

Prevenzione Incendi

*La ricerca antincendio sulle facciate
in Unione Europea*

Fabio Alaimo Ponziani

CORPO NAZIONALE VIGILI DEL FUOCO

Prevenzione Incendi
La ricerca antincendio sulle facciate in Unione Europea

AGENDA

- ❑ Stato dell'arte in Unione Europea: Incendi tipo, Metodi di prova
 - ❑ Incendi distruttivi: alcuni eventi di impatto mediatico
 - ❑ Grenfell Tower: approfondimenti
 - ❑ Facciate: schemi tipici di propagazione dell'incendio
 - ❑ Facciate: la ricerca sperimentale dell'Unione Europea
 - ❑ La ricerca antincendio al di fuori dell'Unione Europea
- ❑ Una nuova visione: forme di incendio, progettazione integrata

Stato dell'arte in Unione Europea : Incendi tipo, Metodi di prova



PROGRAMMA DI RICERCA UE

**Development of a European
approach to assess the fire
performance of facades**

Giugno 2018

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Stato dell'arte in Unione Europea : Incendi tipo, Metodi di prova



PARTECIPANTI

Development of a European approach to assess the fire performance of facades

Austria	Belgium	Bulgaria
IBS - Institut für Brandschutz-technik und Sicherheits-forschung Gesellschaft mbH	Efectis France University of Liege	IBS - Institut für Brandschutz-technik und Sicherheits-forschung Gesellschaft mbH
Croatia	Cyprus	Czech Republic
University of Zagreb	Ministry of Interior	University of Ostrava Rockwool
Denmark	Estonia	Finland
DBI - Dansk Brand og sikringsteknisk Institut	RISE - Research Institutes of Sweden	VTT Expert Services Ltd
France	Germany	Greece
Efectis France	BAM - Bundesanstalt für Materialforschung und prüfung DIBt - Deutsches Institut für Bautechnik	National Technical University of Athens
Hungary	Iceland	Italy
EMI Nonprofit LLC	MVS - The Iceland Construction Authority	LS Fire Testing Institute S.R.L.
Latvia	Lichtenstein	Lithuania
GTC - Gaisrinių tyrimų centras	Efectis France AMT FÜR BAU UND INFRASTRUKTUR, Abt.Baubewilligungen, Ortsplanung; Fachbereichsleitung Baurecht und Brandschutz	GTC - Gaisrinių tyrimų centras

Luxembourg	Malta	Netherlands
Efectis France	-	Efectis Nederland
Norway	Poland	Portugal
SP Fire research AS	ITB - Instytut Techniki Budowlanej	ITeCons - The Institute for Research and Technological Development in Construction, Energy, Environment and Sustainability
Republic of Ireland	Romania	Slovakia
FireCERT	CNSIPC - Centrul Național pentru Securitate la Incendiu și Protecție Civilă	FIRES
Slovenia	Spain	Sweden
ZAG - Zavod za Gradbenstvo Slovenije	AFITI - Asociación para el Fomento de la Investigación y la Tecnología de la Seguridad Contra Incendios	RISE - Research Institutes of Sweden
Switzerland	United Kingdom (England, Scotland, Wales and Northern Ireland)	
VKF - Vereinigung Kantonalen Feuerversicherungen	BRE - Building Research Establishment	

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Stato dell'arte in Unione Europea : Incendi tipo, Metodi di prova



APPROCCI DI SPERIMENTAZIONE

Development of a European approach to assess the fire performance of facades

Prove in scala al vero (full scale)
Bruciatore a gas standard
Riferimento: Room Corner Test
LS Fire Testing Institute

ITALIA : approccio diverso dagli altri

Prove in scala al vero (full scale)
Catasta di legna standard
Riferimento: DIN 4102-20 – BS 8414



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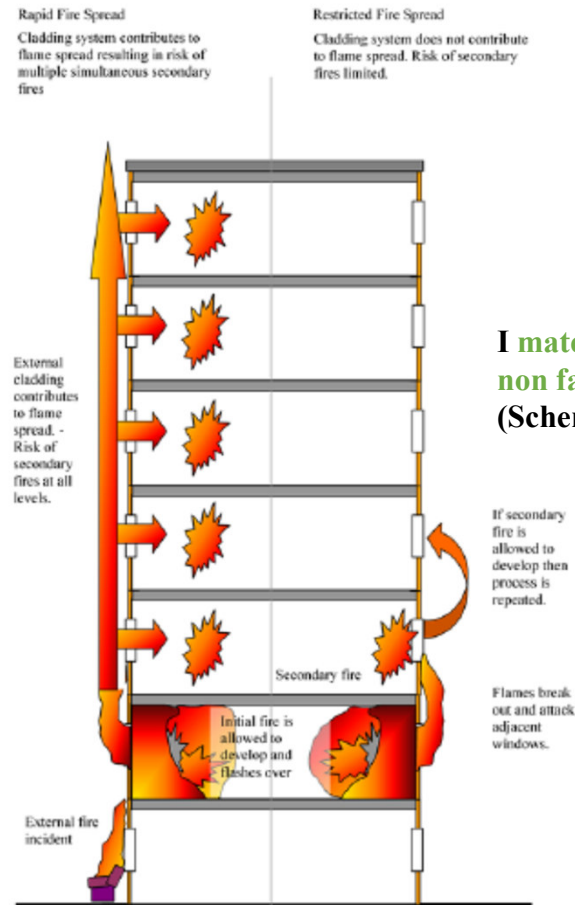
Stato dell'arte in Unione Europea : Incendi tipo, Metodi di prova



Development of a European approach to assess the fire performance of facades

I materiali presenti in facciata facilitano la propagazione dell'incendio (Schema lato sinistro)

Scenari di incendio
BR 135 terza edizione



I materiali presenti in facciata non facilitano la propagazione dell'incendio (Schema lato destro)

INCENDI TIPO

Stato dell'arte in Unione Europea : Incendi tipo, Metodi di prova



Development of a European approach to assess the fire performance of facades

METODI DI PROVA

Diversi metodi di prova disponibili
Schemi costruttivi rappresentati ancora non completi
Condivisione non totale
Perfezionamento di alcune definizioni
Non considerate ancora tutte le problematiche antincendio
Inizio di un percorso di approccio comune (per quanto possibile)

Metodo di prova attualmente scelto basato su Scala al vero tipo DIN 4102-20 – BS 8414

Proposed assessment method	
Advantages	Disadvantages
<ul style="list-style-type: none">• Historical data can be used for those MS using the BS and DIN methods (in four countries), but there most likely will be stricter limitations on the environmental conditions (tests must be done indoors) the use of historical data can be difficult• Easy work to make the methods into standards since they already exist	<ul style="list-style-type: none">• Only a limited number of countries can use historical data• Difficult to get acceptance by the MS (it did not succeed in the EOTA work)• More tests will be needed• The classification system will be complicated – a lot of comments were achieved that this classification system is too complicated• Increase the work for regulators and industry due to the complexity of the classification system, interpretation of data in relation to the development of potentially new legislation and products• The large fire exposure test will not cover the medium fire exposure test
Alternative assessment procedure	
Advantages	Disadvantages
<ul style="list-style-type: none">• Minimized the number of tests (one successful test can cover all regulations in Europe)• Easier to get acceptance by the MS• The large fire exposure test also covers the medium fire exposure test (limits the test burden for industry), and potentially also the external fire exposure• Simple classification system• The test methods will be upgraded with the current knowledge on façade testing	<ul style="list-style-type: none">• The use of historical data may be limited• More work is needed to ensure the repeatability and reproducibility of the test methods



Le diversità fra metodo *proposto* e metodo *alternativo* risiedono nelle variazioni dei parametri definiti nei criteri di prestazione

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APPENDIX E – PROPOSED ASSESSMENT PROCEDURE

Assessment of fire performance of facades – Based on DIN 4102-20 & BS 8414 Series

2 NORMATIVE REFERENCES

ISO 13943 Fire safety - Vocabulary

EN 60584-1 Thermocouples – Part 1: EMF specifications and tolerances

EN 1364-3 Fire resistance tests for non-loadbearing elements – Part 3: Curtain walling – Full configuration (complete assembly)

EN 1364-4 Fire resistance tests for non-loadbearing elements – Part 4: Curtain walling – Part configuration

EN 16733 Reaction to fire tests for building products – Determination of a building product's propensity to undergo continuous smouldering

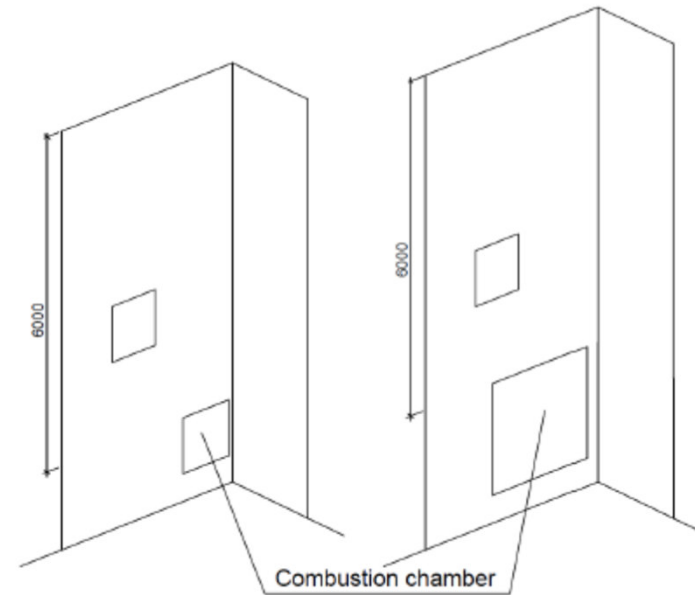
EN 1363-1 Fire resistance tests – Part 1: General requirements

EN 13238 Reaction to fire tests for building products – Conditioning procedures and general rules for selection of substrates

EN 13501-1 Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests

EN 13501-2 Fire classification of construction products and building elements – part 2: Classification using data from fire resistance tests, excluding ventilation services

Tipici schemi di prova
Varianti similari



Esposizione al fuoco (fire exposure):

Media (medium) – schema a sinistra

vs

Grande (large) – schema a destra

NO protezione attiva – almeno per ora

Incendi distruttivi : alcuni eventi di impatto mediatico



Shangai 2010



Dubai 2015



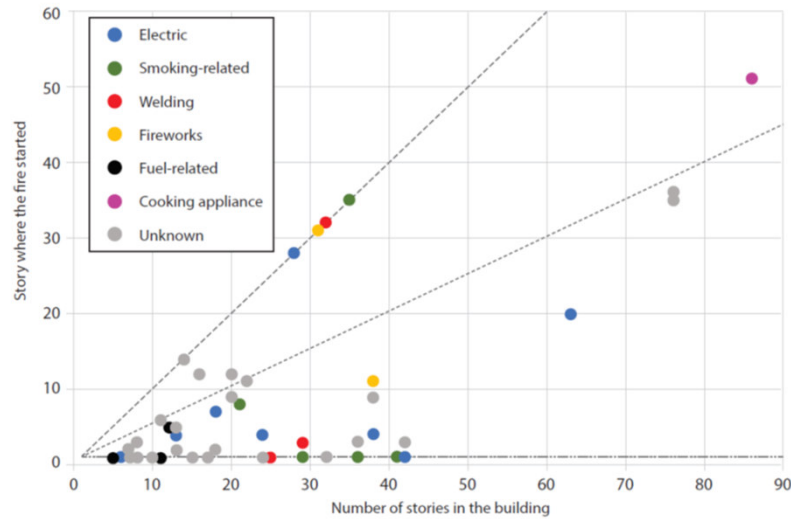
Londra 2017

Esempi
2008 : 2018

Incendi di facciate
Effetto distruttivo

Building	Location	Year	Description	Damage
Jeffries Tower (18 stories) (Everett 2018)	Atlantic City, US	2018	Fire started at the mechanical room located in the 3 rd floor which eventually spread throughout all 18 floors.	No injuries
10 storey hotel building (Cockburn 2017)	Rostov on Don, Russia	2017	The cladding on the building was made of 'very flammable material containing toxic elements' which increased the danger of rapid fire spread, according to government officials	2 dead
Grenfell Tower (Kirkpatrick et al. 2017) (24 stories)	London, UK	2017	Fire started at 4 th floor and spread rapidly through the external cladding which consisted of ACM panels with PE core	79 dead 70 injured
Marco Polo Apartments (36 stories) (Farrer and Barney 2017)	Honolulu, US	2017	Fire started on the 26 th floor and blaze rapidly spread higher. Influence of façade materials is still under investigation	3 dead 12 injured
The Address Downtown Dubai (302m tall) (Schreck and Gambrell 2016)	Dubai, UAE	2016	Fire started at the 20 th floor during the new year's eve fire work display and spread rapidly through the ACP façade	14 minor injuries
Marina torch (352m) (Austin and Williams 2015)	Dubai, UAE	2015 & 2017	Fire initiated in the 52 nd floor and spread quickly exacerbated by high winds	No injuries
16 Storey apartment building (Reuters 2015)	Baku, Azerbaijan	2015	Rapid fire spread along the cladding which were fitted after a renovation. 'Polyurethane panels' according to reports.	17 dead 60 injured
Tamweel Tower (160m tall) (Miers 2016)	Dubai, UAE	2012	A fire ignited which burned two separate broad vertical bands of exterior cladding from ground to roof level. ACM panels with PE core	Repair works have begun after 3 years
Saif Belhasa Building (13 stories) (Miers 2016)	Dubai, UAE	2012	Fire started at the 4 th floor and spread rapidly to the roof level. Cladding consisted of ACM panels with PE core	9 flats destroyed 2 injured Debris damaged 5 vehicles
Lacrosse Building (Toscano and Spooner 2015)	Melbourne, Australia	2014	Fire started on the 6 th floor and Fast-running flames soon ignited external wall cladding and aided by combustible material located within the wall structure quickly spread to the top of the building	No injuries
18 storey building (FPA 2012)	Roubaix, France	2012	Dramatic upwards spread of the fire from its origin to the top of the 18-floor building, apparently fuelled by its highly flammable outer cladding	1 dead 6 injured
28 storey building (Barboza 2010)	Shanghai, China	2010	Building was undergoing renovations which involved installing energy saving insulation. Fire was believed to have spread on polyurethane insulation to external walls	53 dead 90 injured
Monte Carlo Hotel (32 stories) (Duval 2008)	Las Vegas, US	2008	Fire was burning along the combustible components of the building's architectural trim and the exterior insulation and finish system which consists of a layer of expanded polystyrene foam adhered to gypsum sheathing	13 minor injuries

Incendi distruttivi : alcuni eventi di impatto mediatico



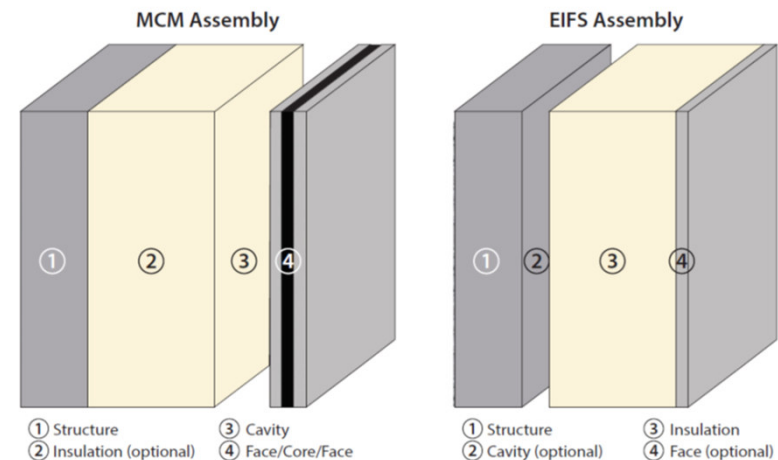
“Most of the identified fires have occurred in buildings recently constructed, within the last 10 years. Furthermore, before 2000, there were no façade fires in buildings higher than 30 stories identified in the database.”

Database incidenti tipo ricorrenti

Incendi di facciate

Fire and Safety CTBUH Journal 2019 Issue II

Metal Composite Material MCM
Exterior Insulation Finish System EIFS



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Grenfell Tower : approfondimenti



Londra 2017

Grenfell Tower fire

Approfondimenti

Reconstruction of Grenfell Tower fire. Part 1: Lessons from observations and determination of work hypotheses

Reconstruction of Grenfell Tower fire. Part 2: A numerical investigation of the fire propagation and behaviour from the initial apartment to the façade

Reconstruction of Grenfell Tower fire. Part 3—Numerical simulation of the Grenfell Tower disaster: Contribution to the understanding of the fire propagation and behaviour during the vertical fire spread

[Fire and Materials 2019](#)

Grenfell Tower Inquiry:

Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017

[Volumi 1:4 Report 2019 Phase 1](#)

Grenfell Tower : approfondimenti



Londra 2017

Grenfell Tower fire

Approfondimenti

Grenfell Tower
Inquiry

**GRENFELL TOWER INQUIRY:
PHASE 1 REPORT OVERVIEW**
REPORT of the PUBLIC INQUIRY into the
FIRE at GRENFELL TOWER
on 14 JUNE 2017

Chairman: The Rt Hon Sir Martin Moore-Bick
October 2019

Grenfell Tower Inquiry:
Report of the Public Inquiry into the Fire at Grenfell Tower on 14 June 2017
[Volumi 1:4 Report 2019 Phase 1](#)

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Grenfell Tower : approfondimenti



Londra 2017

Incendio della Grenfell Tower

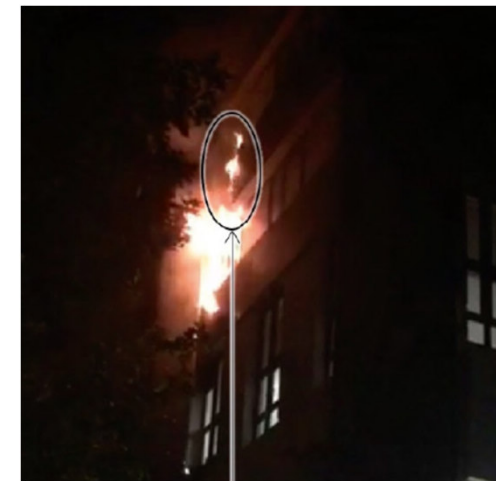
Rapida transizione da incendio interno ad incendio esterno



Inizio incendio Piano 4 appartamento 16



Dopo circa 4 minuti



Sviluppo incendio esterno

Grenfell Tower : approfondimenti



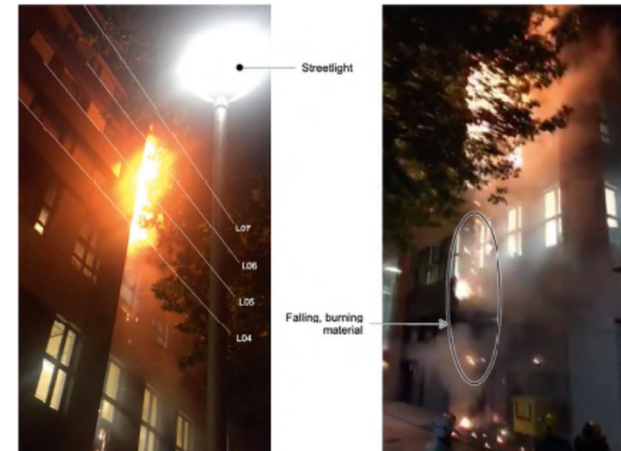
Londra 2017

Incendio della Grenfell Tower

Estensione dell'incendio



Fiamme esterne e gocciolamento incendiato



Incendio ai piani superiori e caduta di materiale incendiato



Fiamme intermittenti e attacco esterno acqua

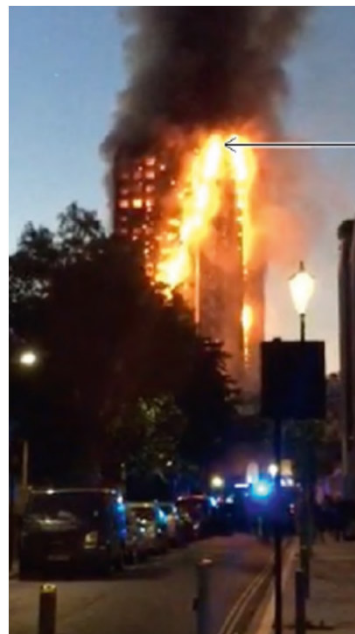
Grenfell Tower : approfondimenti



Londra 2017

Grenfell Tower	
Floor Level	Flat Number
23	201-206 inc
22	191-196 inc
21	181-186 inc
20	171-176 inc
19	161-166 inc
18	151-156 inc
17	141-146 inc
16	131-136 inc
15	121-126 inc
14	111-116 inc
13	101-106 inc
12	91-96 inc
11	81-86 inc
10	71-76 inc
9	61-66 inc
8	51-56 inc
7	41-46 inc
6	31-36 inc
5	21-26 inc
4	11-16 inc
3	1-6 inc
2	2-5 inc
1	2-5 inc
Ground	Accessed from externally
	1 - Grenfell Cinema and Nursery
	16 - Oak Youth Club

Incendio della Grenfell Tower Particolarità dell'incendio



Possible gap between flames from South and Flames from West

Interazione delle fiamme



Downward spread along column

Downward spread along column

Propagazione verso il basso

Grenfell Tower : approfondimenti

Incendio della Grenfell Tower Particolarità dell'incendio



Incendi interni – Getti d'acqua esterni

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Incendi distruttivi : alcuni eventi di impatto mediatico



Shanghai 2010



Dubai 2015



Londra 2017

**Incendi di facciate
Effetto distruttivo**

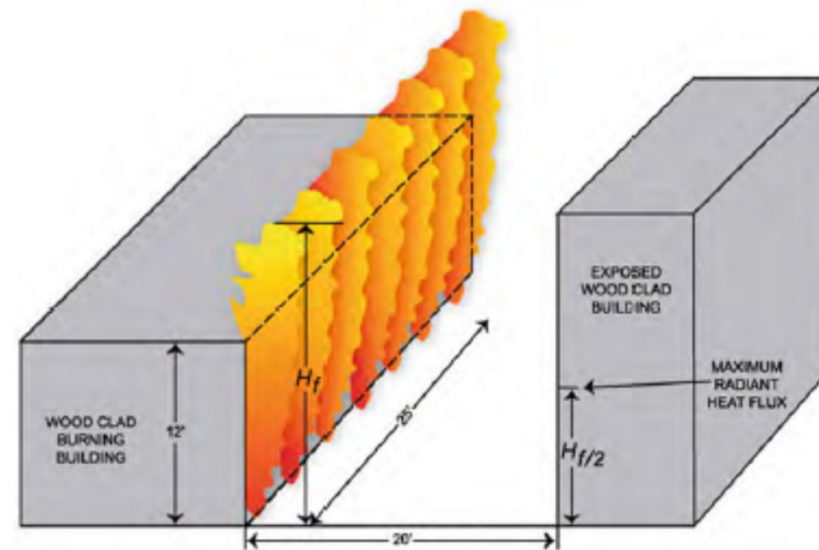
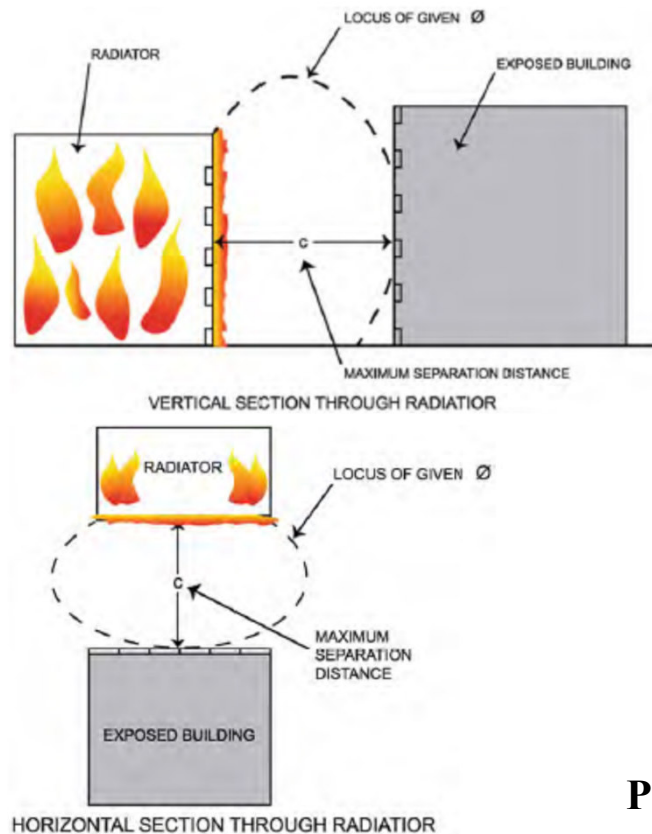


Isola di Man 1973

Summerland Leisure Center Isle of Man 1973

Facciate : schemi tipici di propagazione dell'incendio

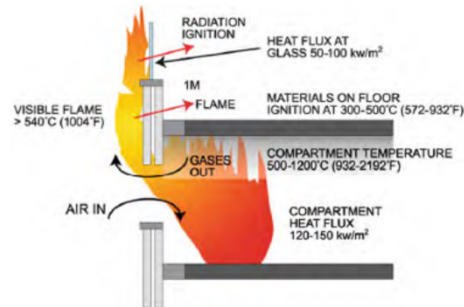
Facciate – Schemi di propagazione di incendio



Propagazione da facciata e propagazione lungo la facciata

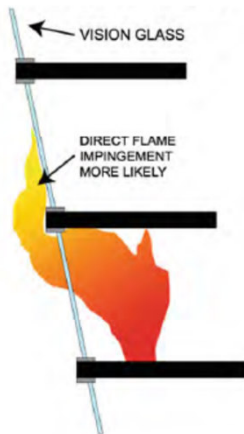
Facciate : schemi tipici di propagazione dell'incendio

Facciate – Schemi di propagazione di incendio



Meccanismi
di attacco

Propagazione verso il piano superiore



Inclinazione in avanti della facciata
Effetto peggiorativo

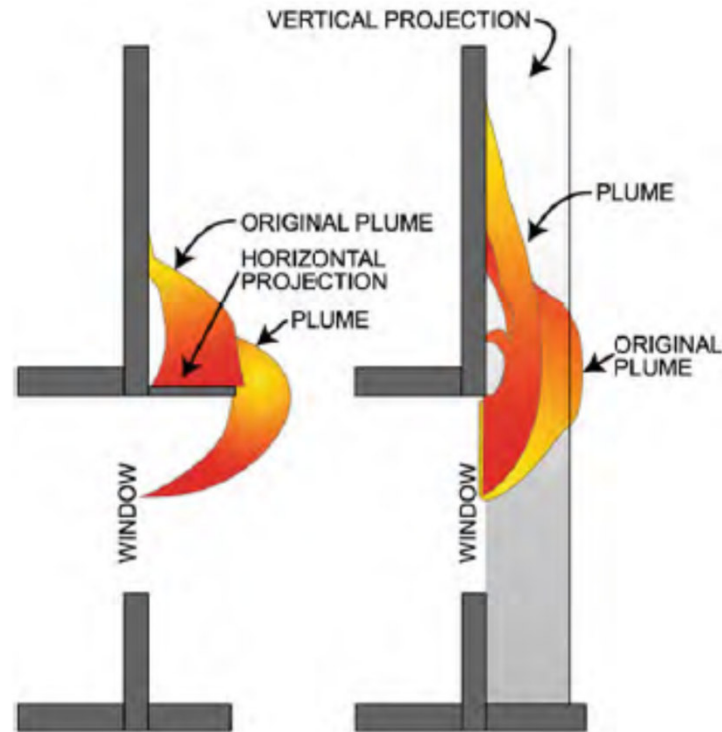


Inclinazione all'indietro della facciata
Effetto migliorativo

Facciate : schemi tipici di propagazione dell'incendio

Facciate – Schemi di propagazione di incendio

Meccanismi
di attacco



**Propagazione verso
il piano superiore**

Presenza di diaframma esterno orizzontale
Effetto migliorativo

Assenza di diaframma esterno orizzontale
Effetto peggiorativo

Facciate : la ricerca sperimentale dell'Unione Europea



PROGRAMMA DI RICERCA UE

**Development of a European
approach to assess the fire
performance of facades**

Finalisation of the European approach to assess the fire performance of façades

Draft progress report 3

Giugno 2022

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Facciate : la ricerca sperimentale dell'Unione Europea



Finalisation of the European approach to assess the fire performance of façades

**Development of a European
approach to assess the fire
performance of facades**

Attività in corso

Theoretical round robin and assessment method

Prova “round robin” teorica e metodo di valutazione

Introductory tests

Prove introduttive

**Round robin = serie di prove interlaboratorio, condotte da
almeno due laboratori indipendenti, per verificare un
metodo o una apparecchiatura di prova**

Experimental Round Robin

Prova «round robin» sperimentale

ELEMENTI ESSENZIALI

Facciate : la ricerca antincendio al di fuori dell'Unione Europea

BS 8414-1 Regno Unito (catasta di legna)

GB/T 29416 Cina (catasta di legna)

NFPA 285 Stati Uniti d'America (gas naturale)

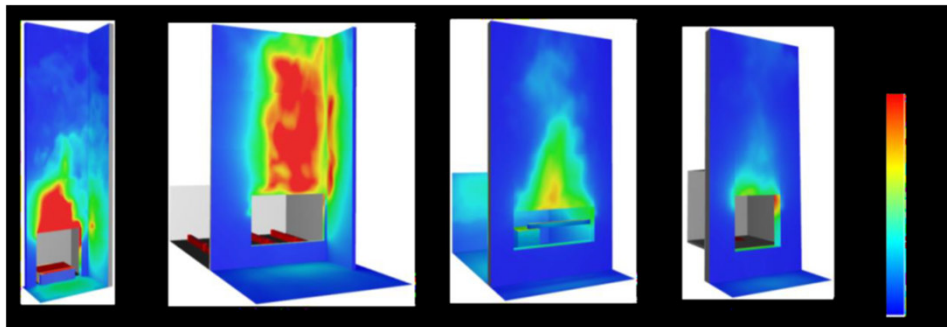
ISO 13785 – 2 (propano)

JIS A 1310 Giappone (propano)



BS 8414-1 GB/T 29416 NFPA 285 ISO 13785-2 JIS A 1310

Alcuni esempi di sperimentazione
fisica e di simulazione numerica



BS 8414-1 ISO 13785-2 NFPA 285 JIS A 1310

Heat flux
CFD

RICERCA EXTRA UE

An exploration of equivalent scenarios for building facade
fire standard tests
Journal of Building Engineering - Marzo 2022

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Una nuova visione : forme di incendio, progettazione integrata

Tipiche problematiche antincendio per le facciate

Materiali facilmente combustibili

Facilità di propagazione dell'incendio

Ampie superfici geometriche

Amplificazione degli effetti del vento

Canali interni di tiraggio aerodinamico

Distacco e coinvolgimento di porzioni

Una nuova visione : forme di incendio, progettazione integrata

Ulteriori problematiche antincendio per le facciate

Transizione da incendio interno ad incendio di facciata

Transizione da incendio di facciata ad incendio interno

Varie modalità di propagazione del fronte di fiamma sulla facciata

Effetto delle forzanti aerodinamiche interne (convezione)

Effetto delle forzanti aerodinamiche esterne (vento)

Effetti geometrici di bordo (spigoli, curvature)

Una nuova visione : forme di incendio, progettazione integrata

Progettazione integrata antincendio per le facciate

Integrazione funzionale dei sistemi antincendio di protezione passiva, protezione attiva, gestione della sicurezza antincendio ed operatività antincendio

Facciata intesa come «*sistema*», ossia composta da elementi componenti dinamicamente interagenti

Fattore di scala: criticità del superamento di una soglia dimensionale dell'evento

Coordinamento delle azioni antincendio a livello territoriale ed urbanistico

Comunicazione: consapevolezza delle problematiche antincendio e conseguente consapevolezza di dover mantenere comportamenti adeguati (evitare fonti di innesco, segnalare guasti o manomissioni, impegnare tempestivamente le vie di esodo sicure ...)

Monitoraggio periodico delle condizioni attuali

Prevenzione Incendi

*La ricerca antincendio sulle facciate
in Unione Europea*

GRAZIE DELLA VOSTRA ATTENZIONE

THANK YOU FOR YOUR ATTENTION

Fabio Alaimo Ponziani

CORPO NAZIONALE VIGILI DEL FUOCO