



# FISHWALL

**Fire and Seismic performances of Hybrid fire WALLs in case of single-storey industrial and commercial steel buildings**



## SESSION: Experimental campaign – Results and exploitation of fire tests

- **Title:** Sandwich panel fire wall with steel purlins penetration
- Jiri Vanek
- PAVUS, a.s.



# Introduction

Partition fire walls can be solidly attached to the supporting steel structure of buildings, which remains continuous at the position of walls. It is necessary to avoid the collapse of fire walls as a result of significant fire-induced movements of the steel structure, mainly concern the fire protection of steel members (columns, portal frames) supporting the fire walls. In addition, the positioning of fire walls throughout the buildings means that roof members such as purlin and rafters pass through the tops of the walls.

Consequently, structural members penetrating the walls also have to be partially fire protected. This protection has to allow the fire-induced plastic hinges in members to form away from the walls and thus to prevent damage to walls because of the collapse of the heated steel members. Sandwich panels forming the partition fire wall could also be used as a fire protection system of steel members penetrating the walls, as alternative to common passive fire protections.



# Objectives

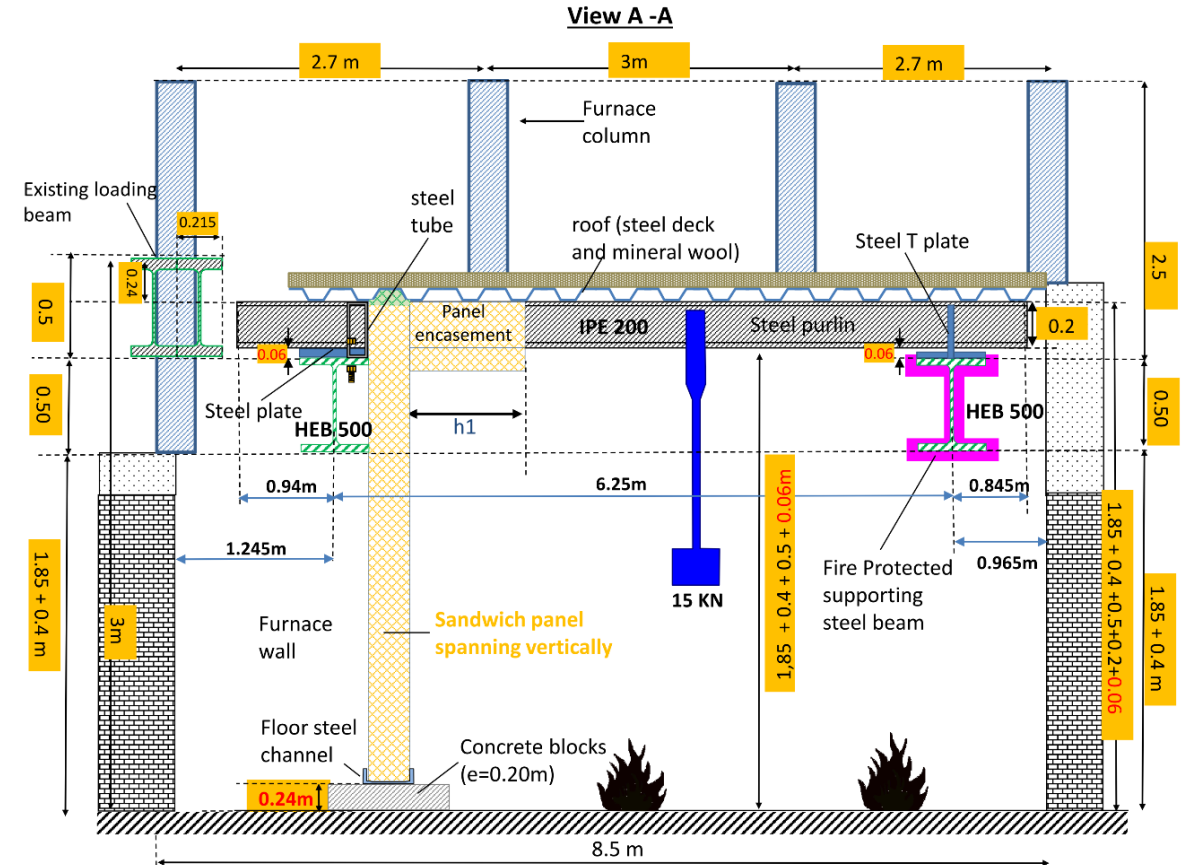
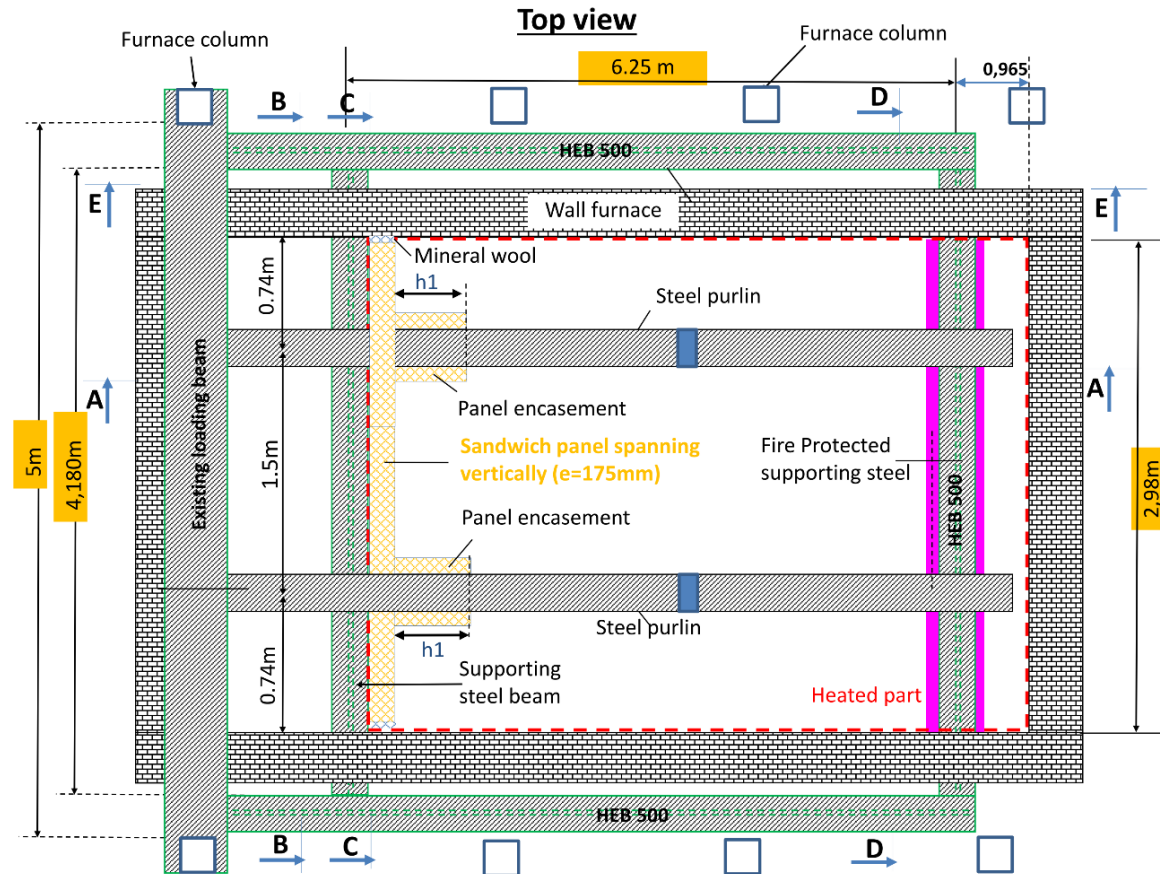
In this context, a fire test was carried out at the Testing Laboratory of PAVUS according to EN 1363-1 on a partition fire wall made of steel-faced sandwich panels solidly attached to an unprotected steel structure and penetrated by two steel purlins supporting a steel roof with insulation.

The main objectives were:

- to investigate the interaction of deforming purlins with the partition fire wall and to check that a sandwich panel-based fire protection along an appropriate length of purlins allows, as expected, preventing wall damage,
- to confirm that the temperature rise of penetrating members on the unexposed side of the fire wall is limited and fulfils the insulation performance criteria.



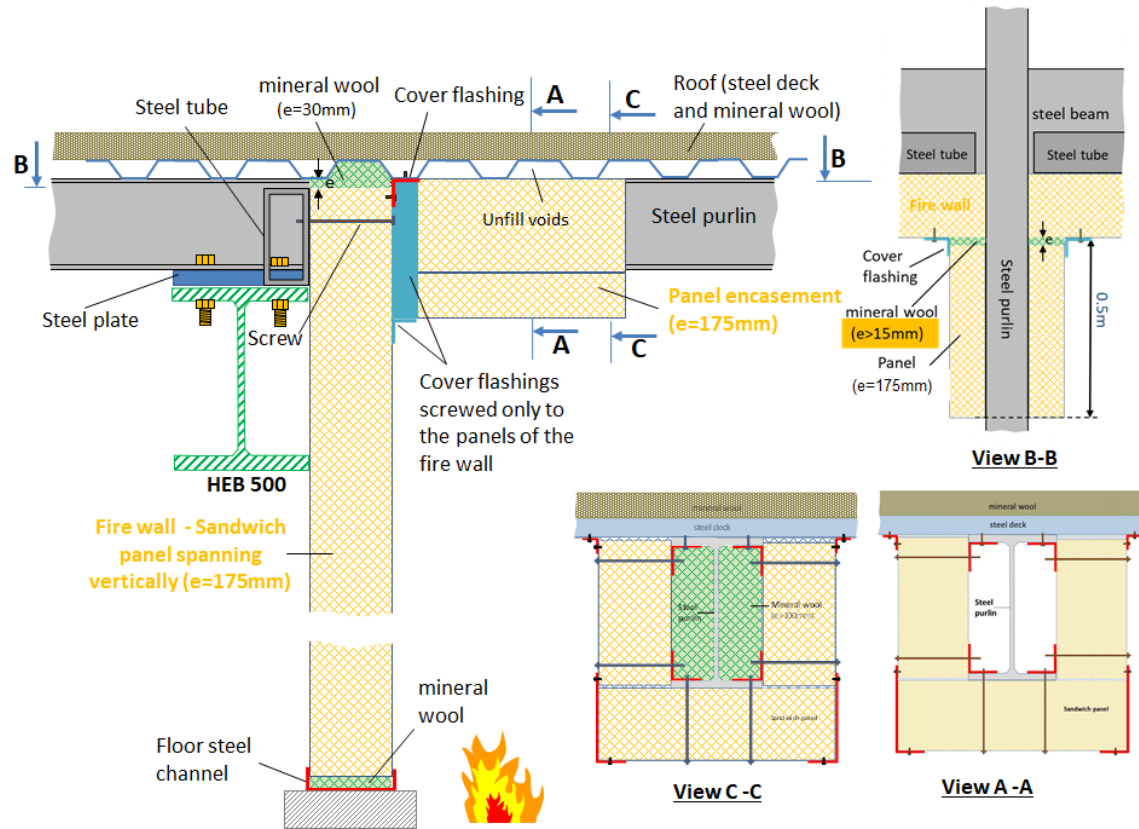
# Schematics of the test specimen



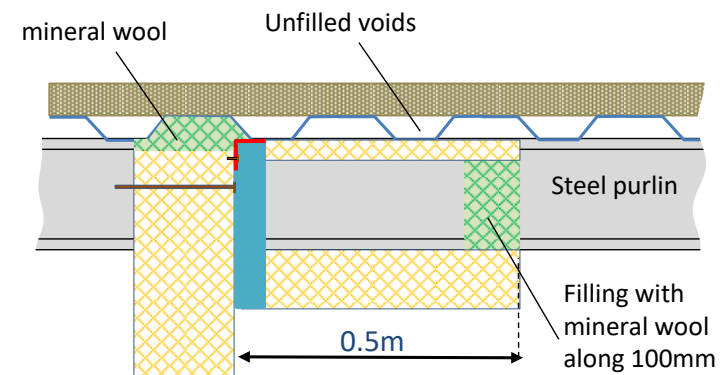
- Two purlins IPE 200 (simple beam with cantilever)
- Sandwich MW panels 175 mm installed vertically
- Steel roof decking (metal sheet + MW)
- Panel encasement 175 mm, length 500 mm



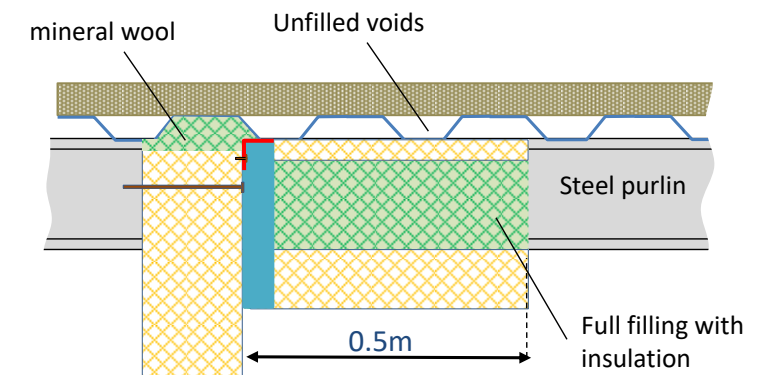
# Constructional details



## DETAILS ENCASMENT PURLIN n°1



## DETAILS ENCASMENT PURLIN n°2





# Assembly of the specimen



A vertical loading of 15 kN was applied at the beam's mid-span using dead weights made from steel elements. The loads were applied on the upper flange of purlins.





# The test course



Integrity failure  
in 58<sup>th</sup> minute



Purlins in the furnace  
after collapse  
(around 18 minutes)



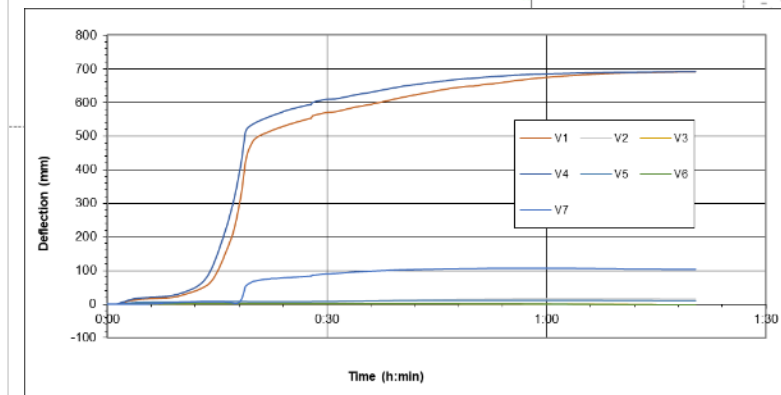
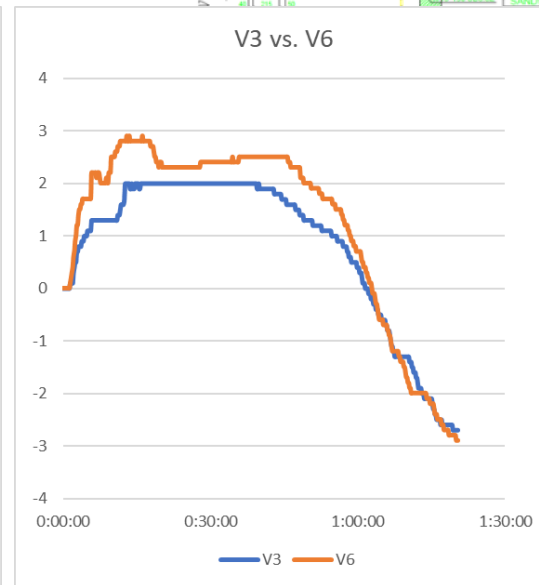
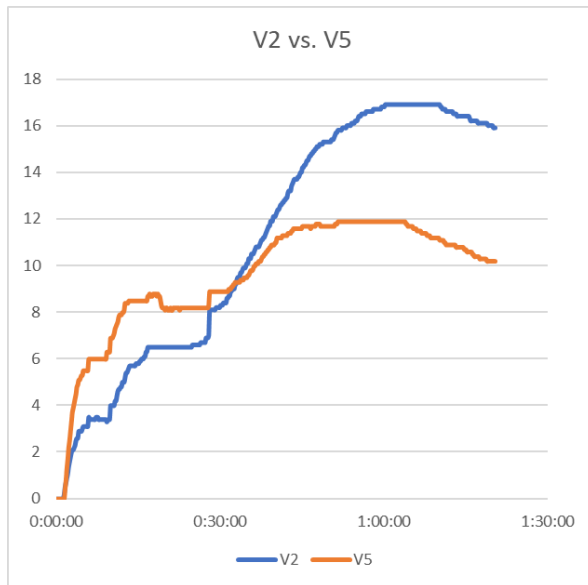
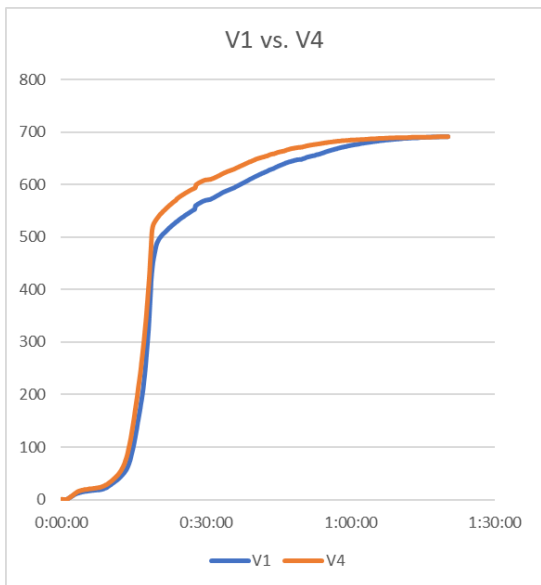
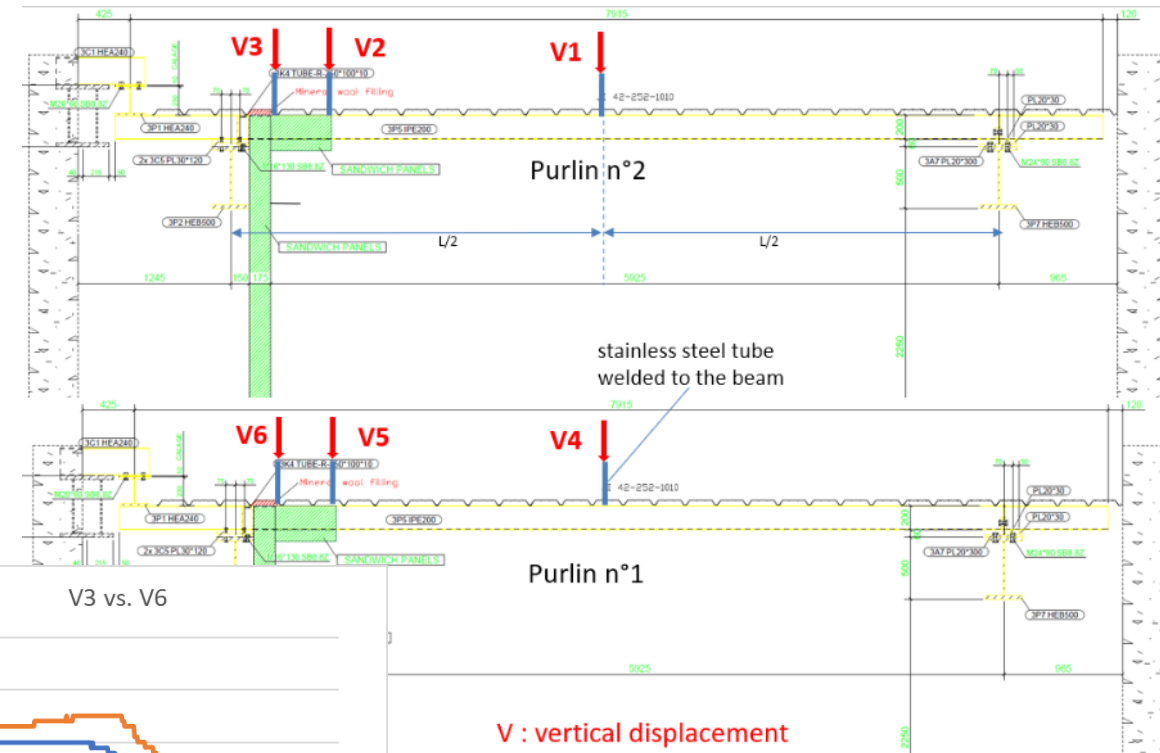
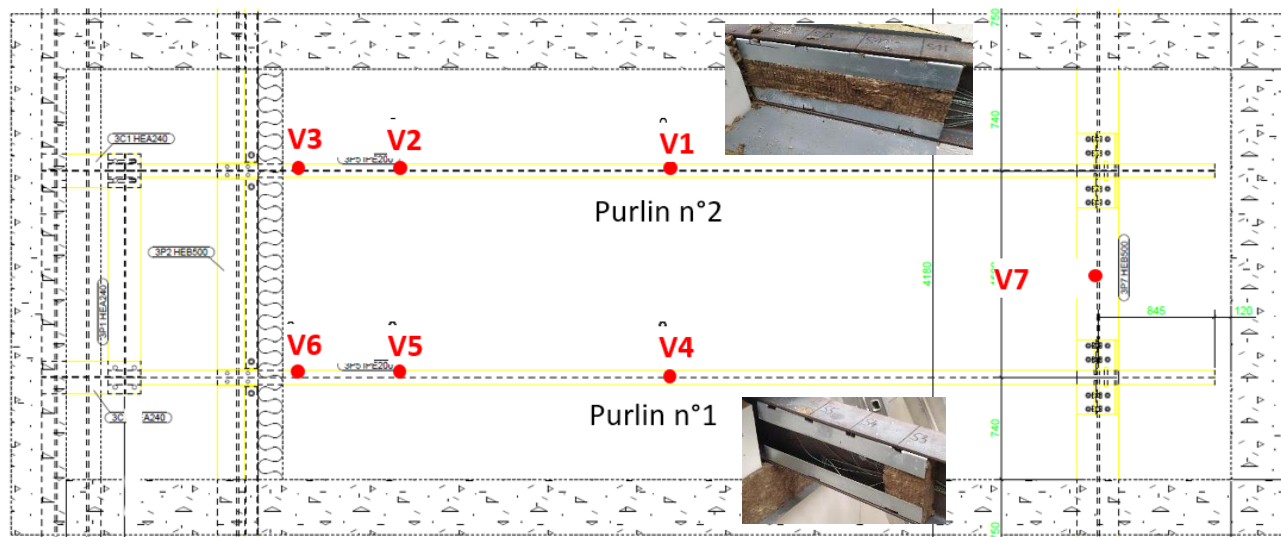


# Specimen after the test





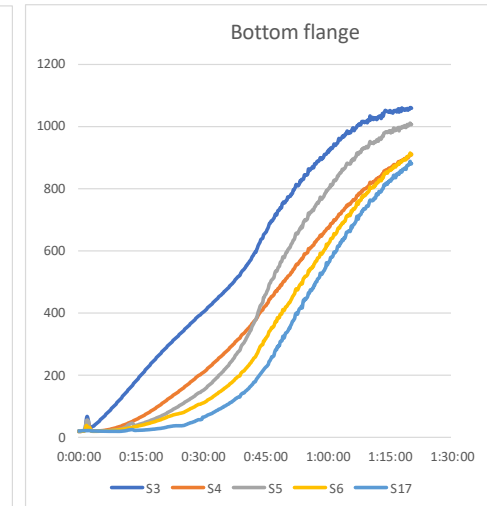
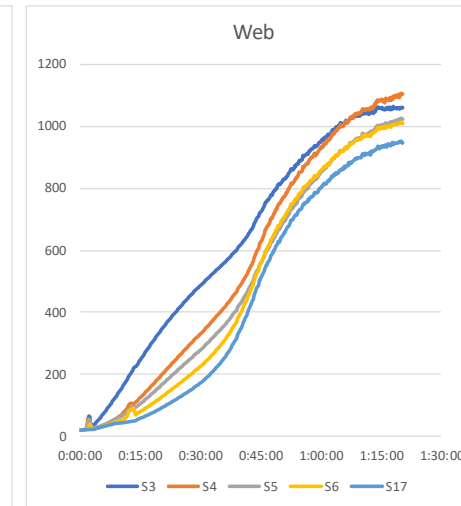
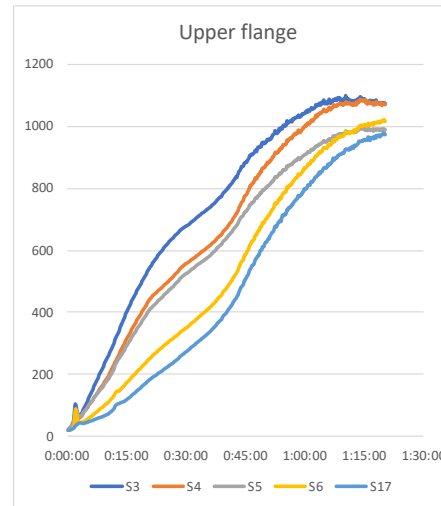
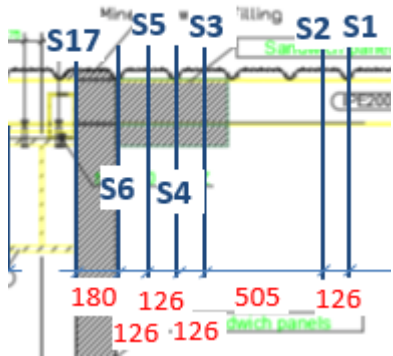
# Test results - deflection



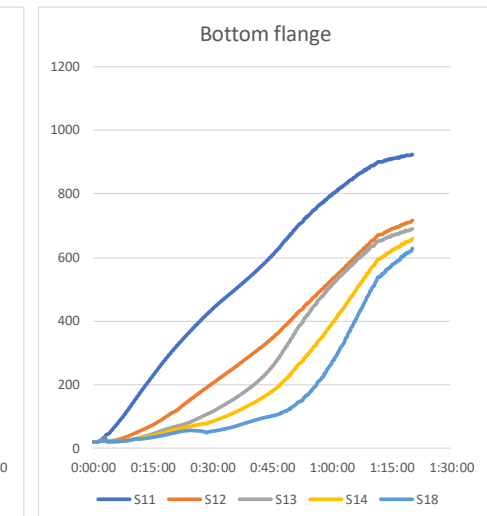
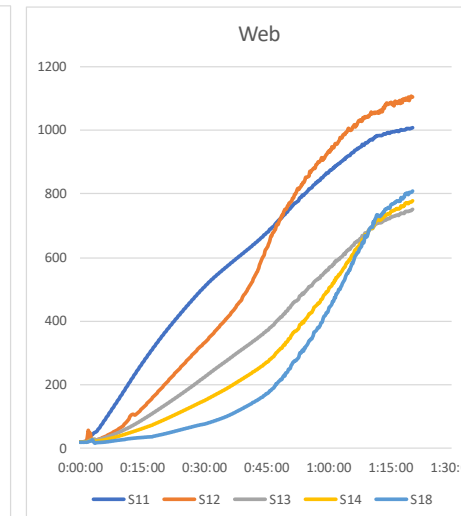
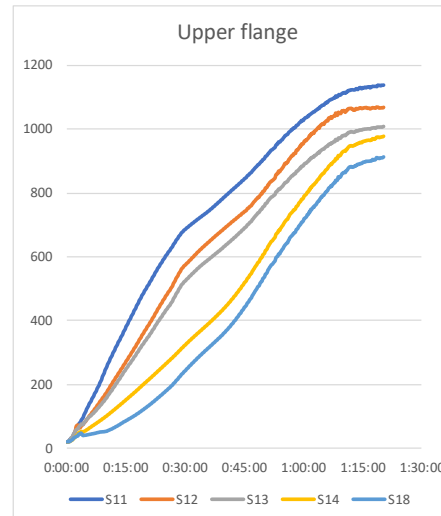
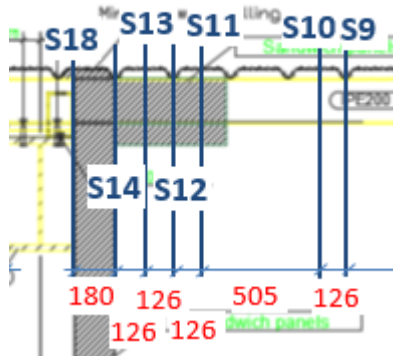


# Test results - steel temperature in the encasement

**Purlin n°1**

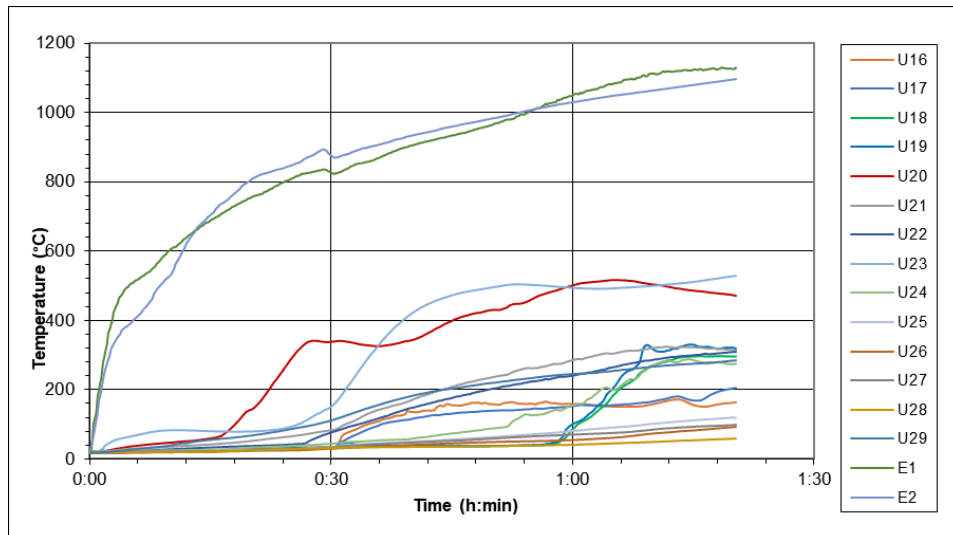
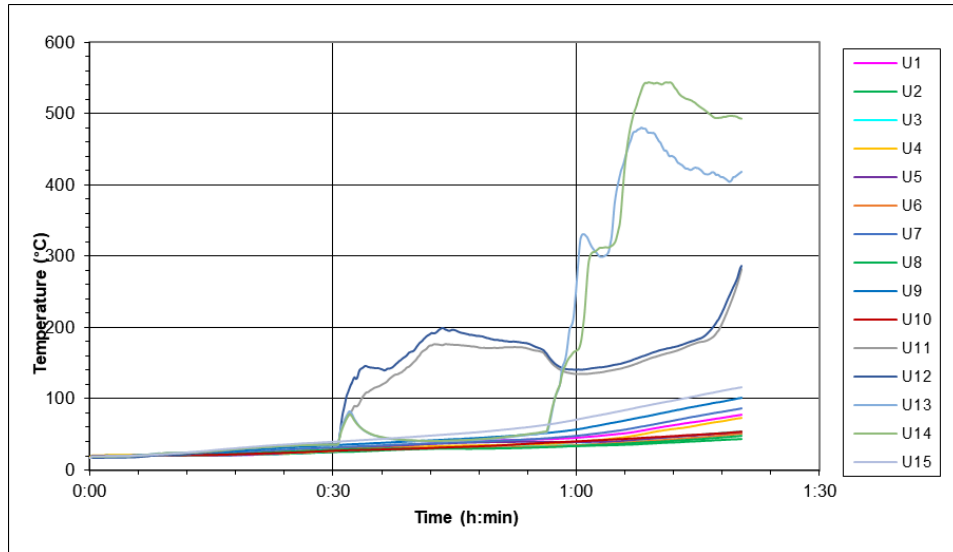


**Purlin n°2**

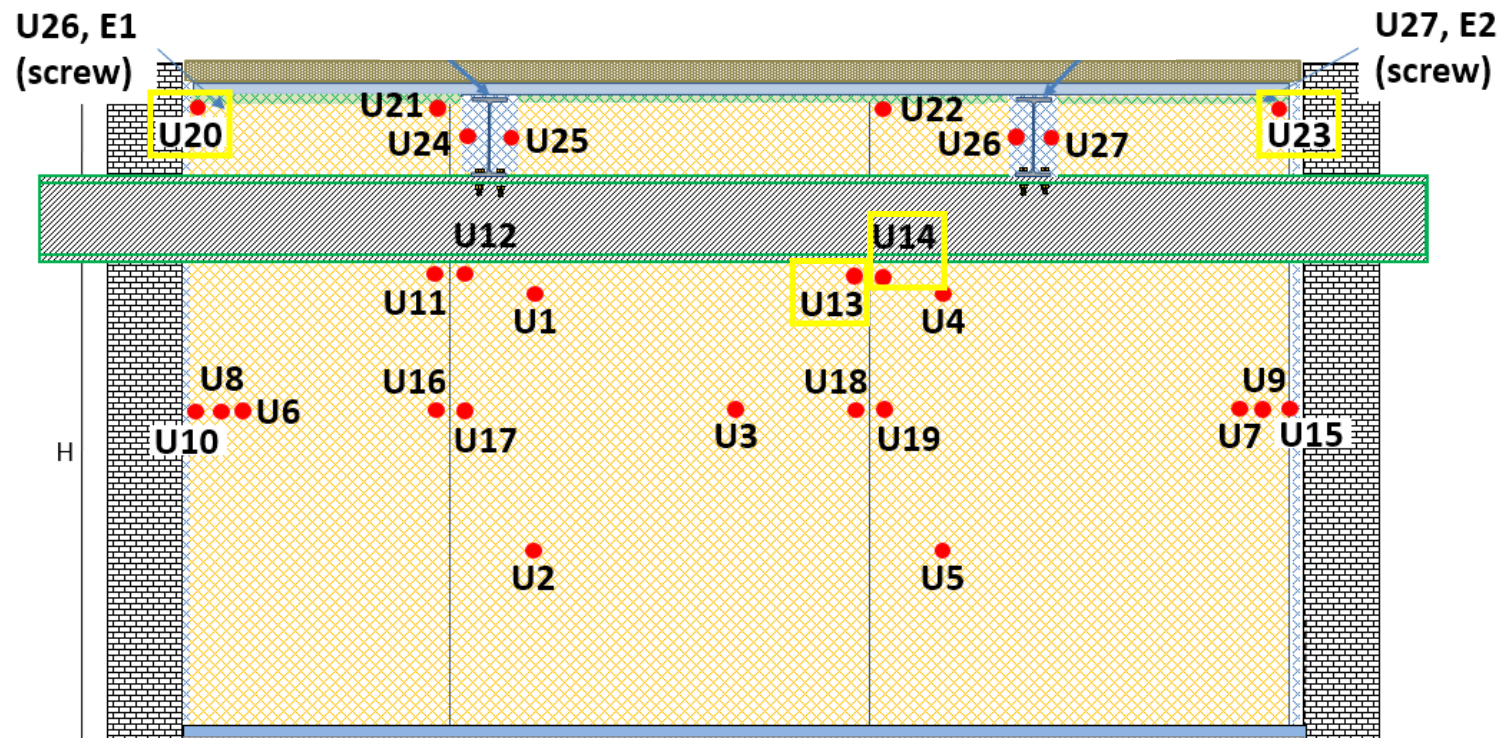




# Test results - temperatures on the wall



The temperature criteria related to the insulation performance of the wall was reached after 22 minutes on thermocouples U20 and U23. In 58<sup>th</sup> minute of the test there was integrity failure of the wall due to ignition of the cotton pad and sustained flaming in vertical joint by TCs U13, U14.





# Summary in Test report Pr-23-2.086-En



**PAVUS®**  
FIRE TESTING INSTITUTE

Order No.: Z210220040

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**FIRE TESTING LABORATORY VESELÍ NAD LUŽNICÍ**

Testing Laboratory No. 1026 accredited by ČIA

Notified Testing Laboratory  
workplace Veselí nad Lužnicí

## **FIRE RESISTANCE TEST REPORT**

**No. Pr-23-2.086-En**

issued on 2023-10-18

For product

**Fire wall connected to an unprotected steel  
structure and penetrated by steel purlins  
(Task 3.2)**

Sponsor: **Consortium of the RFCS project FISHWALL**



### **6.2 Expression of test results - wall made of sandwich panels**

Criterion	Partial criterion	Measured value	Evaluation
<b>Integrity</b>	Cotton pad ignition	57 min	57 min
	Gap gauge passage	80 min, no failure	80 min
	Sustained flaming	57 min	57 min
<b>Insulation</b>	Average temperature	80 min, no failure	57 min <sup>1)</sup>
	Maximum temperature	22 min	22 min

Note:

<sup>1)</sup> The performance criteria "insulation" shall automatically be assumed not to be satisfied when the "integrity" criterion ceases to be satisfied (see [2] cl. 11.4.2).



# Conclusion, recommendation



After 58 minutes of the test strong flaming appeared also below the steel decks at the junction with the wall. It was necessary to stop the test after 80 minutes due to safety of personnel and impending damage to the equipment of the laboratory.

This was probably caused by the imperfect filling of the wall openings managed at the level of purlins and the void formed between the wall top and the rib of the steel deck placed above. It is recommended to use mineral wool with the higher density. Maybe using of some intumescent product (for example together with mineral wool) could also be the solution.

The test results showed that the tested encasement system placed around purlins remained undamaged and was enable to avoid large wall damage in spite of the collapse of the heated steel purlins.





# Thank you for your attention!

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