

# **Green Fire Safety Issues**

### An Insurer's View



Not a Doctor (or a Professor)

Mark Redding 17<sup>th</sup> May 2023

### Insurance Lesson: Regulation versus Resilience





### Risk Selection – a commercial decision



Individual risk selection but based on a foundation of

History (1681) and Statistics (340 years) Personal experience (30+years)

If we don't fully understand it we are far less likely to insure it



### Do we remember the past?

In the 1800's sprinklers were brought in to protect wooden floors in mills

#### In the UK we seem to have forgotten again







### Do we learn from the past?

### Timber





### Polystyrene





The Insurer never forgets





### **Risk Selection**

#### What do we like?

- Separation
- Compartmentation
- Resilient materials
- Active fire protections

#### What do we need?

- Third party certification
- Reference standards (fire testing)
- Quality assurance
- Evidence and documentation





Not to design and build down to the "life safety before collapse" objective but rather insist upon resilience, beyond Building Regulations.

The Protection	RIBA Plan of Work 2020	Principles	Description	Phase		
Kanochillon WALKCALLIONAY	Work Stage 0	Α	Strategically Assess Resilience	the desired of Factor		
DDM01 A to 7 of Ferential Dringinles	Strategic Definition	в	Engage Insurers Early	1 Undertake Early Consultation		
BUMUI – A to Z of Essential Principles	Work Stage 1	С	Support Firefighting Operations			
for the protection of buildings		D	Maximise Non-Combustibility	2 Prevent Fire		
BY - D. M. H. H. H.	Briefing	E	Anticipate Arson Attempts	2 Prevent Fire Starting		
	Mark Stops 9	F	Monitor Building Services			
	Concept Design	G	Address Occupational Issues			
		н	Extend Structural Stability			
		1 B	Reduce Fire Severity			
Resilient Ruilo	inas	U	Control Compartment Cavities	3 Lower Property		
	in 195	ĸ	Separate External Openings	Loss		
and the second sec		L	Resist Fire Ingress			
the second lines with the second		м	Expect Adverse Weather	4 Enhance Design		
	Work Stage 4	N	Minimise Consequential Damage			
The second s	Technical Design	0	Facilitate Simple Repair			
		Р	Plan Salvage Operations			
A DEPART AND A DEPARTMENT		Q	Follow Identified Standards	Robustness		
	Work Stage 5	R	Provide Reliable Detection	5 Check		
	Manufacturing and	s	Complete Performance Tests			
	Construction	т	Procure Quality Materials	Construction		
The subject of the second states which is the	Work Stage 6	U	Require Competent Work	Achieved		
	Handover	v	Verify Recorded Information			
CELLE LE	Work Stage 7 Use	w	Manage Fire Safety			
		х	Action Statutory Assessments	6 Improve Facilities		
RISK INSIGHT, STRATEGY AND CONTROL AUTHORITY		Y	Keep Maintenance Commitments	Management		
REALING POLINICLE IN TREAL OLD LARVE WE RELEASE Vision 2 Politics 200		z	<b>Critically Review Experience</b>			



### Sustainability v Resilience Challenge



<u>versus</u>

- Resilience and Sustainability silos
- Pace of innovation: new materials and systems not adequately tested or understood



A **SAFR** (Sustainable And Fire Resilient) approach to building regulation and design is advocated

NFPA Fire Safety Challenges of 'Green' Buildings and Attributes October 2020



### Green 'Sustainable' Attributes

Material / System / Feature	Material / System / Feature	Material / System / Feature
Structural Materials and Systems	Exterior Materials and Systems	Alternative Energy Systems
- Lightweight engineered lumber	- Structural integrated panel (SIP)	- PV roof panels
- Lightweight concrete	- Exterior insulation & finish (EFIS)	- Oil-filled PV panels
- FRP elements	- Rigid foam insulation	- Wind turbines
- Plastic lumber	- Spray-applied foam insulation	- Hydrogen fuel cells
- Bio-polymer lumber	- Foil insulation systems	- Battery / energy storage systems
- Bamboo	- High-performance glazing	- Cogeneration systems
- Phase-change materials	- Low-emissivity & reflective coating	- Wood pellet systems
- Nano materials	- Double-skin façade	- Building integrated photocoltaics
- Vegetative roof systems	- Bamboo, other cellulosic	- Solar radiance concentration
- Extended solar roof panels	- Bio-polymers, FRPs	Façade Features
- Mass fimber (e.g., CLT)	- Vegetative roof systems	- Area of glazing
- Additive manufacturing / 3-D printing	- PVC rainwater catchment	- Area of combustible material

- Conventional timber
- Modern insulations
- Natural materials
- Building systems
- Electricity generation
- Alternative power sources

"Sustainability arguably does not embrace fire safety, in particular fire resiliency"

- Building integrated carbon capture	- Extent (area) of lawn
- Organic insolation	- Water catchment / features
- Composite window framing material	- Vegetation for shading
- Mass timber & timber façade systems	- Building orientation
- Ultra-High Performance Concrete	- Increased building density
- Additive manufacturing / 3-D printing	- Localized energy production
- Hongbereite	- Localized water treatment
Building Systems	- Localized waste treatment
- Natural ventilation	- Reduced water supply
- High volume low speed fans	- Hydrogen infrastructure
- Refrigerant materials	- Community charging stations
- Grey-water for suppression	- EES fuel loads / hazards
- Rain-water for suppression	- EV fuel load / bazards / chargers
- On-site water treatment	- Propane vehicle bazards
- On-site waste treatment	- Fuel all vehicle bazants
- On-site cogeneration	- Bicycle storage impact exits
- High reliance on natural lighting	- Reduced FD apparatus access
- Heat pumps	- Densification / fire spread
- Interior EV charger	- EV chargers on building exterior
	Building Integrated autons capture     Organic incudation     Composite window framing material     Mass timber 4 <sup>st</sup> timber façade systems     Ultra-Higb Performance Concrete     . Additive meanglochering / 3-D printing     . Hemperede Building Systems     Natural ventilation     High volume low speed fans     Refrigerant materials     Grey-water for suppression     Rain-water for suppression     On-site water treatment     On-site vaste treatment     On-site cogeneration     High reliance on natural lighting     Hut famps     Interior EV charger

#### NFPA Fire Safety Challenges of 'Green' Buildings and Attributes October 2020

- Low carbon materials
- Innovative materials
- Internet of Things
- · Living walls and roofs

NFPA Fire Safety Challenges of 'Green' Buildings and Attributes October 2020



## Green Utopia or Insurance Nightmare?

- CLT (wooden structure)
- Living roofs (combustible membranes / insulation and vegetation)
- Green walls (see above)
- Irrigation systems
- PV panels, inverters and batteries
- Electric charging points (inverters, batteries etc)
- Bike and scooter charging



#### How do we:

- Compartmentalise?
- Protect the structure?
- Manage the fire risk?
- Manage the occupants?
- Dry out the building?





- 1. Out of Scope
- 2. Materials
  - we understand
  - we don't understand
- 3. Building systems
- 4. Resource conservation and power generation
- 5. Technology





### 1. Out of Scope

- Waste recycling
- Waste to energy
- Biomass (anaerobic digestion)
- Hydrogen

#### ACCEPTABLE SUBJECT TO HIGH STANDARDS OF PROTECTION AND MANAGEMENT

Other alterr MANAGEN vehicles, ethanol vehicles and fuel cells

### WATCHING BRIEF ON HYDROGEN





### 2. Materials: testing challenges

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<ul> <li>A set of the set of</li></ul>	the left of the service						elements of Construction used to provide COMPARTMENTATION		. ,	resistance requirements for compartmentation given in the LPC Design Guide for Fire Protection of Buildings: 2000	External walls   Certain walls   Cavity barriers   Roofs where fire resistance is required (loadboaring and non-loadboaring)   Loadboaring compartment floors   Insulated panels
Characterization of the end of the station of the coefficiency	a manual and		and the second s								used for enclosing production and storage areas in food factories. The result of such tests is a Fire Rating (FR) which relates to inculation and integrity as specified in British
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### 2. Materials we understand - polystyrene

- Composite panels
- Roof insulation (inverted roofs)
- Green roofs



- Structural insulated panels (SIPs)
   Leigpzig Fire Tests
   MARGINALLY ACCEPTABLE IN <u>VERY</u> SPECIFIC CIRCUMSTANCES
- External insulation (ETICs)
- Insulated concrete formwork (ICF)



**SIPs** 



ICF



**ETICs** 



### 2. Materials - recycled

- Insulation e.g.
  - glass foam
  - plastics
  - textile fibres
- **Circular Steel**



### LIKELY TO BE ACCEPTABLE SUBJECT TO

- TRACEABILITY -
- TESTING \_
- **UKAS ACCREDITED TEST HOUSES** -
- DOCUMENTATION AND RECORDS -





### 2 Materials we (I) don't understand

• Low carbon emission concrete - fire safety challenges, in particular when it is very low porosity

•	Ultra-high pe	erformance concrete - very little testing under load; challenges						
	with spalling	MAY BE ACCEPTABLE SUBJECT TO						
•	Carbon-reinf performance	- SUITABLE APPLICATION	steel - fire					
•	Hempcrete - bearing	- IMPROVED INSURER UNDERSTANDING	be used as load-					
		- ACCREDITED TESTING						
•	Interactive p	- DOCUMENTATION AND RECORDS	anging material					

• Natural organic insulation (e.g. reeds, bagasse cattail, corn cob, cotton, date palm, durian, oil palm fiber, pineapple leaves, rice, sansevieria fiber, sunflower and straw)



#### Five different types of cladding

- Non-combustible board and metal stud detail changed during construction to bitumen impregnated softboard (Class F) on timber frame
- Rendered EPS, ACM; HPL; PIR insulation (Class E)





### 3. Building Systems - lightweight timber frames

- Resistance completely dependent on the correct application of fire-resistant materials
- Very heavy reliance on the quality of the workmanship
- Only required to resist a fire starting from the inside

Houses likely to be fine. There may be a degree of reticence in insuring large timber framed structures



of British Insuran re Charts Council n Fire Brigade on Legal Group Sastry Publications L

Tenth edition: August 2022 Incorporating Amendment 1: January 2022

🛞 RISCAuthority 🚽 💬 🖓 Statistics













### 3. Building Systems - Modular Construction

- Large variety of systems and material combinations
- Absence of large scale fire testing
- Treatment of voide is critical <u>MAY</u> BE ACCEPTABLE SUBJECT TO INSURER INVOLVEMENT IN DESIGN AND CONSTRUCTION
- Enhance

- Documentary and of one of the MATERIALS USED) workmanship standards
- If it is already built how can insurers make a valid judgement?





## 3. Building Systems – Cross Laminated Timber (CLT)

- Fire testing still relatively limited
- Ability to withstand burn-out unproven
- Structure continues to add to the fire load once the "test f
   <u>MAY</u> BE ACCEPTABLE SUBJECT TO INSURER INVOLVEMENT, AN APPROPRIATE LEVEL OF
- Reliant or MITIGATION AND LIMITATION OF VALUES AT RISK
- Exposed timber is aesthetically desired
- Partial replacement will be a challenge

"Massive timber building designs are being proposed of a form and at a construction scale that is running ahead of current scientific understanding, testing and research"



Another successful 120 min fire resistance test with cross-laminated timber! #CLT #FireSafety #ETH





#### Potential mitigations

Separation Compartmentation Active protection NC insulation NC facades Water management



### 3. Building Systems - Green Roofs

- Vegetation, roof insulation, membranes and geotextiles are made from combustible materials.
- Minimal fire testing on green roofs
- The risks can be managed by:



- prevent
   ACCEPTABILITY LIKELY TO BE DEPENDENT ON A
   PARTICULAR INSURER'S EXPERIENCE (AND PERCEPTION)
   AND PROPORTION OF ROOF COVERED
- creating ептестіve тіге preaks
- reducing the organic content of the growing medium
- increasing the non-combustible content of the growing medium



August 2015 Department for Communities and Local Streeman er



### 3. Green Walls

- Combustible materials; plastic membranes, irrigation systems, planting modules, and plant material.
- Fire risk may be influenced by weather changes and maintenance standards.



#### Fai ACCEPTABILITY LIKELY TO BE DEPENDENT ON A dar PARTICULAR INSURER'S EXPERIENCE (AND PERCEPTION)

Testing and certification methods for the approval of these cladding systems are considered inappropriate

to have been caused by the by-product of arc welding landing on the felt lining of the planting facade.





### Materials and Systems - Insurance summary

- Credible fire testing is critical
- Insurer reticence in the absence of detailed information and independent
   accreditation
- Defects liability insurance cover may be a challenge
- Property cover may be a challenge without full disclosure

A lack of historic data is a challenge difficult to surmount in the short term



### 4. Resources - Solar Photovoltaic (PV) Systems)

- What are they being installed on?
- What are they made of glass/glass or glass/foil
- Fire Service access



Compustible root insulation

- Isolatic ACCEPTABILITY SUBJECT TO INSTALLATION AND OPERATIONAL STANDARDS BEING ADHERED TO
- Location of inverters
- Cabling and fire separation
- Space between the roof and the panel: flue and debris
- Maintenance





106 point checklist

17 point checklist



# 4. Resources - Building Integrated Photovoltaics (BIPV)

- Enhanced inception hazard?
- External fire spread?
- Partial replacement
- Insurance placement (loss estimates)



#### IN THE WORDS OF DONALD RUMSFELD **"A KNOWN UNKNOWN"** INSURERS MIGHT ASSUME THE WORST



### 4. Resources – (small scale) battery charging

- Counterfeit equipment
- Faulty equipment
- Damaged equipment
- Overheating / over-cooling HOW DO WE MANAGE THE RESIDENTIAL RISK?
- Overcharging
- Over-discharging









### 4. Resources - vehicle charging

- Located outside
- Located inside
  - Access for fire fighting
  - Fire segregation and separation
  - Fire protections
  - Ventilatic.
- Spatial separation
- Protection against damage
- Signage
- Appropriate electrics and protection





### 4. Resources – commercial battery use / storage



#### EACH SITUATION JUDGED ON ITS MERITS







### 4. Resources - Energy Storage Systems

- Location
- Fire compartmentation
- Monitoring and BMS

Isolation

#### ACCEPTABLE IF GUIDANCE AND PROTECTION STANDARDS ADHERED TO

- Fire protections
- Explosion / pressure venting





**Need to Know Guide RE1** 

commercial lithium-ion

battery installations

Battery energy storage systems:



RISCAuthority

### 5. Technology

- Building Information Modelling (BIM)
- Building Management Systems (BMS)
- Internet of Things (IOT)



- HIGHLY BENEFICIAL WITH THE APPROPRIATE APPLICATION
- Water use monitoring

Plant mor







### In Summary

- Early insurer engagement (professional indemnity, construction, defects liability, building and contents)
- Fire safety needs to be considered early in the green design process (products, systems and fire service issues)
- Better provision of **information** better insurance terms
- Better granularity and comparability in **incident reporting**
- More robust and appropriate testing regimes (integration of green and firesafe agendas)
- More research is required on PV-systems, various façade systems, mass and high-rise wood construction, densification, energy storage systems, renovation practices and the use of recycled materials NFPA Fire Safety Challenges of 'Green' Buildings and Attributes October 2020
- Advancement of SAFR (Sustainable And Fire Resilient) approach to building regulation and design





