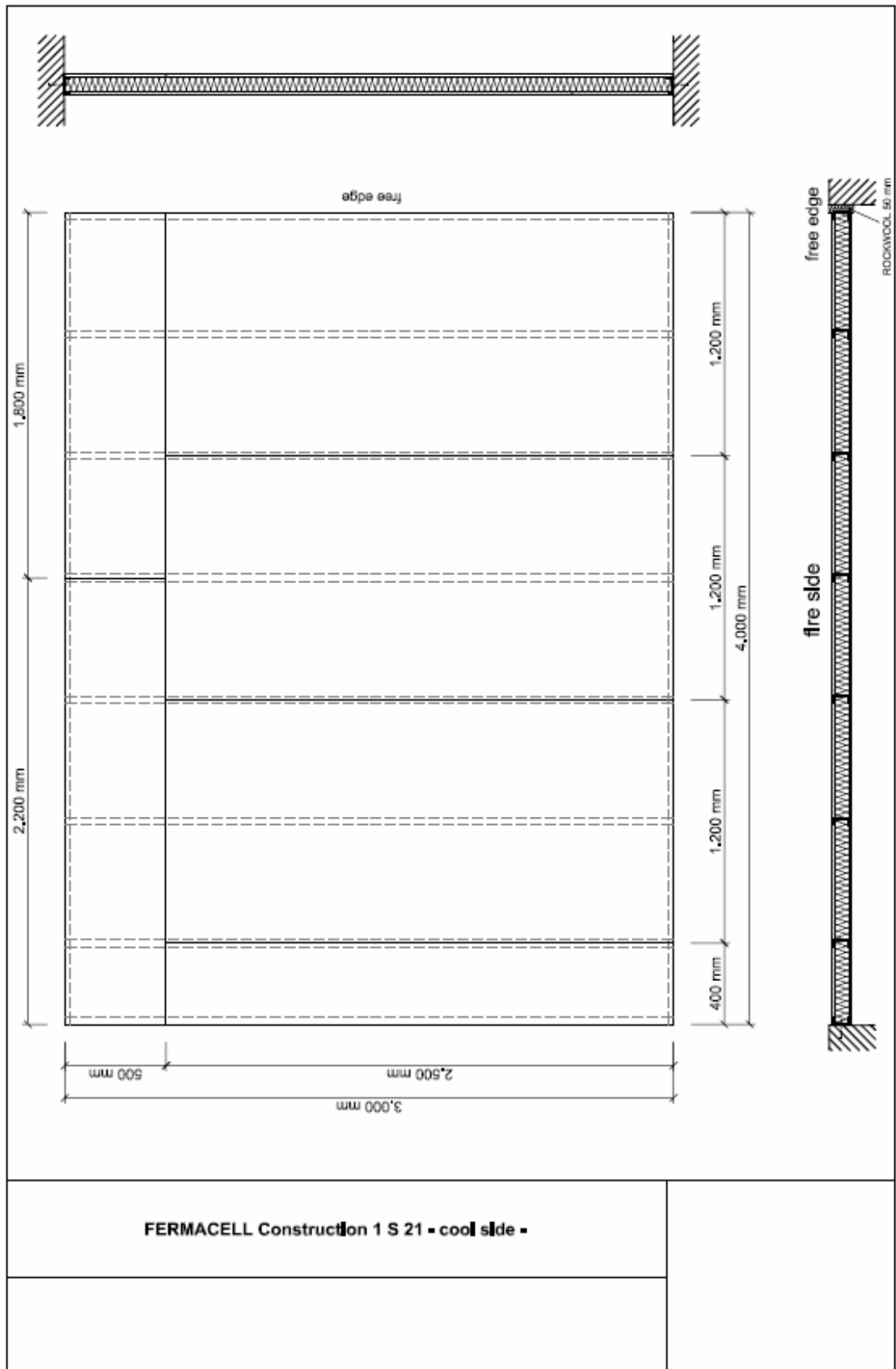


Figure 1: Overview test specimen, seen from cold side.

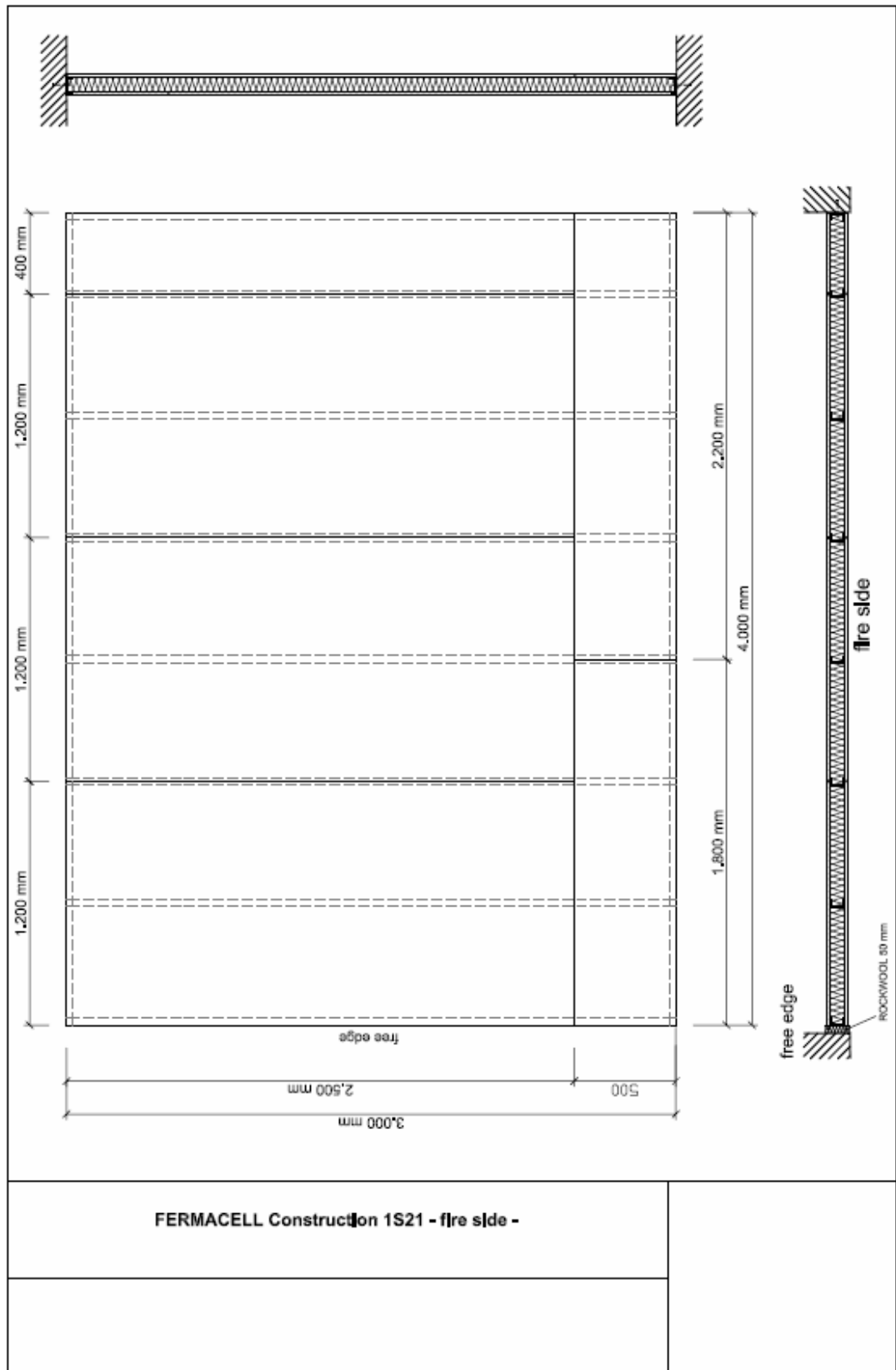


Figure 2: Overview test specimen, seen from fireside.

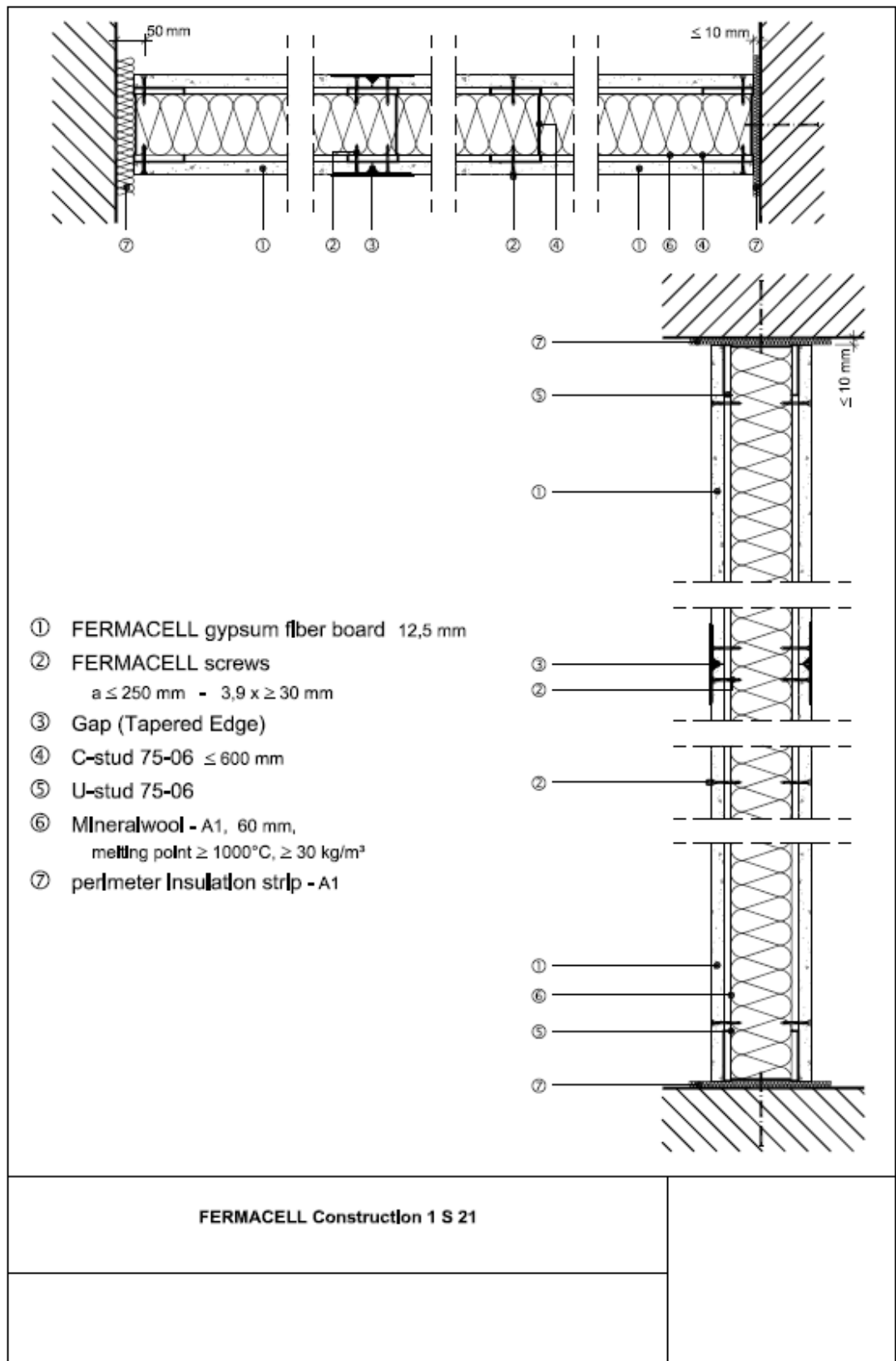


Figure 3: Cross-section overview of test-specimen