

TALL BUILDING FAÇADE FIRE INCIDENT DATABASE FOR A MACHINE LEARNING ENVIRONMENT

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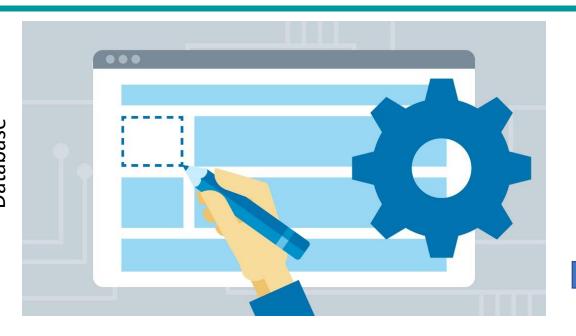
Tall Building Conference, London, 18th June 2019

BACKGROUND



Database

Machine learning



Split Datasets Training Models results Training Historical Data Validation Models results Validation Thermo-physical properties Design parameters Test and regulatory characteristics Tests Compare results Models Hold-out Adapted from Angarita N. Machine Learning has Predict performance of other Select transformed many aspects of our everyday life, facade systems model can it do the same for public services?

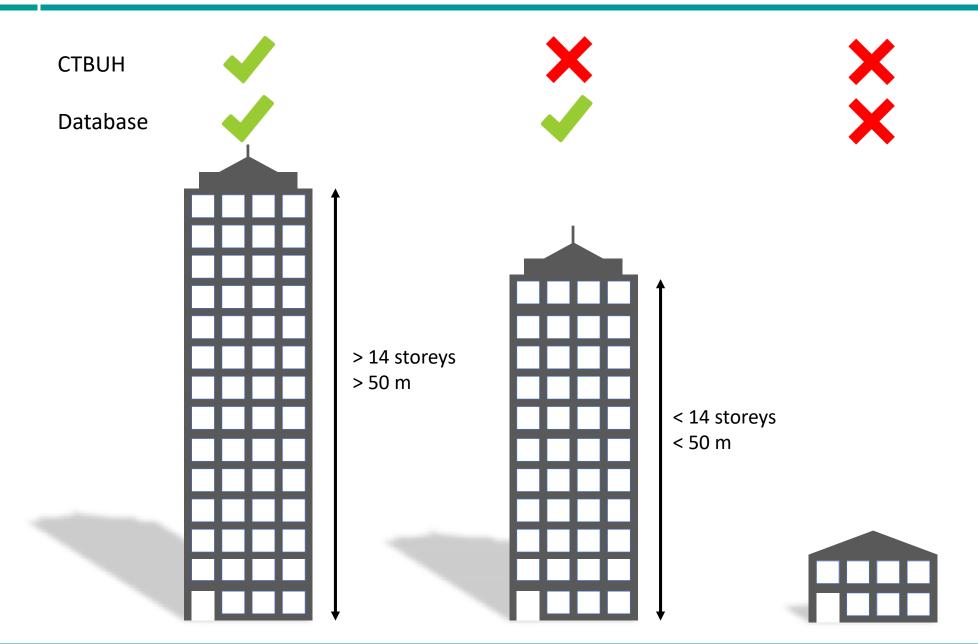
Project funding from:





TALL BUILDINGS

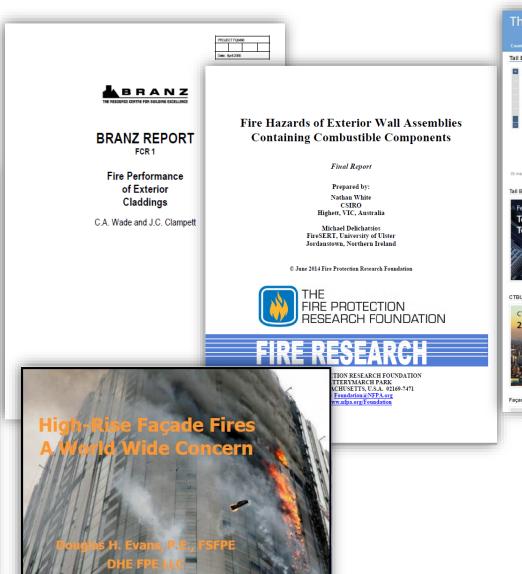




MEDIA, PUBLISHED REPORTS, DATABASES









59 INCIDENTS





DATABASE



Location	Description	Floors	Room Type	ie Pri	imary type A	udritectural	Height (m)	Country	Country	Region	Yearbuilt Ye		Year refurbished	Ago at	Construction type	Construction	n Façade description	Façade type	Cavity	Face material Co	re material Incu		Cause	Starting floor	ignition floo	Caculties	Fatalaties In	juries Si	rinklers	Sprinklers Wind a	a factor Wi	vied Falli	ring materia
The Address Dates 2015-01-01	The building complex a mixture of antidental and botal		O but	Official /	Hotel	height (m)	902	186	1145	Middle Corr	2000	2000	before incident	incident	Coccus	Concrete	Cladificat described as	MCM	Unknown	Aluminium	mat 05 Inc	rial	Dartic 3	20	20	Minister		% A100	Aler sustant Sur	dr Not known (1)	or or other	Fire array Callin	factor
	accompdation. The fire was started by an electrical short-		hote	el .	Hours	10	~~	UAL .		WILLIAM TOTAL		-			COLUMN	Conseile	aluminium plastic		United	Auman	Pi UII	by electrical wires of		~	~	andmer		wasi	stalled but			199	eported to ha
The Torch, Dubai 2015-00-21	Reports imply that the building was clad with ACM. Fire started around the 50th floor on one of the building's	86	SG Resi	idential Ra	recidential	352	352	TAL	UME	Middle fast	2011	2011	6/4	4	Concrete	Concrete	Reports imply that the building was clad with ACM.	MCM	Unknown	Aluminium	PE Unk	own Barbecue grill on Sist floor balcony	oking_appliance	m_1 51	Si	4 injuries	0	4 Probye	Milers report Spr gests that	rk_Not_known_0 Wind	anned crease_f	fire_growt Vide	deas show fall ourning mater
The Torch, Dubai 2017-09-01	The second fire is the building since the previous one is	86	SE Resi	idential Ra	residential	352	362	UAE	UAE	Middle fast	2011	2011	Ongoing since	6	Concrete	Concrete	Reports imply that the	MCM	Unknown	Aluminium	PE Unk	own Gleknowe	Unknown_0	Unknowe	Unknown	None	0	0 Report	on previous Spr	rk,Not,known,0	o 8		bris seen falli
Tamweel Tower, Dubai 2012-15-18	2015. The exterior cladding was reportedly being renovated the Tamweel Tower is a mixed use and recidential building	25	25 Resi	idential / Ra	residential	160	160	UNE	UAE	Middle fast	2009	2009 ps	nya nya	3	Concrete	Concrete	building was clad with ACM. Metal composite panels	MCM	Unknown	Aluminium	PE Unk	own Reportedly digarette	oking_related_	45 Roof	26	None	0	 Probyt 	Mercreport Spr	d Not known 0		No Photo	the ground. stographs sug
Saif Belhara Building, Tecom 2012-10-06	The fire was thought to have started by a cigarette discarde the Saif Belhaus building has 156 apartments and lower car	4	13 Resi	ice idential Ra		0		UAE		Market Com	Websers 100		1/2	Unterson		Unknown	consisting of aluminium Metal composite panels	11711	Unbarren	Attendation	AT 1340	discarded arts pile of own Short-circuit or over	Bectric_3			Several reports		tug.	pests that			do	downward for Around 5 car
an amadabang score 200-200	parking level. During the fire 9 flats were damaged and				PLORISA				uni ,	WILLIAM TOTAL	CORNO DE	and an		Garages			consisting of aluminium	MCM.	Unkilowii	Autoria	Pi UIK	heating (appears to be	a means	4		state 2 injuries						dest	stroyed by fai
La Tour Mermoz, Roubaix 2010-05-14	The fire started on a second floor balcony. The spread of the fire appeared to be enhanced by the profile created by the	e 18	18 Reci	idential Ra	recidential	55	55	France	France	Europe	1966	1966	2003	7	Unknown	Uhknown	The first storey was covered with "formo-phenolic"	MCM	Unknown	Aluminium	PE Unk	own Presumably of proidental	Unknown_0	2	2	I death; & injuries	1	6 0	Anowe N	io_sprk_system Wind	incted owase_f	_fire_grow Ran	ming debris f he panels fell
Groony-City Towers, Groony; 2013-04-09	Construction had just completed in this unoccupied, high	28 or 60	28 Hotel	sel and Ra	residential	88	**	Russia	Russia	Europe	2013	2013	1/4	0	Unknown	Unknown	Façade materials believed	MCM	Unknown	Unknown U	Inknown Unk	own Attributed to a short	Rectric_3	Upper floor	28	None	0	0 Yes, 0			0 N		Linknown
MSM Monte Carlo Hotel, Lac. 2008-05-25	rise building, ignition attributed to a short circuit in an air. The fire started on the upper levels of the hotel tower due.	22	22 Hotel	idential rel / carino	Hotel	110	110	USA	USA No	orth America	1995	1995	0/8	12	Vinteran	Unknown	to be metal composite DEC consisted of a lawer of	000	Hokonen	Ontomer	n/a 695	vec Malding	Welding 40	Roof	22	Dimension of		12 Yes	nescess of San	rk Not known 0 Grek		No Burni	mine debris fe
Vegas	to waiting The fire spread mainly internity with some			,													expanded polystyrene foam								_	were reportedly	-		FPA13				evacuating
Palace Station, Las Vegas 1998-07-20	The fire occurred during a thunderstorm and lightning may have been the cause. The fire was confined to the outside	20	20 Hutte	tel	Hasel	76	76	USA	USA No	orth America	2976	1976	1/2	22	Linknown	Uhknown	Polyurethane foam and urethane coated EPS	SHE	Unknown	Unknown	n/a i	J Lightning	stural_occurano	to_füleknowe	Unknown	4 injuries	0	4 Yes	activated) Spr	rk_Not_known_0	o 8	No	No
Eldorado Hotel, Reno, Nevada 1997-09-30		26	26 900	sel	Hasel	92	92	USA	USA No	orth America	2973	1973	1996	1	Unknown	Unknown	Believed to be hard cost	MCM	Unknown	Polymer U	inknown EPS	XPS Electrical fault	Rectric_3	Unknown	Unknown	None	0	0 Sprink	er protected Spr	rk_Not_activated	o 8	No It app	ppears the fa
Wooshin Golden Suites 2010-10-01	on an external wall. No spread into the building was The fire appeared to have started at a janitor's garbage	- 10	as Mar	nton to	residential	140		South Yours S		Asia	2005	2005	0/8		Constructor.	Steel	golyurethane 'sign' over SPS	MCM	Helenous	Alternatives.	96 695	XPS Fire started on the	Rectric 3			Challedge 14		f but	o internal sted to be Son	rk Not activated Windre		fire growt	material did n Unknown
Rusan	collection room. A vertical 'U' shaped channel enhanced fin		lmo	only	PLORISA		200		DOG! AGES						reinforced concrete		panels with a 2 mm		Unkilowii	Autoria		fourth floor due to a				residents, 1 fire-		sprink	er protected	have Tu	iled the		
Television Cultural Centre, 2009-03-09 Mandarin Oriental Hotel,	The upper portion of the China Central Television headquarters (CCTV) facade was ignited by illegal firework.	31	21 Hotel	tel	Hasel	159	199	China	China	Asia	n/a	n/a	4/2	0	Steel	Steel	Setruded insulating foam gazels and polystyrene	ERFS	Unknown	Zinc	n/a EPS	XPS Ignited by illegal	Fireworks_dil	9 Roof	31	15re-fighter danth: 7 injuries	1	7 Lack	of working Spr	rk_Not_activated Strong	winds ofighting	ng_operatio Melti	dting and drip
		SO	50 Offi	lor	Office	202	209	China	China	Asia	2009	2009	1/2	0	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown U	Inknown Uhik	own Gleknowe	Unknown_0	Cisknowe	Unknown	Linksown	0	0 0	sknowe N	io_sprk_system Clek	iowe n	No Ur	inclear whet
Nanjing City Raku, Binagadi district 2015-05-19	Photographs show burning material from the building. The fire occurred in an apartment building that had been	- 46	16 Res	otental to	welderfold	Linksown	Urknown	Assistation	Ametrican	Asia	Unknown Un	- inner	2062	2	Cinknown	Uhknown	Reports imply the facade	000	Hokonen	Holonoun	n/a fo	m (Malanama	Unknown_0	- Continuos	Universal	15 deaths: 63	15	0 0	Anowe N	io_sprk_system Stron	winds crease_f	fire grown	falling mater
	renovated as part of a wider programme started around		9 900		residential											Unknown	was made of MCM with PE									injuries				fano	ditte		
Raku, Zikh highway 2015-08-10	The fire occurred in an apartment building that had been renovated as part of a wider programme started around forwar contained flats about profit princerses. The fire was		-			Linksown	Unknown	Azerbaijan J	Azerbaijan	Asia	Linksown	nknows	2062	3	Unknown		Report mentions that the facade was made of low	Other	Unknown	Unknown U	inknown this	own Gleknowe	Unknown_0	Unknowe	Unknown	None	0			io_sprk_system			Linknows
Polat Tower, Istanbul 2012-07-17		42	42 Resi	idential Ra	residential	152	152	Turkey	Turkey	Europe	2001	2001	0/2	11	Linknown	Unknown	Unknown	Unknown	Unknown	Unknown U	Inknown Unk	own Faulty air conditioning	Rectric_3	Rase of tower	1	None	0			rk_Not_known_0 Fire wo		fire_grows	Linknown
Al Taver Tower, Sharlah 2012-04-28	fanned by strong winds and burned through the building's the fire is thought to have stanted from discarded cigarette	41	41 840	idential Re	reidential	161.68	161	URE	UAE 7	Middle Sast	2009	2009	n/a	3	Concrete	Concrete	Metal composite panels	MCM	Unknown	Aluminium	PE Unit	own Granette butt	oking related	45 1	1	None		0 0	dings fire	io_sprk_system Report	gwinds.	fire growt Dest	estruction o
Water Club Tower, Atlantic 2007-09-28	butt landing on a fat floor balcony which contained the fire cocurred while the building was nearing		42 Hotel	ul (ruino	Hatel	121.5		USA	IISA NI	orth America	2007	2007	0/8			Concrete	consisting of aluminium	MCM			P6 EP5	_	Unknown 0					a Social		rk Not known 0 Wind o	nt factor	fire grow Falls	fline debris
City 2007-09-29	completion. The aluminium composite panels were used a	. "	42 1400	ser / casono	Hasel	141.5	141	USA	USA N	orth America	2007	2007	nya.	0	Locciese	Concrete	system composed of 3 mm	MCM	Unknown	Aumoun	PL 1PS	195 Distrowe	Unknown_0	4	4	Name	0		he 10th floor	debris	smoke.		ning dean sificant aro
Középszer Street, Miskolc 2009-08-15	The fire started in a kitchen and resulted fire spread over	11	11 Resi	idential Ra	residential	Linksows	Urknown	Hungary	Hungary	Europe	1968	1968	2007	2	Concrete	Concrete	RFS on the exterior walls	SRE	Unknown	Render	n/a EPS	XPS Gleknowe	Unknown_0	- 6	6	2 deaths	2	0 0	rknowe N	io_sprk_system	owe n	No	Linknow
268 Kennedy St. Winniges. 1990-03-10	the facade to the top of the building as well as smoke Appartment building with open-air parking on the ground		8 800	idential Re	reidential	Unknown	Urknown	Canada	Canada No	orth America	1967	1967	0/8	3	Unknown	Unknown	Sansisting of 70 mm thick	DES	Unknown	Unknown	n/a fo	m (Jeknowe	Unknown 0		1	None		o Uni	olicklened N	io sork system Wind	ushed crease f	fire growt	Unknow
Manisoba	floor. Fire started in the garage involving 25 cars which ther		-						France	_		1973				Unknown	thick feam but up to \$40				n/a ses		Fuel_related_5						uilding	io_spk_system Win	cross the	fire grown	
Sonacotra building, Dijon 2010-11-14	The fire started in a garbage container at the base of the againment building. Fire spread appeared to be influenced	Deanowe	20 444	idential R	accessor.	Linksows	Ultkhows	France	Hance	Europe	CHEROWIE	2972	1987	24	Dittercoun	Unknown	Façade believed to be SHS system with EPS insulation	10.7	Unknown	Unanown	1/3 195	XPS External garbage container	HARLINGSEQ.)	1		7 deaths; 11 injuries	,	11 0	rknowe N	fame	blew crease_f	jine grown	Litterow
reskowstraße Pankow, Berlin 2005-04-21	Fire started in a second floor apartment with flames from a	7	7 Resi	idential Ra	reidential	Linksows	Urknown	Germany	Germany	Europe	1996	1996	r/a	9	Concrete poured with a lost	Concrete	The façade consisted of 80	SRE	None	Render	n/a EPS	XPS Gleknowe	Unknown_0	2	2	2 deaths; 2	2	3 0	Anowe N	io_sprk_system	owe n	No	Linkney
Aunich, Germany 1996-03-00	window igniting the EFS façade. Fire and smoke spread into A fire in a container of rubblish spread to the façade. Fire	5	S Rec	idential Re	reidential	Linksown	Urknown	Germany	Germany	Europe	Unknown Un	iknowa	Unknown	Unknown	With a lost Unknown	Uhknown	mm flame-retarded Façade made of a composite	DES	Unknown	Unknown	n/a EPS	xPS Rubbish container fire	Fuel_related_S	S6 1	1	None reported			Anowe N	io_sprk_system Clek	owe 5	No.	Linkney
Cnowsley Heights, Liverpool 1995-08-05	spread to upper floors through broken windows. The exact		11 Resi		widowing.			England				1965	1990			Concrete	thermal insulation (about					on the exterior	Fuel related S									No.	
nowsky Heights, Liverpool 1995-08-05	way to the highest floor, seriously damaging the outer wall	. "		1-00-1538 RX	accessor.	Unknown	Unknown	angiana	UK.	surope			1990		Concrese		installed with a 90 mm air	Other	Ventrated	Unanown 0	manown unk	outside the building		1	1	reane				io_sprk_system Unk		-	CHEROCO
iarnock Court, Irvine 1999-06-11	Fire began in a flat on the fifth floor and broke through a	13	13 Reci	idential Ra	residential	Linksows	Urknown	Scotland	UK	Europe	1967	1967	1995	- 4	Concrete	Concrete	New uPVC window frames.	Other	Unknown	Polymer t	Inknown Uhik	own Room fine	Unknown_0	- 5	s	1 death; 5 injuries	1	s u	sknowe N	io_sprk_system	owe n	No Clade	dding fell
iman One, Aiman 2016-09-28	windows with the result that flames reaching the twelfth The fire started in one tower in the complex and then	36	X 800	idential Re	reidential	130	130	UNE	UAE 1	Middle Sast	2011	2011	n/a	5	Concrete	Concrete	Exterior wall around the Reported to be ACM.	MCM	Unknown	Aluminium I	Inknown Unik	own Flaming material	oking related	45 1	1	None			Anowe N	io sork system Strong	winds crease f		least one ming deb
lafa Tower, Dubai 2016-07-20	spread to a neighbouring tower when winds carried burnin Fire started on the 36th floor.	-	76 Resi		residential	288		UNE				2000				Concrete						(possibly coal used in	Unknown 0		*				Mnowe N	io sork system (/ek	with Site	No Sire to	ing to the
	His started on the sach floor.	_ ^		1-00-1538 RX	accessor.		200	OA1	CAL I	Middle said			nya.		Concrese	Concrete	Linkstown	Unknown	Unknown	Unanown 0	manown unk	own Deanowe	Unknown_0			reane			Minowe N	io_spin_system Disk	owe h		spread w y flaming
ulafa Tower, Dubai 2012-06-08	Residents were forced to evacuate from the fire that starte	d 76	76 Resi	idential Re	residential	288	288	140	UAE	Middle fast	2000	2010	1/2	2	Concrete	Concrete	Unknown	Unknown	Unknown	Unknown U	Inknown Unk	own Unknown	Unknown_0	- ×	×	None	0	0 0	iknowe N	io_sprk_system	owe h	No	Linkson
iroshima Motomachi 1996-10-28	on the 20th floor early in the morning. The incident involved a fast spreading fire spread owing to	20	20 Resi	idential Ra	esidential	Linksown	Urknown	Japan	Japan	Asia	1972	1972	Unknown	26	Steel reinforced	Concrete	1 m tall, 9-20 mm thick	Other	Unknown	Unknown	Polymer Uhk	own Gleknowe	Unknown_0			Unknown	0	0 0	Anowe N	io_sprk_system Wind o	scribed N	No	Linknes
Mancheder, New Hampshire 2005-06-07	PMMX fences used in the balconies of the building. The fin the incident involved a flash fire on the exterior of the				Office	Unknown		USA	USA N			. 📙	Unknown		concrete	Uhknown	PMMA blindfold doors along GFS, no further information	MCM				own External radiation	Fuel related S					. —	Anowe N	io sork system (Jek	at 1 m/s	No.	Linkney
	building due to exposure to radiant heat. The fire was	_ ′	/ 014	100	Cittice		Unknown		USA N	ers America	Linknown Un	skrows	Charlown	Unknown	Ditties	Unknown	has been found.	MCM	Unknown	Unanown 0	manown unk				Unknown	reane					owe A		
akeside Plaza, Virginia 2005-06-05	The fire started in a rubbish chute. Extensive vertical sprea- did not occur so that damage was limited to floors above	d 12	12 Resi	idential Re	residential	45.21	-6	USA	USA No	orth America	1983	1982	5/2	22	Concrete	Unknown	BFS system with 25 mm thick XPS backing	RIFS	Unknown	Linknown	n/a EPS	XPS Fire started in a trach chute on the fifth or	Fuel_related_S	SE Sen or en floor	S	None	0	0 0	ránowe N	io_spri_system	owe N	No	Linkney
ountry Comfort Motel, 2005-06-20	The fire started in a third-floor apartment and when flamer		8 Mon	sel	Hasel	42	42	Autolia	Australia	Corania	1990	1980	1/2	25	Concrete/masonry	Concrete	Fibreglass panels beneath	SIFS	Unknown	Unknown	n/a Miner	I wool gleknowe	Unknown_0	- 2	3	None	0	0 0	ránowe N	io_sprk_system Clek	owe n	No	Linked
bury, NSW	broke through a window there was rapid spread to the top Fire caused uPVC window frames to melt and drip, which		34 Resi		residential				_		1975	1975			construction		the windows.						Unknown_0					. —		io_sprk_system Disk		No.	Linker
itler House, Grays, Esses 2997-05-06		54				Linksown	Unknown	England	UK.	Europe			1/2	22	Distressi	Unanown	Linkstown	MCM	Unknown	Unanown 0	manown unk	own Deanowe		36	14	reane							
prosse Tower, Melbourne 2014-11-25	A discarded cigarette started a fine on an eight-floor balcon which led to rapid flame spread over the building cladding.	y 21	21 Reci	idential Ra	recidential	72	72	Autolia	Australia	Oceania	2012	2012	4/2	2	Maspery, concrete and dry Wall	Concrete	Polyethylene core aluminium cladding	MCM	Unknown	Aluminium	PE Unk	own Cigarette	oking_related_	45- 1		None	0	O Yes	- worked Sp	ork_Contained_2 Wind	Skely crease_f red in		debris i
lakerTower 4, Sharjah 2012-05-18	The building's exterior was made of flammable materials	29	29 Resi	idential Ra	residential	Linksown	Urknown	UAE	UAE	Middle fast	2000	2010	1/2	2	Concrete	Concrete	Unknown	Urknown	Unknown	Unknown U	Inknown Unk	own Lit oignrette that was	oking_related_	45 1	1	None	0	0 Une	prinklered N			fire_grown	Links
eo Soho, Jukarta 2017-15-09	and the weather and wind speed were major factors that	- 10	28 Resi	Otherstold St.	residential	Underson		Industria.		Asia	atr.	0/2	0/2			Unknown			Helenous	Helenes I	inhanana iinhanana	thrown off the balcon	Unknown 0			# Indoor			uilding Mnowe N	najor f	ctor that	No Lira	rae fallin
	still under construction. The fire started on the ninth-level		men.	all list		LULANDAN	CHARLOWN	Hadreta	INCIPUS		10/2	14.2		٠				CHARACTER	Unkilowii	CONTRACT O	and the same	out Discour				2 mpary	-					end	ndanger
mat Gan, Tel Aviv 2016-06-13	The fire started in an apartment and spread quickly along the huilding systems. On pants were even upon their	13	13 Reci	idential Ra	recidential	Linksown	Urknown	Israel	Israel 1	Middle fast	Linksown Un	skrows	Unknown	Unknown	Linknown	Unknown	Polyethylene (playthene lair Ti composite cladding	Other	Unknown	Unknown	PE Unk	own Unknown	Unknown_0	2	2	None	0	0 0	iknowe N	io_sprk_system	owe N	No fact	Burning
enfell Tower, London 2017-06-14	The fire started in an electrical appliance in a fourth floor	26	24 Resi	idential Ra	residential	۵	۵	England	UK	Europe	2974	1976	2065	2	Concrete	Concrete	Aluminium sheets with a	MCM	Unknown	Aluminium	96 6	R Electrical	Rectric_3	4	4	71fatalaties; 74	71	26	No N	io_sprk_system	owe n	No Fire-	o-Fights
ellerache, Villefranche-sur- 2015-09-17	againment before spreading to the outside of the building. A fire broke out in a stock of builty goods, which had been	,	2 200	idential Re	welderfold	Unknown	Urknown	France	France	Europe	Unknown Un	- inner	Unknown	Hokonen	Tinknown .	Uhknown	golyethylene core and Pik	Hidonan	Hokonen	Holonous I	Inknown 1868	nen Weinnen	Unknown_0			Injuries 20 injuries		20 00	Anowe N	io_sprk_system (Jek			protec Unke
ne .	stored at the foot of the building. The fire moved into The incident was a garbage fire that broke out in front of th		12 944		widowich							1930													1		-						
ise-Pascal, Montmarin 2015-09-29 trict, Vesquil	The incident was agarbage fire that broke out in front of the building. The fire destroyed a section of the newly.	o Disknowe	17 Nec-	idential Ra	recidential	Linksown	Unknown	France	France	Europe Li	Sey between 967 and 1979	1970	2062	3	Unknown	Uhknown	Unknown	Unknown	Unknown	Unknown U	inknown this	own Gleknowe	Unknown_0	1	1	2 hospitalisations	0	2 0	rknowe N	io_sprk_system (Jek	owe A	Alo	Linker
mond House, Charles 2015-05-26		20	20 Resi	idential Ra	residential	58	58	Scotland	UK	Europe	2961	1961	2011 or 2013	54	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown U	Inknown Unk	own Unknown	Unknown_0	About half way,	12	3 injuries; S	0	2 U	rknowe N	io_sprk_system	owe n	No Dri	ripping
eet, Glasgow d Road flats, Glasgow 2014-09-26	witness reports suggest that cladding contributed to the Fire was discovered in the external cladding. Building was	31	21 840	idential Re	reidential			Scotland	UK	Europe	1966	1966	1/3	- 44	Street	Steel	Unknown	Unknown	Unknown	Unknown U	Inknown Unik	own Weknowe	Unknown_0	"12 from video	Unknown	hospitalisations Linky		1 0	Anowe N	io_sprk_system	owe 5	No -	flats
	demolished in 2015. Summer for rafe localization the immediate vicinity of some				_	-			-																		-						
Case 2 2009-00-00	Damage façade localised to the immediate vicinity of some of the windows but beyond this the damage appeared to	22	22 Resi	idential Ra	recidential	Linksown	Unknown	LIK	LIK	Europe	-1965	1965	2007	1	Unknown	Uhknown	Insulated render - mineral wool insulation conforming	293	Unknown	Render	n/a Miner	I wool Gleknowe	Unknown_0	11	11	None	0	0 0	sknowe N	io_sprk_system (ink	owe A	No	Links
Case 2 2000-07-00	Several factors contributed to this fire including	16	16 ReG	idential Re	reidential	Linksows	Urknown	LIK	LIK	Europe	*1965	1965	Unknown	45	Concrete	Concrete	Cladding panels had fibrous	SIES	Unknown 1	ineral fibre boar	n/a Comb	stible Disknowe	Unknown_0	12	12	Unknown	0	0 0	Anowe N	io_sprk_system	owe n	No -	Citab
Lauser Tower, Shanlah 2015-10-01	combustible panels on the underside of balconies, outside Fire occurred in a combined residential and parking	36	as Rec	Official St	reidential	Universe	Urknown	UAE	1146	Middle Corr	2015	2015	0/8		Concrete	Concrete	combustible insulation	Unknown	Hokonen	Holonous I	Inknown 1868	nen Melonen	Unknown 0			Winister		50 Uni	orinklered N	io sork system Crek		No Se	Small s
	building. The right side of the building was severely																							_					uilding			bu	burnin
aur Tower, Doha 2006-05-28	Second of two fires occurred while the building was under construction. It is not clear whether the first fire involved	24		idential Ra	recidential	100	100	Qatar	Optor 1	Middle fast	n/a	n/a	0/2	2006	Linknown	Unknown	Polyethylene core	MCM	Unknown	Aluminium	PE Unk	own Unknown	Unknown_0	1	1	None	0	0 0	iknowe N	io_sprk_system Stron	winds ofighting	g_operatidignitir	ition of to
nantou Xintiote Shopping 2008-11-29		32	32 Shop	opping/ Co	Commedal	Linksows	Urknown	China	China	Asia	2008	2008	1/2	0	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown U	Inknown Uhik	own cleánowe	Unknown_0	- 1	1	None	0	0 0	sknowe N	io_sprk_system	owe n	No	Dist
Gigitar vei 360, Harbin 2008-10-10	façade of the building. The fire was extinguished by the The fire occurred while the building was under construction		29 Resi	idential idential Ra	welderfold	99.8		China	Olina	Asia	n/a	0/2	n/a	0	Unincen	Uhknown	Makanan	Historian	Unknown	Holosowa I	Inknown 1916	nen Meldine	Welding_60	Cinknown	Historian	None			rånowe N	io_sprk_system (Jak		No.	Cini
	Workers ignited construction materials while welding.																										-						
nyang Royal Wansin, 2015-02-03	The fire started due to fireworks	28	28 Resi	idential Ra	residential	152	152	China	China	Acia	2009	2009	1/2	2	Linknows	Unknown	Façade clad in ACM with XP1 insulation and a 190 - 600	MCM	Ventilated	Aluminium	PE EPS	XPS Fireworks	Fireworks_68	P 11	11	None	0	0 0	rknowe N	io_sprk_system Clek	owe h	No	Cited
pherds Court, London 2016-09-19	The building was retrofitted with a new cladding around	18	18 Resi	idential Ra	residential	28	98	England	UK	Europe	2971	1971	2006	10	Unknown	Unknown	Panels comprised a 17-23	SES	Unknown	Steel U	inknown EPS	XPS Faulty tumble dryer	Rectric_3	7	7	None	0	0 0	rknowe N	io_sprk_system	owe n	No	Dist
tworth Estate, Trafford Unknown	2006. Fire started in a piece of faulty whiteware equipment Rayen, Osprey, Falcon and Eagle Courts. The buildings were	- 45	15 Resi	Official By	reidential	6		England	18	Europe	1970	1970	1995	Hokeowa	Vinteran	Unknown	mm thick plywood board,	Other	Ventilated	Holonous I	Inknown 1868	nun Meknowa	Unknown 0	Cinterna	Universal	Mone			Mnowe N	io sork system Crek		No.	Cini
	retrofited with a new cladding in the mid-1990s. Since then						-	-	-	-							horisontal and vertical				- Oik												
Termium Business Center, 2009-06-26	The Fire was thought to have started after the building was struck by lightning.	29	19 Offic	ice	Office	72	72	Romania	Romania	Europe	2006	2006	1/2	3	Unknown	Uhknown	ACM with 2 mm thick polyethylene core bonded	MCM	Unknown	Aluminium	PE Unk	own Lightning	stural_occurano	in_lideknowe	Unknown	None	0	0 Una	orinklered N uilding	io_sprk_system	owe 5	No	Dist
charect isim Hospital, listanbul 2018-04-05	The fire reportedly started on the outside of a building	Disknowe	11 1900	ipital I	Medical	Linksown	Urknown	Turkey	Turkey	Europe	2013	2013	1/2	0	Linknown	Uhknown	Unknown	Unknown	Unknown	Unknown U	inknown tink	own Uteknowe	Unknown_0	Roof	Unknown	None	0	0 0	Mnowe N	io_sprk_system	owe n	No Burni	rning (
w Murry, Bucharret 2012-07-07	under construction. Smoke entered the building and the fire began in an outside ground floor warehouse.	- Tableson	20 Proj	Official	residential	Universal		Romania		Europe	Unbarre		Unknown	Unteres		Unknown	formation 1 :	000	Underson		n/a EPS	var distance	Unknown 0						Move N	io sork system - Unk	_	No But	ing to
	Flames spread to the top floors in less tan 10 min. Failure to	DIERROWS .					Unknown	xomania	Romania		LITERAD WITE	sknows		Unknows	Untercoun		composite systems (ETICS)	1955	Unknown	Linknown	n/a ses			1	1	LINKSOWS	-						kumin obs
sebong Green Apartments, 2015-05-10		90	10 Reci	idential Re	recidential	Linksown	Unknown	South Korea S	outh Korea	Asia	2013	2013	1/3	2	Unknown	Unknown	Flammable 'styrofoam'	Other	Unknown	Unknown U	Joknown Unk	own Motorcycle spark	Rectric_3	1	1	4 fatalities; 100	4	100 6/	sknowe N	io_sprk_system Down	Straight N	No -	Link
ijeongbu iovaya Vysota, Krasnoyansk 2014-09-21	other adjacent residential buildings. Reports suggest that The building is also referred to as the 'New Pinnade'. The	25	25 Reci	idential Ra	residential	96.83	86	Russia	Russia	Surope	2010	2010	n/a	4	Unknown	Unknown	traterial Ventilated vinyl siding and	Other	Ventilated	Polymer U	Inknown Unk	own Welding	Welding 60	Lowerlevels	1	None	0	0 0	rånowe N	io_sprk_system (i/ek	owe A	No.	Link
	fire spread on two sides of the building to the entire height																plastic-furnished balconies																
tness centre, Jecheon 2017-12-22	The fire started in the first-flor car park level. Reports suggest the cladding was afactor in the development of the			mmercial Co	Commedial	Linksown	Urknown	South Korea S	iouth Korea	Asia		2012	1/2	- 5	Unknown	Uhknown	Cladding materials made of a persent and foam	ERFS	Unknown	Render	n/a Fo	m Glectrical spark	Bectric_3	1	1	29fstalises; 29 Injuries		1950	oort suggests. Spr kiers failed	rk_Not_activated Unk			Links
world's Orlineary Marc On 20	suggest the cladding was afactor in the development of the The fine was as the result of cooking fat starting a fine is a	6	6 Reta	ail G	ommedal	Unknown	Urknown	Moldova	Moldova	Europe	2012	2012	Unknown	4	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown t	Inknown Unk	own Spark in ventilation	Rectric_3	1	1	None	0	0 0	Anowe N	io_sprk_system	owe n	No -	Link
	umake ventilation system. The fire spread to building																																

	Name	The Address, Dubai	ID	1
	Coordinates (Longitude, la	rtitude, elevation above sea level)	(25.1936328, 55.2790710, 3)	
alling its				

Incident description

The building contains a mixture of residential and hotel accomodation. The fire was started by an electrical short-circuit. It was reported that 14 people suffered minor injuries, one person was moderately injured and another had a heart attack due to overcrowding and smoke at the site. A strong wind blew some of the fiercest flames away from the building, but burning panels drifted up to a street block away and ignited secondary fires on adjacent roofs, despite the fire service's rapid attendance and their hosing down rooftops from tall aerial platforms. Investigations suggest that the facade panels were tested in 2007 to ASTM E-119 in combination with gypsum board which provided the fire resistance rather than being tested to NFPA 285.

ut Obse	P	rimary database content	Machine learning data					
	Date	2016-01-01	Age	8				
14	Floors	63	Floors	63				
dars. Obse	Туре	Residential / hotel	Туре	Hotel				
	Height (m)	302	Height	302				
20	Country	UAE	Country	UAE				
N	Year built	2008	Year built	2008				
20	Year refurbished	n/a	Under cons.	No				
ensi atio	Construction type	Concrete	Construction	Concrete				
otes.	Façade description		Cavity	Unknown				
20	Cladding described as alun	ninium plastic composite panel with 'anti-toxic'	Face	Aluminium				
	polyethylene core materia	I.	material					
70			Core	PE				
N			material					
ut N			Insulation	Unknown				
ghs zio			material					
dars. ights	Cause							
N	Short circuit was caused by	electrical wires of the spotlight used to	Cause	Electric_3				
SEP_	illuminate the building bet	ween the 14th and the 15th floor						
20								
N	Starting floor	20	Starting floor	20				
d p	Casulties	16 injuries	Fatalaties	0				
ut N			Injuries	16				
20	Sprinklers		Sprinkler	Sprk_Not_known_0				
ì		talled but there were conflicting reports on						
20		. Some reports say the activated system ran out						
Obta	of water after 15 min.							
Obser	Wind as a factor	Yes	Wind	Decrease_fire_growth				
20	Falling material as a factor	Falling material was reported to have caused the	Falling material	Increase_fire_growth				
ĺ		fire in a lower flat and threatened people below						
		the building.						
		Sources						

Source

- Evans D. High-rise façade fires: a world-wide concern. Fire Safety in Towers Conference, Sept 2017.
- www.telegraph.co.uk/news/worldnews/middleeast/dubai/12076792/Dubai-skyscraper-fire-newyears-eve-2015-live.html
- www.dailymail.co.uk/news/article-3380507/Fire-rips-Dubai-hotel-close-city-hold-New-Year-celebrations.html
- www.thenational.ae/uae/dubai-hotel-s-sprinklers-ran-out-of-water-15-minutes-into-fire-1 207750
- 5. Fire risks from external cladding panels A perspective from the UK, Probyn Miers Ltd, 2018.
- 6. www.skyscrapercenter.com/building/the-address/468

BUILDINGS, FREQUENCY AND REGION



Number (%)

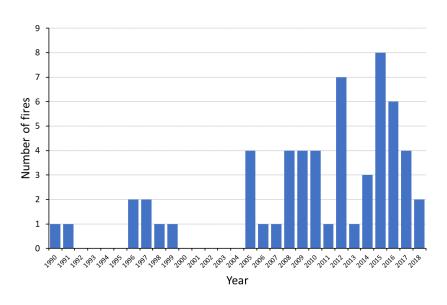
44 (76%)

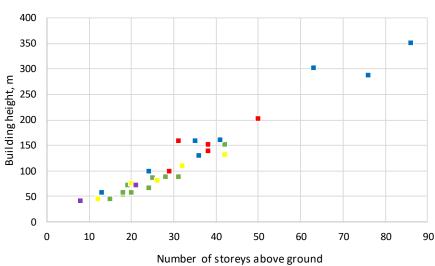
7 (12%)

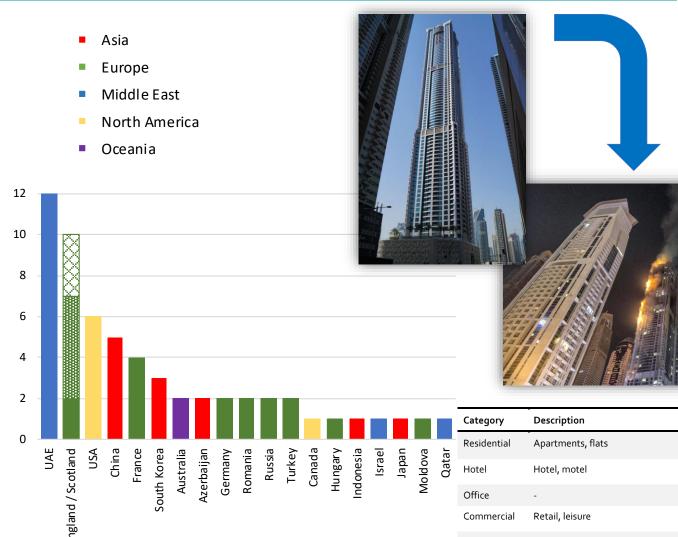
3 (5%)

3 (5%)

1 (2%)





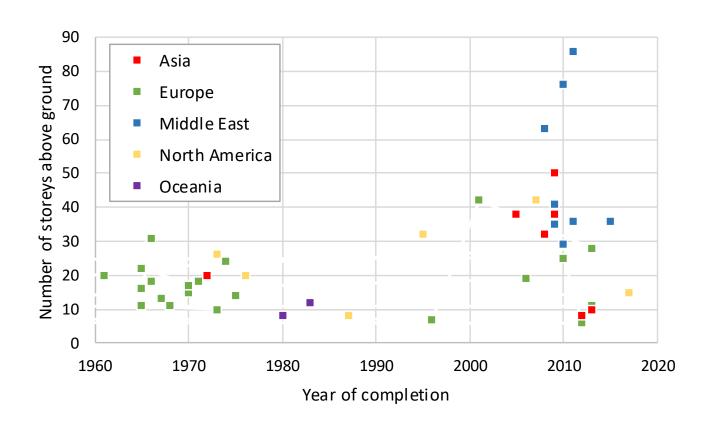


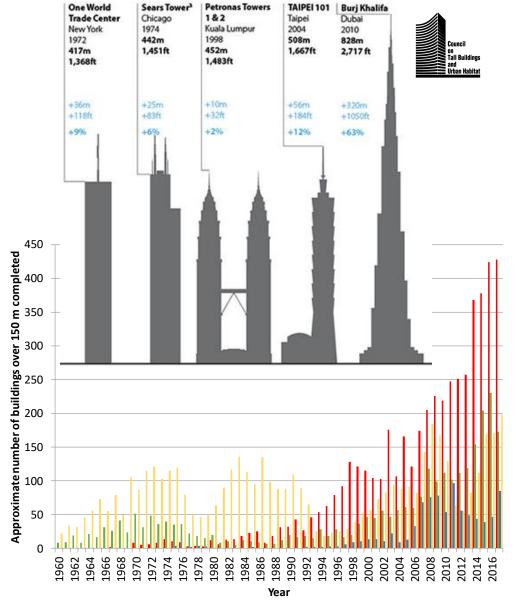
Medical

Hospital, medical centre

COMPLETION

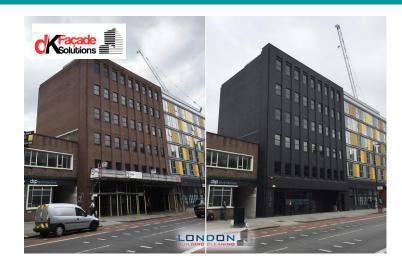


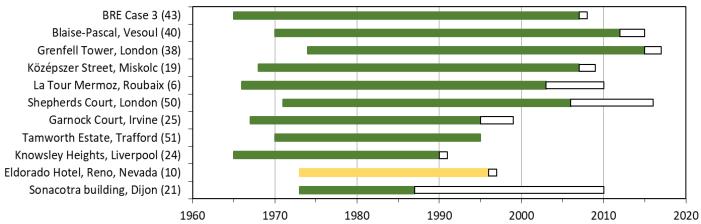


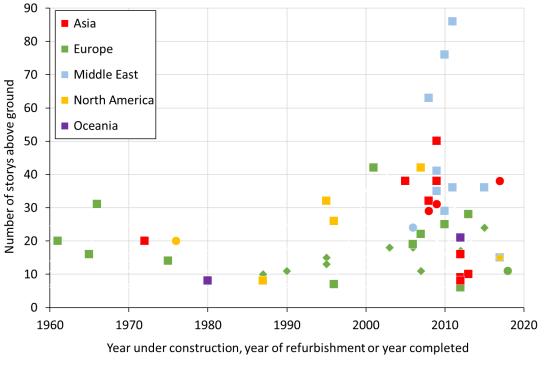


REFURBISHMENT







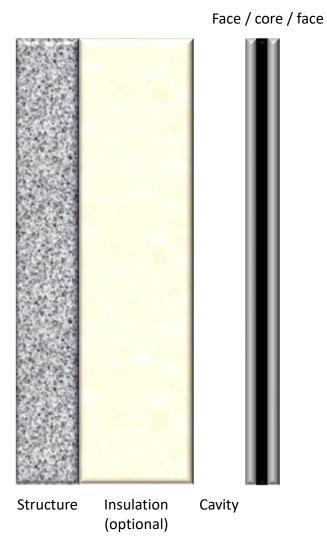


Year constructed, refurbished and year of incident

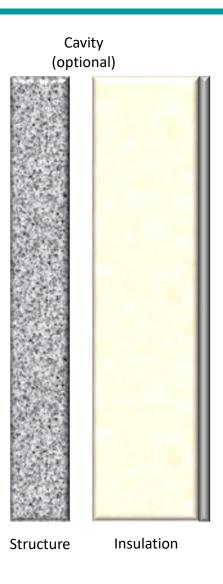
Excludes two incidents in Asia in which year built is unknown but fire occurred 2 yr after their refurbishment

FAÇADE TYPE

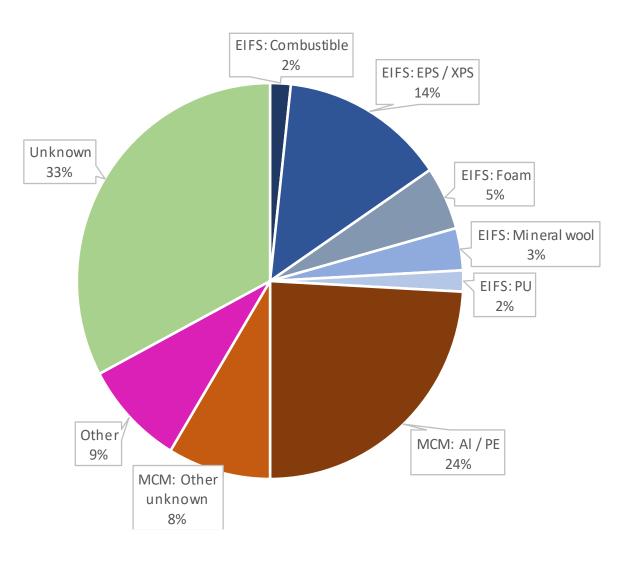




Metal composite material (MCM) assembly

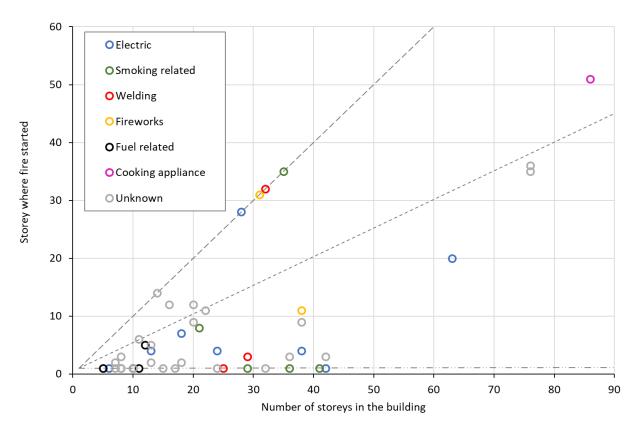


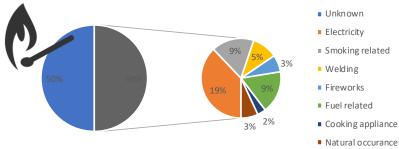
Exterior Insulation Finish System (EIFS) assembly

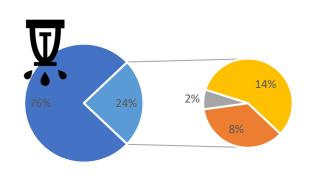


FLOOR OF ORIGIN AND OTHER FACTORS

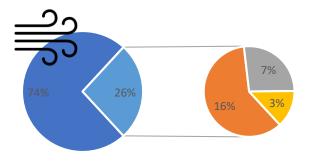




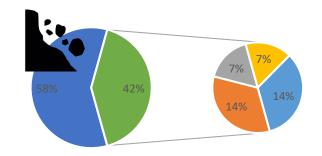




- No sprinkler system
- Did not activate
- Contained fire
- Effect unknown



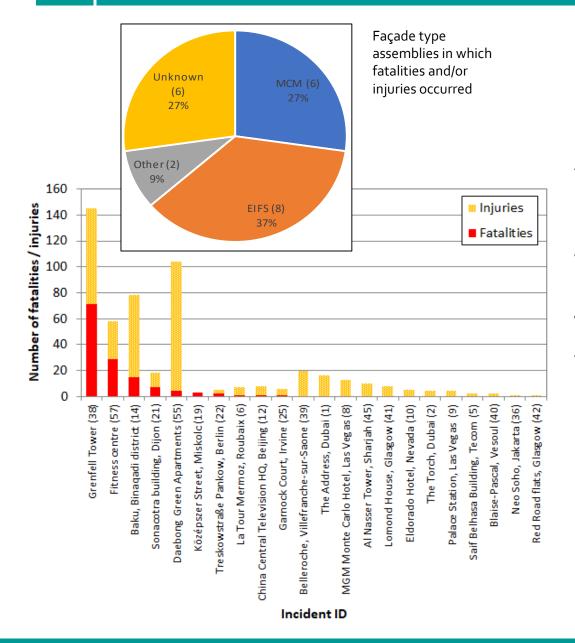
- Unknown / no wind effect
- Increased fire growth
- Decreased fire growth
- Impact on firefighting operations

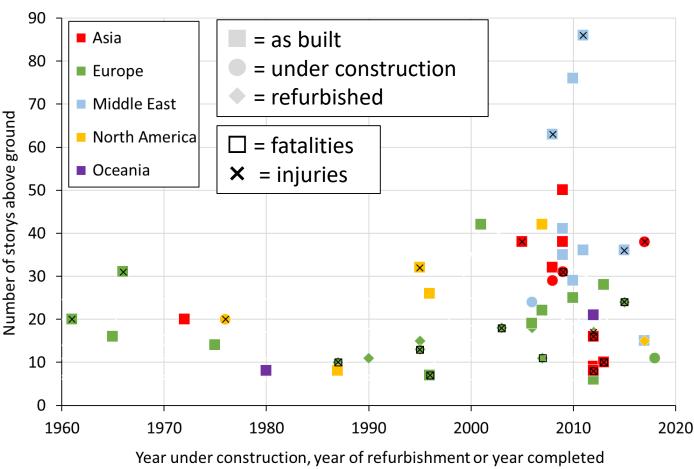


- No falling material
- Increase fire growth
- Caused property damage
- Impact on firefighting operations
- Observed without specific impact

FATALITIES AND INJURIES







DATABASE FINDINGS



- Not all incidents resulted in significant outcomes
- Façade incidents in tall buildings constructed in North America proportionally less than the rest of the world

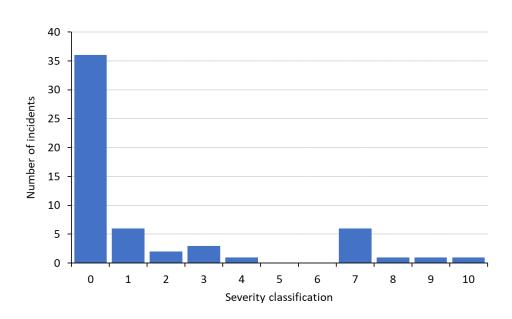
- Fatality incidents
 - 60% of incidents in older buildings later refurbished
 - Less than 32 storeys tall
 - EIFS-type assembly façade
- Analysis less conclusive when injuries considered

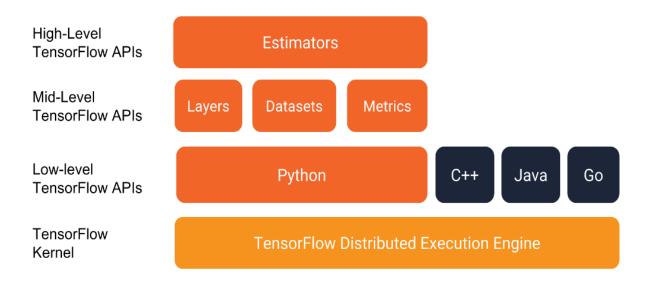
• Limited data suggests reliability of sprinklers systems in façade fires is ~80%

MACHINE-LEARNING SETUP



Severity class (S)	Fatality (v_f)	Injury (v_i)
0	$v_f = 0$	$v_i = 0$
1	$v_f = 0$	$1 \le v_i < 5$
2	$v_f = 0$	$5 \le v_i < 10$
3	$v_f = 0$	$10 \le v_i < 20$
4	$v_f = 0$	$20 \le v_i < 50$
5	$v_f = 0$	$50 \le v_i$
6	$1 \le v_f < 5$	any
7	$5 \le v_f < 10$	any
8	$10 \le v_f < 20$	any
9	$20 \le v_f < 50$	any
10	$50 \le v_f$	any





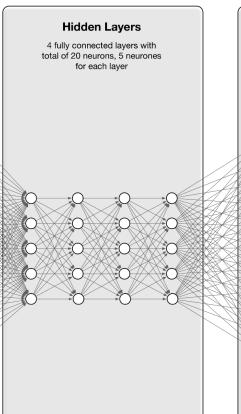
PREDICTIVE OUTCOME



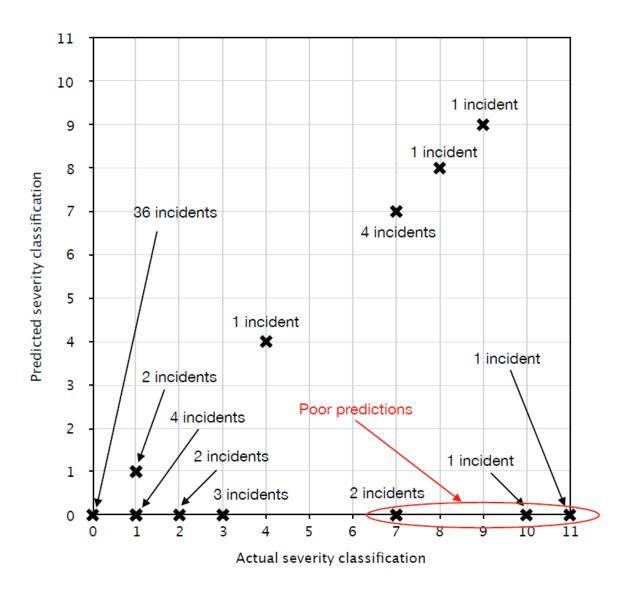
Input Layer

Consists of 18 features which are processed based on surveyed data

- floors
- floors_bucketised
 - primary_type
 - country
 - year_built •
- - construction
 - - cavity
 - face_material
 - core_material
 - insulation_material
 - sprinklers
 - under_construction



Output Layer Consists of 12 classifications calculated based on fatality and injury surveyed data 0.001% 97.161% 0.000% 2.773% 0.066% 0.000% 0.000% 0.000% 0.000% 0.000% 9 0.000% 10 probability of this Severity class Example model prediction outcome



CONCLUSIONS



- Useful database of tall building façade fire incidents
- Some interesting findings
- Very limited data for machine-learning environment
- Poor predictive capability for a given 'severity' metric
- Investigating uploading the data onto Wikidata
- Scope to include new incidents
- Further reading
- Spearpoint M J, Fu I, Frank K. Façade fire incidents in tall buildings. CTBUH Journal, Issue II, 34–39, 2019, global.ctbuh.org/resources/papers/4063-Journal2019 Issue%20II FacadeFireIncidents.pdf
- Data can be download from the OFR Consultants website from http://www.ofrconsultants.com/research

