



FIRE + RISK  
CONSULTANTS

# TALL BUILDING FAÇADE FIRE INCIDENT DATABASE FOR A MACHINE LEARNING ENVIRONMENT

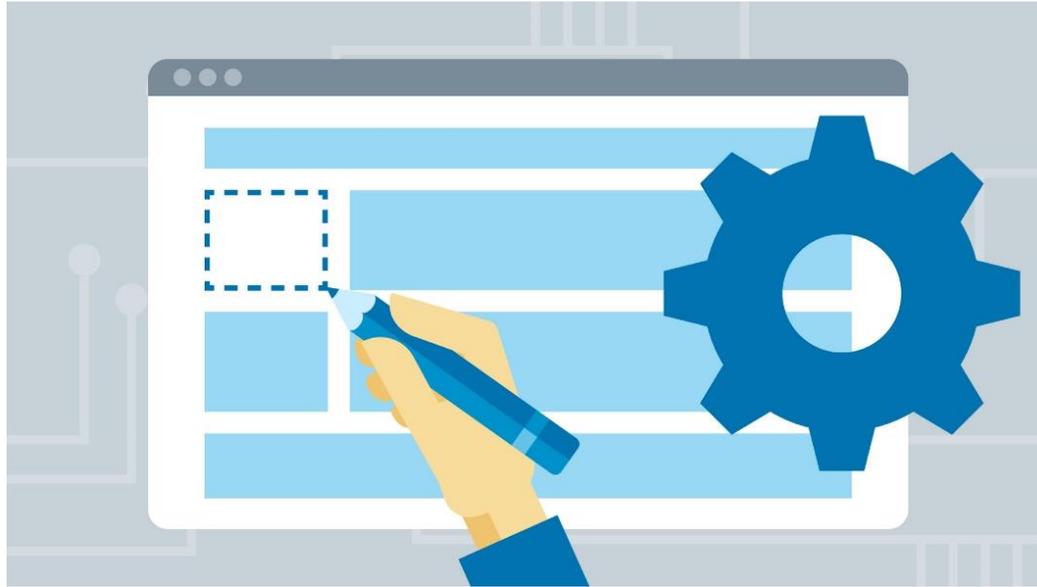
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Michael Spearpoint  
Research Leader, OFR Consultants

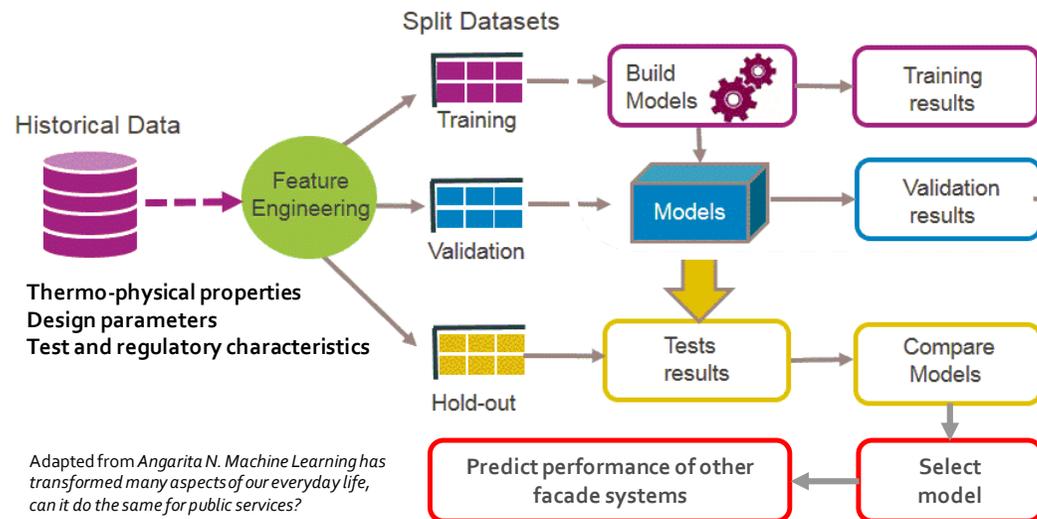
Tall Building Conference, London, 18<sup>th</sup> June 2019

# BACKGROUND

Database



Machine learning



Project funding from:

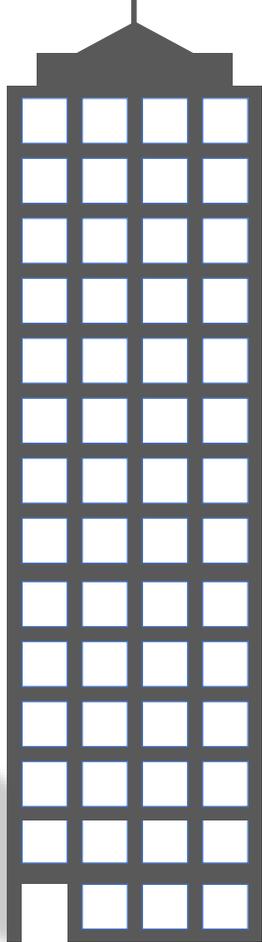


# TALL BUILDINGS

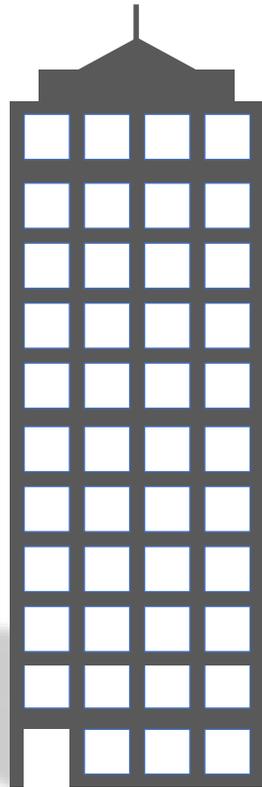
CTBUH



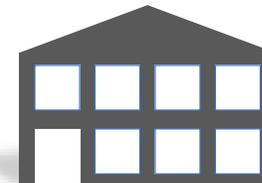
Database



> 14 storeys  
> 50 m



< 14 storeys  
< 50 m



# MEDIA, PUBLISHED REPORTS, DATABASES



**BBC** Your account News Sport Weather iPlayer TV Radio

## NEWS

Home UK World Business Politics Tech Science Health Family & Education

World Africa Asia Australia Europe Latin America Middle East US & Canada

### Large fire sweeps through Istanbul 42-storey building

17 July 2012

Hundreds of people were evacuated from the building.

A large fire has swept through a Turkish city of Istanbul.

Television footage showed the Police of smoke, with pieces of debris falling from the building.

Firefighters - backed by helicopters - were seen spraying water on the building.

**GULF NEWS**

## EMERGENCIES

May 14, 2018 | Last updated 4 minutes ago

UAE NEWS BUSINESS SPORT OPINION LEISURE LIFE&STYL

COURTS 5 CRIME 2 WEATHER 6 SOCIETY 4 HEALTH 2 TRANSPORT 9

### Fire breaks out in Tecom building

Firefighters were able to control the blaze at Tecom's Saif Belhassa building at around 10:57am on Saturday

Image Credit: Zanina Fernandes/ Gulf News

Published: 14:00 October 6, 2012  
By Florence Pia G. Yu, News Editor, and Janice Ponce de Leon, Reporter

**GULF NEWS**

**BRANZ**  
THE RESOURCE CENTRE FOR BUILDING EXCELLENCE

## BRANZ REPORT FCR 1

### Fire Performance of Exterior Claddings

C.A. Wade and J.C. Clampett

*Final Report*

Prepared by:  
Nathan White  
CSIRO  
Highett, VIC, Australia

Michael Delichatsios  
FireSERT, University of Ulster  
Jordanstown, Northern Ireland

© June 2014 Fire Protection Research Foundation

**THE FIRE PROTECTION RESEARCH FOUNDATION**

## FIRE RESEARCH

### High-Rise Façade Fires A World Wide Concern

Douglas H. Evans, P.E., FSPPE  
DHE FPE LLC

**The Skyscraper Center**  
The Global Tall Building Database of the CTBUH

Search Buildings, Companies, Cities & Countries

Countries Cities Buildings Companies Create Lists/Graphics Compare Data Search Submit Data Chinese (中文)

### Tall Buildings

Quick Facts - Global  
Tallest Building: Burj Khalifa, Dubai, 828 m  
# of 300m+ buildings: 130  
# of 200m+ buildings: 1,331  
# of 150m+ buildings: 4,290

Interactive Data - Global  
Completed Tallest Buildings  
Tallest Buildings Under Construction  
Tallest Buildings Proposed  
Tallest Buildings Demolished  
All Tall Buildings

25 map by amCharts

Featured Tall Building  
**Toranomon Hills, Tokyo**

Quick Links  
Height Criteria  
100 Tallest Buildings  
Interactive Data

CTBUH Website Resources  
Latest data study produced by the CTBUH

CTBUH Research  
**2017 Year in Review**

Latest Building Edits  
Victoria Square 2  
Dalian, China  
267 m / 876 ft  
Info Updated

Victoria Square 1  
Dalian, China

**EMPORIS**

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Over 600,000 building, design and construction images

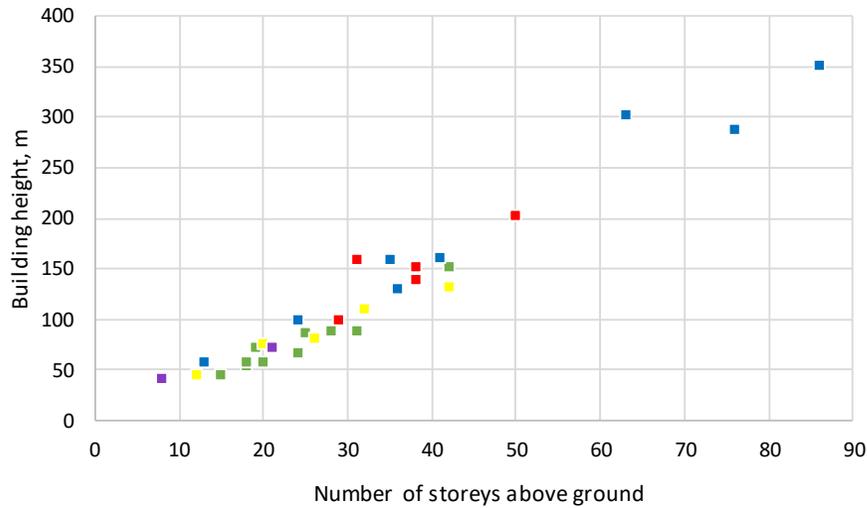
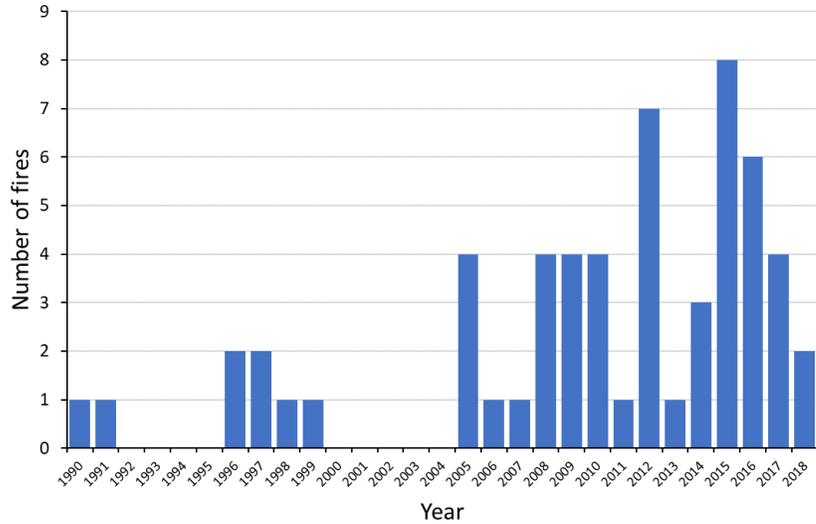
Start Research  
Browse Images  
Add Your Company

# 59 INCIDENTS

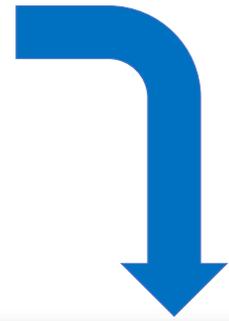
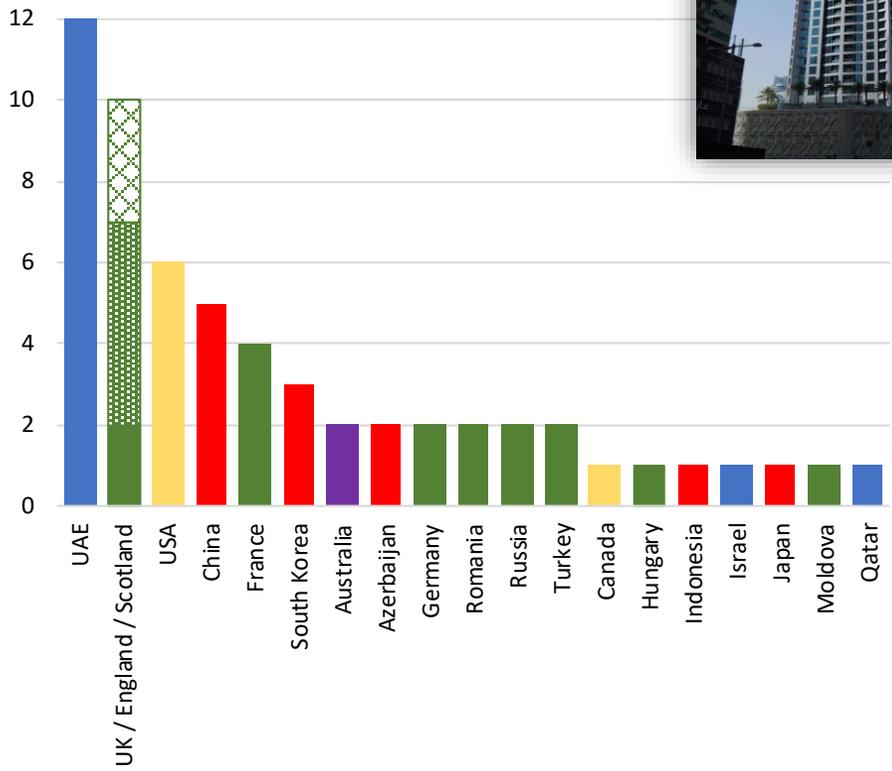




# BUILDINGS, FREQUENCY AND REGION

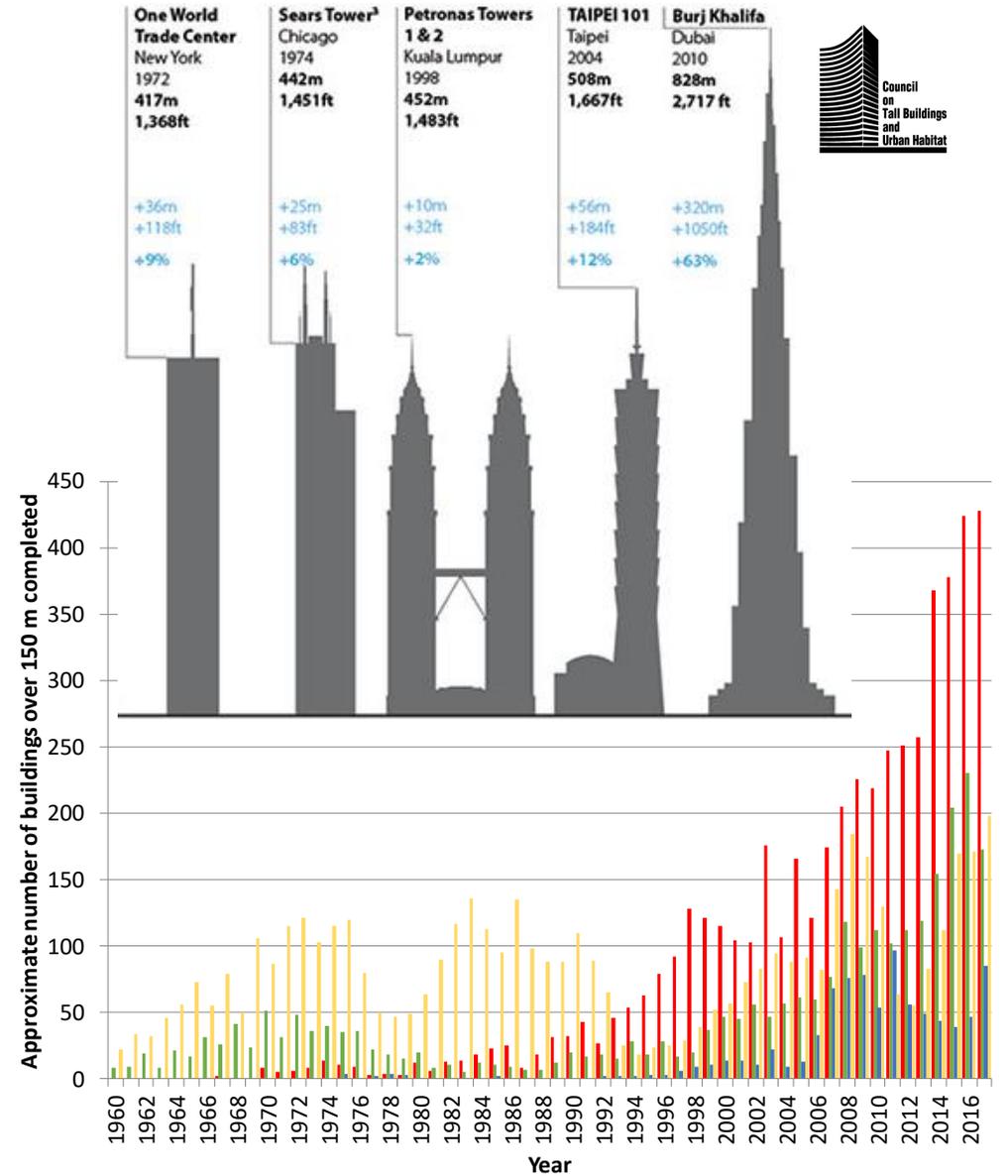
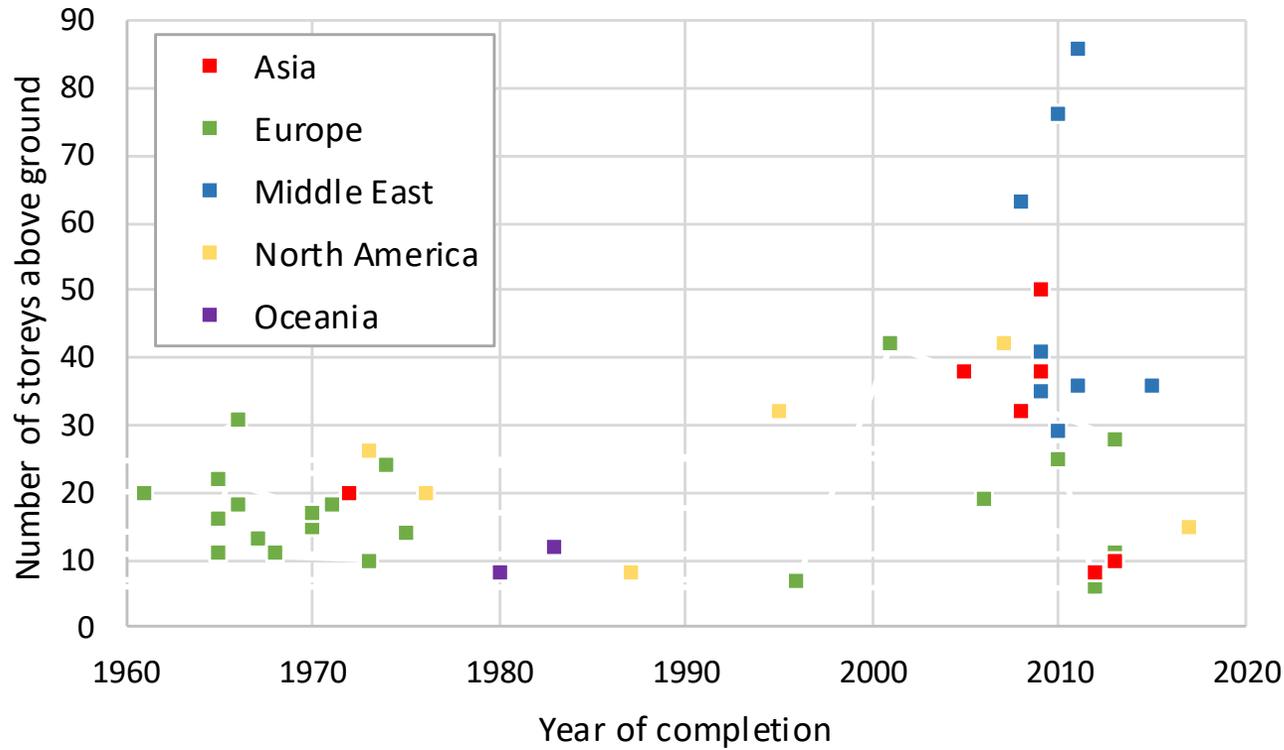


- Asia
- Europe
- Middle East
- North America
- Oceania

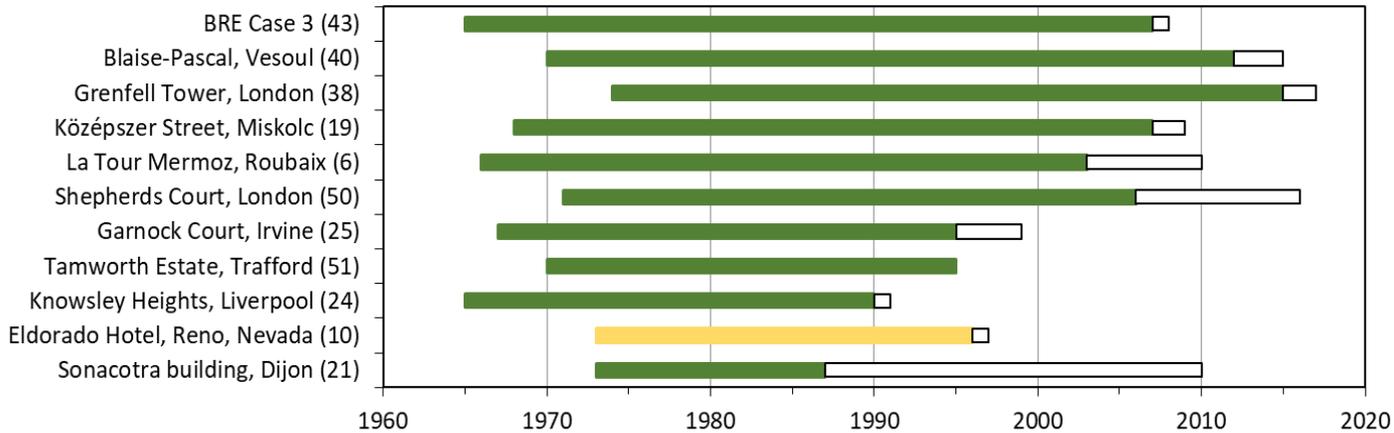


Category	Description	Number (%)
Residential	Apartments, flats	44 (76%)
Hotel	Hotel, motel	7 (12%)
Office	-	3 (5%)
Commercial	Retail, leisure	3 (5%)
Medical	Hospital, medical centre	1 (2%)

# COMPLETION

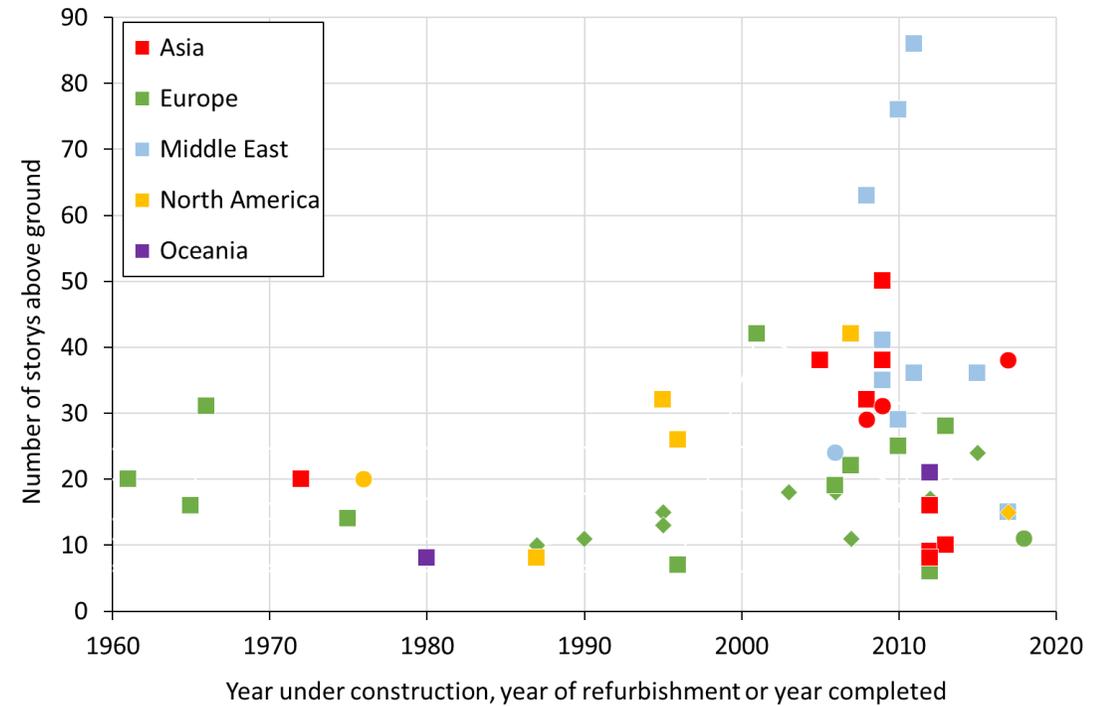


# REFURBISHMENT

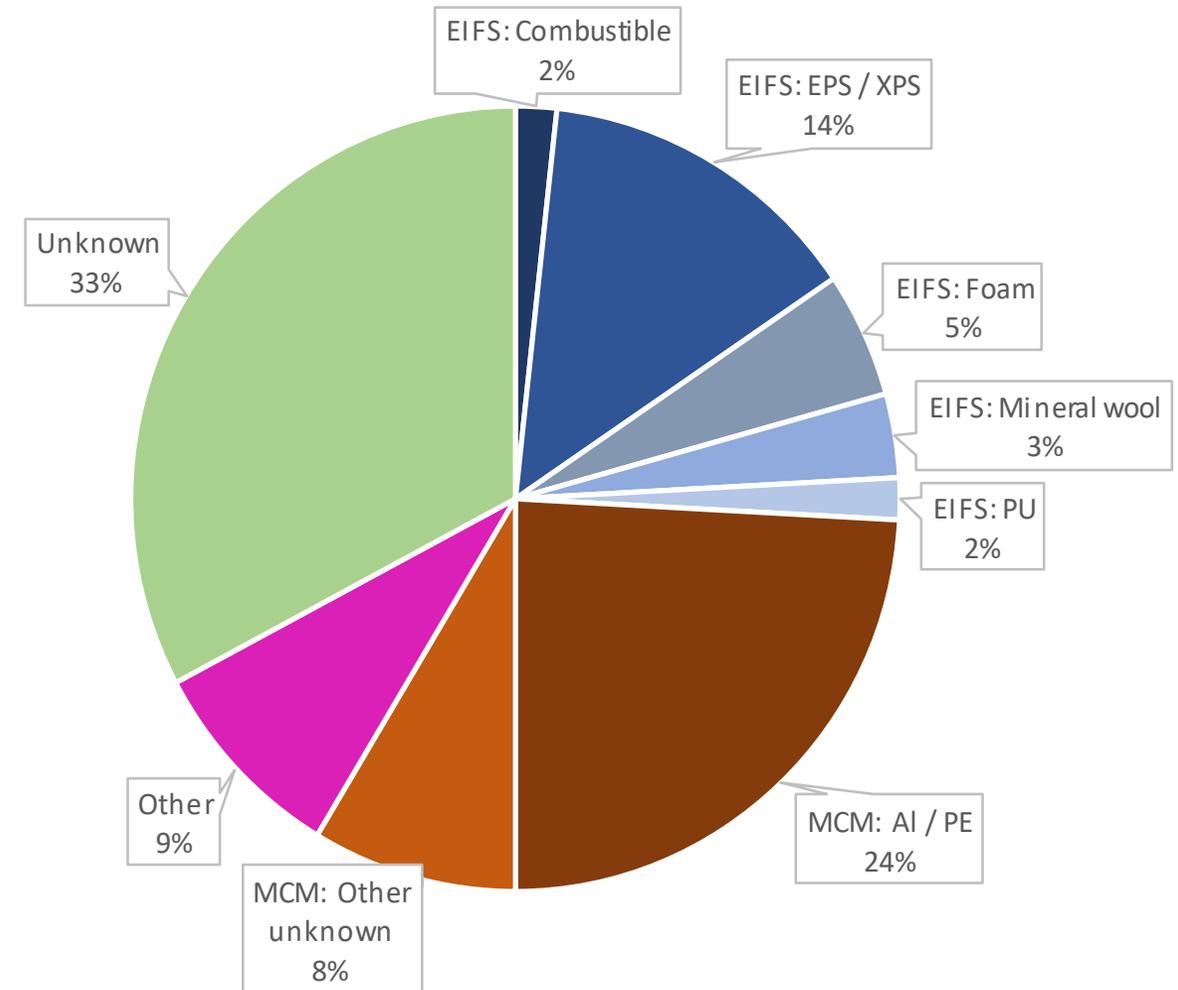
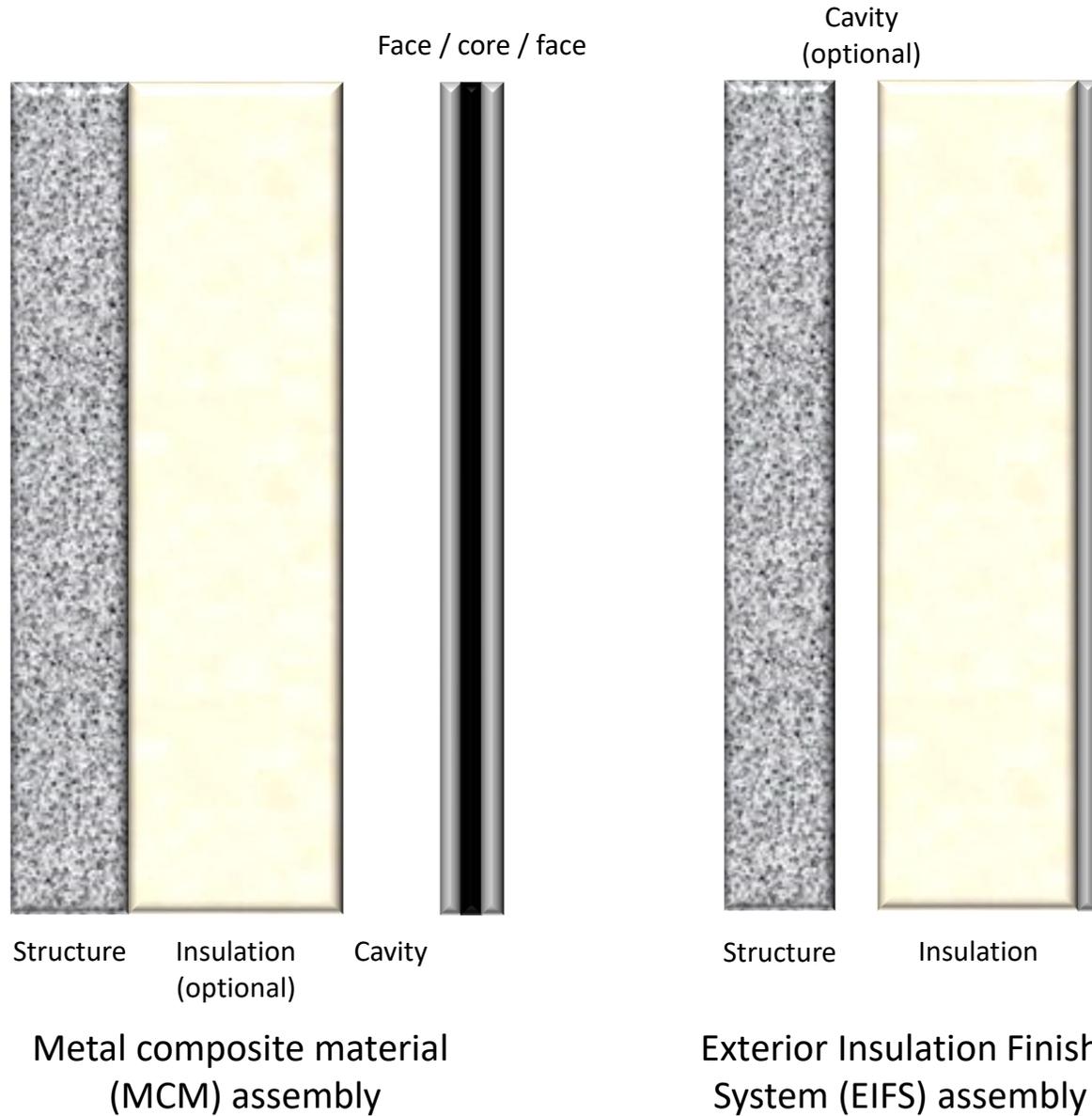


**Year constructed, refurbished and year of incident**

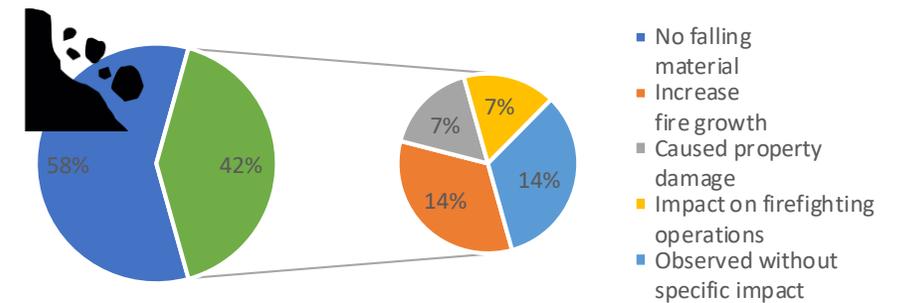
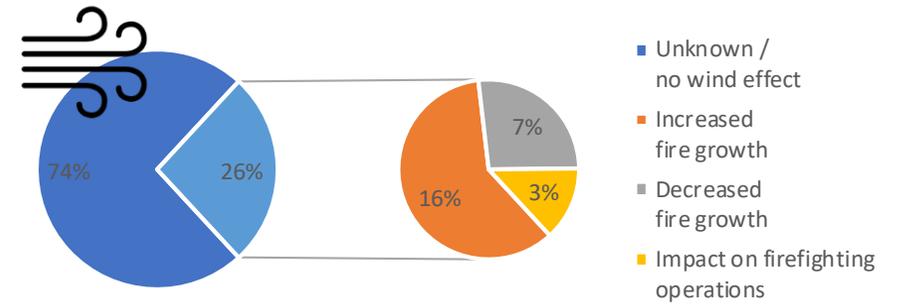
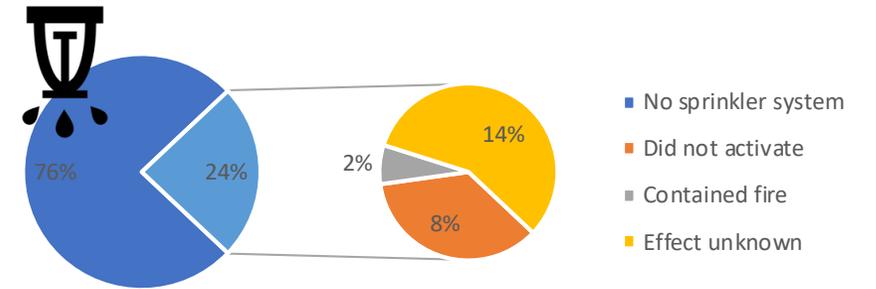
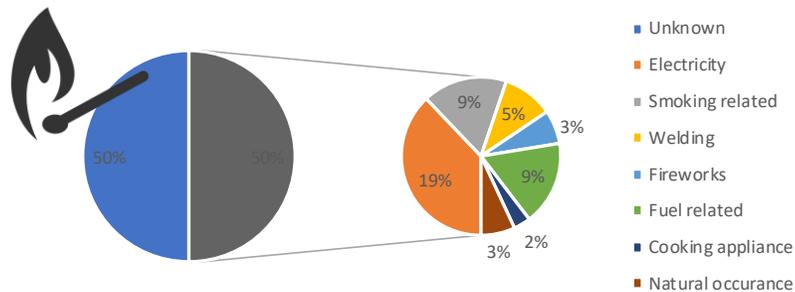
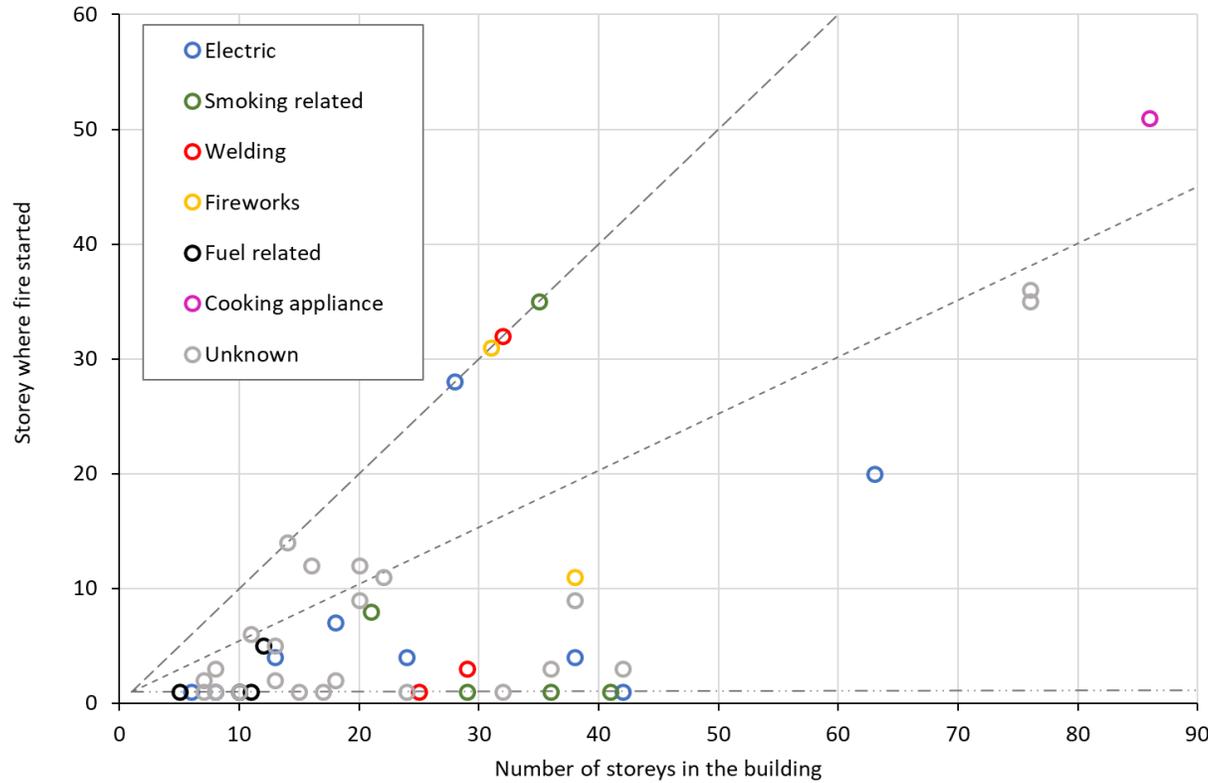
Excludes two incidents in Asia in which year built is unknown but fire occurred 2 yr after their refurbishment



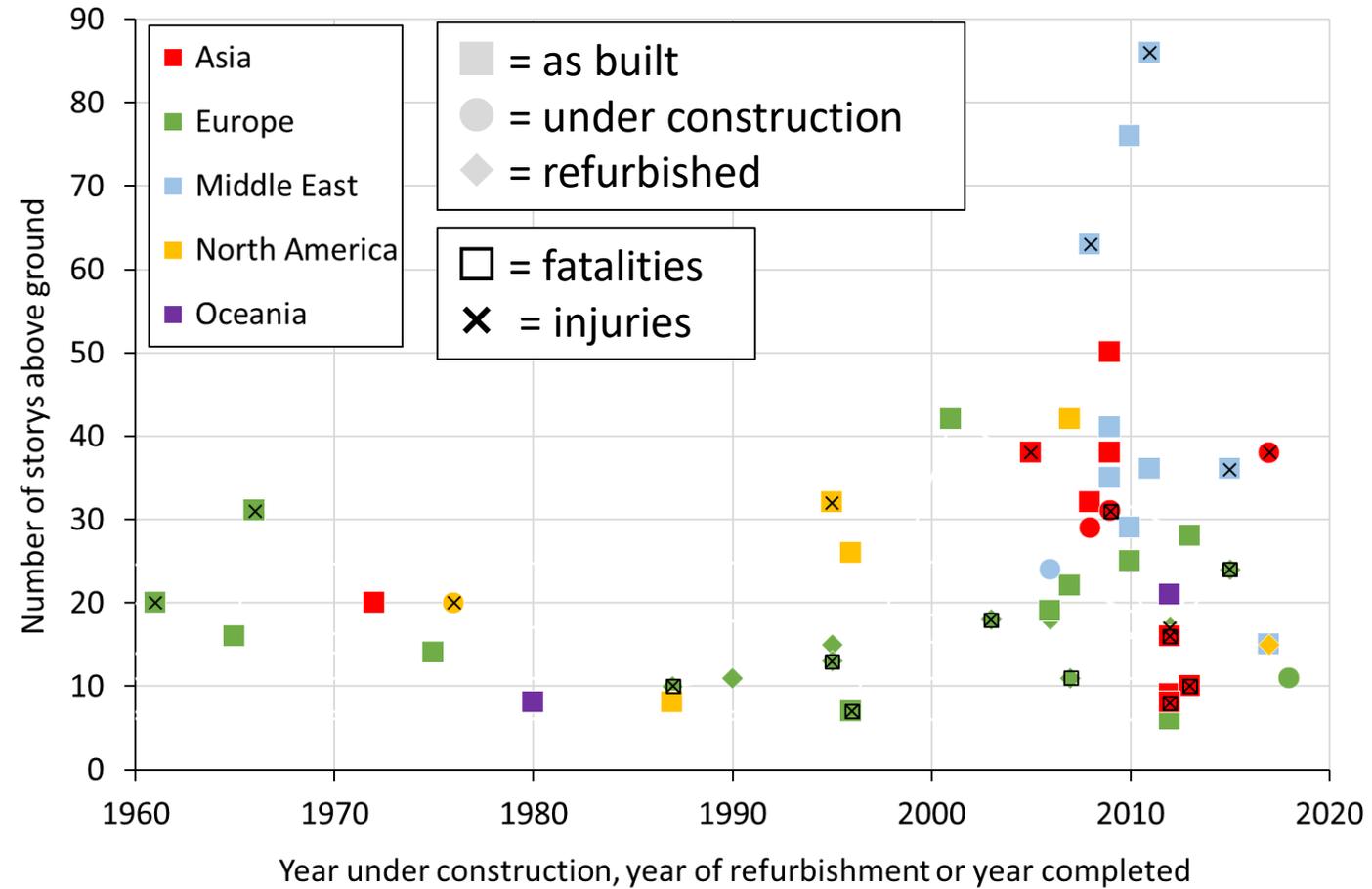
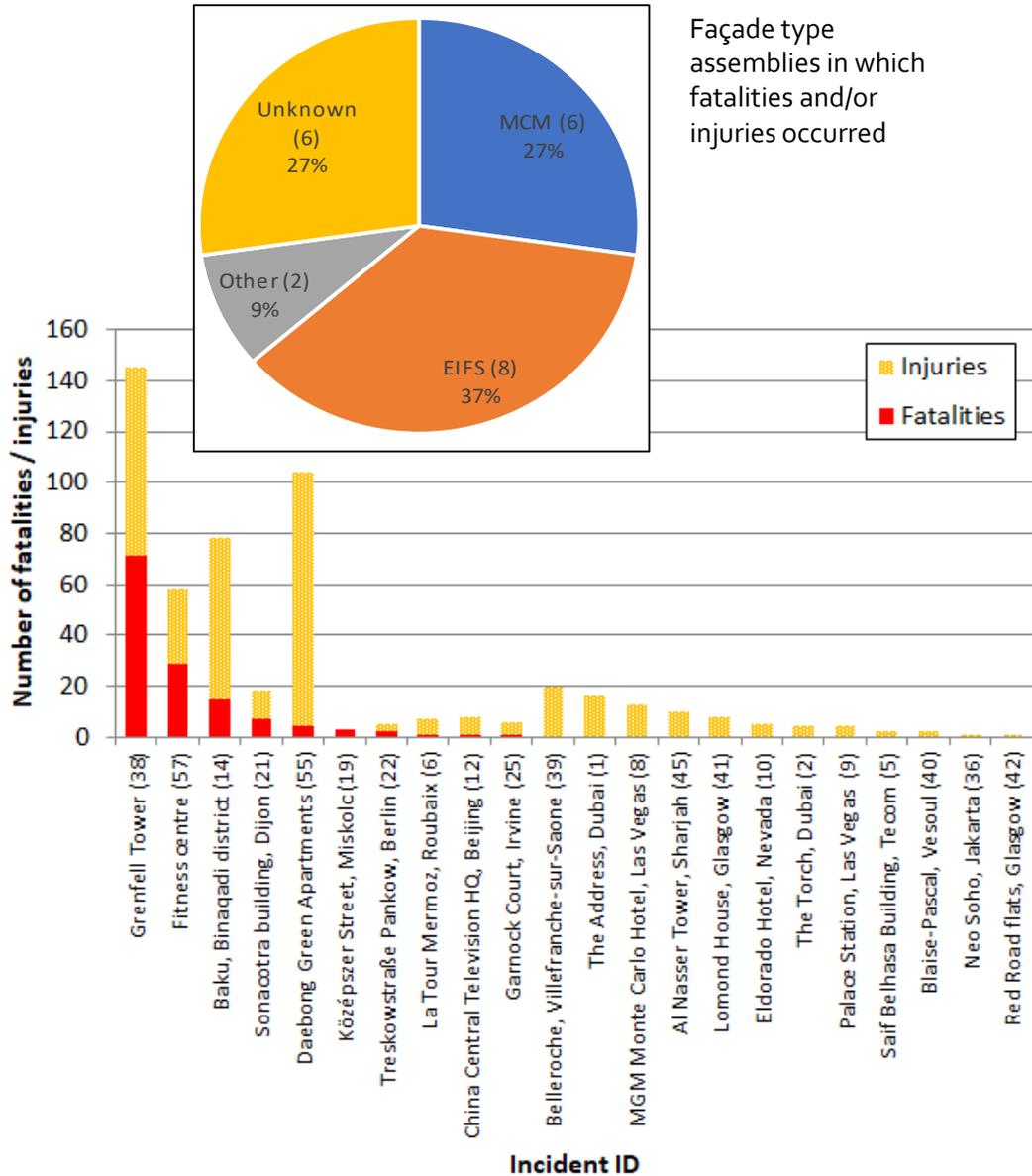
# FAÇADE TYPE



# FLOOR OF ORIGIN AND OTHER FACTORS



# FATALITIES AND INJURIES

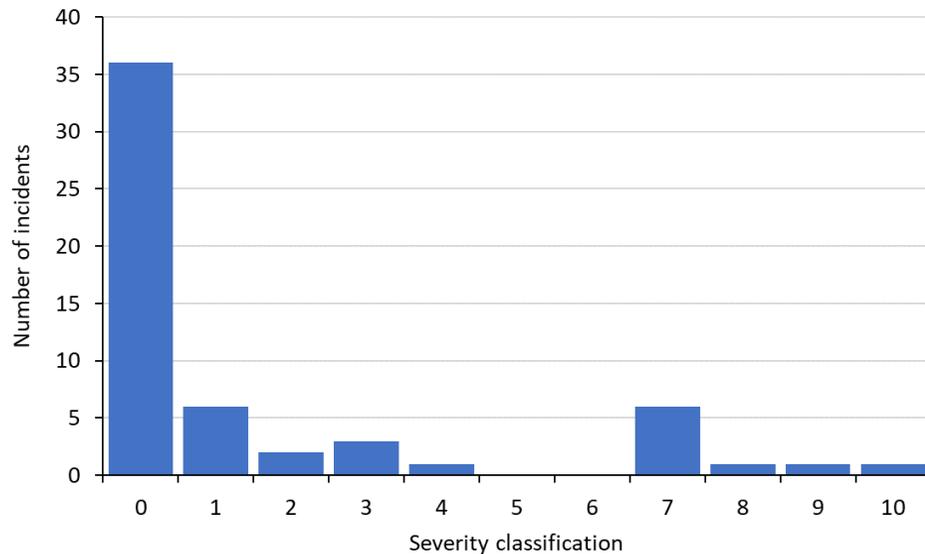


- Not all incidents resulted in significant outcomes
- Façade incidents in tall buildings constructed in North America proportionally less than the rest of the world
- Fatality incidents
  - 60% of incidents in older buildings later refurbished
  - Less than 32 storeys tall
  - EIFS-type assembly façade
- 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	$v_f = 0$	$1 \leq v_i < 5$
2	$v_f = 0$	$5 \leq v_i < 10$
3	$v_f = 0$	$10 \leq v_i < 20$
4	$v_f = 0$	$20 \leq v_i < 50$
5	$v_f = 0$	$50 \leq v_i$
6	$1 \leq v_f < 5$	<i>any</i>
7	$5 \leq v_f < 10$	<i>any</i>
8	$10 \leq v_f < 20$	<i>any</i>
9	$20 \leq v_f < 50$	<i>any</i>
10	$50 \leq v_f$	<i>any</i>



High-Level  
TensorFlow APIs

Estimators

Mid-Level  
TensorFlow APIs

Layers

Datasets

Metrics

Low-level  
TensorFlow APIs

Python

C++

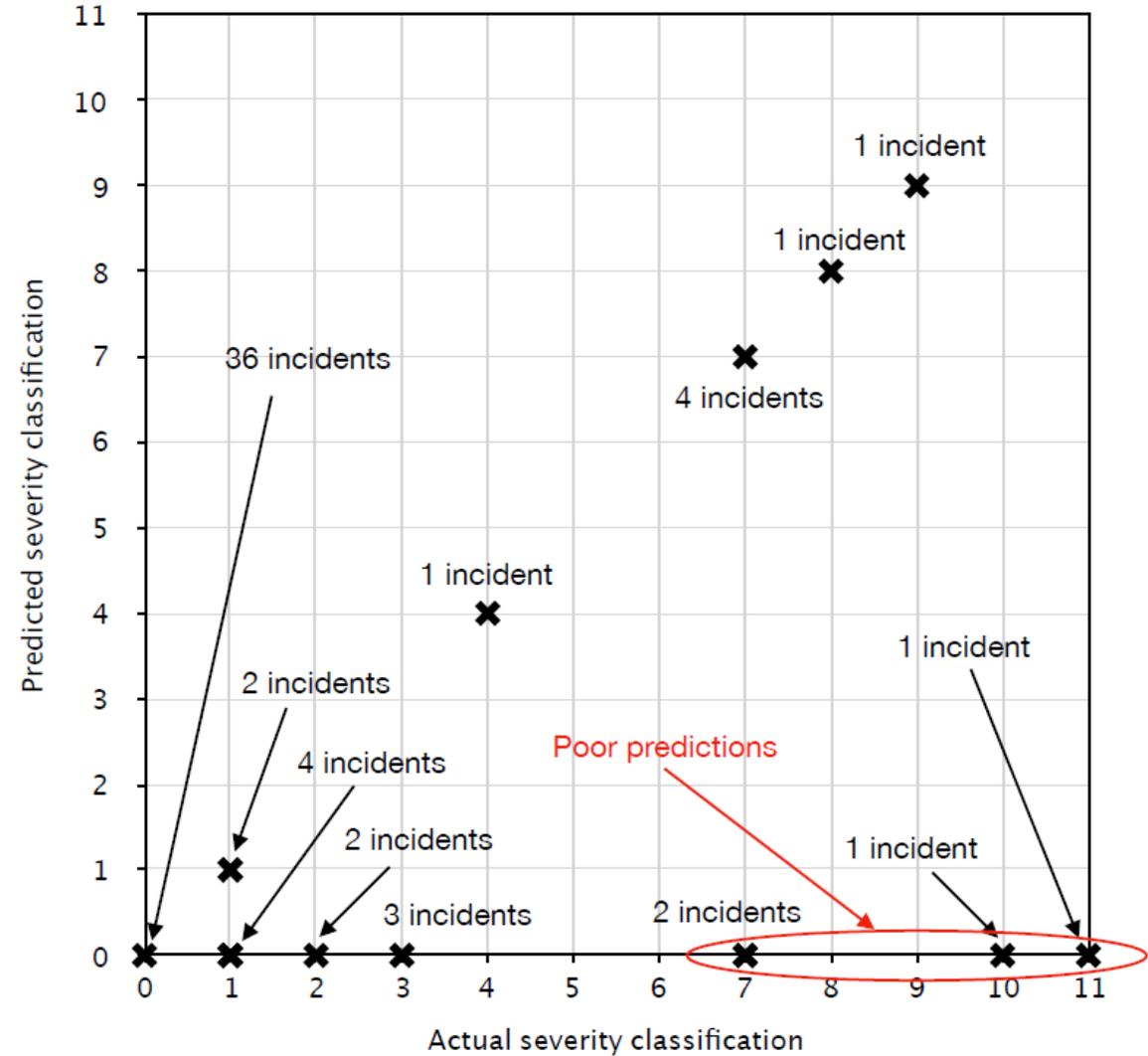
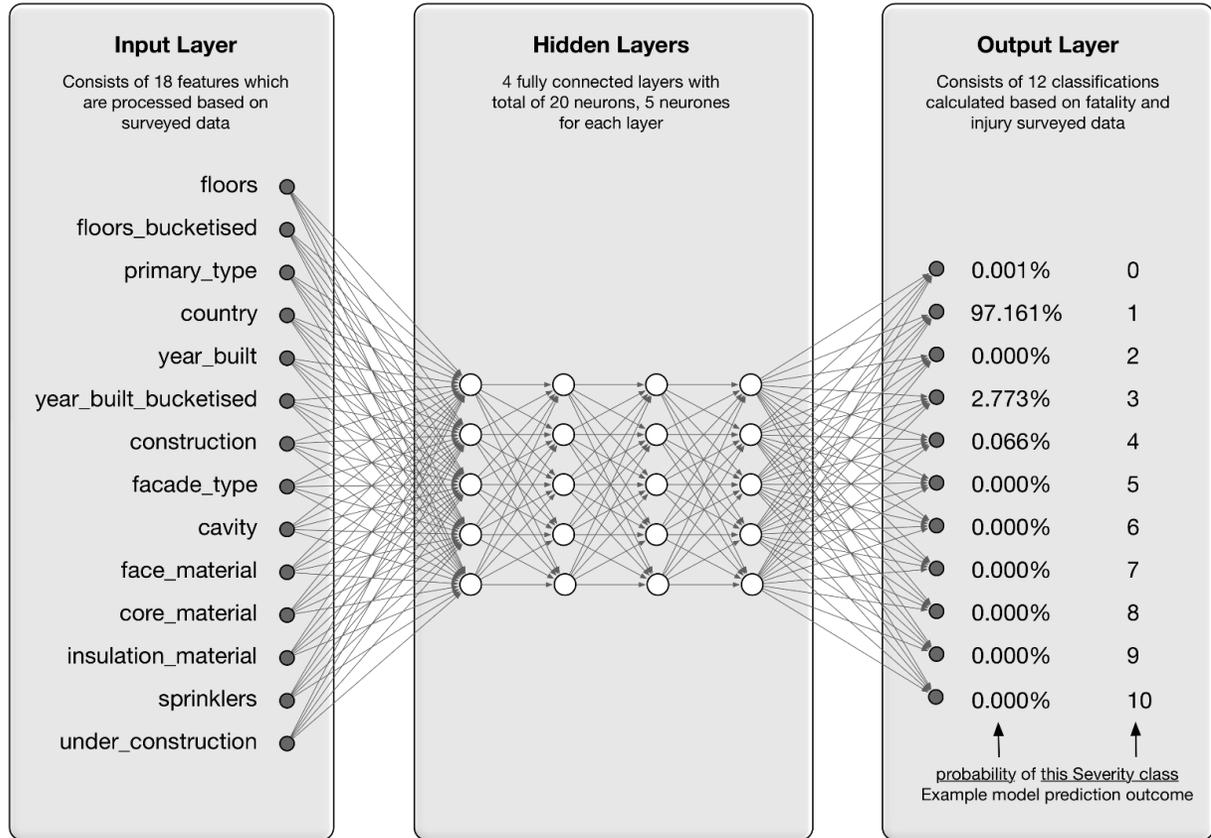
Java

Go

TensorFlow  
Kernel

TensorFlow Distributed Execution Engine

# PREDICTIVE 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](http://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>

The image shows a composite of two documents. The top document is a research paper titled "Façade Fire Incidents in Tall Buildings" from the CTBUH Journal, Issue II, 34–39, 2019. The authors listed are Michael Spearpoint, Ian Fu, and Kevin Frank. The abstract discusses the development of a database of façade fire incidents and the application of machine-learning to analyze them. The bottom document is a screenshot of the OFR Consultants website, featuring a navigation menu (ABOUT, PEOPLE, PROJECTS, RESEARCH, NEWS, CAREERS, CONTACT) and a section titled "Fire engineering is a rapidly evolving area of science, engineering, social and economic endeavour." It also includes a link to the "Tall building façade fire incident database" and a date stamp: "Singapore, 5 May 2017".

Singapore, 5 May 2017