steel CONNECT

FIRE TEST REQUIREMENTS FOR EXTERNAL CLADDING

BLUESCOPE

MIDNIGHT OF 14th JUNE 2017

Image by PublicDomainPictures from Pixabay

GOT OUT OF BED TO CHECK OUT THE ALARM

Image by https://www.verywellhealth.com/why-do-people-die-in-their-sleep-4098302

HEAVY SMOKE FROM KITCHEN OF FLAT 16 (4TH FLOOR)

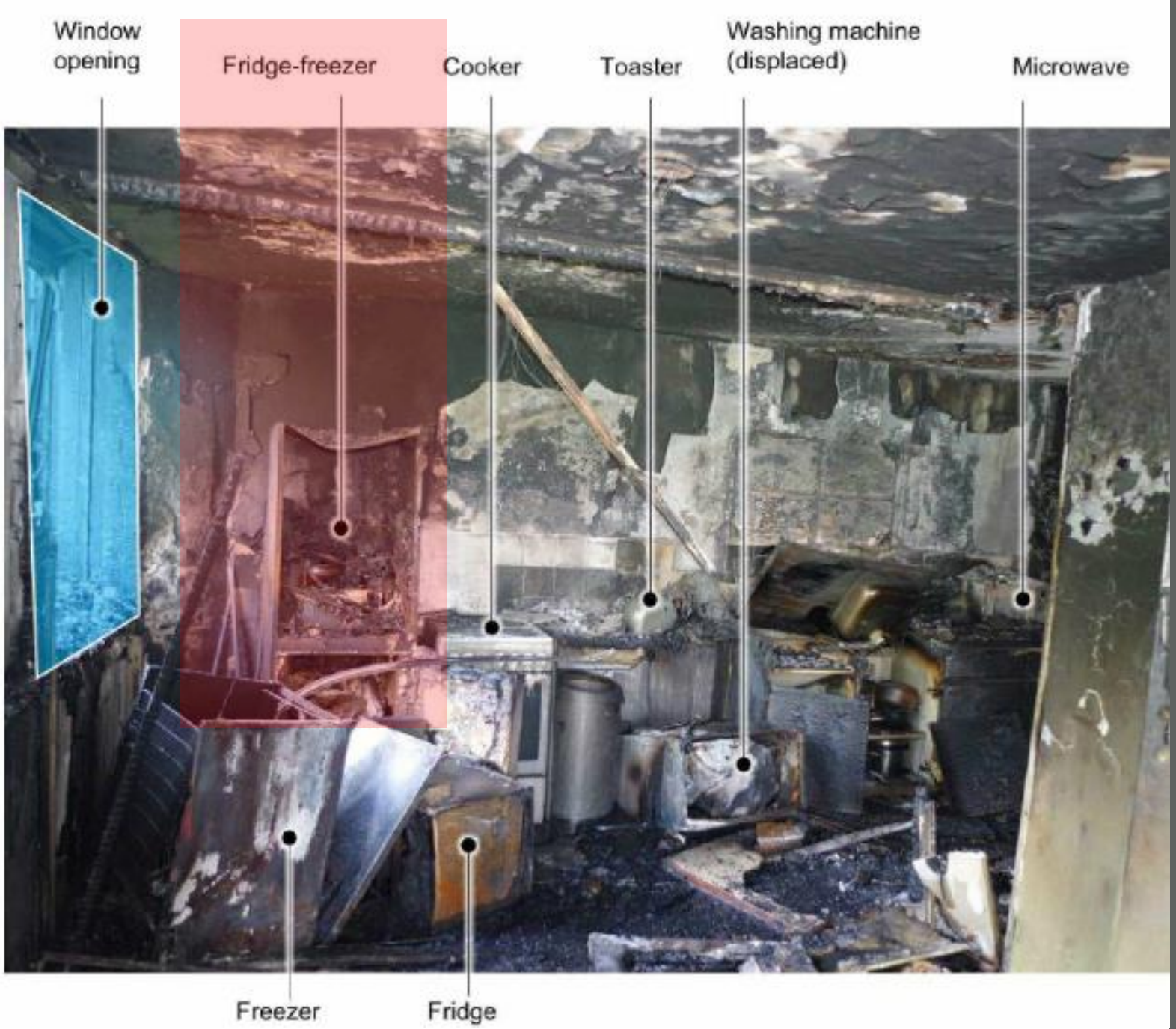
Image from Grenfell Tower Inquiry: Phase 1 Report, Volume 4. Ref: HC 49-IV

VISIBLE FIRE FROM FLAT 16 (4TH FLOOR) WINDOW

Video from Mr Kebedes phone, ref: MET000083355; MET000083357

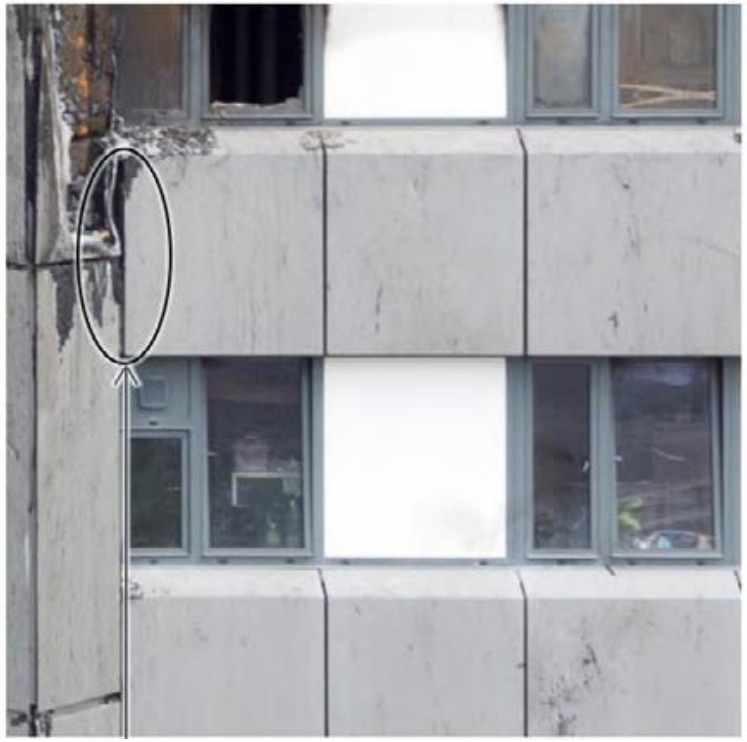
FIRE REACHED 24TH FLOOR WITHIN 20 MINUTES

Video from Mr Kebedes phone, ref: MET000083355; MET000083357



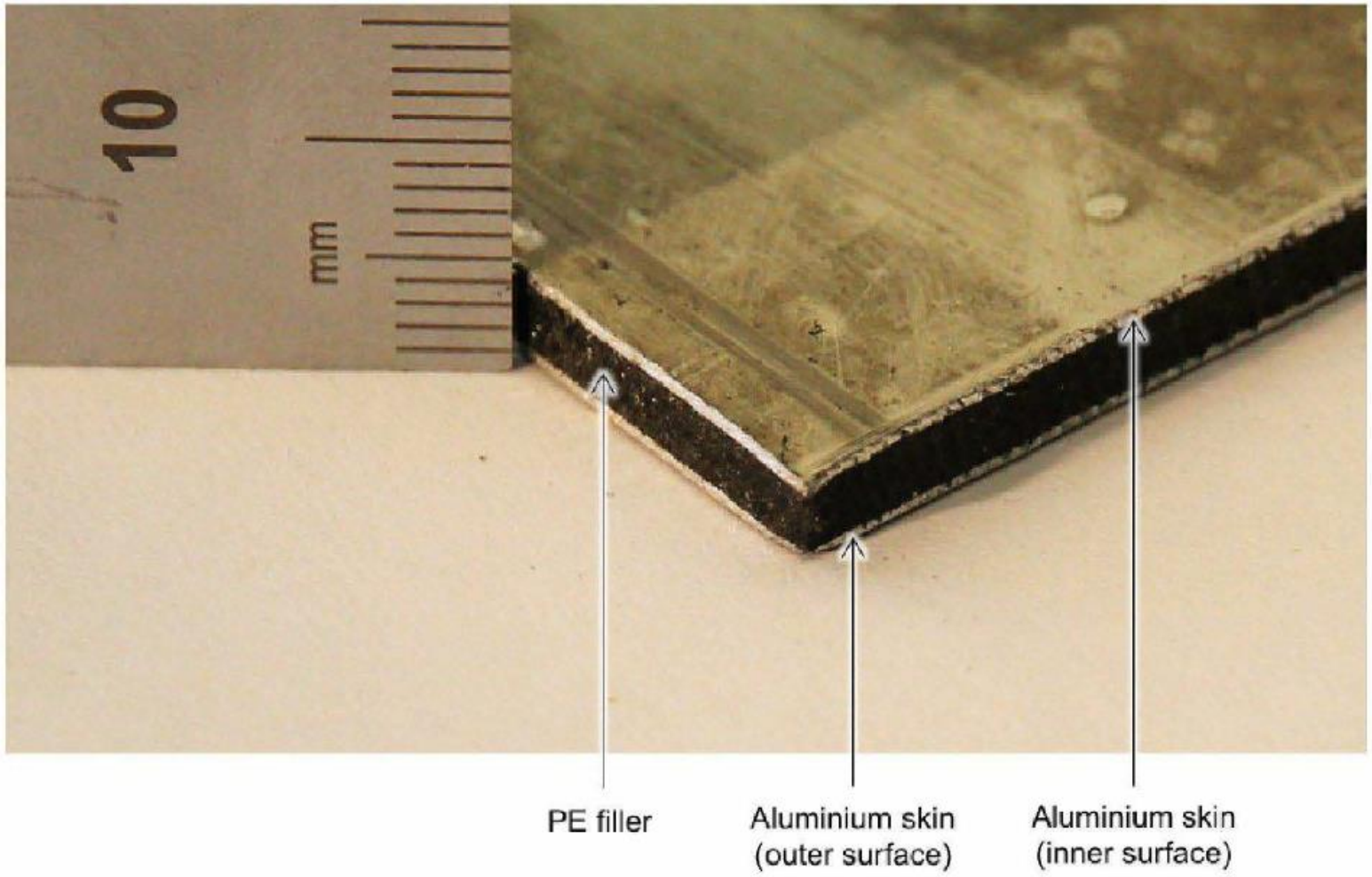
FIRE ESCAPED FROM WINDOW

Image from Grenfell Tower Inquiry: Phase 1 – Final Expert Report by Proffesor Luke Bisby. Ref: LBYS0000001_0001



FIRE ESCAPED FROM WINDOW

Image from Grenfell Tower Inquiry: Phase 1 Report, Volume 4. Ref: HC 49-IV



POLYETHYLENE FILLER IN ALUMINIUM COMPOSITE MATERIAL

Image from Grenfell Tower Inquiry: Phase 1 – Final Expert Report by Proffesor Luke Bisby. Ref: LBYS0000001_0001

PERPUSTAKAAN KUALA LUMPUR

Photo from https://www.bharian.com.my/taxonomy/term/11/2016/01/115573/papan-tanda-perpustakaan-kuala-lumpur-terbakar

PERPUSTAKAAN KUALA LUMPUR

"Kebakaran dikatakan berpunca percikan api ketika kerja kimpalan membuat bumbung tambahan di bangunan itu yang membakar fiber polisterin."

Reported by myMetroTV

Photo from https://www.youtube.com/watch?v=bqM2tgHuuLY&feature=emb_title

PERPUSTAKAAN KUALA LUMPUR

"Walaupun kebakaran hanya membabitkan struktur luar, namun terdapat cermin yang pecah kerana terlalu panas menyebabkan asap daripada fiber polisterin memenuhi ruang dalam perpustakaan."

Reported by myMetroTV

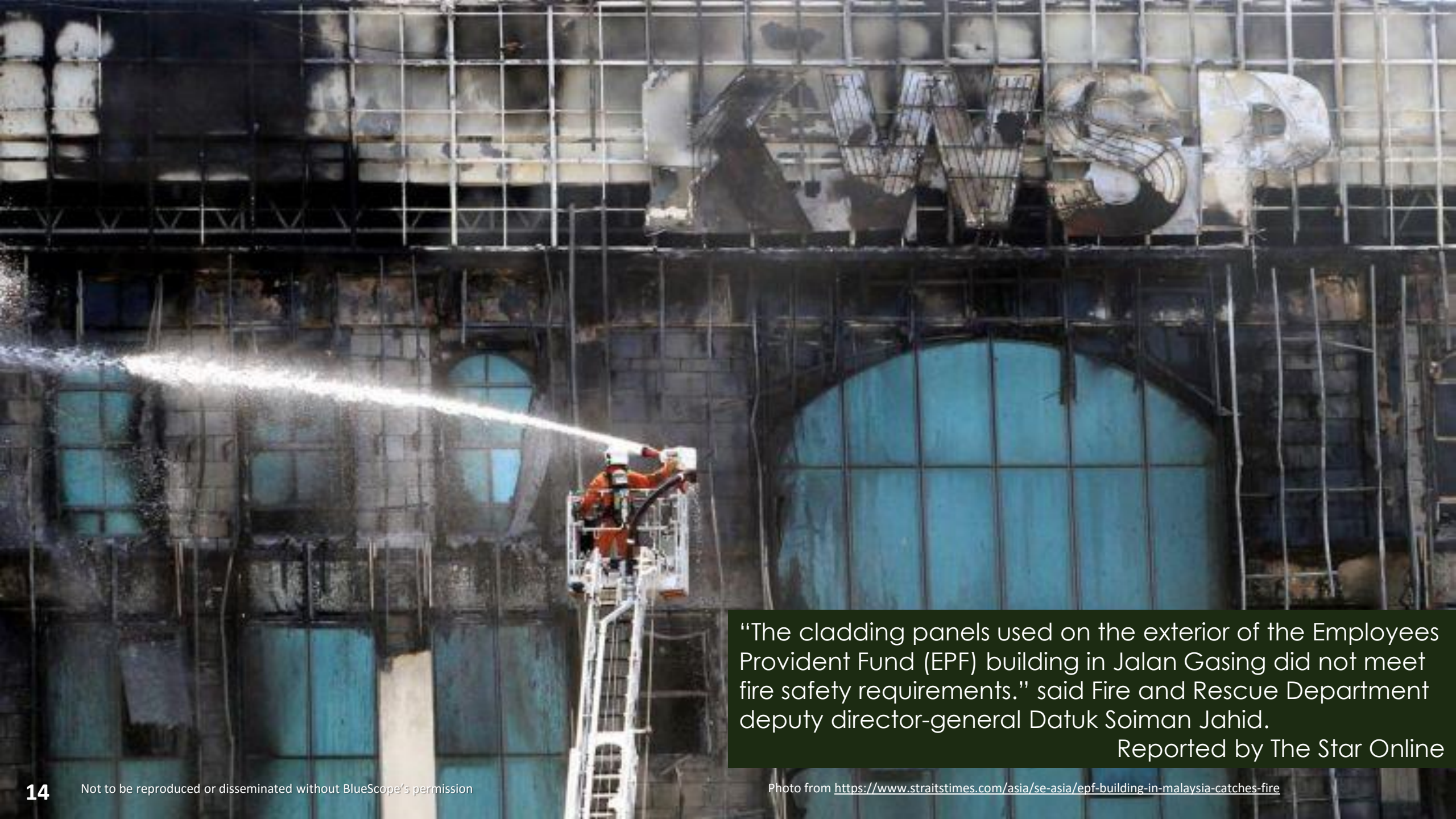
Photo from https://www.youtube.com/watch?v=bqM2tgHuuLY&feature=emb_title

KWSP PETALING JAYA

"Initial investigations revealed that the fire started on the first floor, where maintenance work was being carried out to the exterior of the building." said Fire and Rescue Department deputy director-general Datuk Soiman Jahid.

Reported by The Star Online

Photo from https://says.com/my/news/epf-building-fire-in-pj-members-savings-and-data-safe



"The cladding panels used on the exterior of the Employees Provident Fund (EPF) building in Jalan Gasing did not meet fire safety requirements." said Fire and Rescue Department deputy director-general Datuk Soiman Jahid.

Reported by The Star Online

Photo from https://www.straitstimes.com/asia/se-asia/epf-building-in-malaysia-catches-fire

USE OF POLYFOAM

Source from https://www.freemalaysiatoday.com/category/bahasa/2018/02/13/bomba-percikan-api-kerja-selenggara-punca-bangunan-kwsp-terbakar/

Fire tests on complete external cladding system

UK Class	Test Classification
BS 8414: Part 1 & 2	Fire performance of external cladding systems

Fire tests on building materials

UK Class	Test Classification
BS 476: Part 4	Non-combustibility test
BS 476: Part 11	Limited Combustibility test
BS 476: Part 6 & Part 7	Class 0
BS 476: Part 7	Class 1 Class 2 Class 3 Class 4

SERIES OF FIRE TESTS

FIRE TESTS ON BUILDING MATERIALS

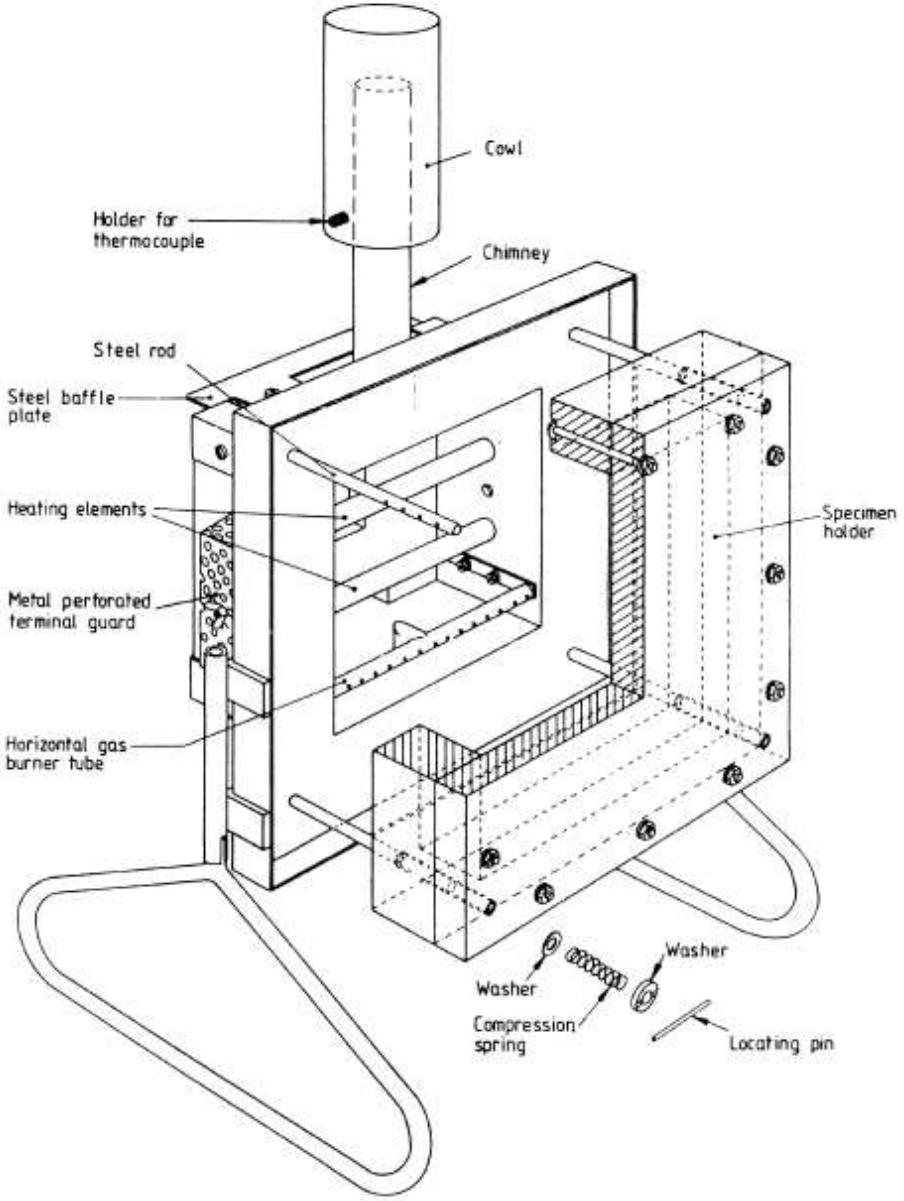
Photo from BlueScope

Fire tests on building materials

UK Class	Test Classification
BS 476: Part 4	Non-combustibility test
BS 476: Part 11	Limited Combustibility test
BS 476: Part 6 & Part 7	Class 0
BS 476: Part 7	Class 1 Class 2 Class 3 Class 4

BS 476 PART 6 & 7 FIRE TEST ON FLAME SPREAD

Source: Singapore SCDF Fire Code 2018

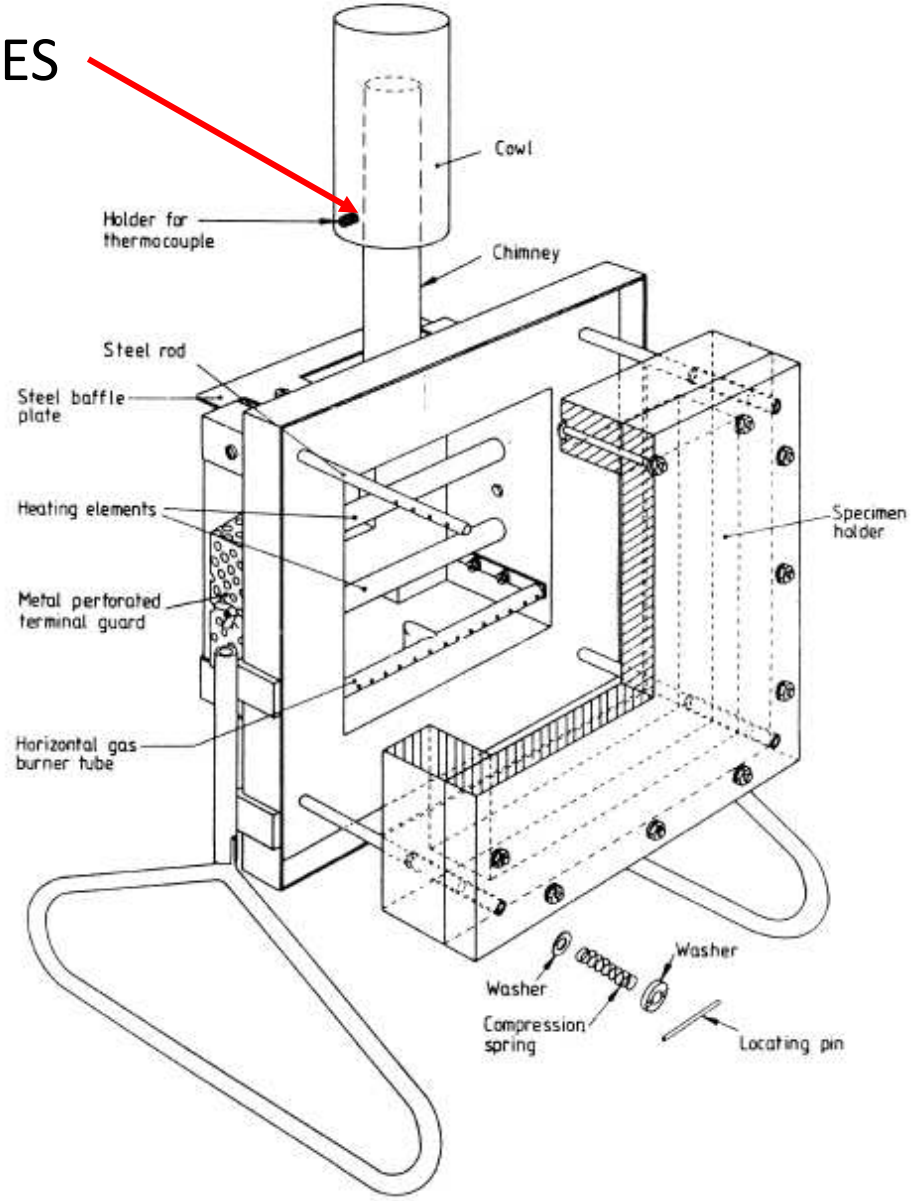


BS 476 PART 6 MEASURES

FIRE GROWTH ON EXPOSED SURFACE

Source: BS 476 Part 6-1989 A1-2009

THERMOCOUPLES

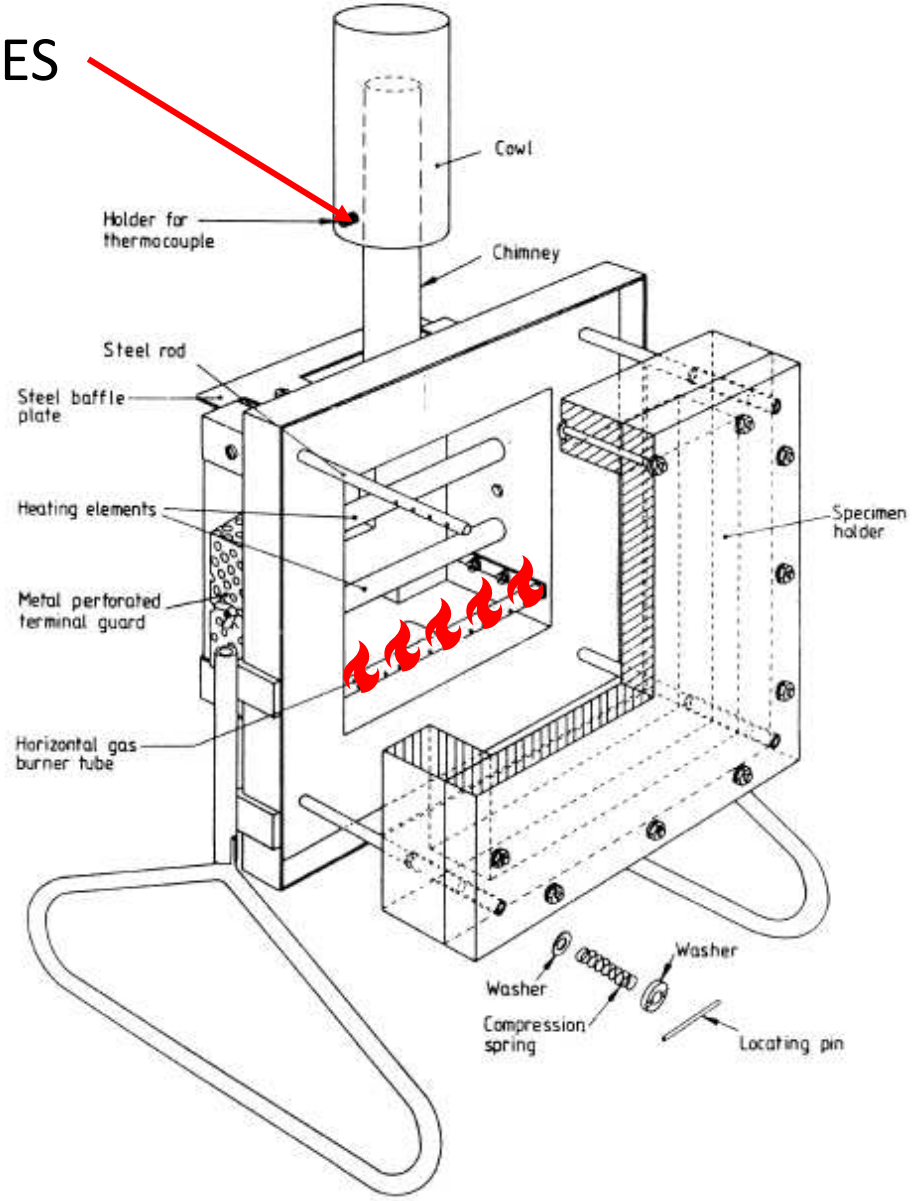


BS 476 PART 6 MEASURES

FIRE GROWTH ON EXPOSED SURFACE

Source: BS 476 Part 6-1989 A1-2009

THERMOCOUPLES



BS 476 PART 6 MEASURES

FIRE GROWTH ON EXPOSED SURFACE

Source: BS 476 Part 6-1989 A1-2009

TEST SPECIMEN PLACEMENT

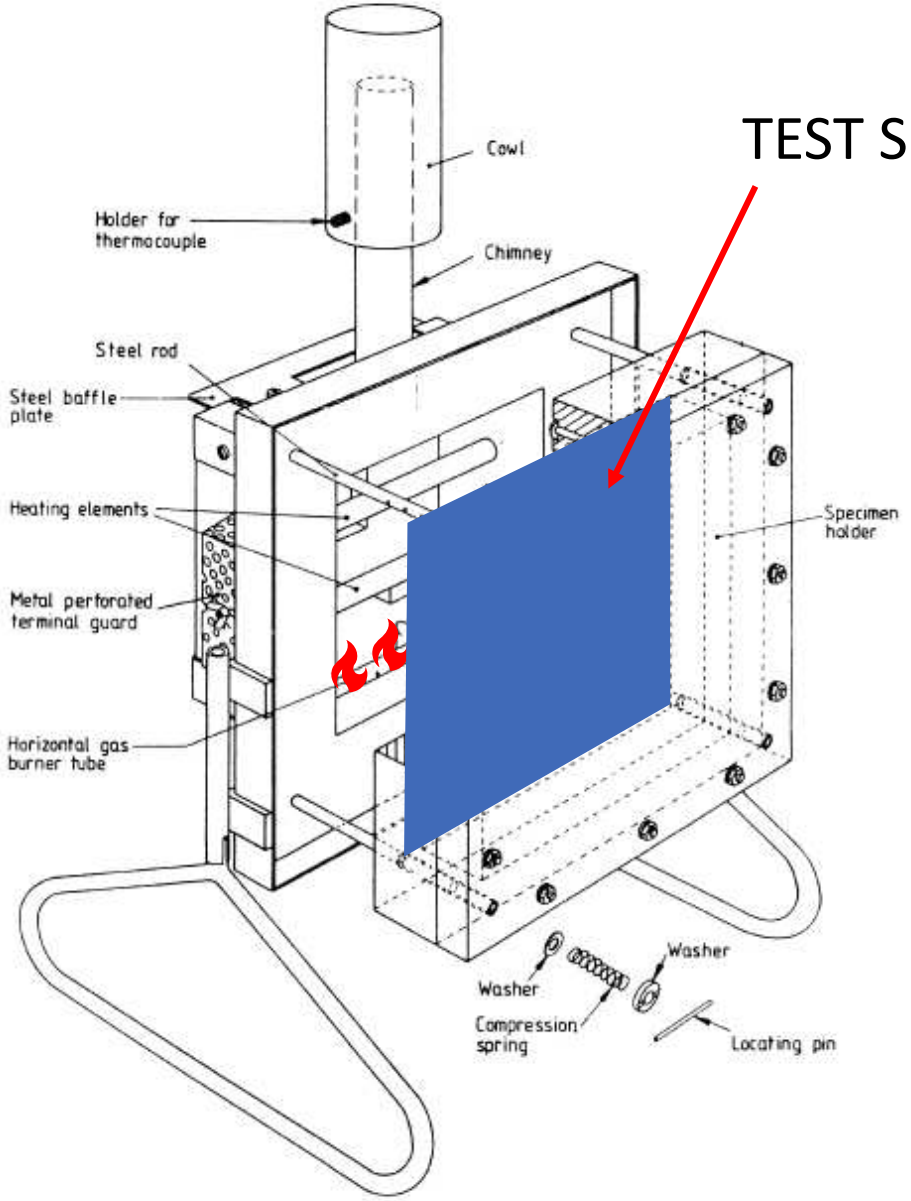


Figure 2 – Diagrammatic representation of the apparatus: rear

Source: BS 476 Part 6-1989 A1-2009

BS 476 PART 6: FIRE GROWTH ON EXPOSED SURFACE

TEST SPECIMEN CAN BE COMPOSITE MATERIAL

Photo from Warringtonfire Youtube video. Link: https://www.youtube.com/watch?v=0obVHZ-mTiM

BS 476 PART 6: FIRE GROWTH ON EXPOSED SURFACE

TEST RESULT EXPRESSED IN FIRE PROPAGATION INDEX (I) & SUBINDICES (i_1, i_2, i_3)

Photo from Warringtonfire Youtube video. Link: https://www.youtube.com/watch?v=0obVHZ-mTiM

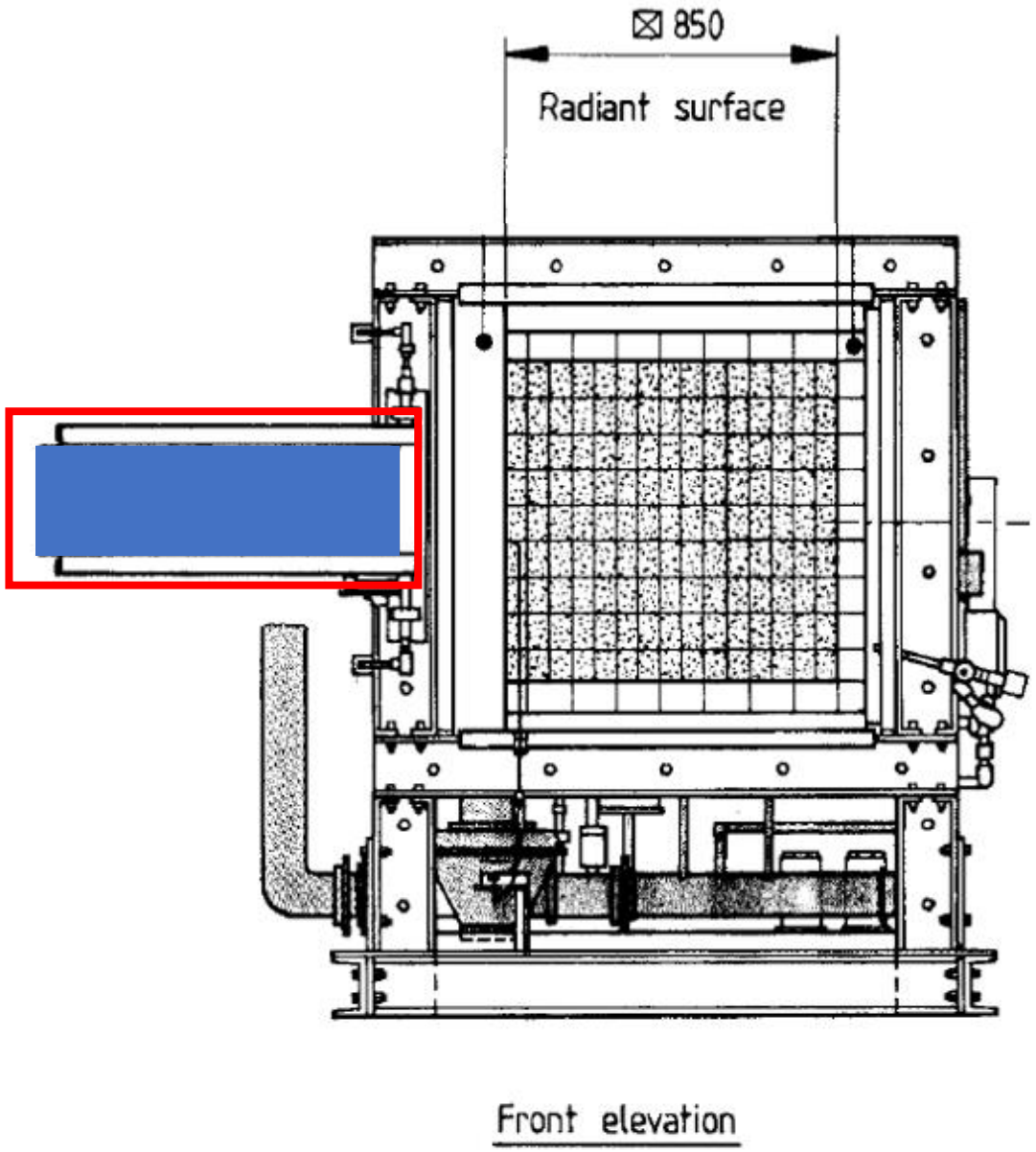
BS 476 PART 6: FIRE GROWTH ON EXPOSED SURFACE

The test results obtained, as an average of the 3 samples tested are as follows:

Index of overall performance, I (Fire propagation index)	=	1.1
Sub-index, i_1	=	0.8
Sub-index, i_2	=	0.2
Sub-index, i_3	=	0.0

TEST RESULT EXPRESSED IN FIRE PROPAGATION INDEX (l) & SUBINDICES (i_1, i_2, i_3)

Source: TUV SUD PSD BS 476 Part 7 Test Report on COLORBOND® steel. Ref: 2018-7191184727-MEC18-2-YWA-PIC



BS 476 PART 7 MEASURES SPREAD OF FLAME ON LATERAL SURFACE

Source: BS 476 Part 7-1997

TEST SPECIMEN (ACTUAL)

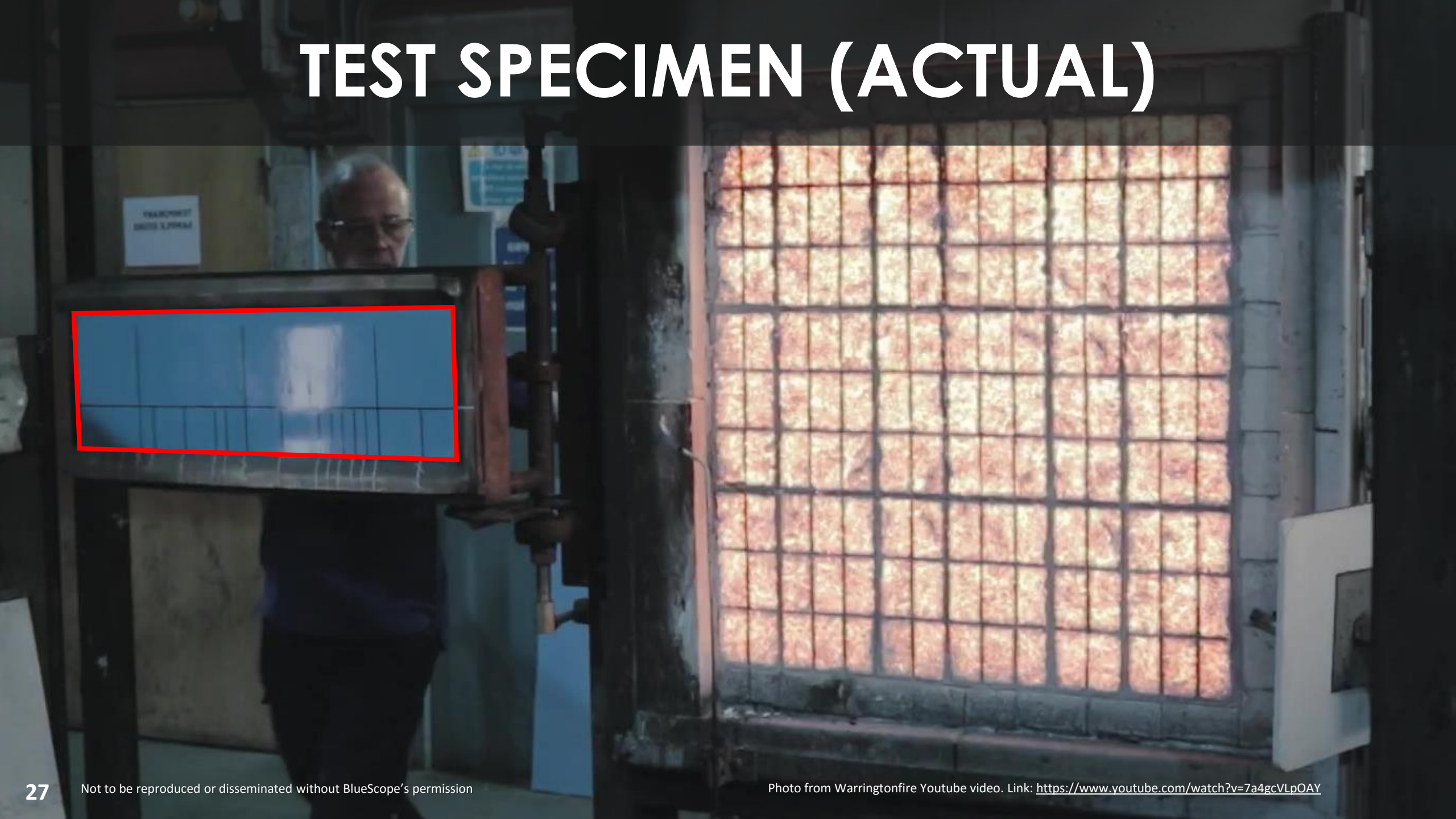


Photo from Warringtonfire Youtube video. Link: https://www.youtube.com/watch?v=7a4gcVLpOAY

ROTATE 90° TO RADIANT HEAT

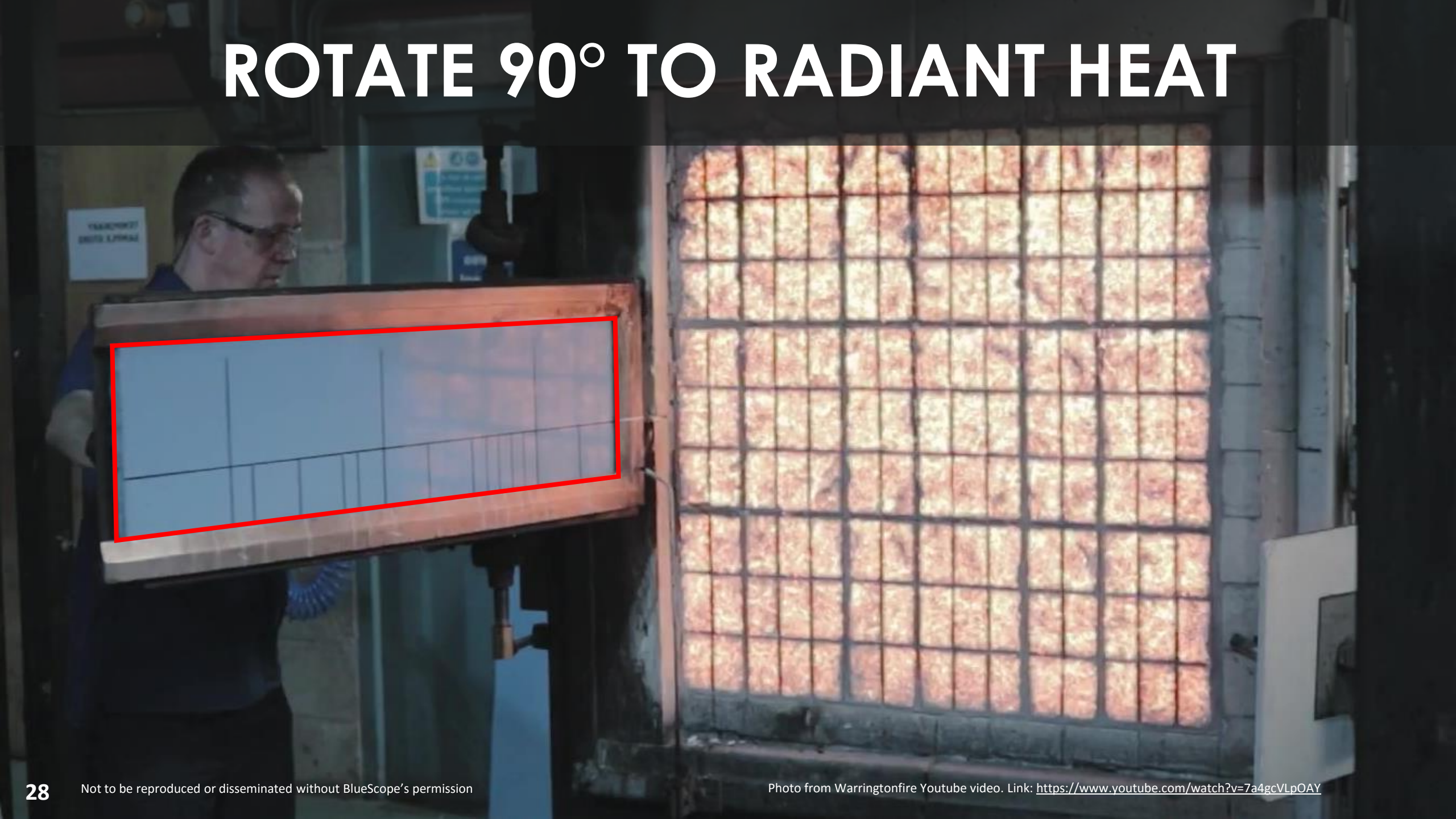


Photo from Warringtonfire Youtube video. Link: https://www.youtube.com/watch?v=7a4gcVLpOAY

OBSERVE FLAME SPREAD

Photo from Warringtonfire Youtube video. Link: https://www.youtube.com/watch?v=7a4gcVLpOAY

RATE OF FLAME SPREAD

Classification of Surface Spread of Flame

Classification	Spread of flame at 1.5 min.		Final spread of flame	
	Limit (mm)	Limit for one specimen in sample (mm)	Limit (mm)	Limit for one specimen in sample (mm)
Class 1	165	165 + 25	165	165 + 25
Class 2	215	215 + 25	455	455 + 45
Class 3	265	265 + 25	710	710 + 75
Class 4	Exceeding the limits for class 3			

Source: BS 476 Part 7-1997

EXTENT OF FLAME SPREAD

Classification of Surface Spread of Flame

Classification	Spread of flame at 1.5 min.		Final spread of flame	
	Limit (mm)	Limit for one specimen in sample (mm)	Limit (mm)	Limit for one specimen in sample (mm)
Class 1	165	165 + 25	165	165 + 25
Class 2	215	215 + 25	455	455 + 45
Class 3	265	265 + 25	710	710 + 75
Class 4	Exceeding the limits for class 3			

Source: BS 476 Part 7-1997

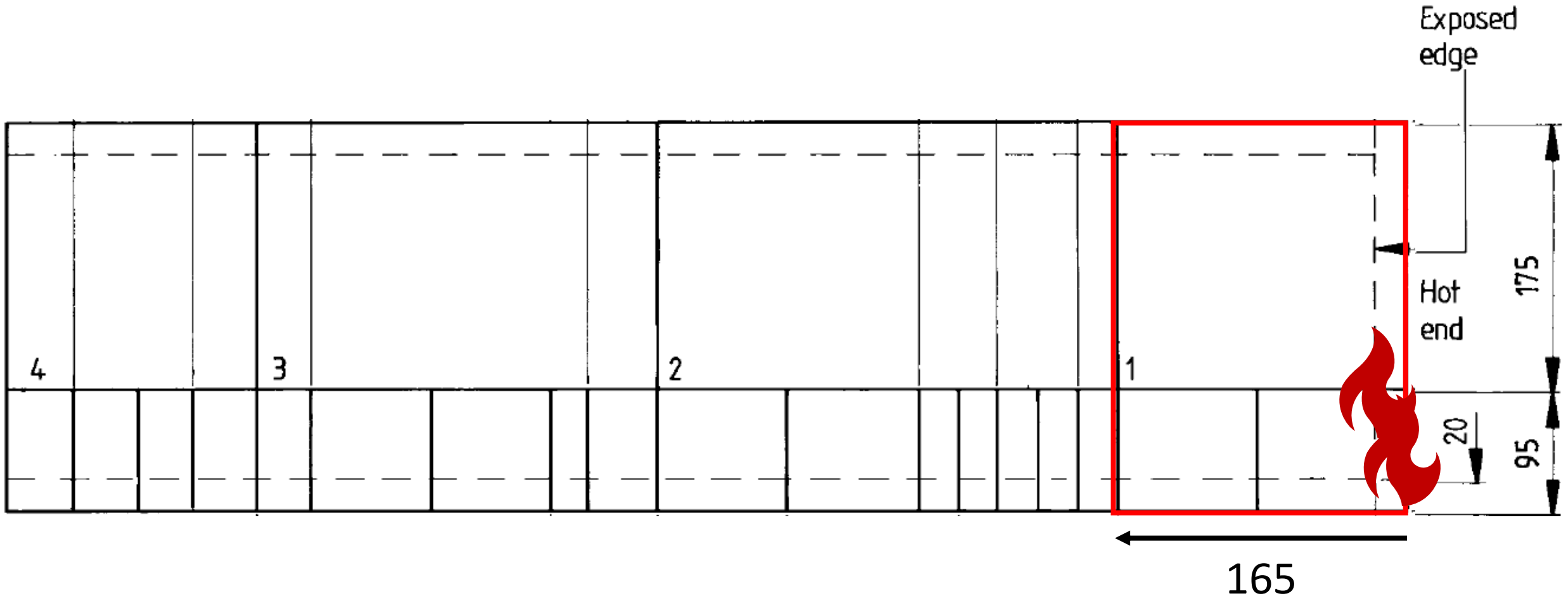
CLASS 1 CLASSIFICATION

Classification of Surface Spread of Flame

Classification	Spread of flame at 1.5 min.		Final spread of flame	
	Limit (mm)	Limit for one specimen in sample (mm)	Limit (mm)	Limit for one specimen in sample (mm)
Class 1	165	165 + 25	165	165 + 25
Class 2	215	215 + 25	455	455 + 45
Class 3	265	265 + 25	710	710 + 75
Class 4	Exceeding the limits for class 3			

Source: BS 476 Part 7-1997

SURFACE SPREAD OF FLAME



Source: BS 476 Part 7-1997

CLASS 1 CLASSIFICATION

Specimen No.	1	2	3	4	5	6
Spread of flame at first 1½ minutes (mm)	0	0	0	0	0	0
Distance (mm)	Time of spread of flame to indicated distance (minutes • seconds)					
Start of flaming	nil	nil	nil	nil	nil	nil
Time of maximum spread of flame (minutes • seconds)	-	-	-	-	-	-
Distance of maximum spread of flame (mm)	0	0	0	0	0	0

Source: TUV SUD PSD BS 476 Part 7 Test Report on COLORBOND® steel. Ref: 2018-7191184727-MEC18-1-YWA-PIC

CLASS 0 CLASSIFICATION

BS 476 Part 6

- **Results: Fire propagation index, l < 12; and sub-index, i_1 < 6.**

BS 476 Part 7

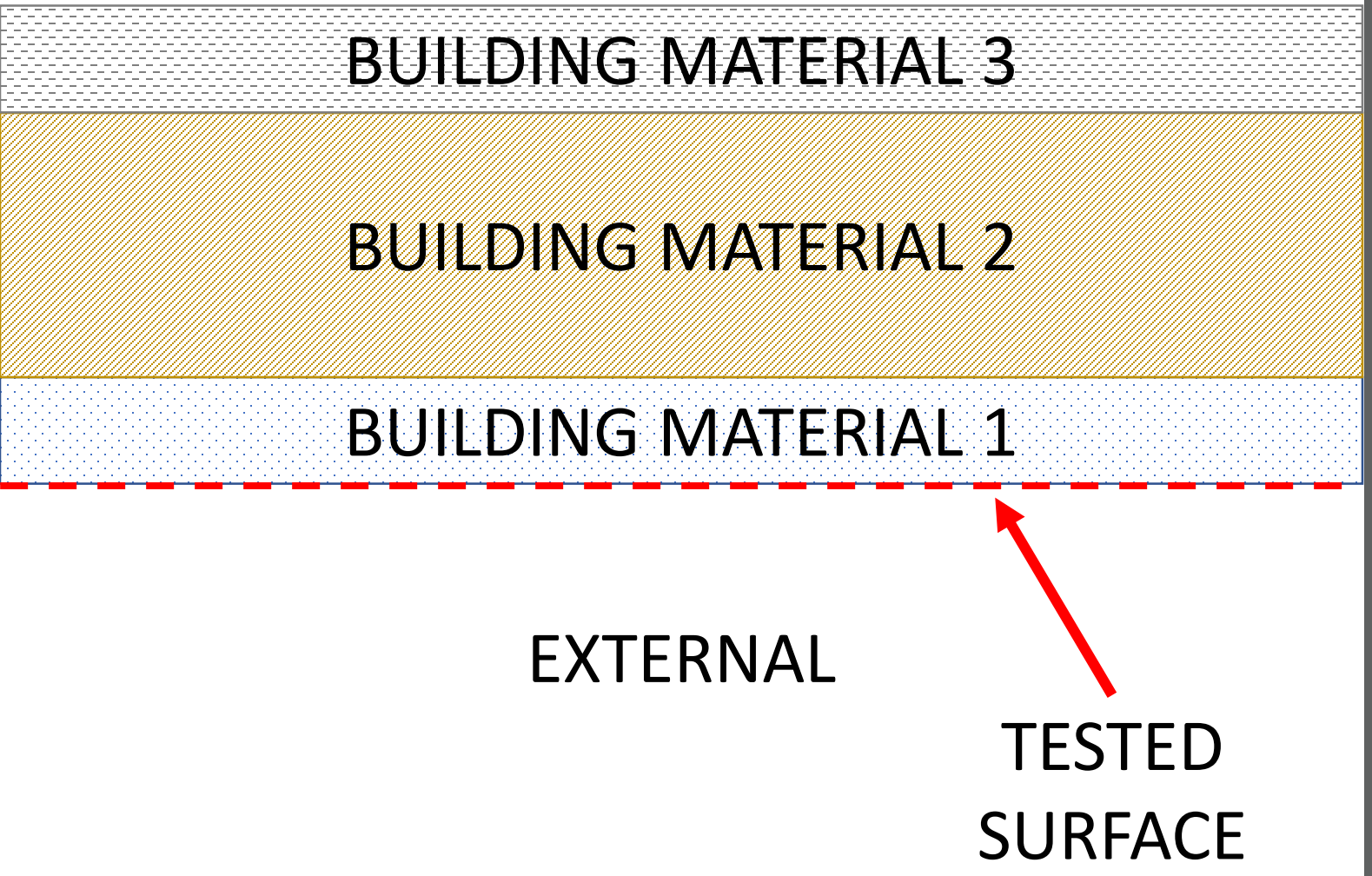
- **Results: Class 1 surface spread of flame.**

Classification	Spread of flame at 1.5 min.		Final spread of flame	
	Limit (mm)	Limit for one specimen in sample (mm)	Limit (mm)	Limit for one specimen in sample (mm)
Class 1	165	165 + 25	165	165 + 25
Class 2	215	215 + 25	455	455 + 45
Class 3	265	265 + 25	710	710 + 75
Class 4	Exceeding the limits for class 3			

BS 476 PART 6 & 7: CLASS O

GENERALLY PREPAINTED COATED STEEL WILL BE CLASSIFIED AS CLASS O

Photo from BlueScope



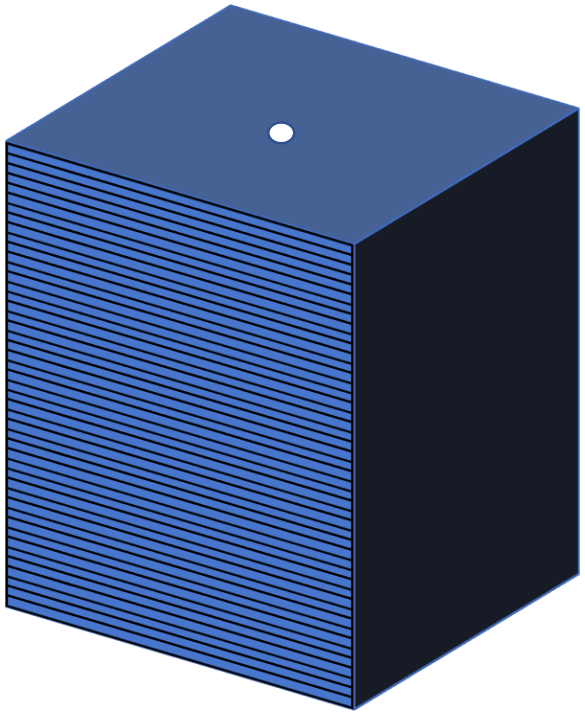
SCOPE OF BS 476 PART 6 & 7

Fire tests on building materials

UK Class	Test Classification
BS 476: Part 4	Non-combustibility test
BS 476: Part 11	Limited Combustibility test
BS 476: Part 6 & Part 7	Class 0
BS 476: Part 7	Class 1 Class 2 Class 3 Class 4

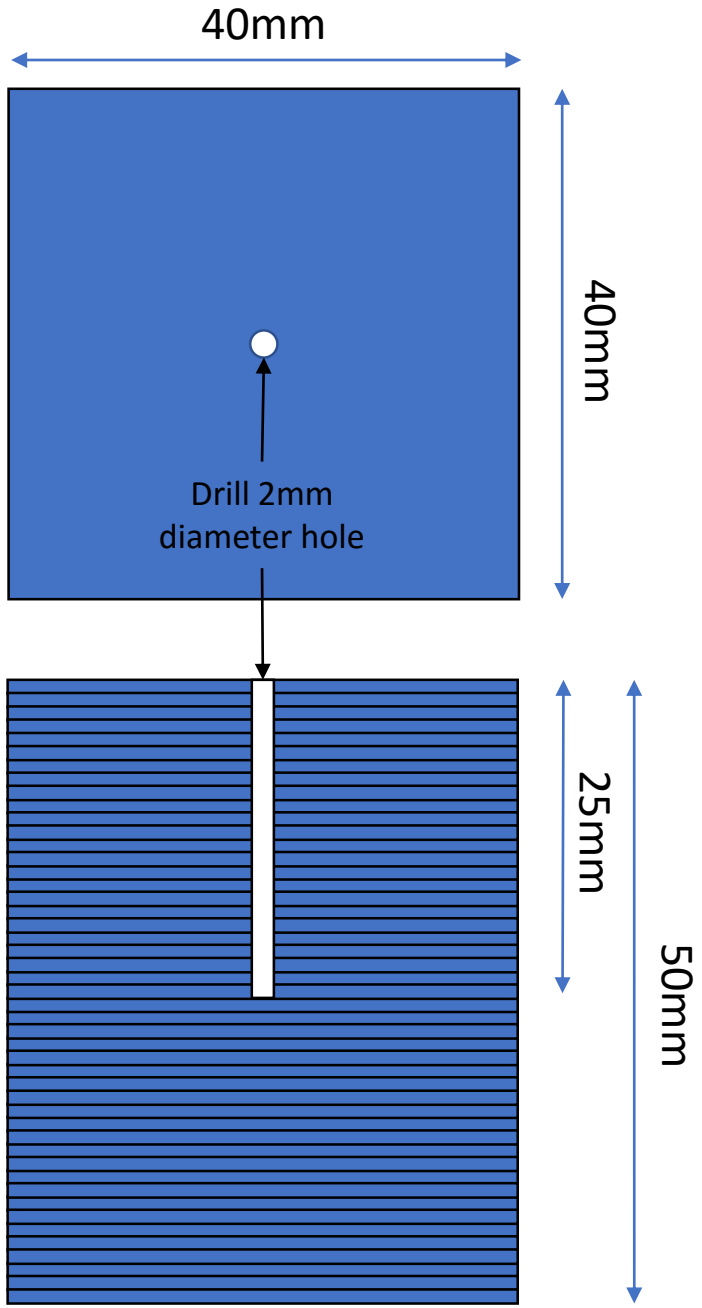
BS 476 PART 4 FIRE TEST ON COMBUSTIBILITY

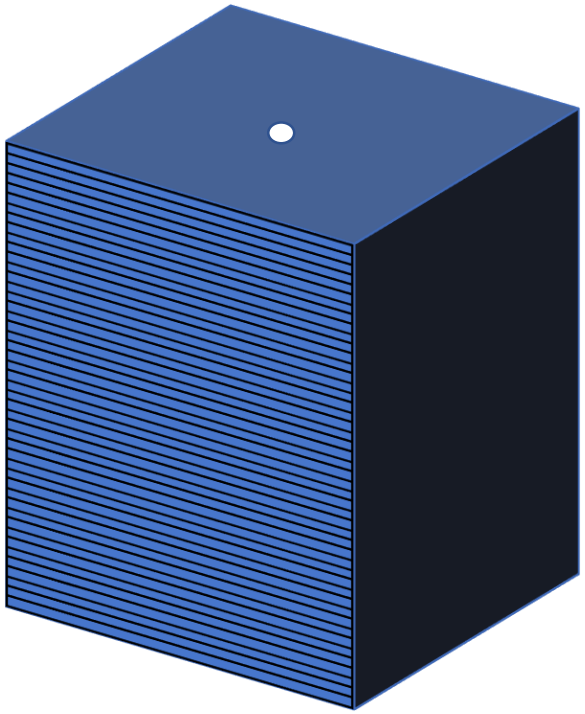
Source: Singapore SCDF Fire Code 2018



TEST SPECIMEN PREPARATION

Source: BS 476-4:1970





TEST SPECIMEN DIMENSIONS

Source: BS 476-4:1970

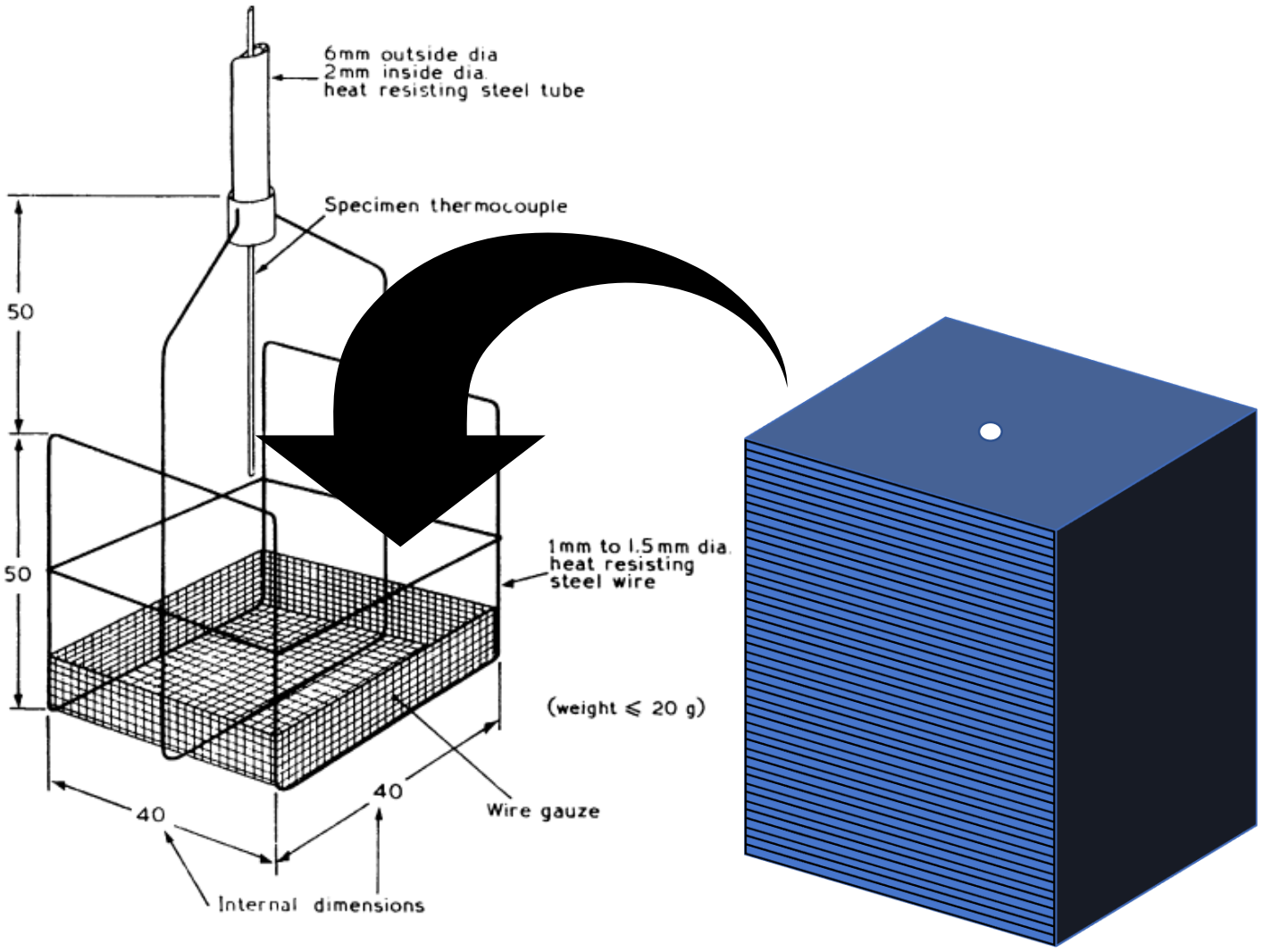
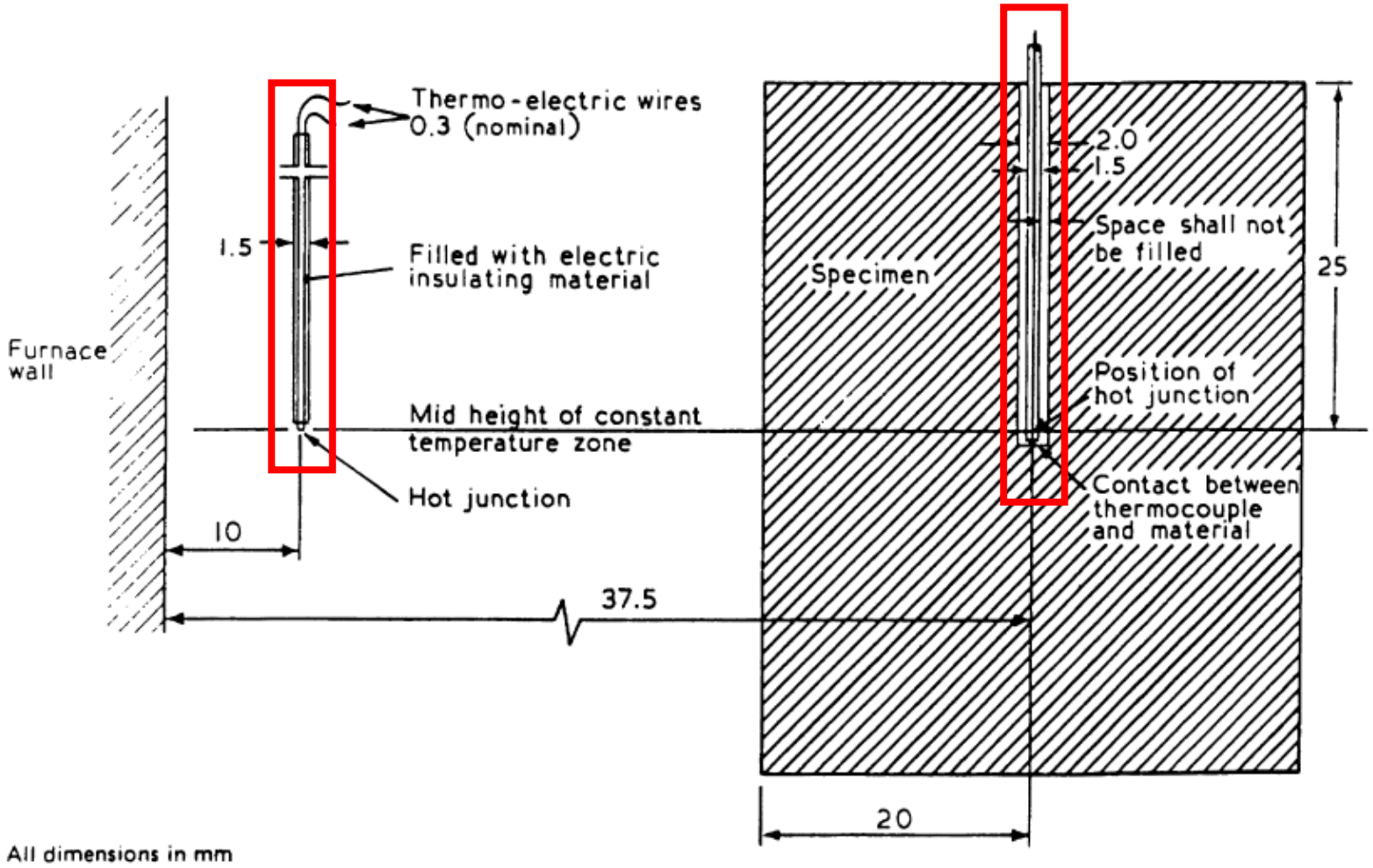


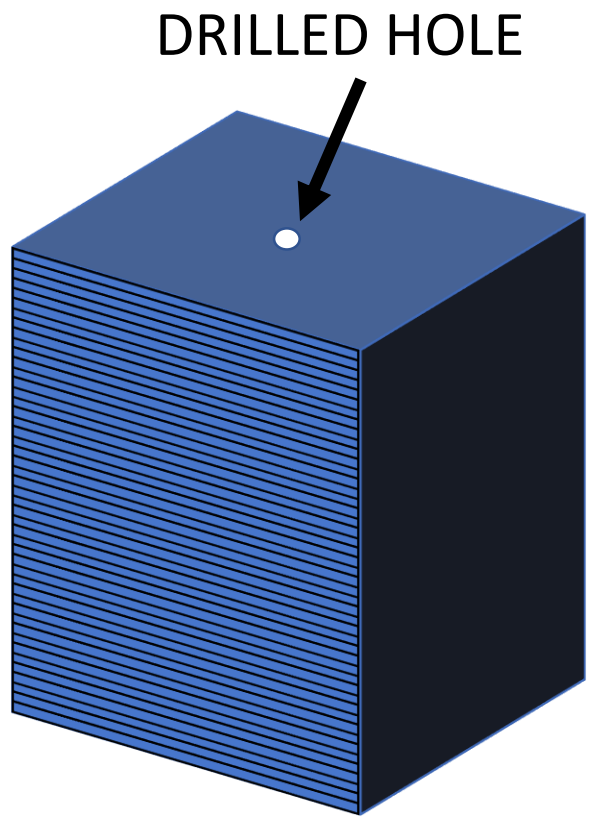
Figure 3 — Specimen holder

TEST SPECIMEN PLACEMENT

Source: BS 476-4:1970

THERMOCOUPLES PLACEMENT





Source: BS 476-4:1970

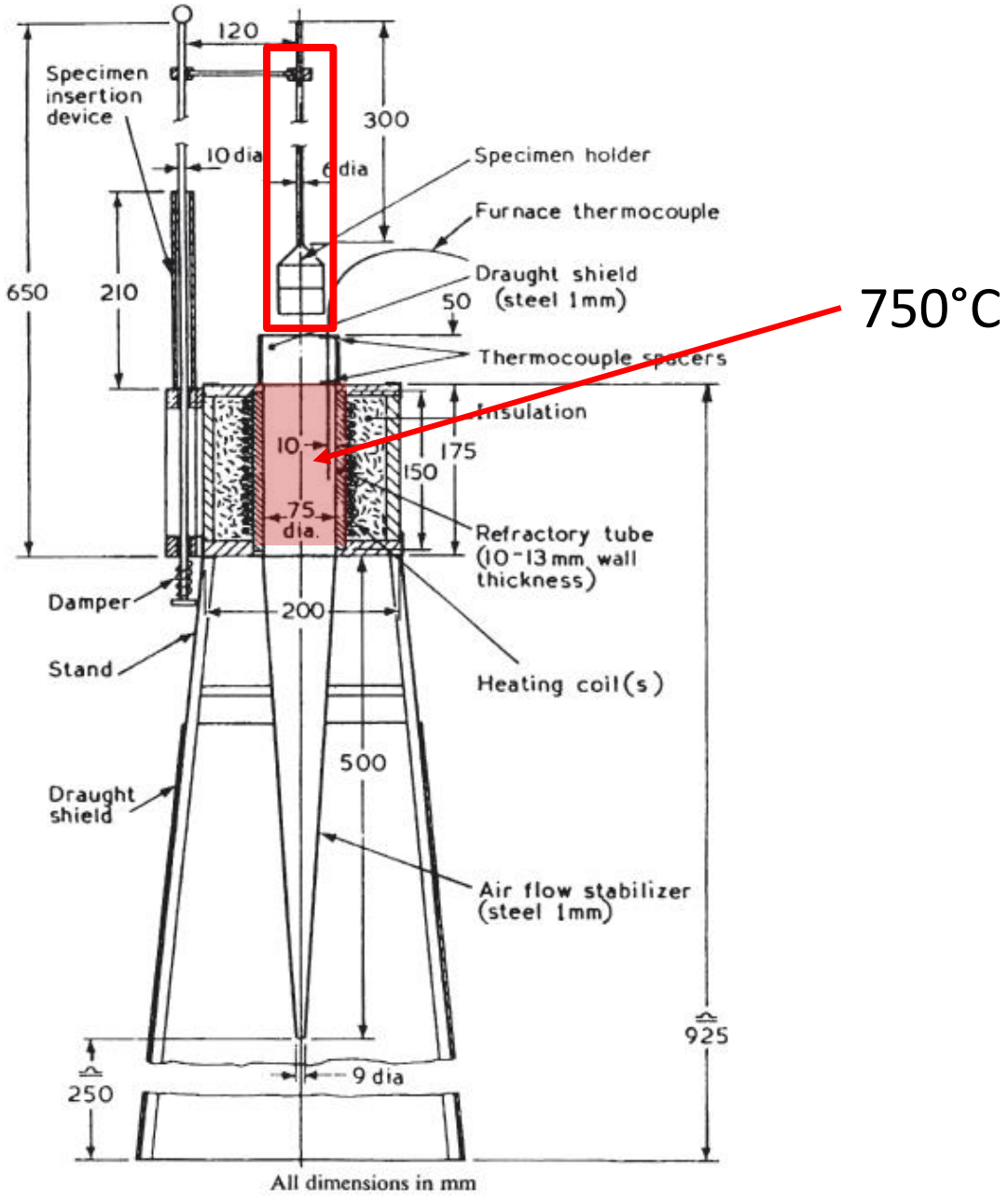


Figure 1 — General arrangement of non-combustibility apparatus

750°C

FURNACE TEMPERATURE

750°C

Source: BS 476-4:1970

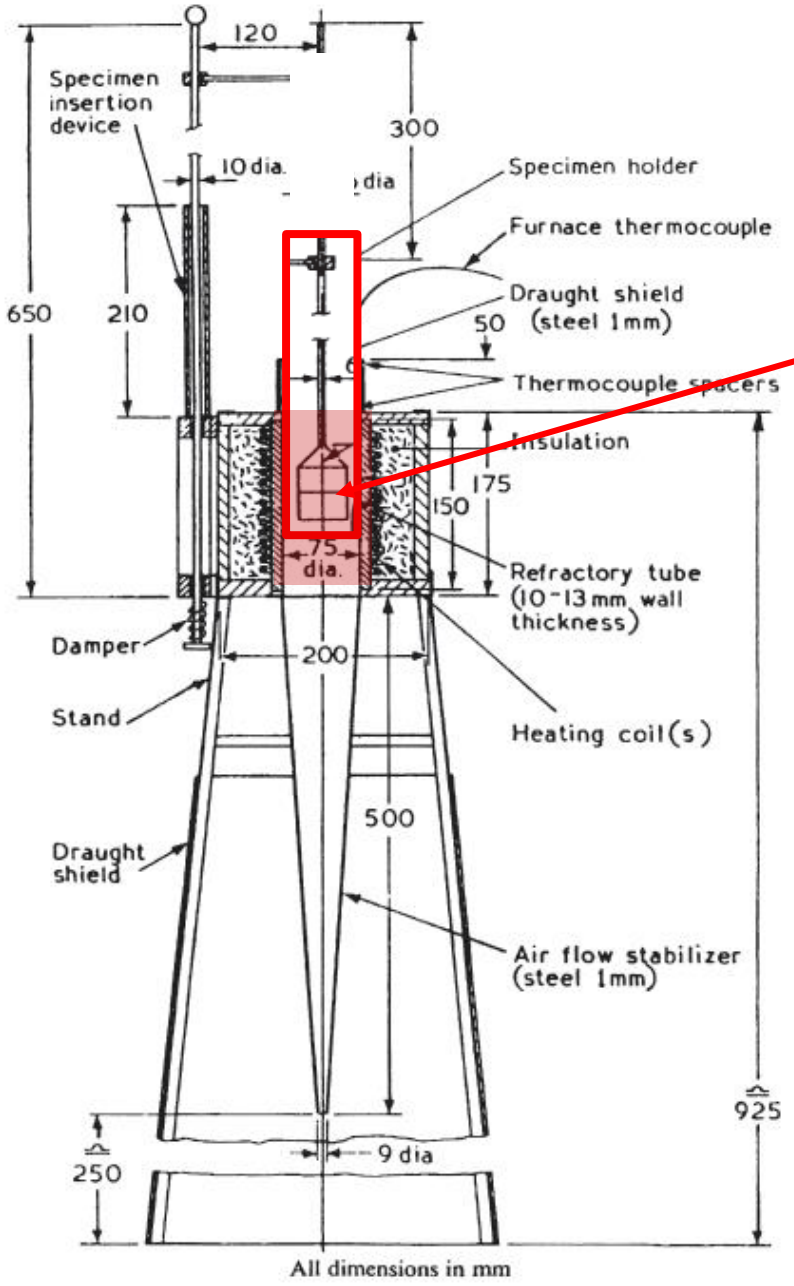


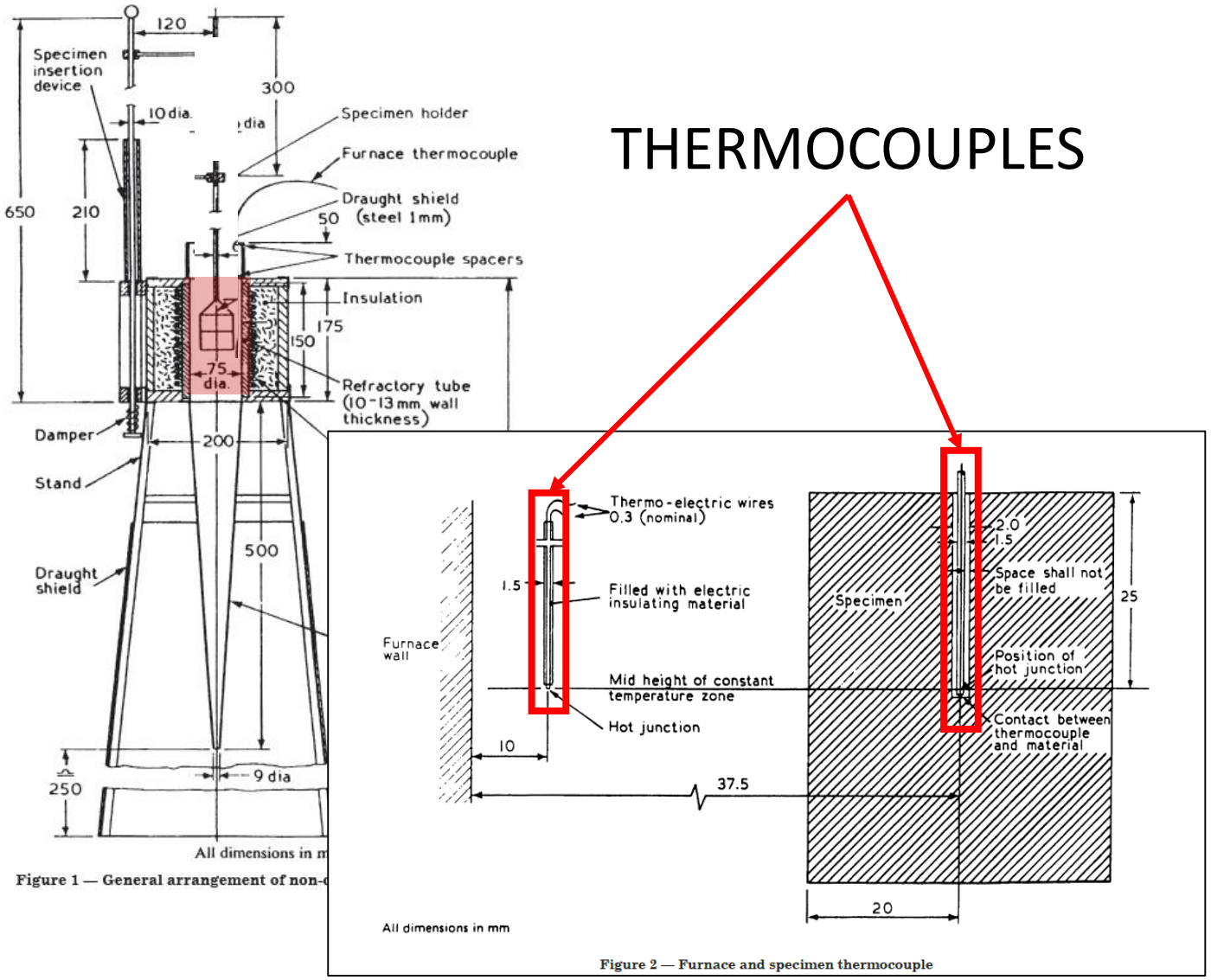
Figure 1 — General arrangement of non-combustibility apparatus

750°C

TEST SPECIMEN MOVE INTO THE FURNACE

Source: BS 476-4:1970

THERMOCOUPLES



TEMPERATURE

<800°C

Source: BS 476-4:1970

BS 476 PART 4: COMBUSTIBILITY TEST

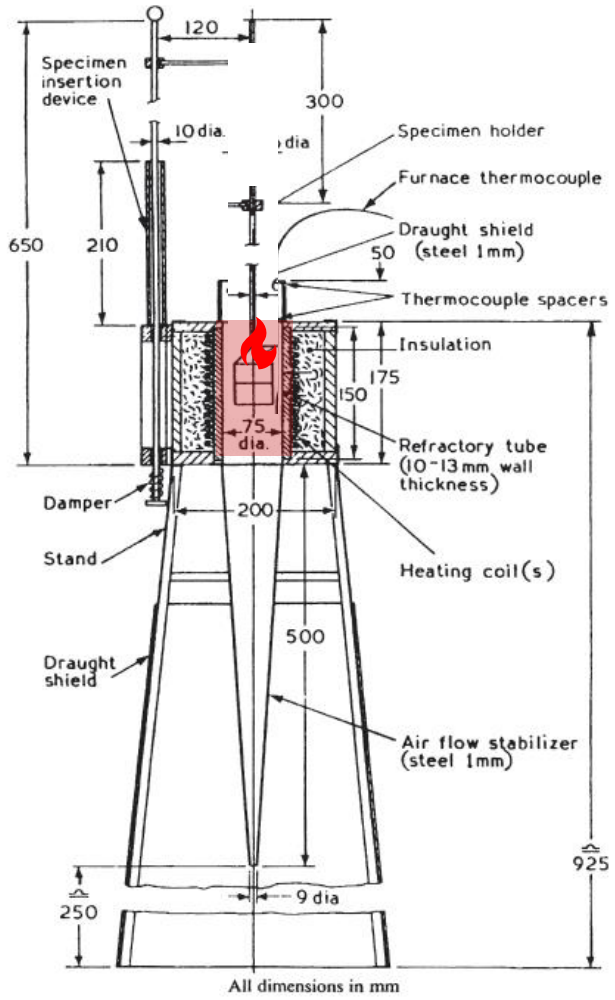
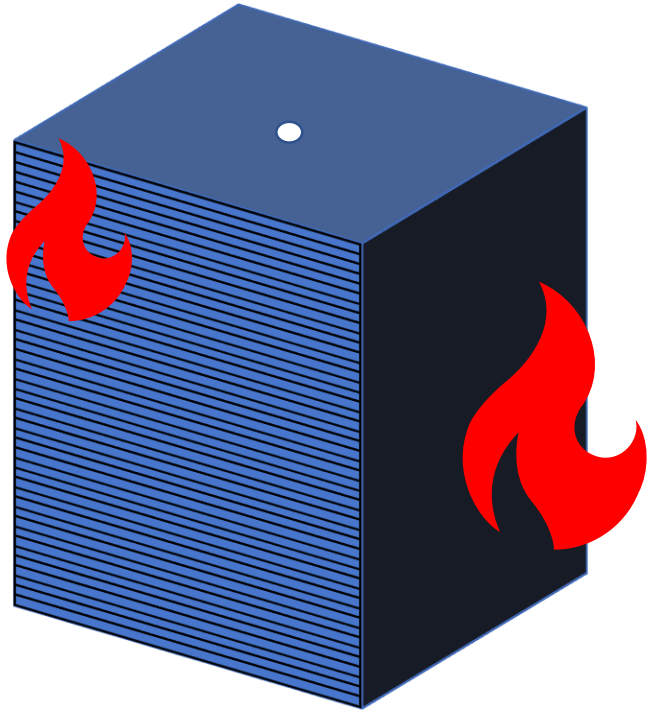


Figure 1 — General arrangement of non-combustibility apparatus



FLAMING IN FURNACE LASTED <10 SECONDS

Source: BS 476-4:1970

NON-COMBUSTIBILITY REQUIREMENTS

Description	Specimen 1	Specimen 2	Specimen 3	Requirements
Time of continuous flaming (sec.)	0	0	0	<10
Temperature rise of furnace above initial furnace temperature (°C)	0	0	0	<50
Temperature rise of sample above initial furnace temperature (°C)	0	0	0	<50
Classification	Non-Combustible	Non-Combustible	Non-Combustible	-

CONCLUSION:

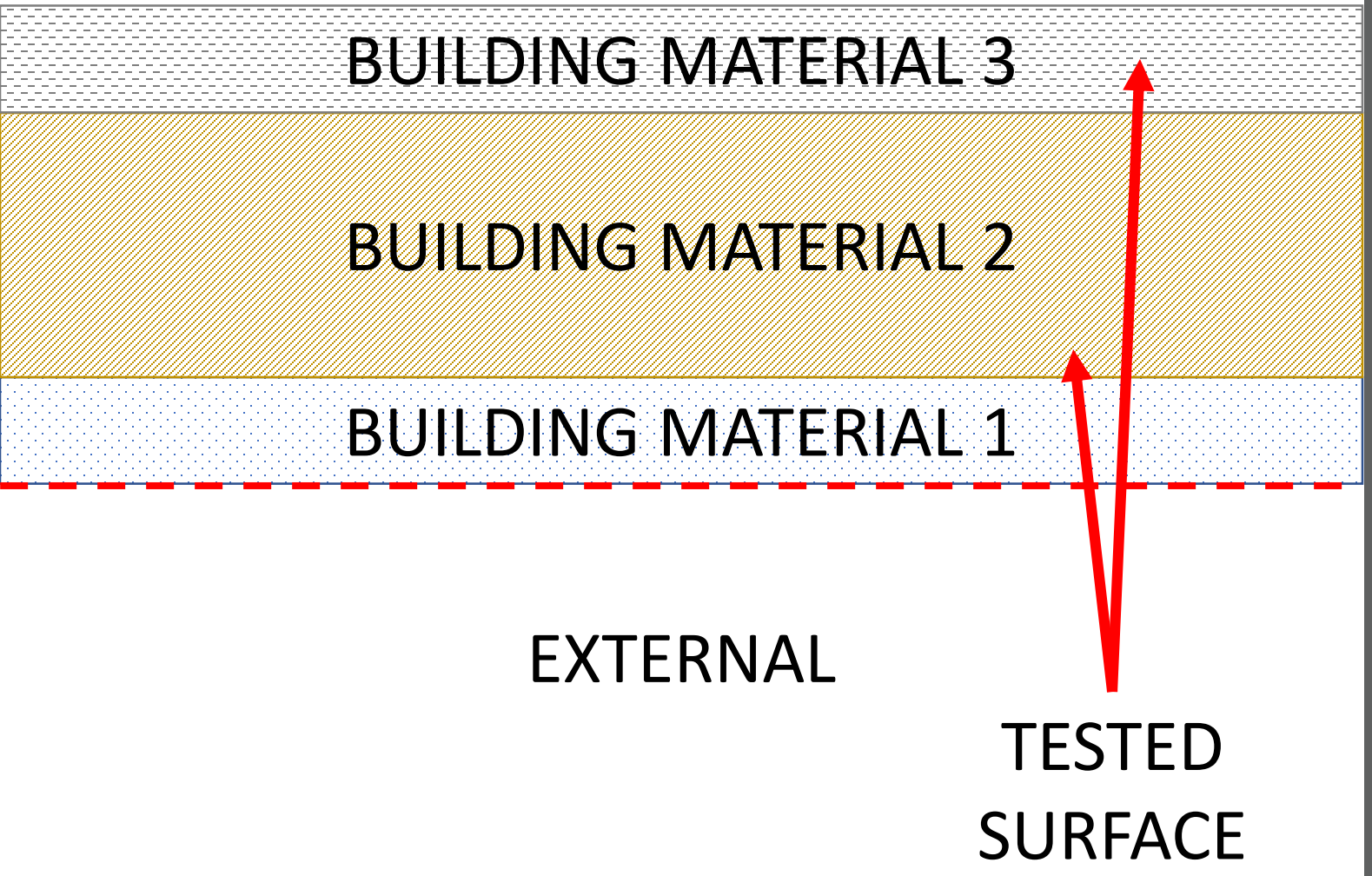
A non-combustibility test for materials in accordance with British Standard 476 Part 4 : 1970 has been performed on the material as described in this report and the classification of the sample is Non-Combustible.

Source: TUV SUD PSD BS 476 Part 4 Test Report on ZINCALUME® steel. Ref: 2018-7191184727-MEC18-3-YWA-PIC

GENERALLY UNPAINTED COATED STEEL WILL BE NON-COMBUSTIBLE

Photo from BlueScope

FIRE TEST FOR NON-COMBUSTIBLE CORE



Fire tests on complete external cladding system

UK Class	Test Classification
BS 8414: Part 1 & 2	Fire performance of external cladding systems

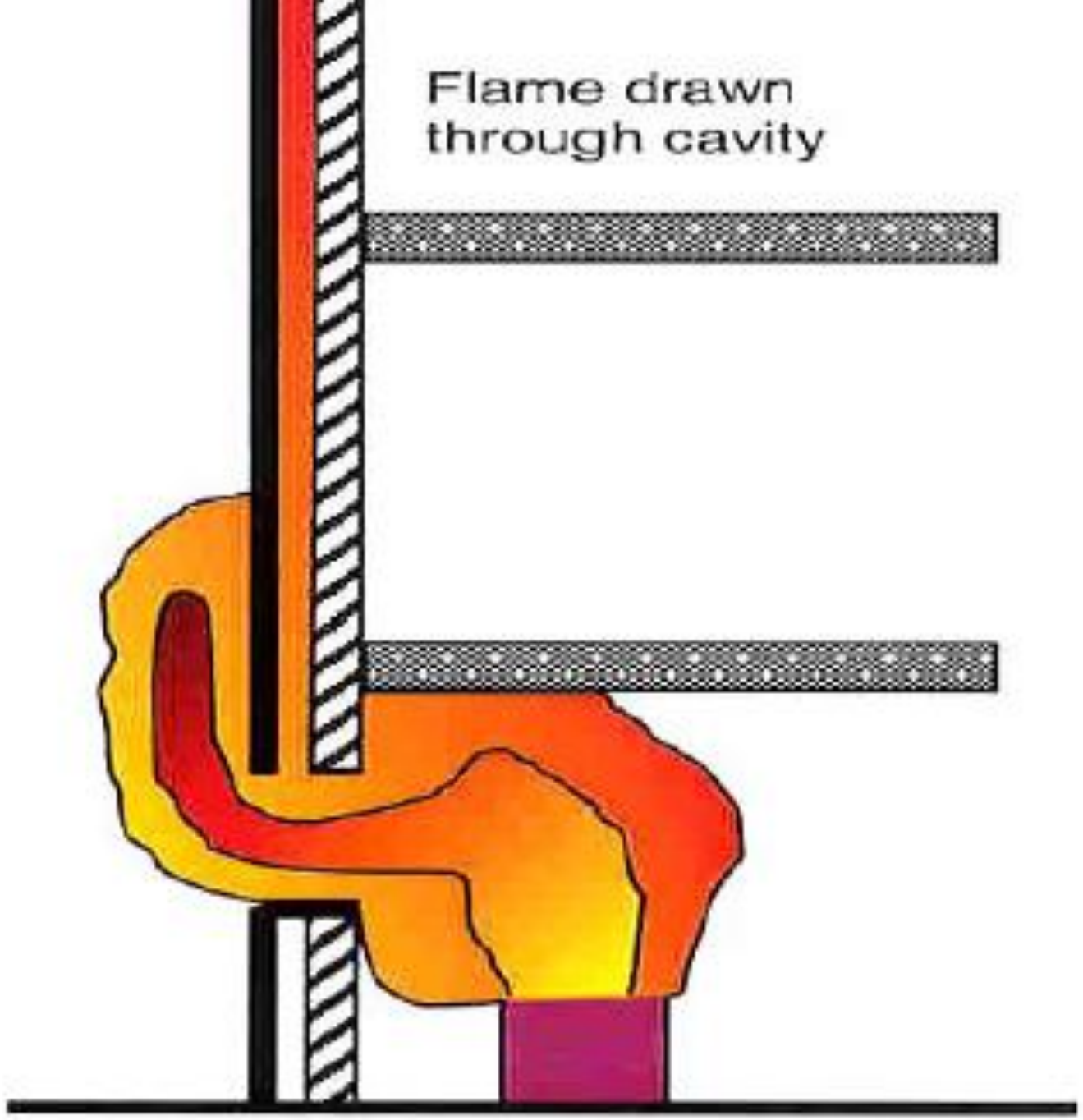
NEW

Fire tests on building materials

UK Class	Test Classification
BS 476: Part 4	Non-combustibility test
BS 476: Part 11	Limited Combustibility test
BS 476: Part 6 & Part 7	Class 0
BS 476: Part 7	Class 1 Class 2 Class 3 Class 4

BS 8414 FIRE TEST OF EXTERNAL CLADDING SYSTEMS

BS 8414 FIRE TEST OF EXTERNAL CLADDING SYSTEMS



SIMULATE FIRE SPREAD THROUGH CLADDING SETUP

FIRE SPREAD MECHANISM

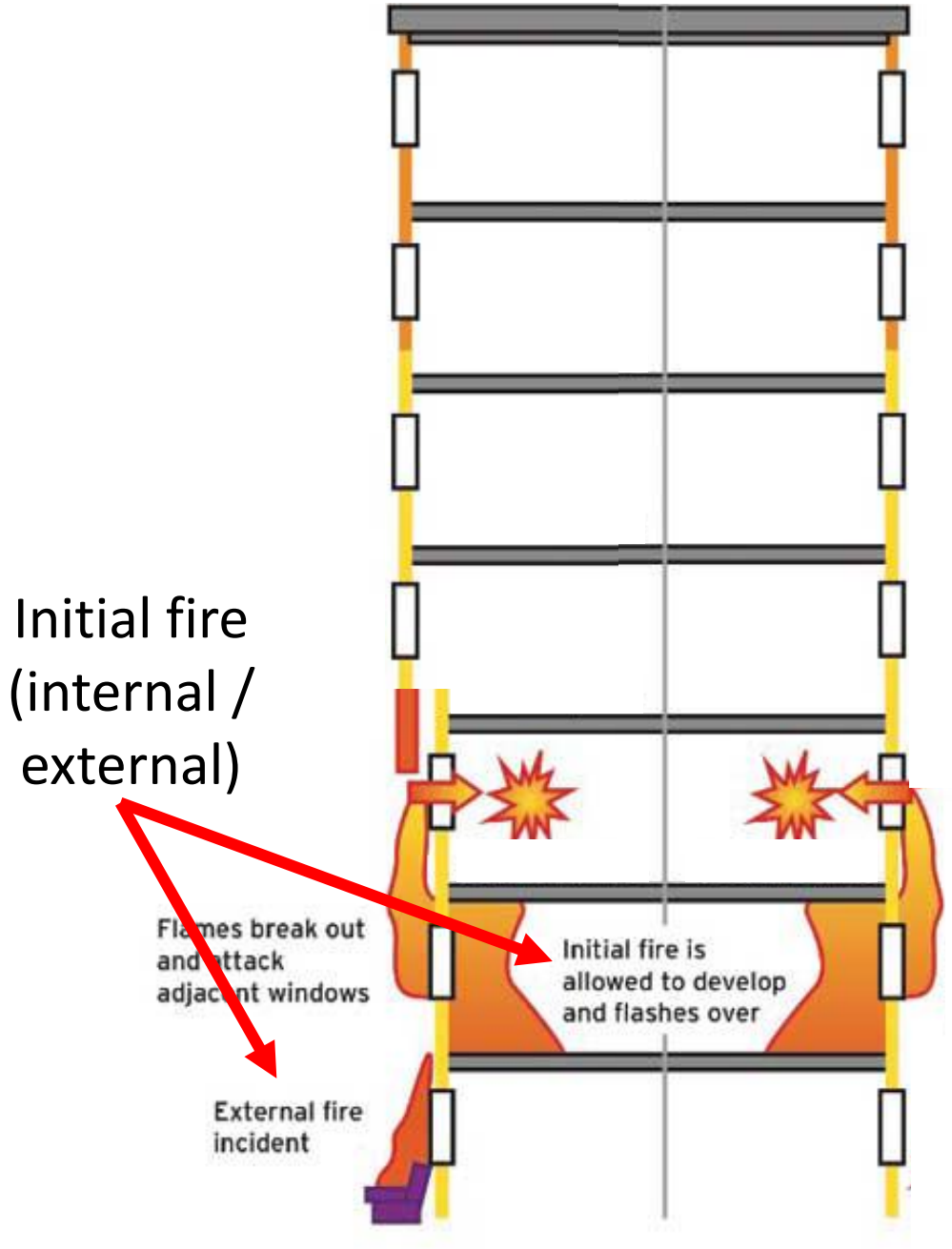


Photo from https://www.constructionspecifier.com/the-leap-frog-effect/

FIRE SPREAD MECHANISM

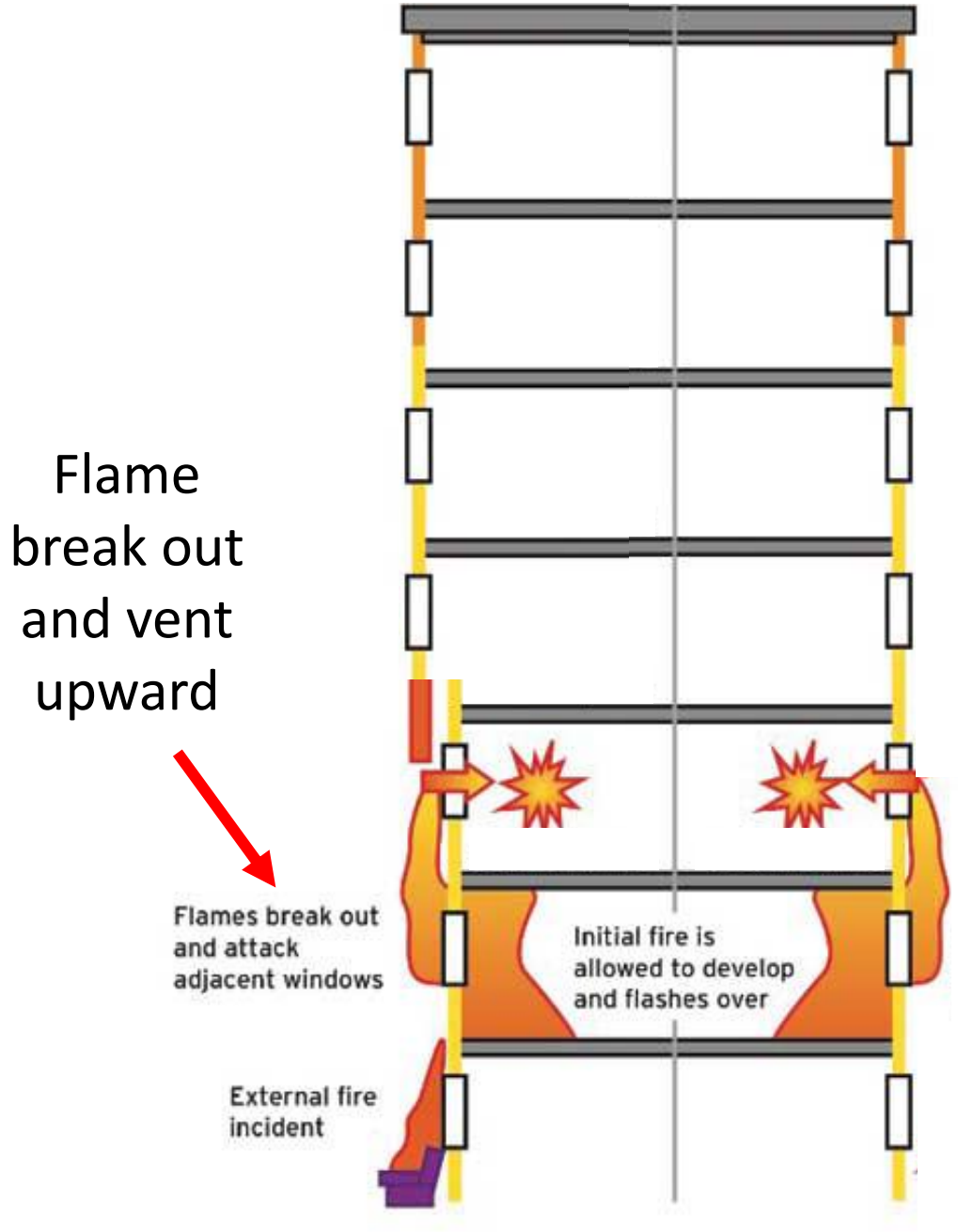


Photo from https://www.constructionspecifier.com/the-leap-frog-effect/

FIRE SPREAD MECHANISM

Rapid Fire Spread
Cladding system contributes to flame spread resulting in risk of multiple simultaneous secondary fires

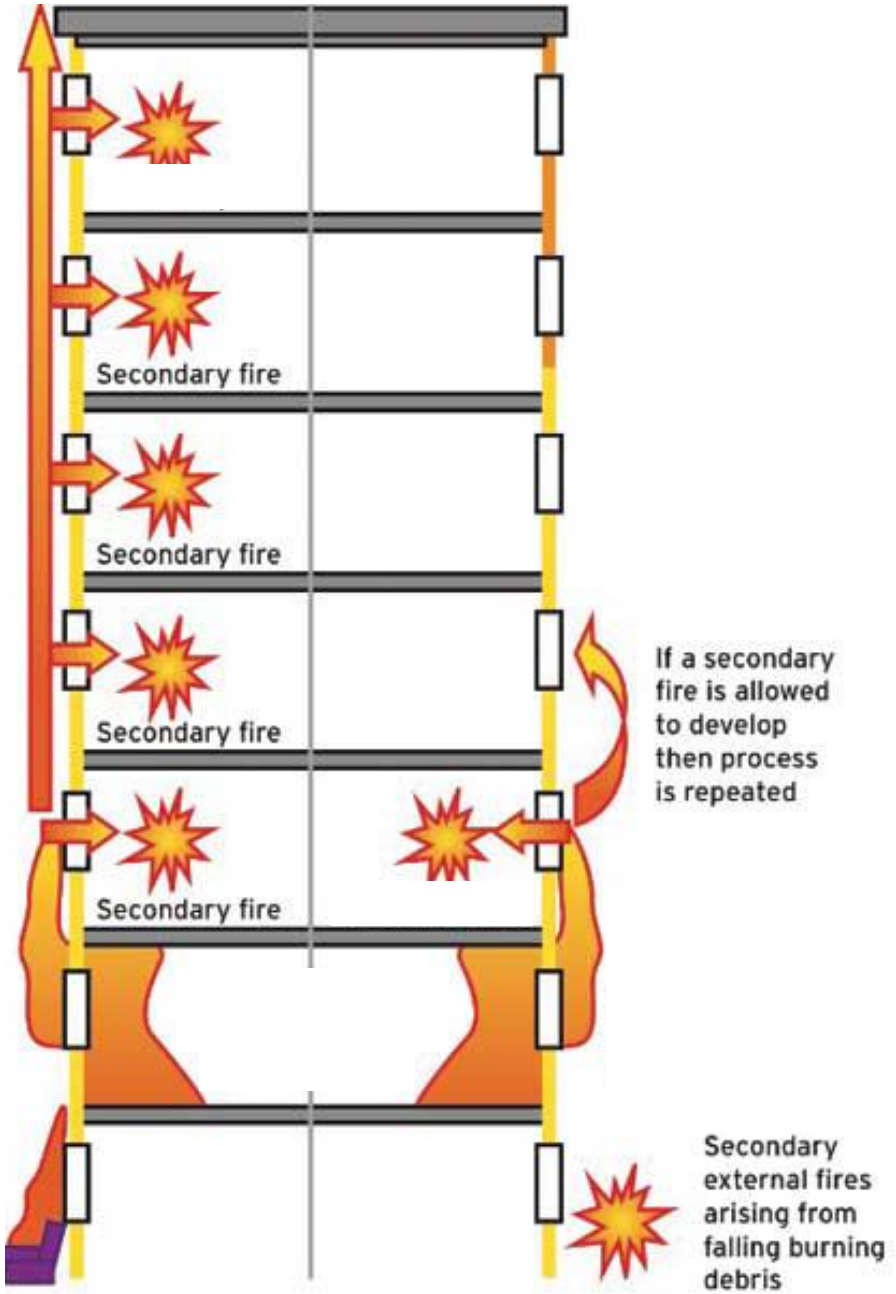


Photo from https://www.constructionspecifier.com/the-leap-frog-effect/

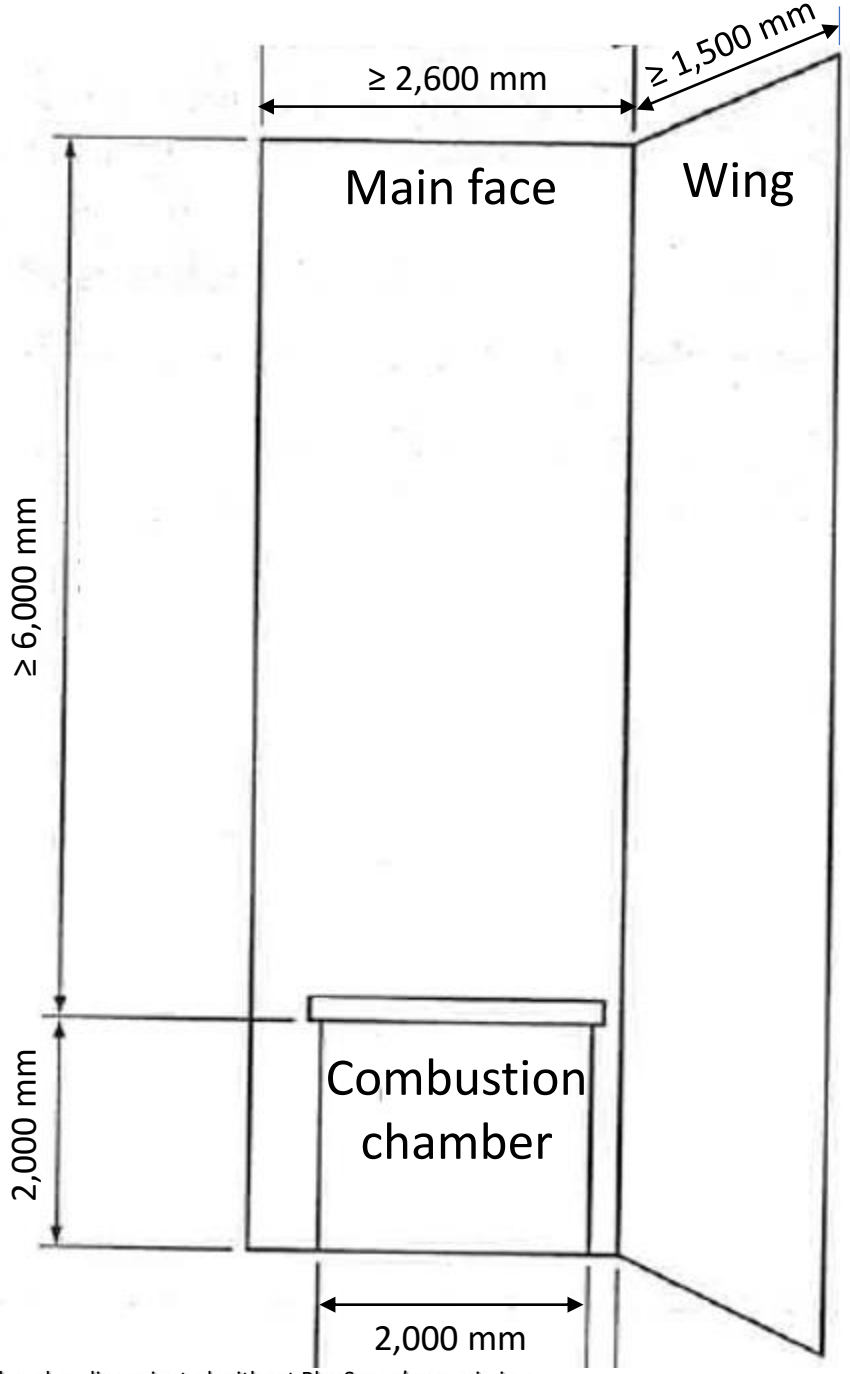
NON-LOAD BEARING EXTERNAL CLADDING SYSTEM

BS 8414 PART 1 & 2

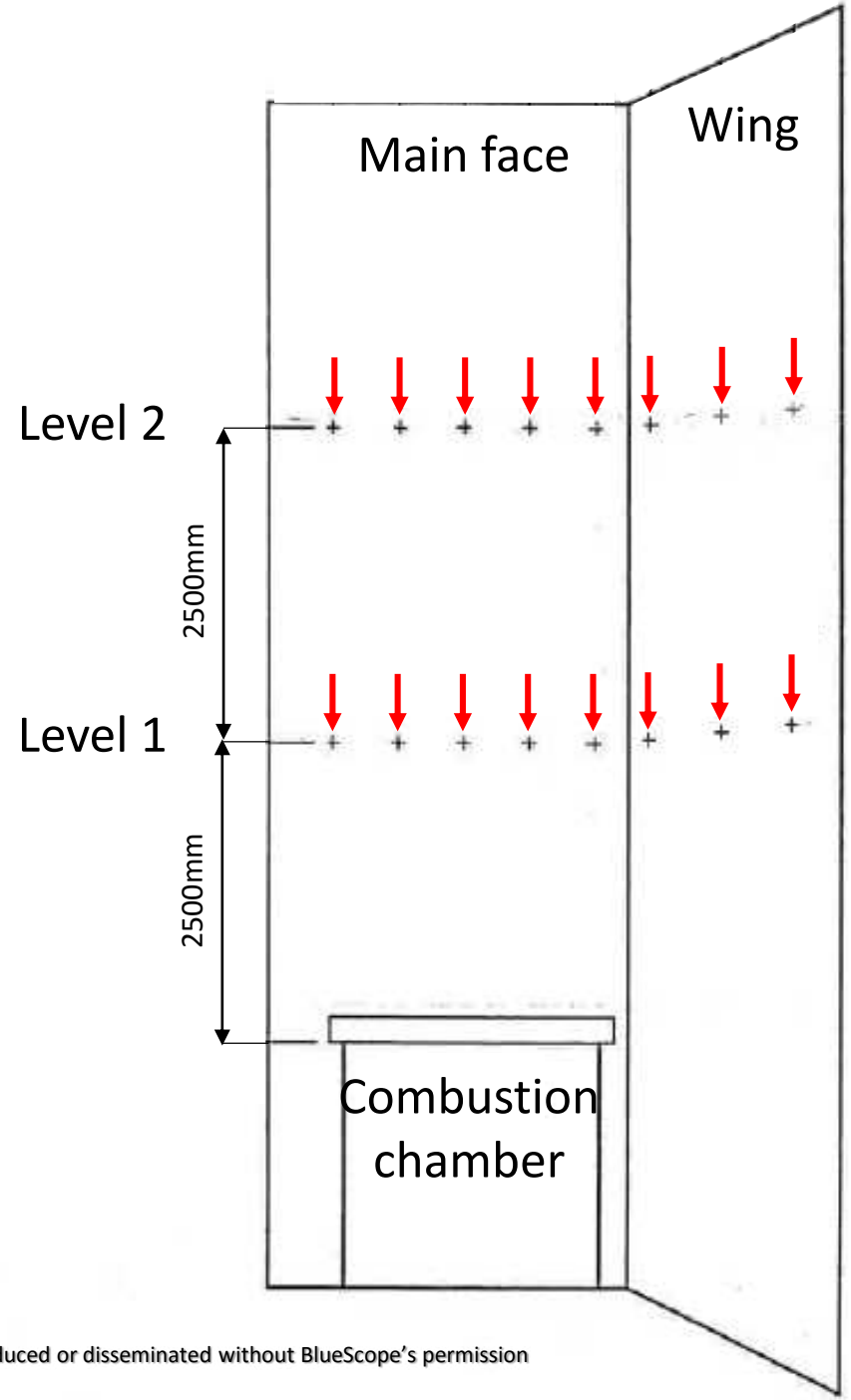
BS 8414-1 Masonry Wall

BS 8414-2 Structural Frame

BS 8414 TEST SETUP

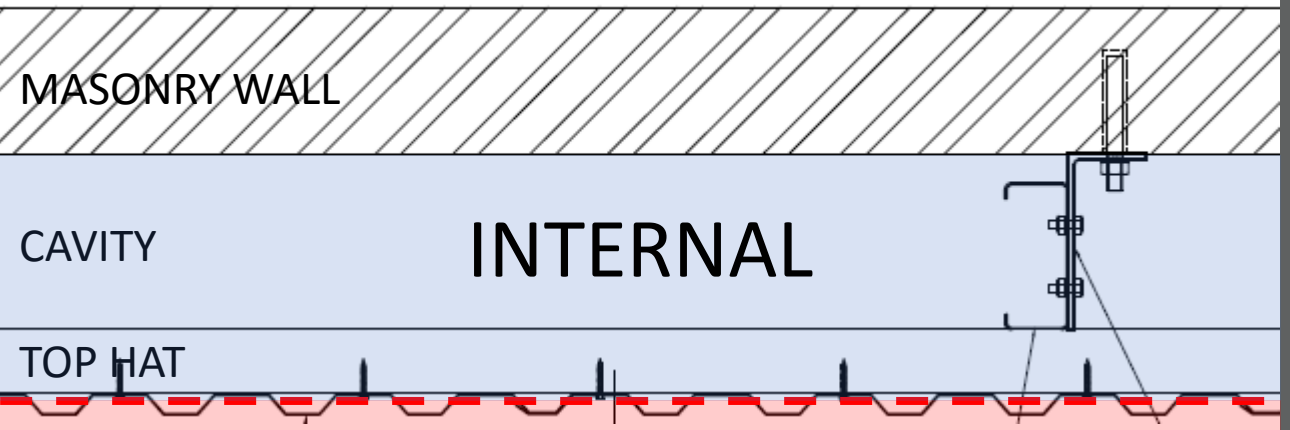


THERMOCOUPLE PLACEMENTS

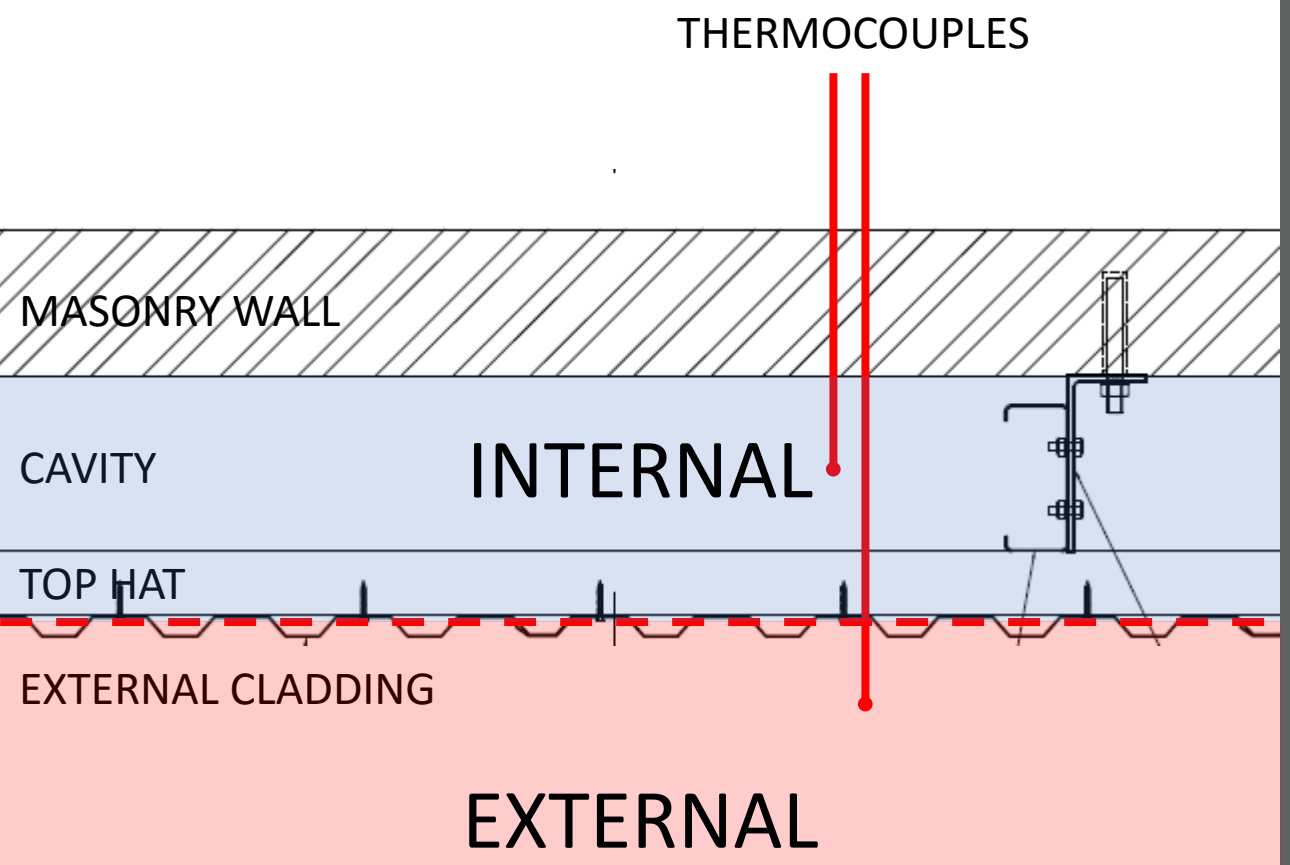


THERMOCOUPLE PLACEMENTS

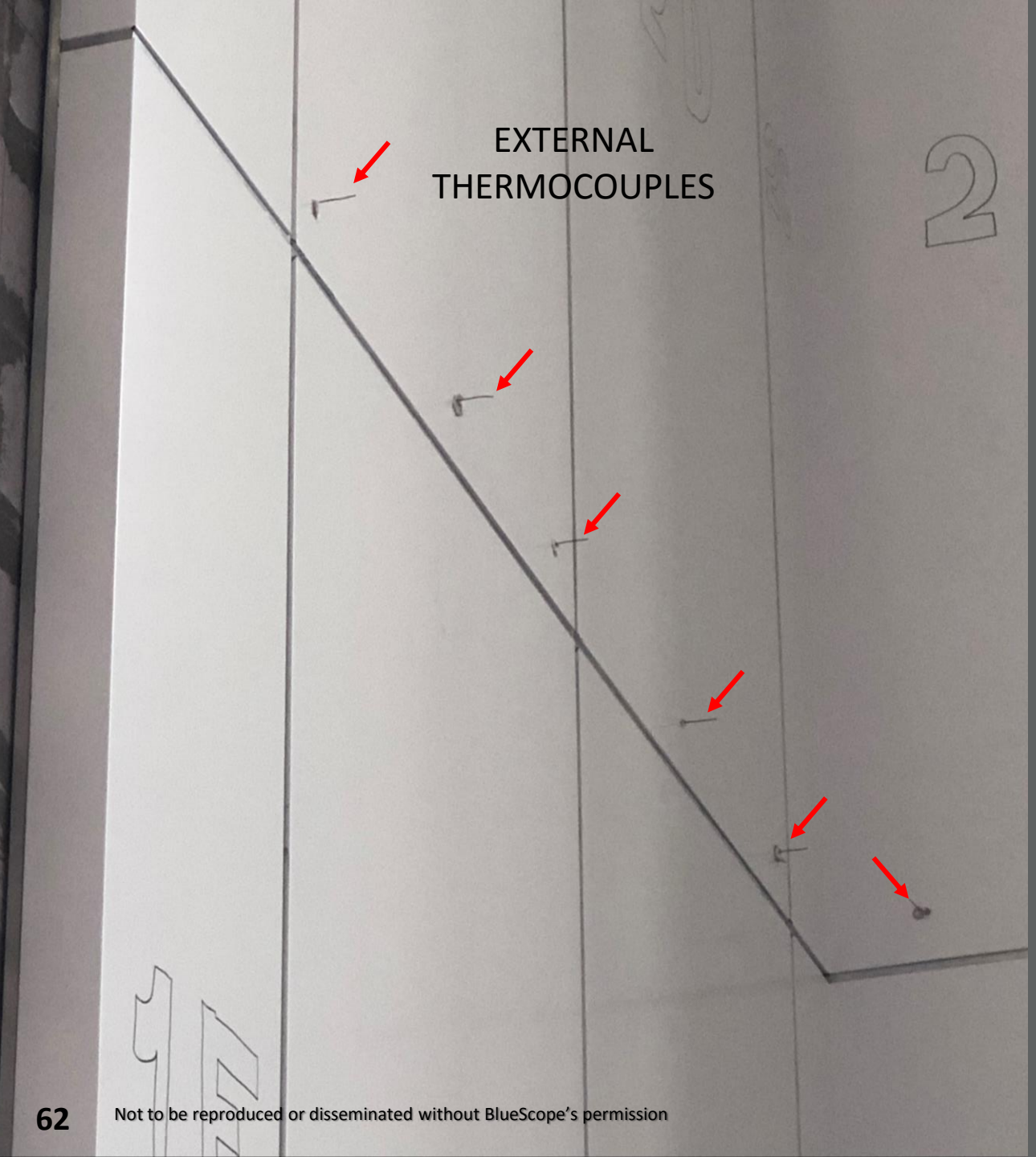
TOP VIEW



EXTERNAL



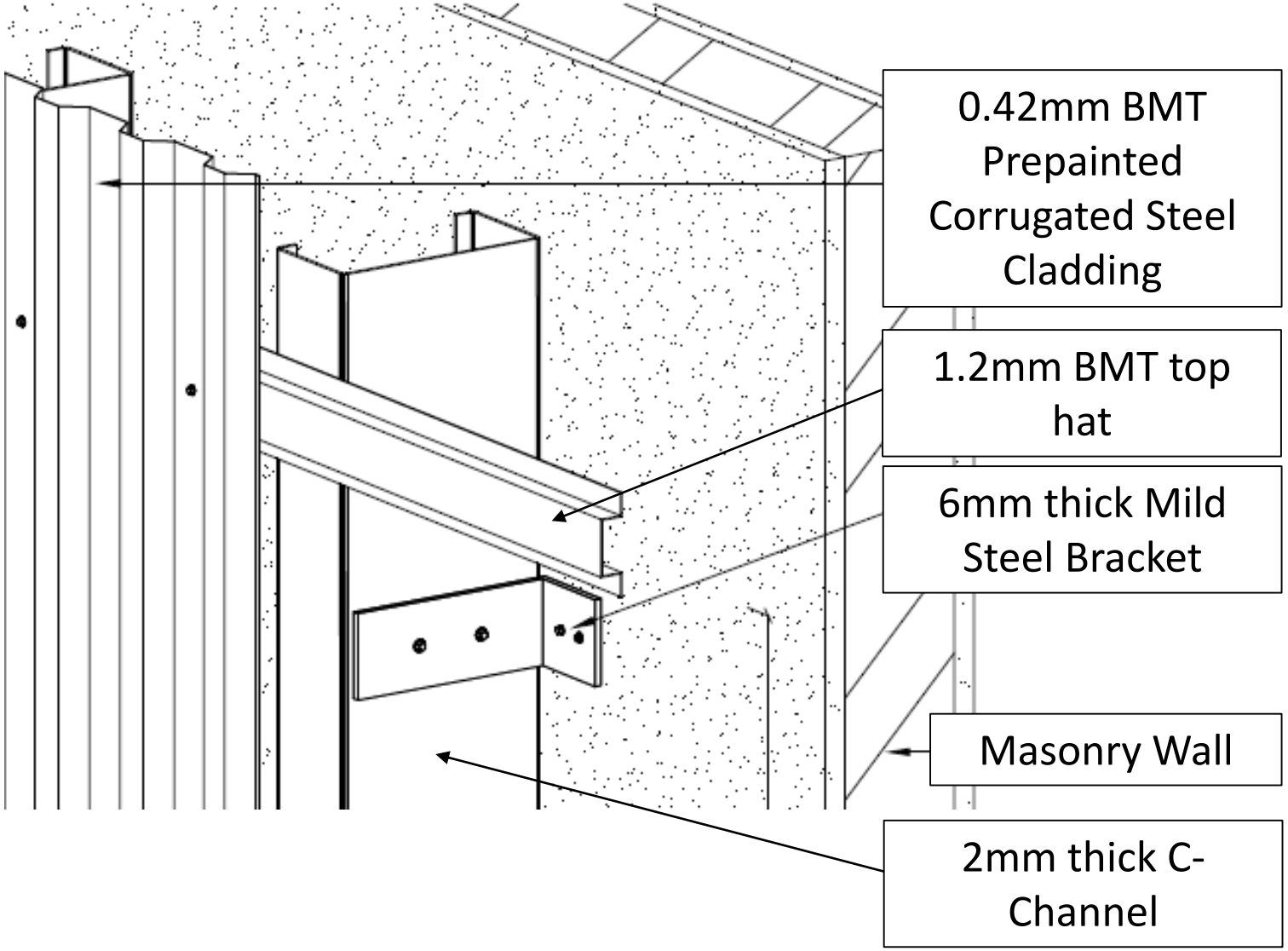
THERMOCOUPLE PLACEMENTS (INTERNAL / EXTERNAL)



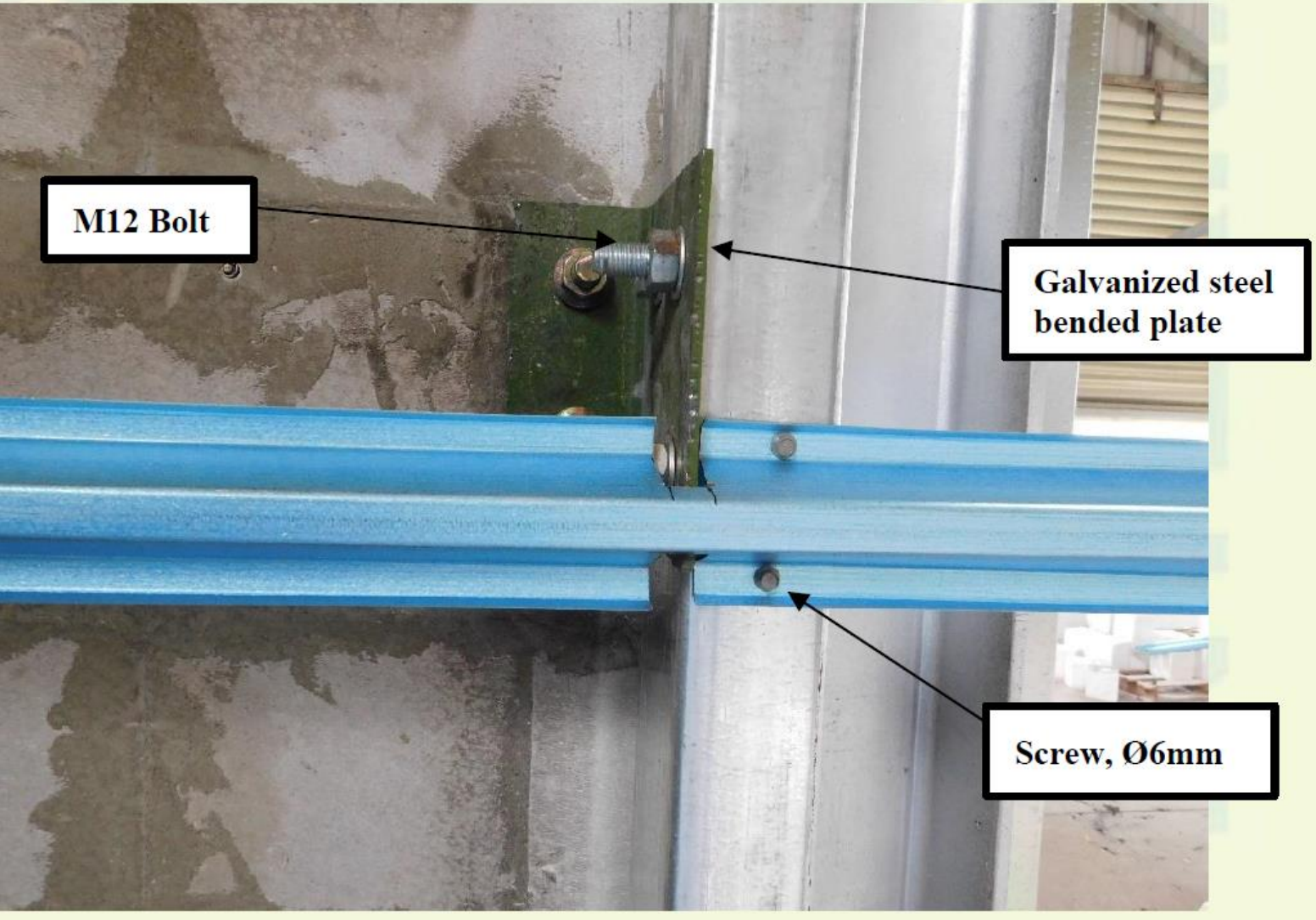
THERMOCOUPLE PLACEMENTS (EXTERNAL)

BS 8414 TEST SETUP

BS 8414 TEST SETUP

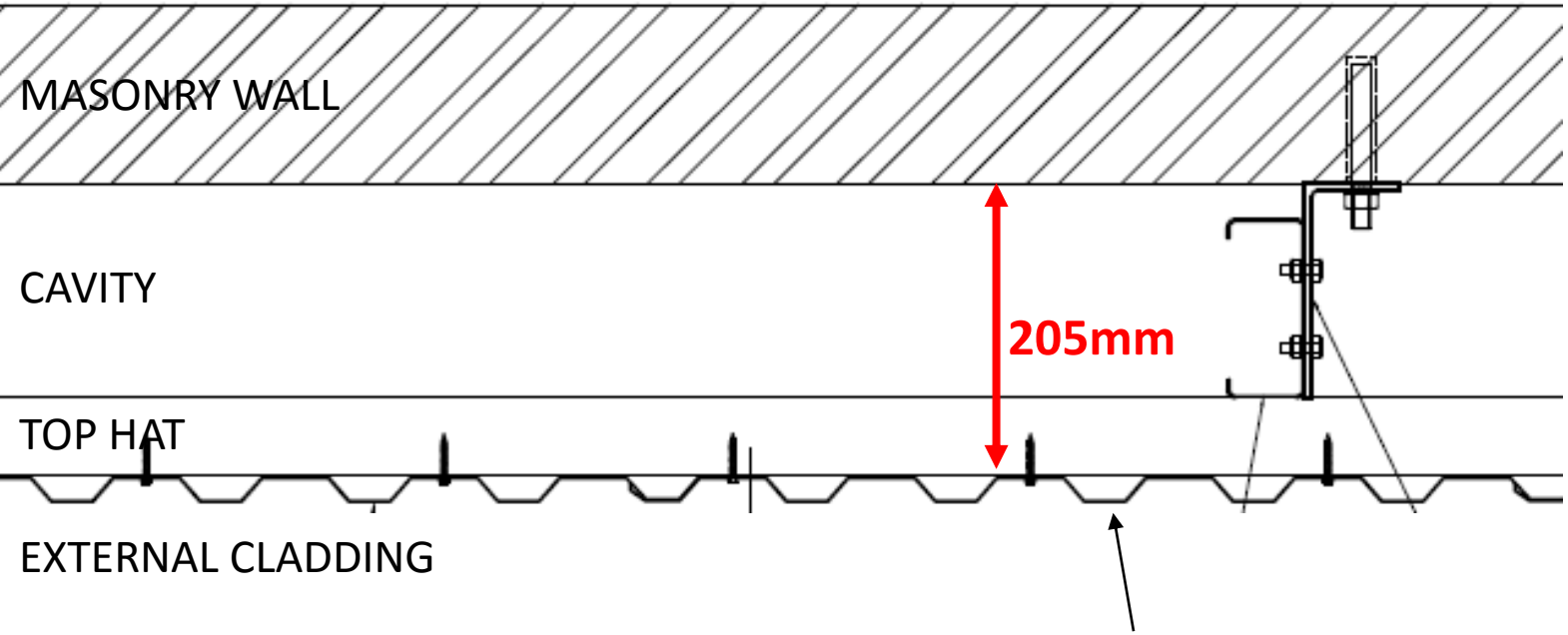


BS 8414 TEST SETUP



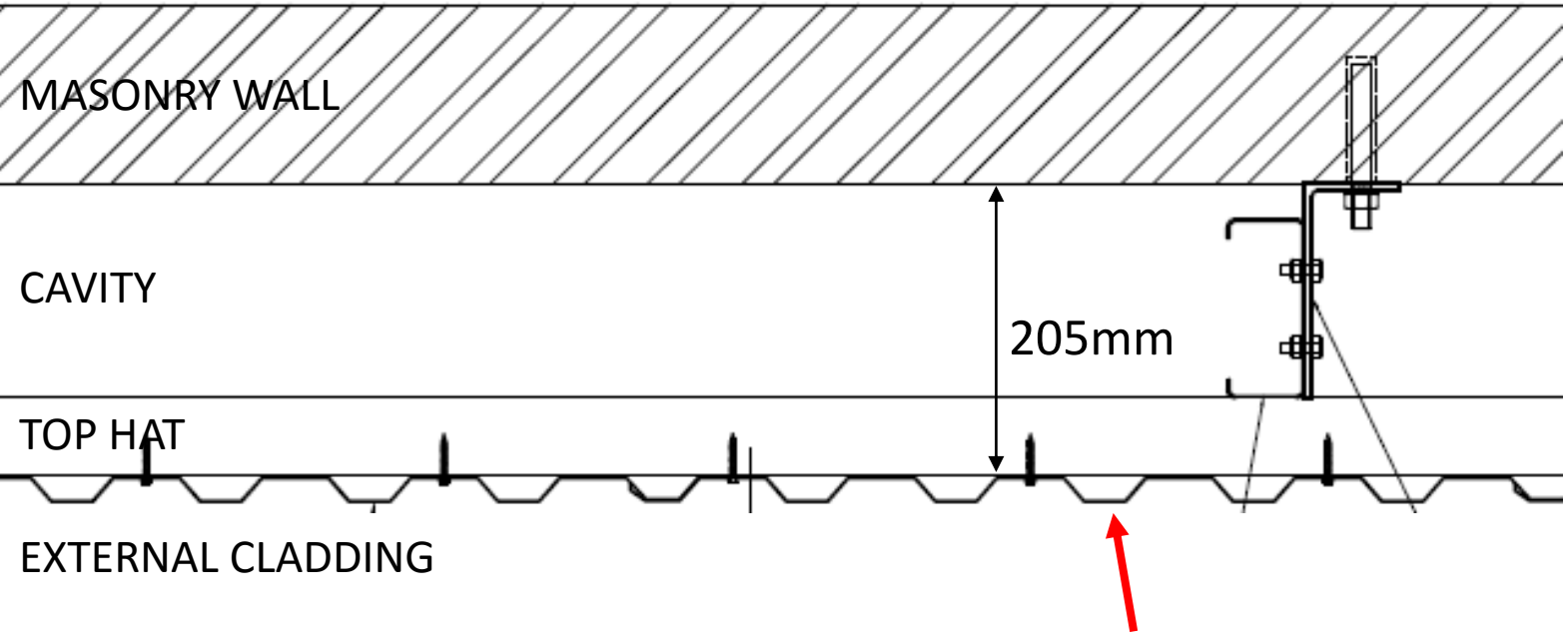
BS 8414 TEST SETUP

BS 8414 TEST SETUP



0.42mm BMT
Prepainted Corrugated
Steel Cladding

BS 8414 TEST SETUP

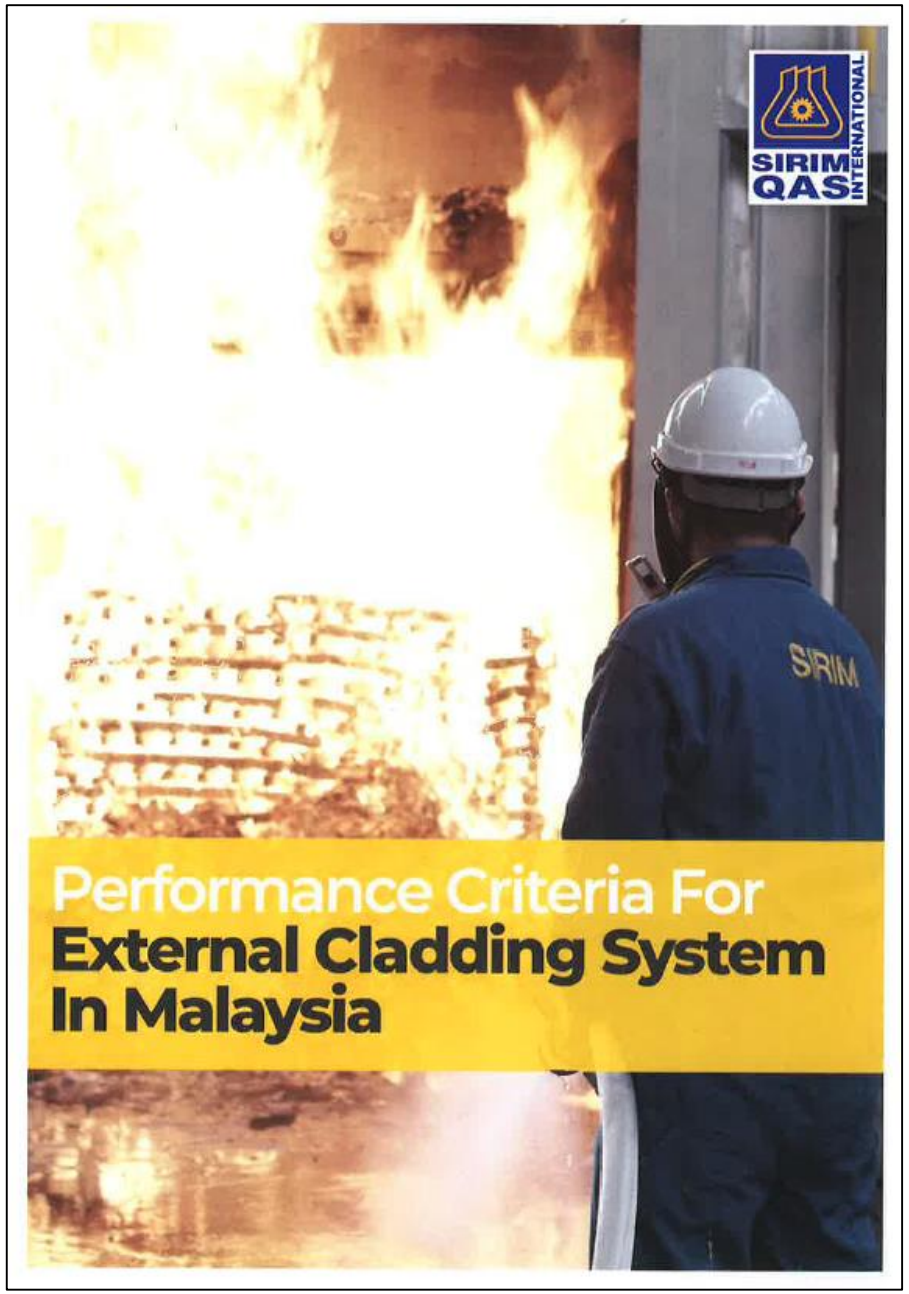


0.42mm BMT Prepainted Corrugated Steel Cladding

30 MINUTES FIRE EXPOSURE

EARLY TEST TERMINATION

Source: Grenfell Inquiry test example. Ref: CLG10000381



PERFORMANCE CRITERIA FOR EXTERNAL CLADDING SYSTEMS IN MALAYSIA FPST/DOC/14-1

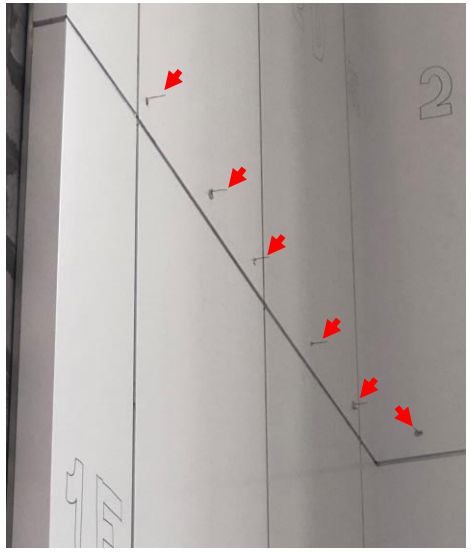
Performance Criteria for External Cladding Systems in Malaysia FPST/DOC/14-1 (Version 1:2019)

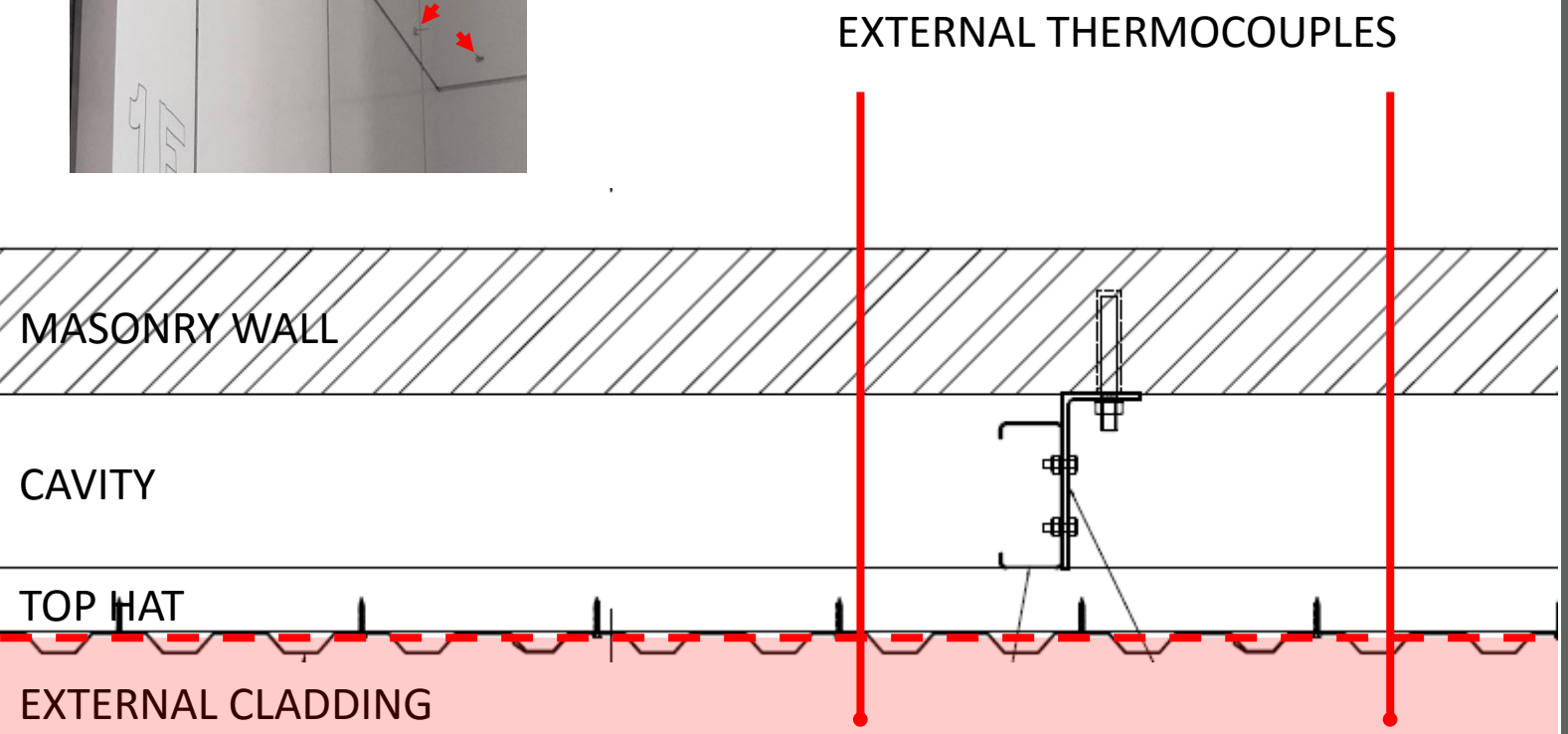
1. External Fire Spread
2. Internal Fire Spread
3. Visible Flaming
4. Mechanical Performance
5. Burning Debris and Pool Fires
6. System Burn Through

BS 8414: FIRE TEST OF EXTERNAL CLADDING SYSTEMS

FIRE PERFORMANCE REQUIREMENTS

Source: SIRIM BS 8414 launch 26th Aug'19





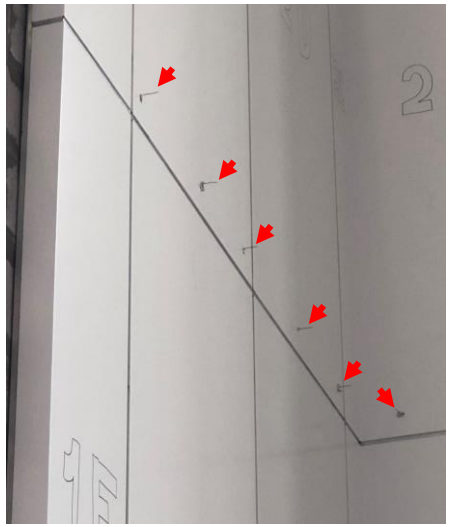
EXTERNAL

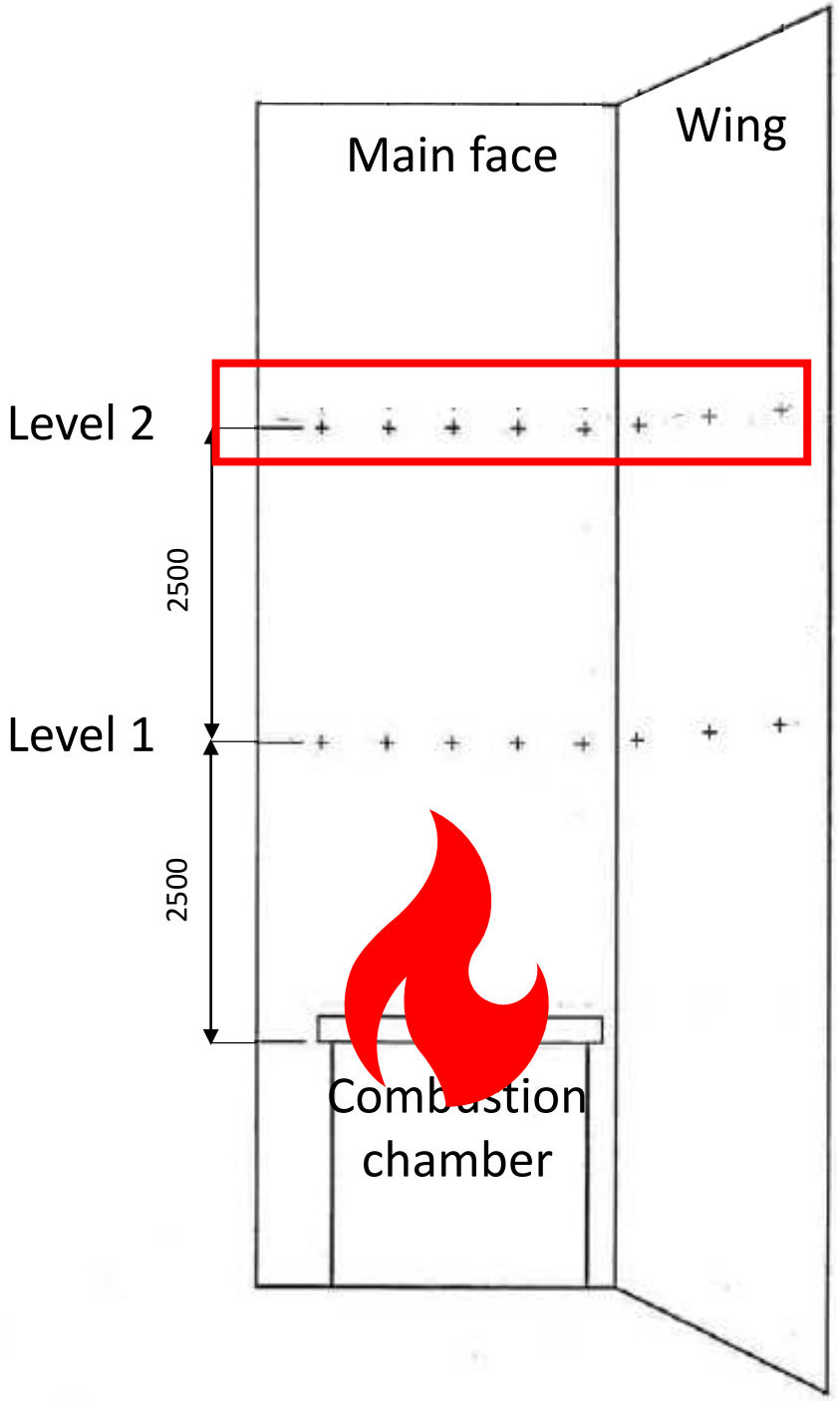
1

EXTERNAL FIRE SPREAD

MEASURE OF EXTERNAL TEMPERATURE

Level 2 EXTERNAL temperatures >600°C for 30s within 15mins from start time.

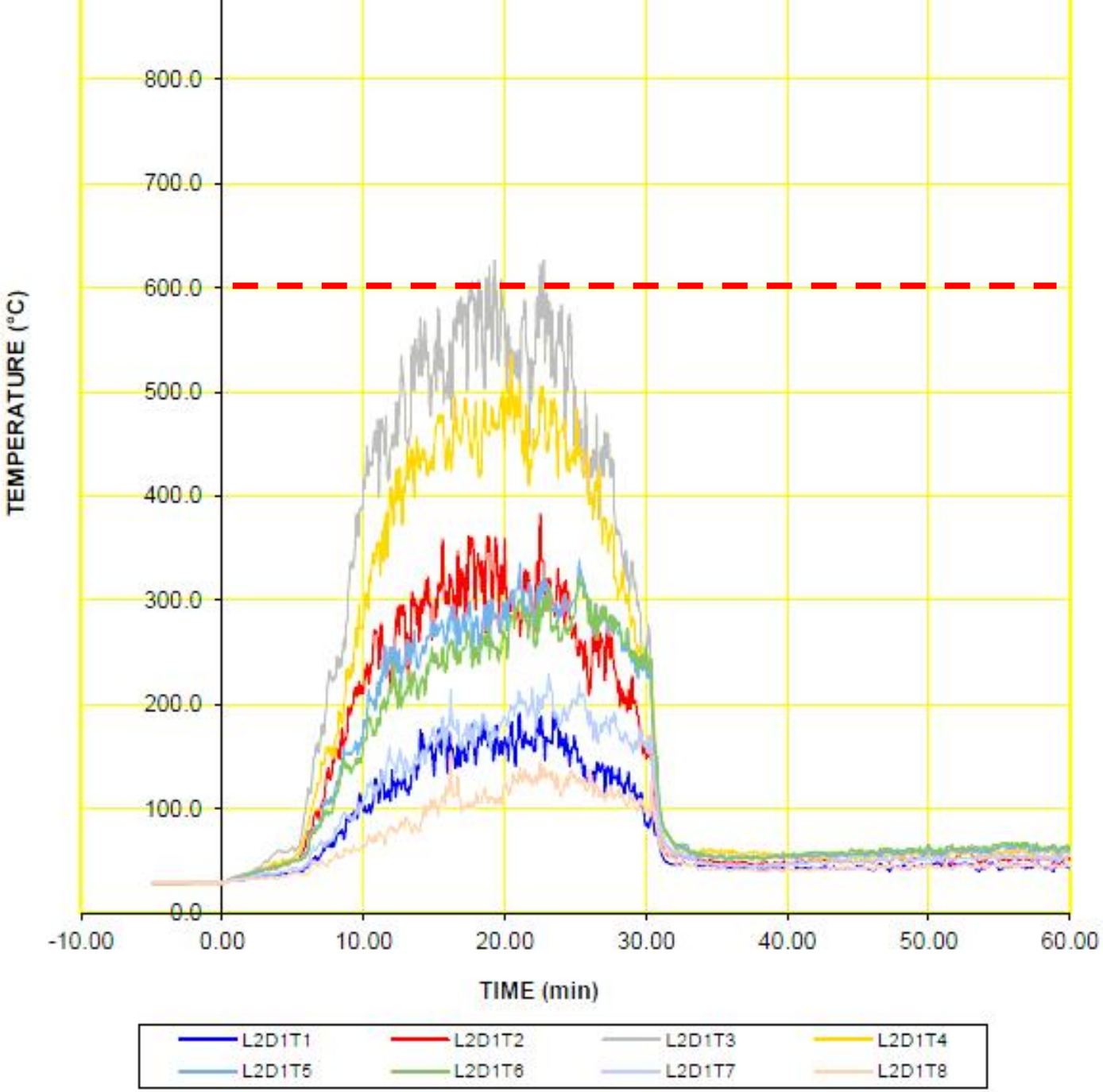




1 EXTERNAL FIRE SPREAD

NO EXTERNAL FIRE SPREAD

NO EXTERNAL FIRE SPREAD

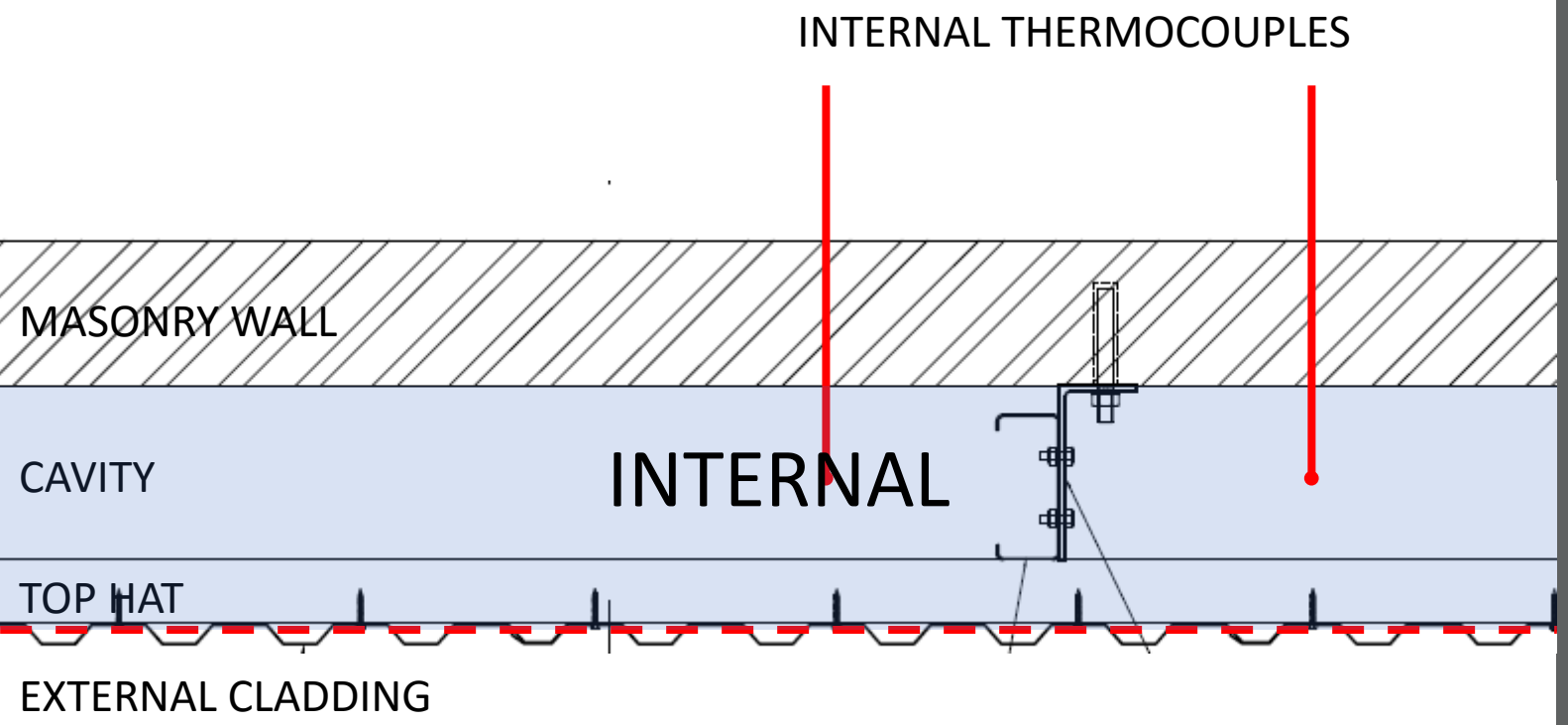


EXTERNAL TEMPERATURE GRAPH <600°C

Source: SIRIM Test Report, ref. 2019FE0729

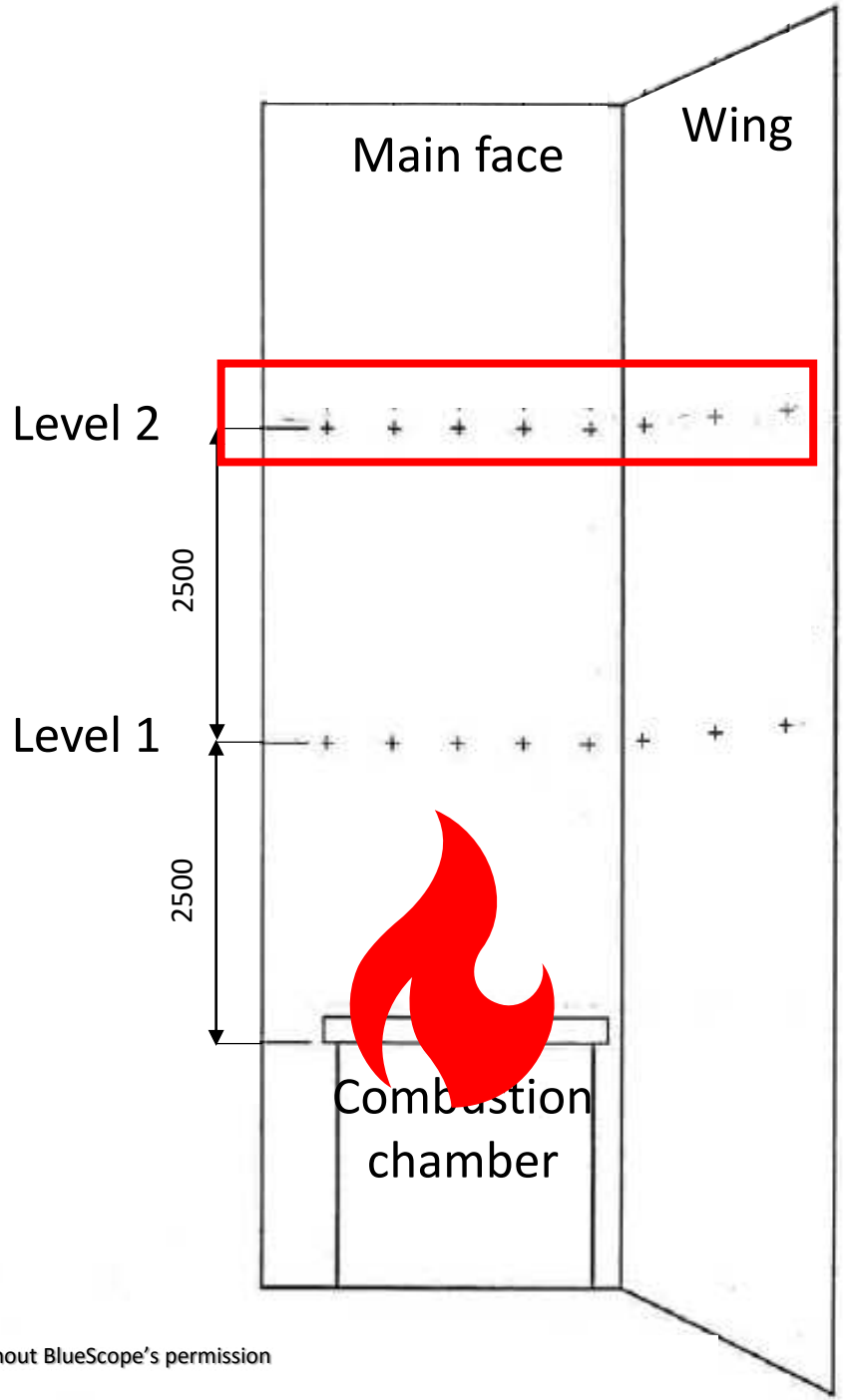
EXTERNAL FIRE SPREAD

EXTERNAL FIRE SPREAD



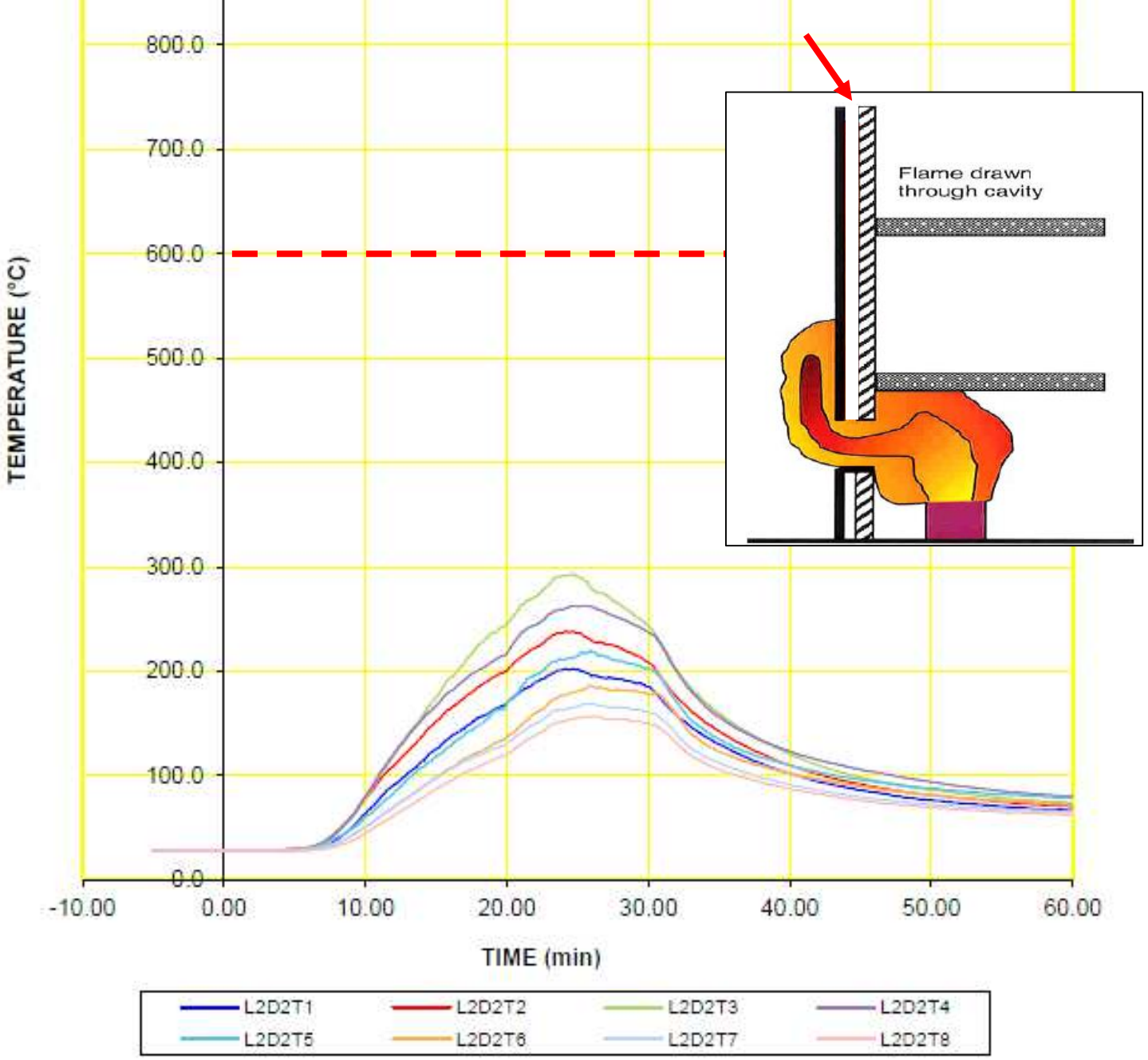
② INTERNAL FIRE SPREAD

Level 2 INTERNAL temperatures >600°C for 30s within 15mins from start time.



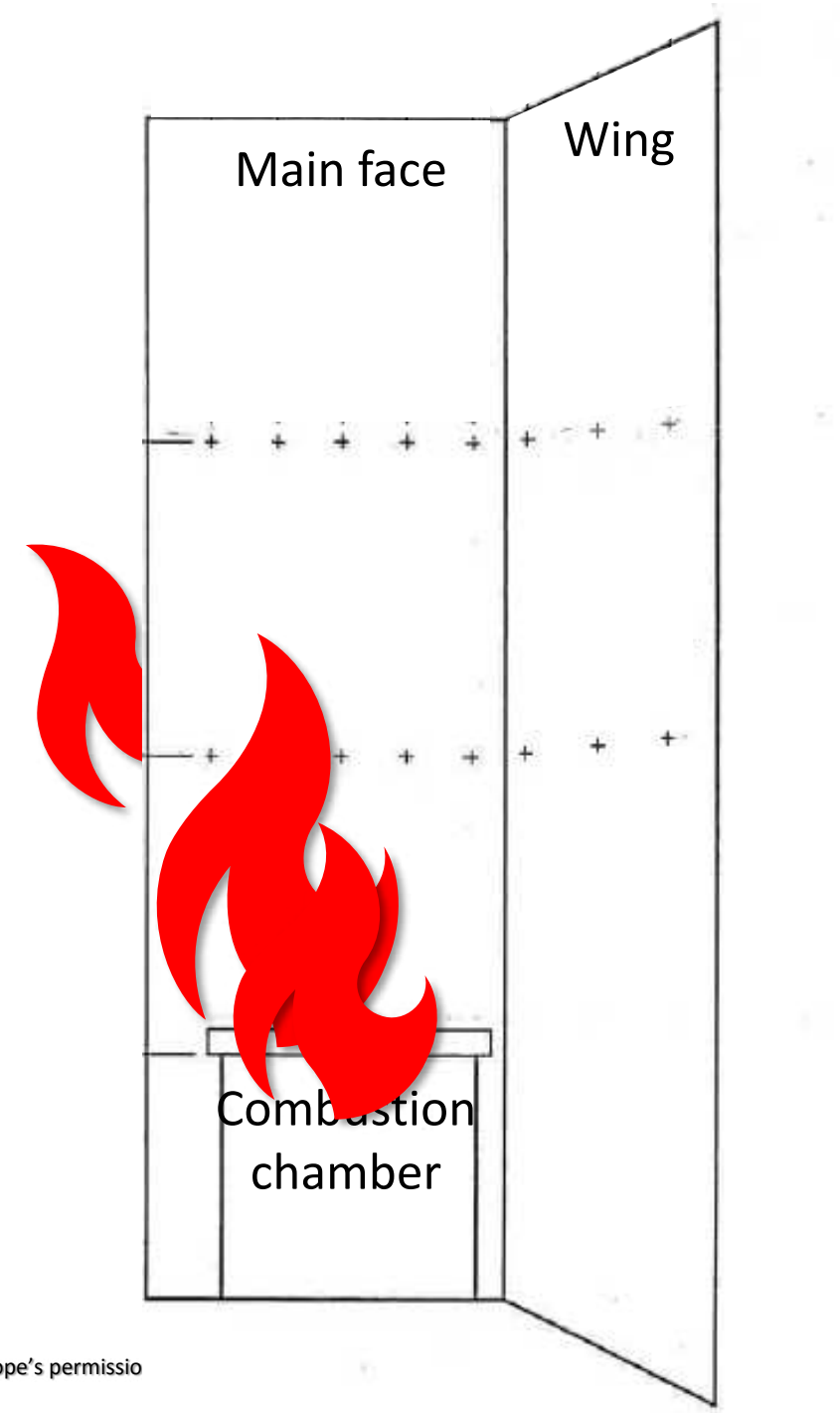
INTERNAL FIRE SPREAD

INTERNAL FIRE SPREAD



INTERNAL FIRE SPREAD

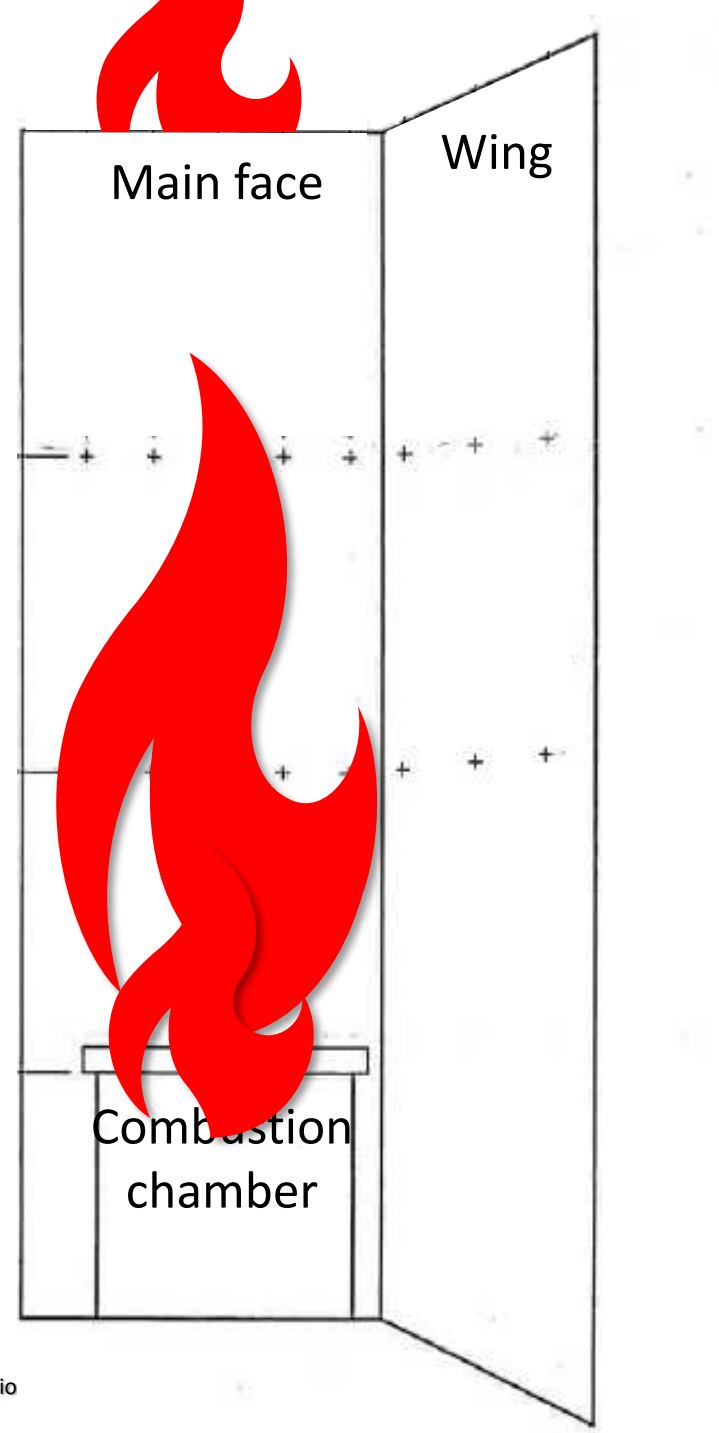
Continuous flame observed on the side for 30s.

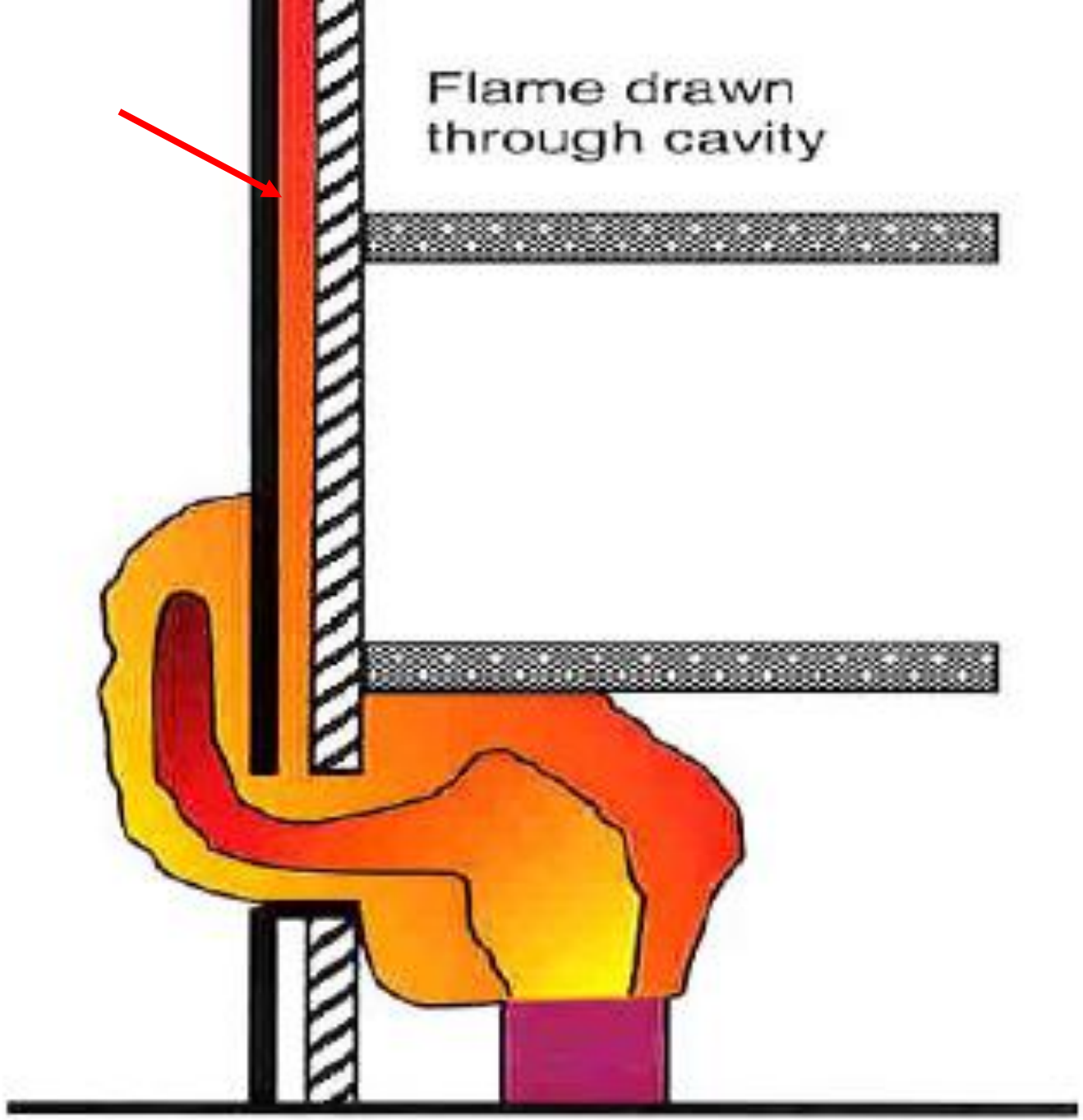


③ VISIBLE FLAME

VISIBLE FLAME

Continuous flame observed on the top for 30s.





FLAME VENT THROUGH THE CAVITY

3 VISIBLE FLAME

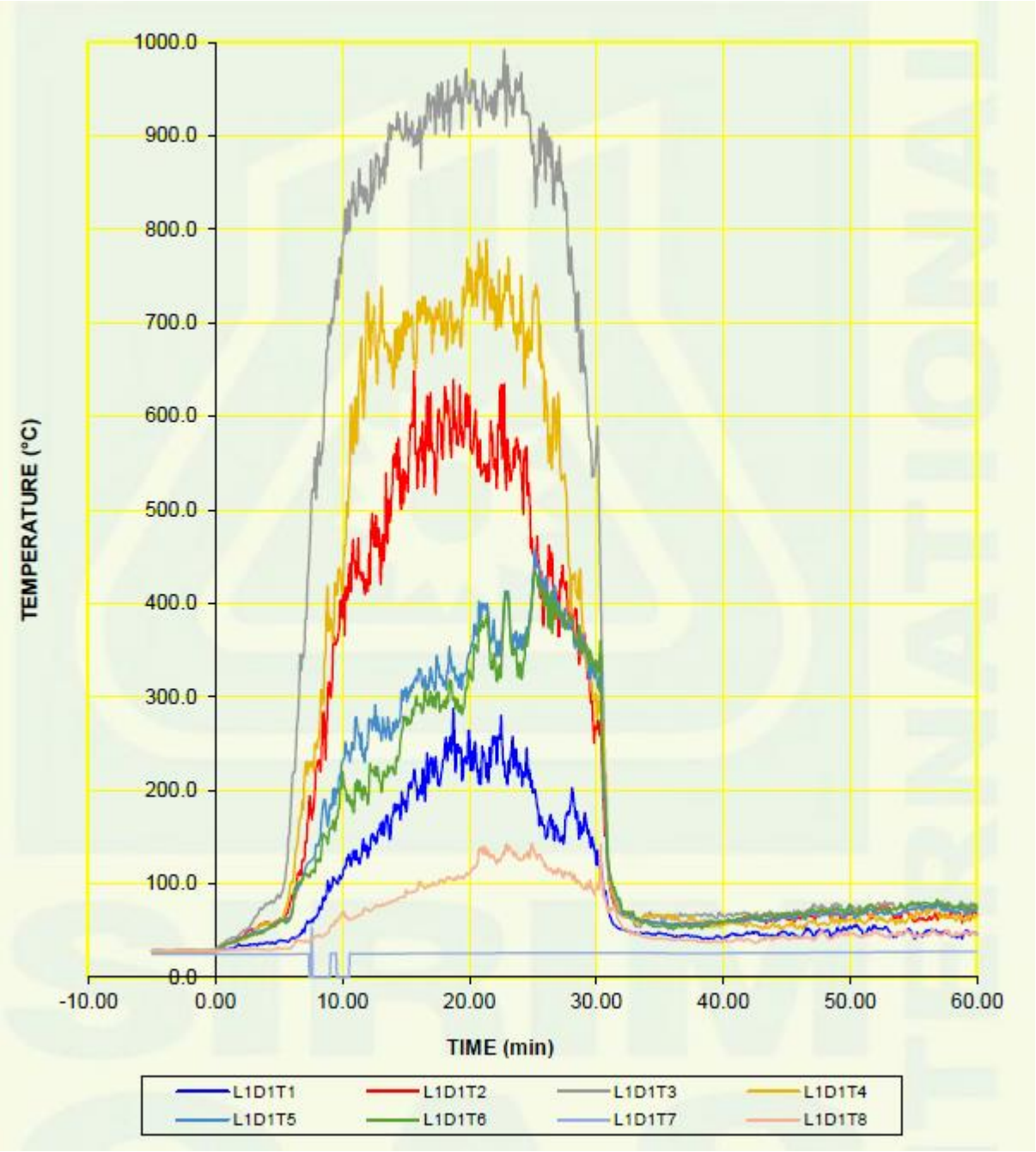
IMPORTANT TO PAY ATTENTION TO DETAILING

BS 8414-1

BS 8414-2

3 VISIBLE FLAME

NO VISIBLE FLAME



3 VISIBLE FLAME

TEMPERATURE OF FIRE AT LEVEL 1 >600°C

3 VISIBLE FLAME

FLASHINGS STAY INTACT

3 VISIBLE FLAME

ATTRIBUTED TO HIGH MELTING POINT OF STEEL

>1400°C

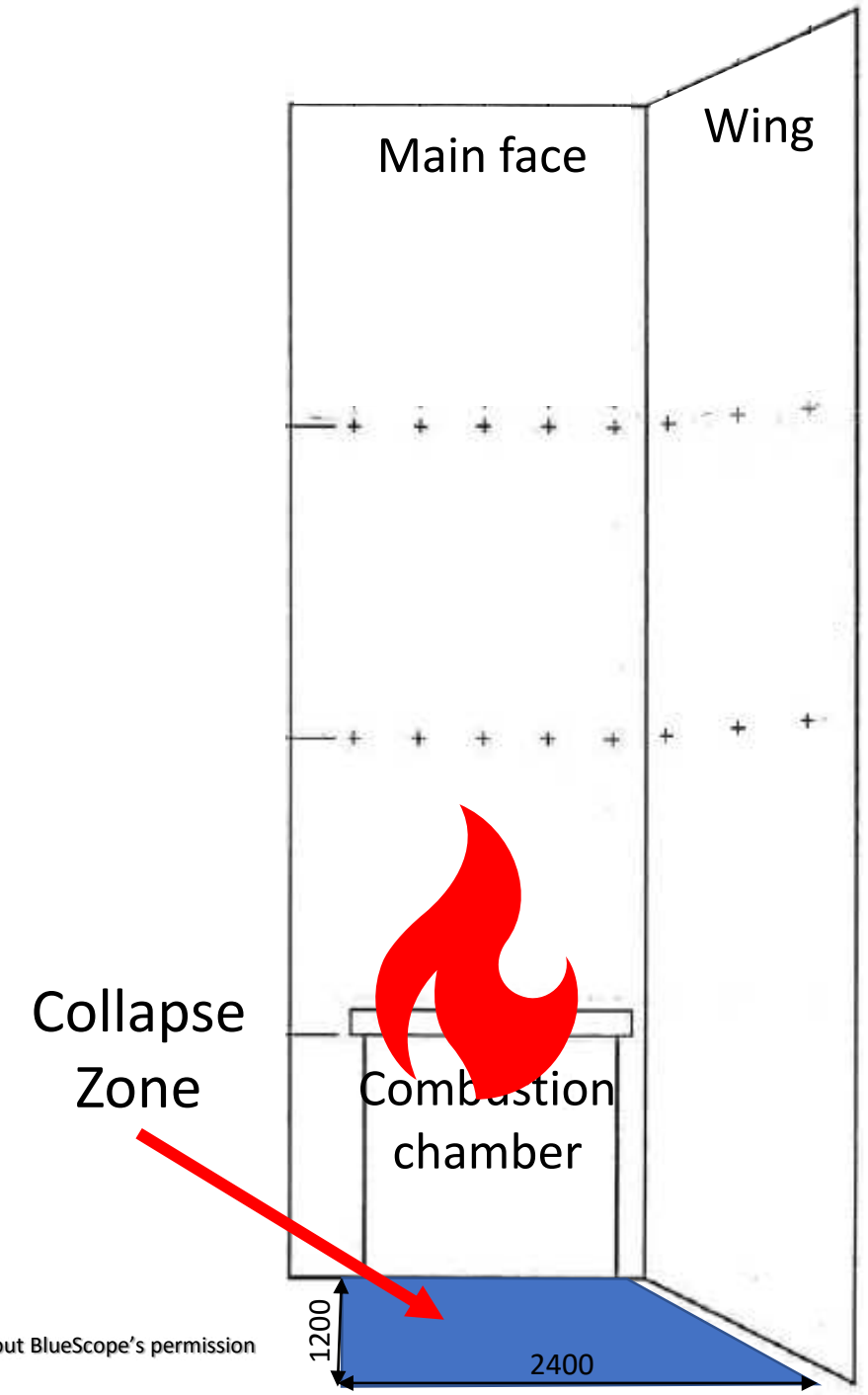
3 VISIBLE FLAME

ATTRIBUTED TO HIGH MELTING POINT OF STEEL

>1400°C

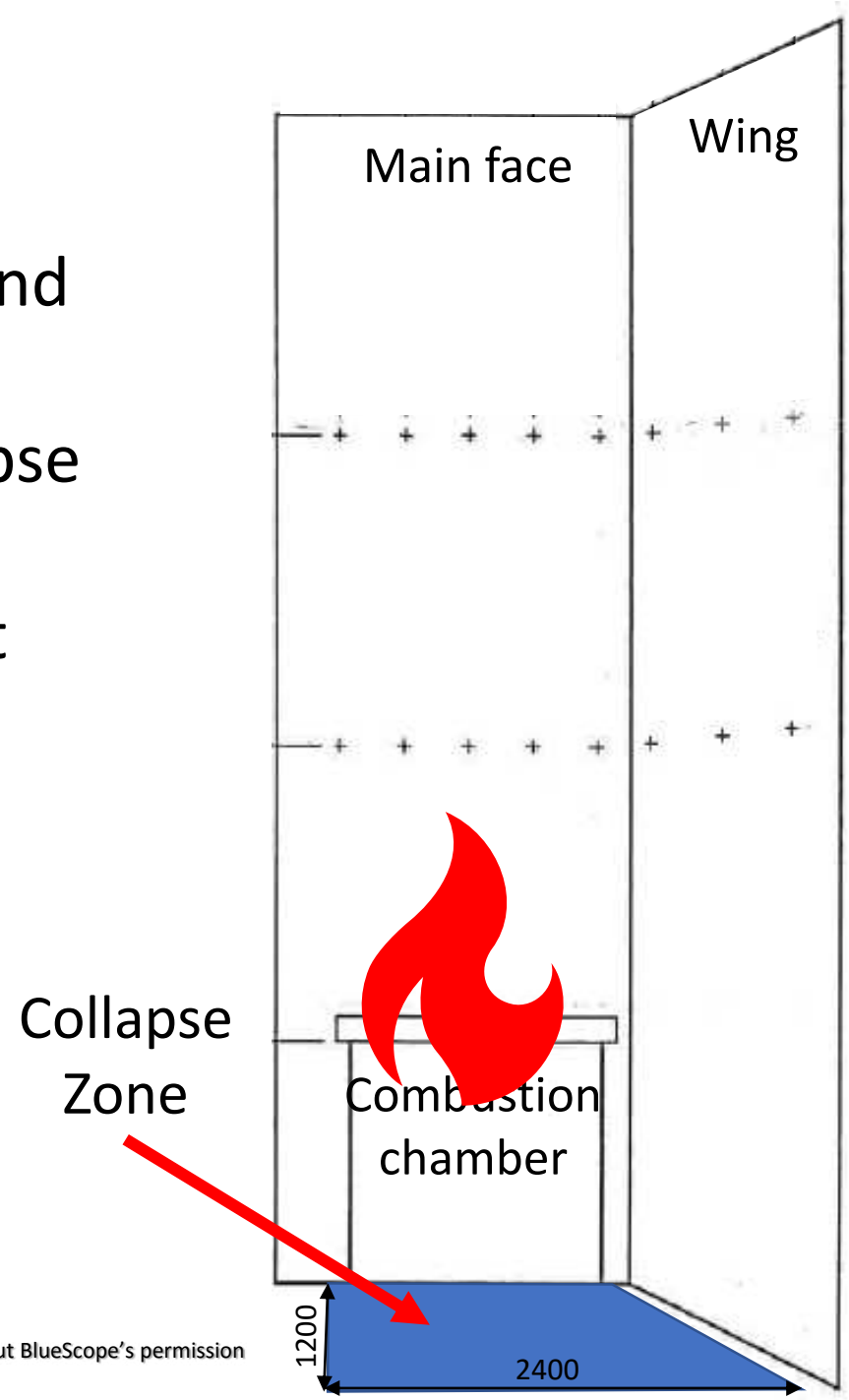
3 VISIBLE FLAME

WHAT IF THE PANELS MATERIAL MELTED?



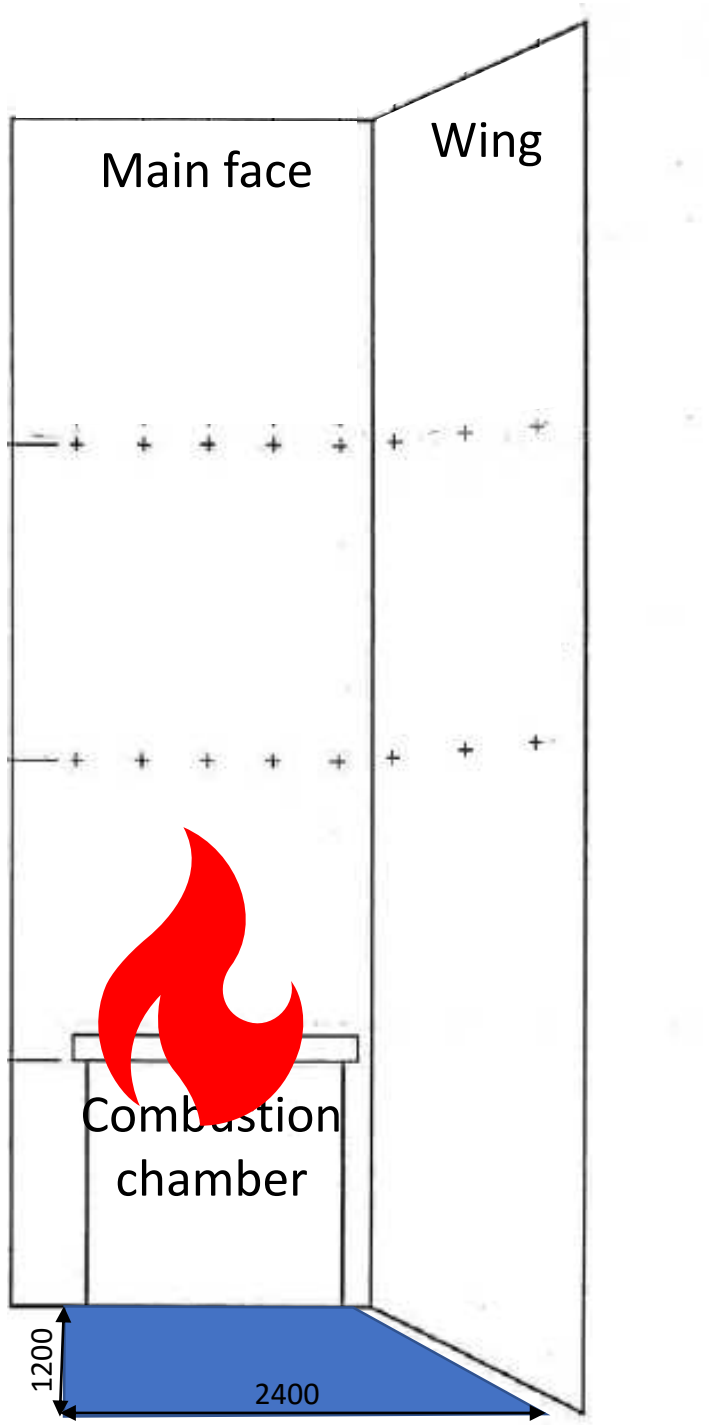
COLLAPSE ZONE AREA 2.4m x 1.2m

Cladding system (500mm length and 200g weight) fall outside the collapse zone within 60minutes of test start.

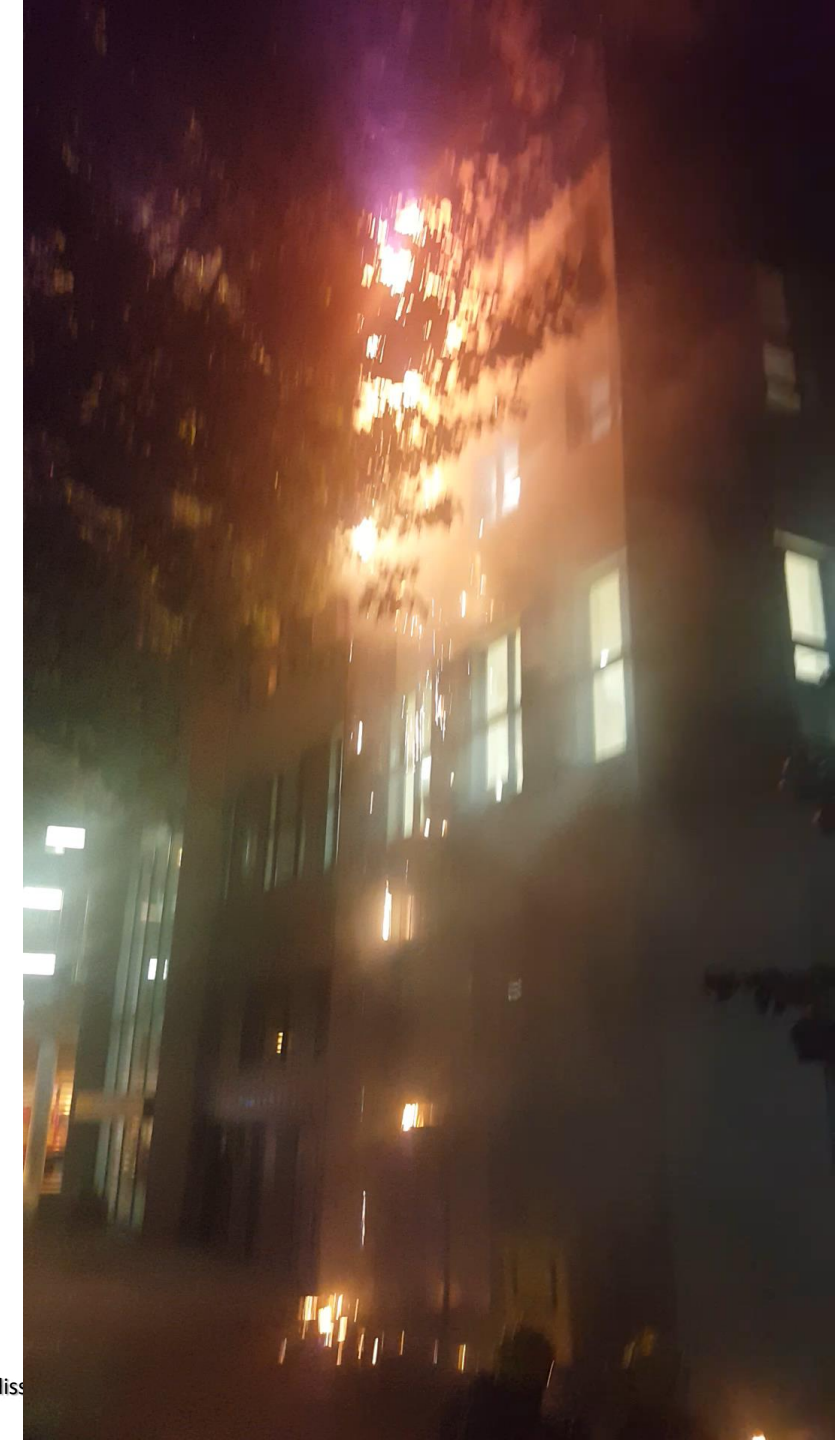


4 MECHANICAL PERFORMANCE

Burning debris or pool fire last for 60s develop outside of collapse zone within 60minutes of test start.



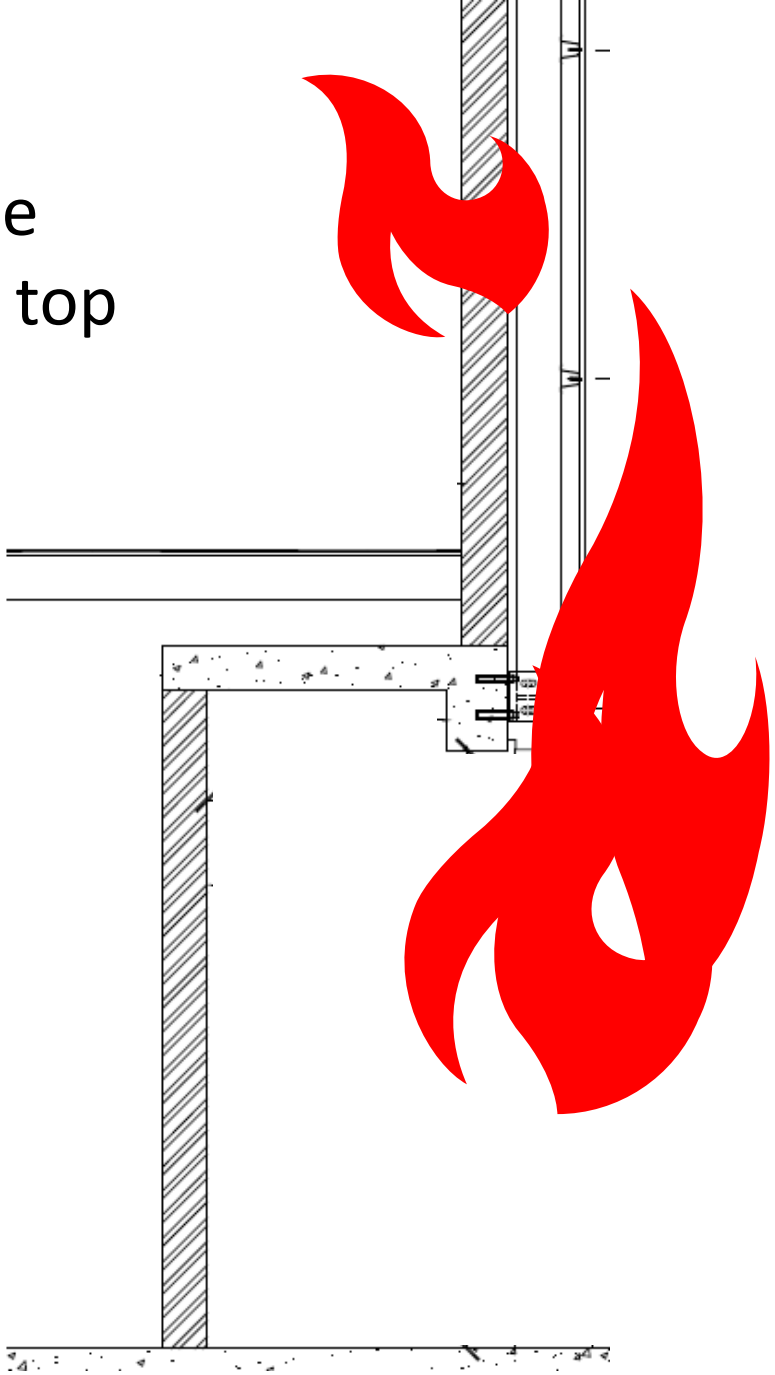
5 BURNING DEBRIS & POOL FIRE



BURNING DEBRIS COULD SPREAD FIRE DOWNWARD

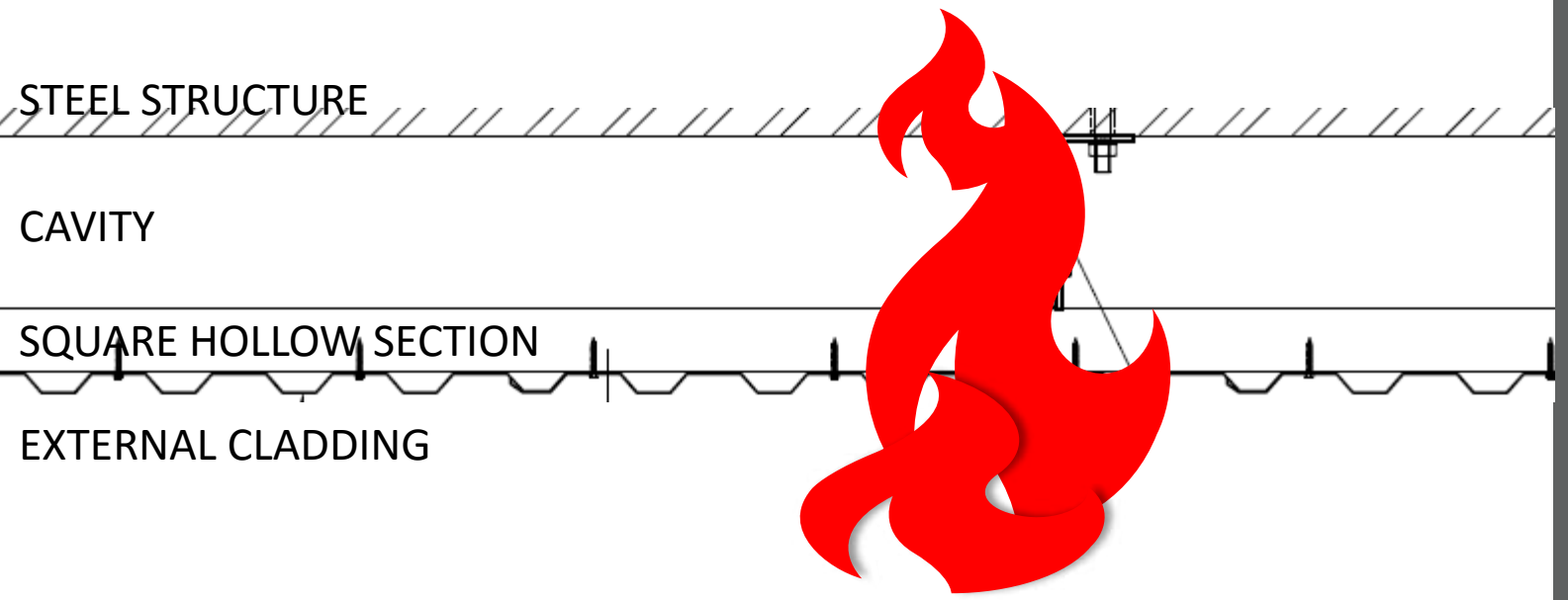
Video from Mr Kebedes phone, ref: MET000083355; MET000083359

Continuous flame observed on the top for 60s on the internal surface.



6

FIRE BURN THROUGH (BS 8414-2 ONLY)



IF CLADDING FAILED/MELTED

6 FIRE BURN THROUGH

IF CLADDING FAILED/MELTED

EXTERNAL FIRE SPREAD

INTERNAL FIRE SPREAD

VISIBLE FLAME

MECHANICAL PERFORMANCE

BURNING DEBRIS & POOL FIRE

FIRE BURNT THROUGH

QUESTION & ANSWER SESSION

Photo from BlueScope

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Colorbond Steel Malaysia