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Insurance challenges of massive timber construction
and a possible way forward

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Chairman of RISCAuthority

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RISCAuthority

About RISCAuthority

RISCAuthority is a research scheme administered by the Fire Protection Association and supported by many UK insurers which, through the operation of its technical working groups, seeks to support measures that improve and promote property and business resilience measures.

The Massive Timber Working group was formed to analyse, address, and communicate the insurance challenges that these newer proposed building methods give rise to with a view to assisting future dialogue in creating buildings that meet all needs of safety, carbon reduction, and resilience to the insured perils of fire, escape of water and flood.

Fire Protection Association

Introduction by the Insurance Industry

The purpose of this White Paper is to communicate the insurance challenges that are presented by massive timber construction, in particular the ambition to construct large multi-storey commercial, residential, and mixed-use buildings out of timber, and to suggest potential solutions where the provision of affordable insurance might be problematic.

Whilst the focus is on property protection, we do believe there to be a scale of build where occupants become so distant from a place of safety, and remote from attending help, that assurance of life-safety may be problematic where the main structure contains combustible materials.

Losses from fire and water damage, which includes flood, water ingress, sprinkler leakage, and escape of water (EoW), are addressed with the insurance impact components of material damage (MD) and business interruption (BI) considered.

It is the desire of the RISCAuthority membership that this White Paper and the associated 'Insurer Underwriting Relevant Building Factors' matrix (see associated spreadsheet) may be used as a foundation for collaboration and encourage healthy dialogue between property insurers and all stakeholders involved in timber construction projects. Through early communication and collaboration, we believe that the goals for reducing carbon emissions, creating more sustainable communities, and assuring fire safe buildings and communities, can co-exist in a way that can leverage workable opportunities for the enhancement of property protection and the net-zero agenda. At this moment in time the hybridisation of traditional and modern building methods is considered to offer the best route forward that might satisfy all positions. **In the longer term, there is a substantial role for government to play in developing Building Regulations that better appreciate the challenges, if more complex construction types are to be embraced.**

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The Insurance Challenges of Massive Timber Construction

Fire Safety Challenges

The UK's Building Regulations are responsible for ensuring life-safety from fire in the home and workplace. Their single legal purpose for the protection of buildings from fire is to ensure the structural stability of the building for a sufficient period of time to support complete occupant evacuation and the fire service intervention required to facilitate this. **The entire framework for the specification of construction materials, methods and safety systems is therefore time-based and, after that time has elapsed, there is no further expectation of the building to resist fire, or regulatory interest in how the event may conclude.**

The provision of buildings insurance demands an analysis of how the building might perform against fire and includes the duration beyond safe evacuation to full material and function recovery. An assessment of the likely financial impact in the form of a loss estimate is an integral part of this. Many important and established approaches are used that include or discount the effectiveness of different protection measures including Estimated Maximum Loss (EML) and the less optimistic Maximum Foreseeable loss (MFL).

Given the above, it is easy to see that, for some (predominantly combustible) construction methods, compliance with building regulations alone might have little relevance or impact to reduce a loss estimate for property damage and business interruption from 100% which will impact an insurers' appetite and available capacity to insure the building. Provision of insurance of 100% EML situations in the industrial sector is not uncommon, but generally requires the application of specialist insurance tools, strict specification of protection systems, conditions of contract, continuous control and monitoring, and premium levels unfamiliar to the office or residential sectors. For multi-storey buildings of conventional construction (having solid non-combustible (NC) compartment boundaries), it is more usual to conclude that, in the event of a fire, the EML will comprise i.e. the fire floor, the number of floors above having fire and smoke damage, and a number of floors below having water damage, which might represent a small percentage of the overall building size and value.

Confidence to make such an assessment is derived from knowledge of the fire performance of the building materials used, the construction method, survey information, and previous loss experience. Introducing sizeable non-industrial buildings where the EML is 100% provides insurers with many new challenges including their own reinsurance protection, pricing, claims volatility and risk management. Insurance is not a right or legal requirement, and like any business insurers will seek to place their available capacity where economic pricing can be achieved for customer and insurer, and manage exposures accordingly: in the current situation, for many, better opportunities for capacity investment exist in areas other than massive timber buildings.

> "For some (predominantly combustible) construction methods, compliance with building regulations alone might have little relevance to a building's insurability"

Water Exposure Challenges

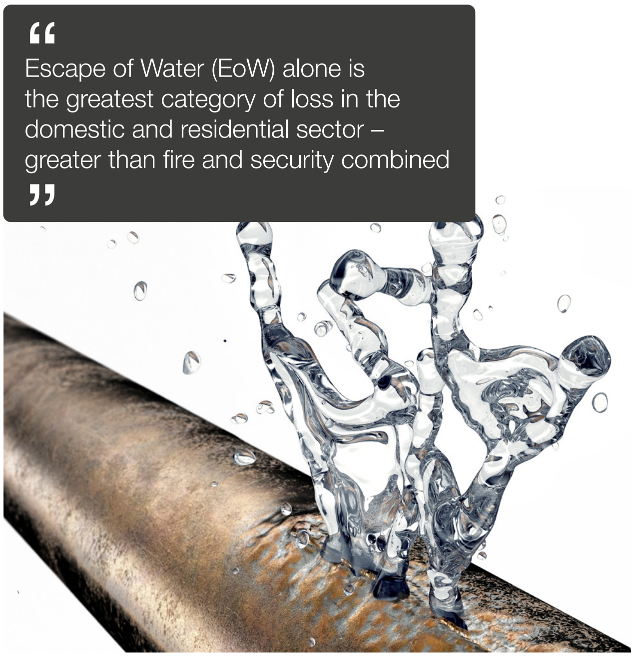
For many reasons water exposure events are prolific in number, take many forms, and incur great cumulative financial loss. Escape of Water (EoW) alone is the greatest category of loss in the domestic and residential sector – greater than fire and security combined. Factors dominant to the scale of an individual loss includes the multi-storey situation, and the presence of materials susceptible to water damage. Currently it is rare for the structural fabric of the building to be included in this consideration but the prospect of glued composite timber materials in panelised or post and beam form is of concern.

Water exposures may result from flood, weather ingress, short term failure of water bearing systems, long-term low-rate exposures, pooling, and during fire-fighting activities. All have the ability to impact the structural integrity, function, and aesthetics of timber through primary (glue denaturing, delamination, swelling, staining) and secondary (rot, moulds, fungus) mechanisms. The impact of water exposure events is normally assessed as a function of severity and likelihood, rather than as a quantified loss-estimate.

What Has Changed?

The UK's Building Regulations have had no property protection requirement for many years, yet we have grown used to buildings performing well under fire as high-performing materials were often specified as the means of satisfying the life-safety requirement. **The 'resilience' associated with more traditional non-combustible methods of construction was therefore never a requirement but an incidental by-product of the life-safety solution.** It is also worth noting that many materials that perform well in fire are also often more tolerant of water exposure, such as concrete.

In 2000 the Regulations were changed to allow the engineering of life-safety solutions so long as equivalency in performance with prescriptive methods could be assured. This change to a fire-engineered approach is now the dominant vehicle for the use of combustible materials in construction and the incidental resilience benefits associated with the materials that might be replaced can be lost. It is important to stress that Fire Engineering is a kit-of-parts that can be used to achieve any ambition set, **the problem is that the low bar of 'evacuation before collapse' can lead to designs with little intrinsic resilience yet are legal and compliant** – and to seek any greater level of protection is entirely voluntary and probably more costly so is seldom, if ever, done.



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> The presence of combustible voids creates one of the greatest challenges for building safety and the insurer

The introduction of combustible materials into the structure, insulation, and cladding of buildings impacts not only the risks associated with material embodied energy and availability, but also key construction design features. EML estimation for fire looks predominantly at the means and likelihood of fire spread through, and over the building. For any building type the quality of fire compartmentation of the occupied spaces (including linings, fire doors, and other penetrations) is examined as the principle internal route for spread, and the construction and material properties of the external wall coverings and cladding (including green roofs and walls) are examined for the role that they might play in the mass communication of fire externally.

A significant change that the use of modern building methods employing combustible materials has introduced is a third dominant potential route for fire spread in combustible voids between the occupied compartments that may run both laterally and vertically throughout the building, even connecting with the external envelope. In more traditional building methods, the occupied fire compartments were typically contiguous – separated by a solid (block) wall made of a single material that met the fire performance requirements and introduced no voids. In many MMC structures the occupied compartments can be essentially suspended within a lattice of combustible voids whose only defence against fire ingress are layers of plasterboard and the provision of cavity barriers.

The presence of combustible voids creates one of the greatest challenges for building safety and the insurer, notably:

- There is no requirement in the UK Building Regulations to prevent fire spread in voids aside from the provision of delaying devices such as cavity barriers (International Building Regulations (US) have much more stringent controls that will stop a fire)
- Plasterboard, often the primary material defining the separation of fire compartment and combustible void, is an easily penetrated material through deliberate (DIY) and accidental (damage and wear and tear) activities.
- Fires will spread into combustible voids once the period of resisting effectiveness of protective coverings (such as plasterboard) is surpassed
- Voids may contain combustible materials
- Once in the voids fires may develop and spread out of reach of normal firefighting control options
- Fire Service doctrine and equipment can have little impact against this scenario
- It is very difficult to determine what will ultimately put the fire out, especially when considering high-rise scenarios.

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In any building's life a number of different insurance phases come in to play: Construction, Latent Defects, and Property. Again, consideration of massive timber buildings has the potential to radically alter not only the scale of loss in each category, but also relevance to the phase of insurance:

- **Construction:**
  As demonstrated by the history of light-timber framing construction fires, timber buildings remain immensely vulnerable to fire until boarded out in fire resisting materials. Timber construction site fires are characterised by their scale, rate of spread, and extent of loss. In addition, a timber building under construction is similarly vulnerable to weather related and escape of water incidents.
- **Latent Defects:**
  In masonry and steel structures latent defect insurance is intended to cover normal use. Accidental damage is generally excluded, and as such disproportionate collapse, which might result from a gas explosion, has tended not to be a significant concern for latent defects insurance. The envisaged creation of massive timber structures however presents a new set of potential risks for disproportionate collapse which will almost certainly fall within the compass of latent defects cover. Scenarios in which collapse might result from weakening due to slower events such as i.e. material aging, water deterioration, rot, fungus, and infestation, suggests that consideration must be broadened to include the thesis that catastrophic failure might feasibly be caused by a combination of systemic weaknesses and small localised failures leading to a catastrophic general failure.
- **Property:**
  The potential for enhanced property damage from fire and water exposure events is covered elsewhere but a significant issue remains around how disproportionate collapse might manifest. Concrete and steel structures generally collapse to their footprint area but there is limited knowledge as to whether there is potential for massive timber structures to 'topple'. Poor collapse behaviour could have significant consequence for scale of loss and life safety. A temperature rise of just 100°C can reduce the load bearing capability of wood by as much as 50%.

In summary, a move from predominantly non-combustible building methods to one that employs mainly combustible materials changes the overall susceptibility of the building to potential fire initiating events, construction imperfection, impact of through-life wear and tear. It should not be a surprise that insurance models, and insurance customer expectations developed around more solid walled, non-combustible construction types, may need to alter quite radically to address these very substantial changes in construction methods and material use.

Insurance Information Requirements

A golden rule of the provision of insurance is that 'you can't insure what you can't quantify'. In respect of massive timber construction, a fuller explanation would require the ability to:

- Assess the building (including the structure, materials, contents, durability, purpose, management, workmanship)
- Assess Estimated Maximum Loss (EML) or Maximum Foreseeable Loss (MFL) and other values for all relevant perils (Fire, Flood, Escape of Water etc.)
- Understand statistical likelihood of fires / water damage events taking place
- Understand statistical likelihood and extent of damage (material damage & business interruption)
- Understand repairability, occupant displacement, costs and timescales
- Assign effective physical and managerial risk control measures where issues arise
- Manage risks using insurance tools where physical and managerial risk control methods cannot be deployed (pricing, deductibles, reinsurance, risk sharing etc.)

Only with this information can the insurer understand whether the building is one they wish to insure at a premium that is tolerable to the client; that makes a sound business case; and does not expose the company to great financial risk. **It is the general experience of insurers that 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 which therefore cannot fulfil the above requirements**. Insurance is not there to fund mistakes on the path to finding how things should have been in the first place – that is the role of research prior to deployment.

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Insurer Essential Principles for Loss Mitigation

Through the auspices of RISCAuthority, and previous incarnations of organisations that research and develop risk control guidance on behalf of insurers, a suite of 'Essential Principles' are maintained. Designed to promote best practice and act as a starting point for all discussions on risk mitigation, these principles can be deeply embedded in insurance processes. Some more than others come to the fore in discussions around the insurability of building methods such as massive timber. To gain an insight into the insurer perspective on massive timber construction it is important to have an awareness of these principles. Included for completeness are the pertinent essential principles for:

- Resilience
- Fire Protection
- Escape of Water Protection
- Flood

Resilience Essentials

(Ref: RISCAuthority document '*Fire Engineering Guide for Property Protection and Business Resilience 2020*)

Resilience is a discreet discipline that seeks to ensure the continuity of service that a property provides, and of the business that might be conducted within it or the service provided from it. Whilst there can be commonality with many risk control measures, resilience considerations and solutions can have a much greater reach and be assured through completely alternative methods. That said, every opportunity to create the most resilient building that will support the continuity of activities conducted within it, and improve recoverability of those activities following disaster, should be taken at the design stage.

Resilience may be broken down into the three principle categories of:

- ***Susceptibility*** – Avoid fire / water damage, being an issue i.e. build out of materials that cannot support combustion / are not ignitable / are not affected by water, do not build on flood plains, reduced dependency on human actions and interventions etc.
- ***Vulnerability*** – Inbuilt features to reduce the extent of damage following a fire / water damage event i.e. compartmentation and sprinkler protection / waterproofing and safe-passage water drainage systems, installation of leak detection systems, locating key systems above maximum flood level.
- ***Recoverability*** – Systems that support the rapid recovery to full capability following fire / water damage events i.e. business continuity planning

In terms of building resilience and timber construction methods, the greatest challenges are around the susceptibility of the materials to ignition and burning, and water damage. Without the ability to select higher performing materials options become limited to improving resilience through management processes and the deployment of systems to reduce vulnerability and improve recoverability once an event takes place – both lesser reliability options.

Essential Principles of Fire Protection

(Ref: Insurer augment ADB, Essential Principles)

There are 26 essential principles of fire protection. In respect of massive timber buildings, the challenges against these principles include:

- Susceptibility of materials and methods to fire (Principle A - Strategically assess resilience)
- Combustible construction (Principle D – Maximise non-combustibility)
- Effectiveness of support from fire service (Principle C – Support firefighting operations) – note that the specification of sprinkler systems (Principle I – Reduce fire severity), a 'suppression system' still demands intervention for complete extinguishment of the fire
- Suitable standards for sprinkler installation in these types of structure – i.e. bare wood surfaces, fire stopping methods of sprinkler ranges through combustible walls (Principles I – Reduce fire severity and Q – Follow identified standards)
- Presence of combustible voids (Principle J – Control compartment cavities)
- Minimisation of consequential damage from fire, smoke and water damage (Principle N – Minimise consequential damage)
- An understanding of repairability (Principle O – Facilitate simple repair)
- A certification and compliance regime (Principles Q – follow identified standards, S – Complete performance tests, T – Procure quality materials, and U – Require competent work)
- An understanding of what specific action will ultimately end the fire event (All principles)

Insurers will expect the highest levels of management, control, procedures and protection to be implemented throughout the construction phase and beyond.

Essential Principles of Escape of Water Prevention

(Ref: RISCAuthority document '*Insurer Requirements for enhanced escape of water protection based on Approved Document G*')

The 12 essential principles for EoW mitigation are provided within an augmented version of Approved Document G "*Sanitation, hot water, water efficiency*" that includes consideration of suppression systems (sprinklers and Watermist systems) as a significant additional water distribution network.

Principle 1 Follow identified standards
The systems shall be designed, installed and commissioned in accordance with the prevailing Regulations and Standards.

Principle 2 Require Competent Work
The designer, installer and commissioner shall be suitably qualified and experienced, belonging to a relevant professional body.

Principle 3 Procure Quality Materials
Only certified products shall be used to build the system.

Principle 4 Risk assess for EoW loss
The design, installation and commissioning of the system shall be risk assessed.

Principle 5 Employ detection and Minimise Consequential Damage
The system shall be designed to reduce the likelihood and consequence of an escape of water incident.

Principle 6 Facilitate Simple Repair & Maintenance
The system shall be designed for ease of maintenance.

Principle 7 Isolate when not in use (Construction)
During installation, the system shall be isolated when unoccupied.

Principle 8 Isolate when not in use (Occupation)
When in-service, it shall be possible to readily isolate the system, by means that are readily identifiable.

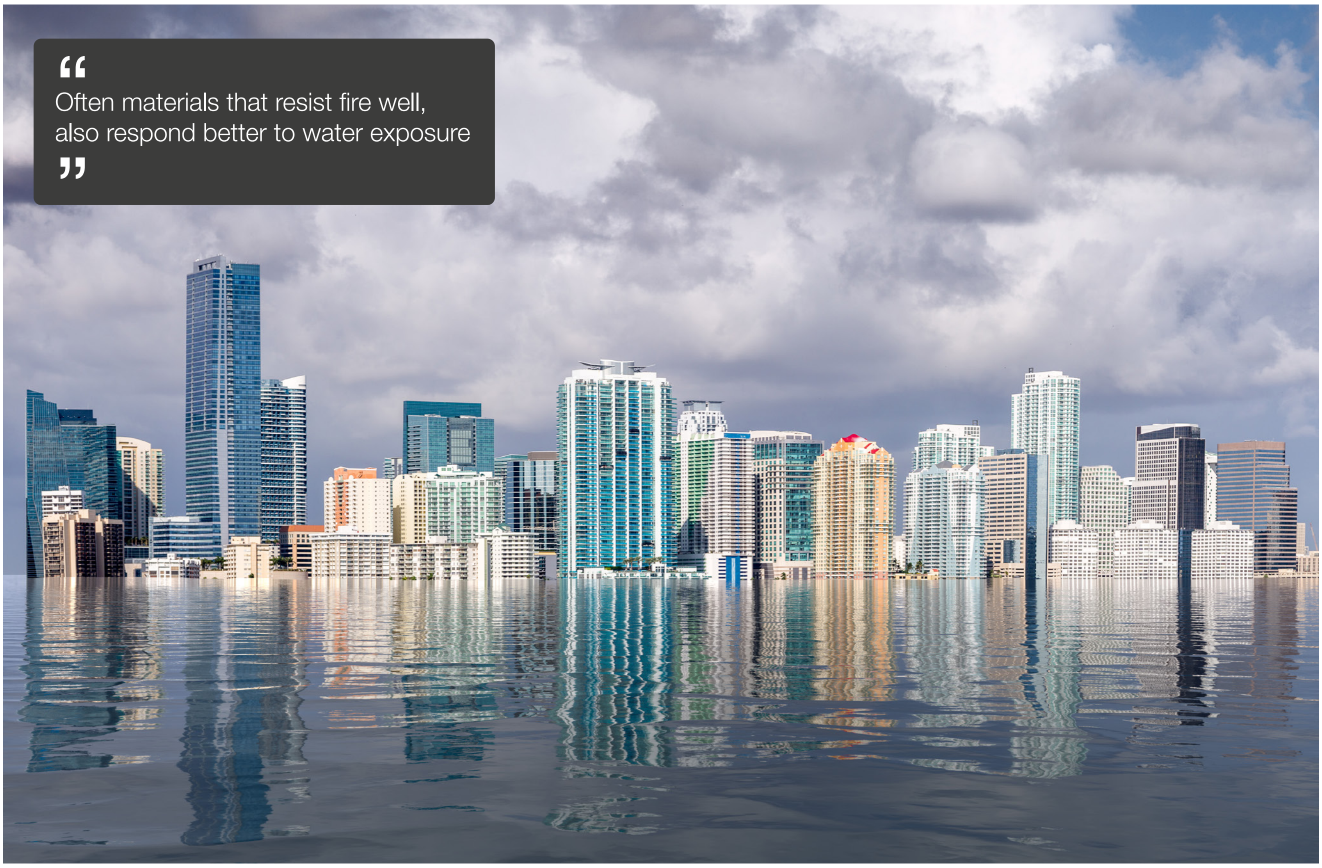
Principle 9 Limit system pressures
The system pressure shall be limited to 3.0-bar.

Principle 10 Pressure test systems
The system shall be pressure tested in accordance with the prevailing Regulations and Standards and a permanent record of those tests made.

Principle 11 Limit system temperatures
The system outlet temperatures shall be limited to 48°C.

Principle 12 Record all information
All documents pertaining to the design, installation and commissioning of the system shall be made permanent and retained.

All principles are considered pertinent to the design of massive timber structures with an emphasis on prevention (Principles 1-4, and 7-11), and the use of fail-to-safe equipment, ease of system isolation, design-for-damage-limitation (Principle 5) and repairability (Principle 6).



Essential Principles of Flood Protection

The basic essential principles for flood protection include:

Principle 1 Do not build on flood plains
Consideration shall be given to all forms of flooding, including risk from rivers and seas, and surface water runoff.

Principle 2 Determine the characteristics of a possible flood event and plan for worst case e.g. the type and source of flooding, frequency, depth, velocity, and speed of onset
Arrange all building contents to minimise the extent of disruption, and cost and time of recovery. Mitigating the potential impacts of flooding through design and flood resilient and resistant construction materials

Principle 3 Raise building and plant above maximum likely immersion depth
Where possible inbuild resilient features such as office-over-car parks designed.

Principle 4 Invest in property level protection
Provide means for preventing water ingress and isolation of sewage sources. Provide adequate flood risk management infrastructure which will be maintained for the lifetime of the building. Reference CIRIA guide Code of practice for property flood resilience (C790)

Principle 5 Have a comprehensive flood plan / business continuity plan and any community resilience groups
Have a comprehensive response that is executable on a timescale coherent with Met Office warnings, that is both tested and regularly rehearsed. Include vehicle relocation to higher ground.

Principle 6 Build back more resilient
Floods are repeating events, and every opportunity must be taken to replace what is lost with a more resilient alternative.

Principle 7 Plan for loss of utilities
In the event of flood power and clean water supplies may be lost. The provision of generation and stored water may be prudent.

Principle 8 Plan for denial of access
Plan alternative accommodation for when property may not be accessible for a considerable period of time.

Principle 9 Have a salvage plan / engage with fire service
In cooperation with the local fire service, identify critical infrastructure and have a rehearsed salvage plan for its protection or removal.

In respect of massive timber buildings Principles 2, 3, and 7 are most pertinent and would best be satisfied by the building of the 1st floor in concrete or steel and locating key plant and auxiliary emergency units on floors above the maximum immersion depth.

Insurance Relevant Design Features

In reviewing the key building parameters that might impact upon the insurability of any building we have determined a minimal list of 26 relevant features divided into 6 principle categories. These 26 features seek to elicit details that consider the potential for internal and external fire spread; additional factors that may promote or reduce impact, and the potential scale of the overall loss. The relevance of each feature in establishing overall building insurability may be heavily influenced by other features selected. Every insurer will have their own view of the importance of each feature and the trust they place in the correct function of all active, passive, and management controls when required. This list has been used to assess where insurability thresholds might manifest, and the reasons behind them, but are equally valuable to the determination of acceptable hybridisation of construction methods, that might satisfy both carbon reduction initiatives, and insurance challenges.

The 6 major categories are:

Building Occupancy and Use

The functional purpose to which the building is put is a key factor in determining whether the material, system, and management controls put in place to assure overall safety and resilience are appropriate to the people that occupy them, their daily activities, and the business conducted within. Industrial processes may warrant the use of more intrinsically robust materials, to separate areas of particularly high risk or value. Similarly, commercial, residential, and mixed-use buildings may require different features to account for the varying levels of familiarity, states of consciousness, and abilities of the occupants. The use of the building and its ability to survive fire and water exposure events can have an enormous impact on the costs associated both with material damage (to building, contents and plant), and business interruption. Business types are often 'rated' in terms of the expected ratio of Material Damage to Business Interruption costs.

Scale

The scale of the building, in association with its proximity to other buildings, essentially sets the maximum worst-case limits on what can be lost to any single event. The key parameters are:

- Number of stories
- Building footprint
- Size of largest compartment by area and volume
- Separation from other buildings
- Mitigations

Insurers use a range of methodologies to estimate potential loss to combined property and business interruption damage. Their meanings and interpretations may vary between insurers and differ through the inclusion or exclusion of mitigations, such as sprinklers, and the ability of passive features to perform. Examples include:

- Normal Loss Expectancy (NLE) – a best case scenario where all systems operate as planned
- Estimated Maximum Loss (EML) – adverse condition, e.g. sprinklers out of service
- Maximum Foreseeable Loss (MFL) – worst cause where all systems fail to operate as planned

Scale is a vital feature of insurability and can exert great influence during the consideration of provision of building insurance, especially where novel methods and materials are used where little claims history may exist.

> "The combination of combustible materials and voids presents new challenges for all stakeholders"

Structure & Fabric

The structure and the fabric of the building can exert great influence in respect of the susceptibility and response of the building to fire and water exposure threats throughout all periods of its life: during construction; from occupation; and through change and wear and tear over time, and as such, is a key focus of insurer consideration. Features include:

- **Ground floor structure** – The susceptibility of even timber framed buildings under construction to arson can be cut if the ground to 1st floor level is built of concrete. The through life benefit to ground level fire raising and flood challenges persist for the life of the building
- **Structural material** – The weight bearing materials of the building influence greatly the possibility for disproportionate damage and collapse, amount of combustible material used, and the building's repairability following an incident.
- **Construction method** – In association with the structural materials used, the construction method may have implications for repairability, and the promotion of fire spread by voids (demand for a high reliance on cavity fire stopping)
- **Core structure** – Building designs that incorporate a non-combustible core can benefit from increased structural stability, improved fire service confidence and response, and a means of routing services vertically via non-combustible, fire resistant, cavities.
- **Floor/ceiling** – The building's floor composition can impact greatly the effective compartmentation period, fire spread over surfaces, structural stability, and fire service response. There are also implications for EoW, where long term issues, such as rot and delamination, might contribute to loss of structural integrity, and short-term escapes might result in unacceptable staining and the loss of aesthetic finish.
- **Cladding system** – The combustibility of the building's external finishing system (cladding and insulation), is a key factor in determining the scope for external fire spread and ingress internally via windows and other openings. Cladding systems with voids, such as rainscreen, used in combination with building methods with voids, such as modular, connect the possibility for simultaneous external and internal fire spread if fire stopping systems are imperfect.
- **Interior surfaces** – If the interior surfaces of the building do not suitably resist flame spread, there is scope for enhanced fire damage, reduced compartmentation, reduced structural stability, raised fuel load, and reduced fire service response. Sprinkler installation rulesets also demand the ceilings from which they are suspended to be non-combustible. As visible building components, the internal surfaces present repairability challenges when impacted by fire or water damage (loss of aesthetic finish, odours, etc.)

Other Risk Factors

Other major factors that can influence insurer assessment of the building include, but are not limited to:

- **Atria** – The presence of atria features can increase the scale of loss to fire and smoke damage as more floors might be simultaneously affected
- **Basement car parks** – Underground car parks present very specific insurance challenges and with a move to electric vehicles, hydrogen fuel cell technologies, and the provision of on-site recharging there is a lack of knowledge on how such risks, which could be structurally significant, are managed.
- **Balconies** – Balconies can allow human access to the exterior features and materials of the building, can be combustible in their own right, and as such can increase the overall risk profile of the building.
- **Swimming pools** – As major source of water, failure of containment and poor maintenance of systems can result in significant loss.
- **Hazardous materials** - Storage, using, or producing hazardous materials (flammable materials, gases, dusts etc.) will have an obviously raised risk profile in terms of fire and explosion risks.
- **Green surfaces** – Green surfaces can introduce significant quantities of combustible materials on to the external surfaces of the building in the form of plastic membranes, irrigation systems, planting modules, and plant material. The fire risk may be influenced by weather changes such as drought and maintenance standards. Failure of membranes may lead to water damage risk for some construction material types. Certification methods for the approval of these cladding systems are considered inappropriate.
- **Blue roofs** – Blue roofs seek to capture and hold up the dispersal of rainwater. As an additional wet system, they may raise challenges for water damage potential of some construction materials if they fail or are poorly maintained.
- **Renewable energy** – Green energy systems, including solar panels, wind turbines, and their associated electrical storage and distribution systems can present challenges when they fail. Fires can be persistent, high energy, in remote locations, and impair fire service response.

> "Timber structures are particularly vulnerable to fire during construction before the fire resisting surfaces have been applied"

Fire Mitigations

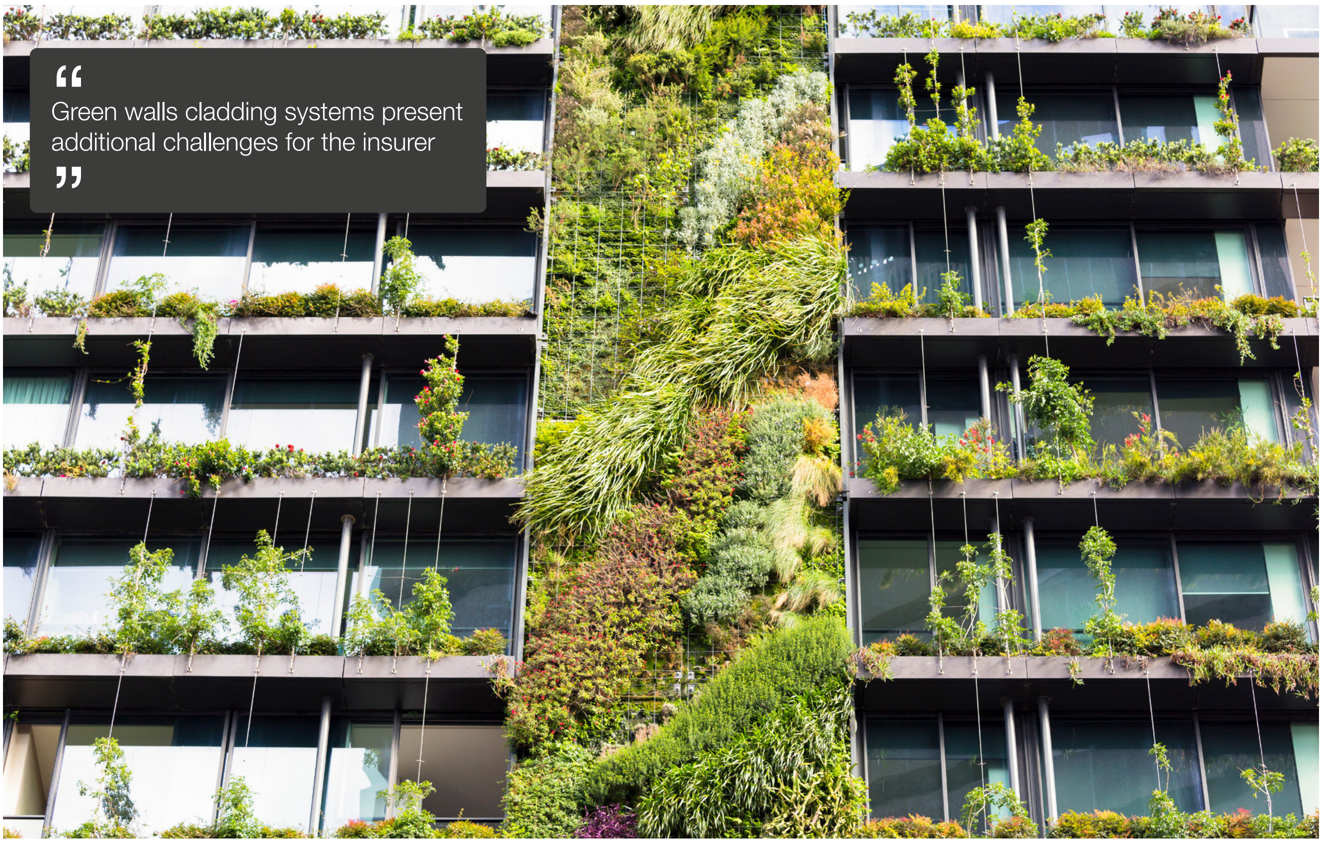
Systems put in place to address insurance concerns are considered in the context of the role they may play in reducing likelihood of loss, and/or scale of loss. The impact may be included in some, but not all loss calculations because, as with any system, they too can fail. It is important to note that life-safety systems, such as watermist systems, detection and alarm systems, and some forms of sprinkler protection (domestic and residential systems), might be ignored as being irrelevant to the curtailment of loss for insurance purposes. Fire mitigations considered include, but are not limited to:

- **Combustible void protection** – The threat of internal fire spread posed by combustible voids can be protected against by lining with NC board, provision of sprinklers, or filling with NC fibre insulation (a requirement under US International Building Codes, but not in the UK).
- **Automatic suppression systems** – Suppression systems can greatly increase the resilience of buildings to fire and prevent internal fire spread. Their provisioning is made against specific rulesets which can be problematic for some construction forms. Only property protection focussed sprinkler installation rulesets are considered appropriate for the massive timber environment (such as BS EN 12845 / LPC Rules for Automatic Sprinkler Installations). Domestic and Residential type sprinkler and watermist installations for occupant life-safety (i.e. BS 9251) are not appropriate. The water sensitivity of local materials must also be considered along with the potential for leakage.
- **Building separation** – The proximity of the building to others is important in understanding all initiating risks, and the potential scale of loss.
- **Firefighter provisions** – Whilst firefighters are under no obligation to take risk in the preservation of property or business, inbuilt features that assure the structural integrity of the building, such as NC material choices, good access (external and stairwells), and the provisioning of reliable resources (water supplies, dry and wet rises etc.), can increase their effectiveness if the situation permits.
- **Stairwells** – Improved access in and out of the building supports improved safety and fire service response.

Water Exposure Mitigations

For certain building geometries and material make up, water-perils may pose as great a financial risk as fire if not more. The key mitigations fall into the categories of:

- **Designed for flood** – In flood zones positioning the building above the highest predicted flood level and introducing measures that provide a way to reduce the risks to people and property enabling households and businesses to reduce flood damage, speed up recovery and reoccupation of flooded buildings, and help ensure future insurability of the building. (Reference CIRIA guide Code of practice for property flood resilience (C790)).
- **Designed for Escape of Water** – Consider the consequence of long term and short term EoW events on the building and design in fluid systems that fail-to-safe discharge, and room designs that can drain-to-safe place.



Current Appetite for Massive Timber Insurance and Design Solutions

A series of one-to-one discussions were held with members of the RISCAuthority massive timber working group to assess their view of the challenges, current situation, comfort thresholds, and possible routes forward. On all counts there was great variation of view but dominant factors influencing decisions on property insurance were:

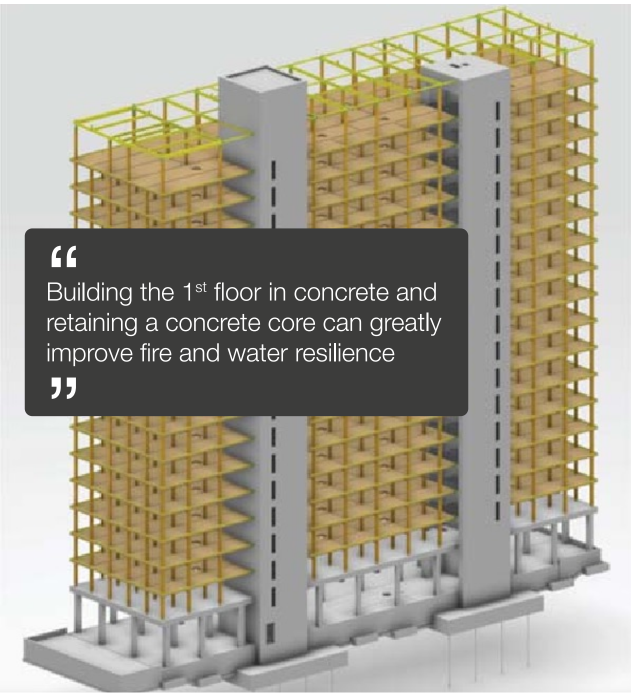
Building scale - impacts scale of material damage and business interruption exposure.

Who the customer is - Insurers strive to satisfy the needs of their customers. Through long held relationships, trust, and good communication channels negotiating building design variation to include insurance relevant features is made easier by the collaborative understanding of the benefits of resilience to customer and insurer alike.

Building location – there was a stark difference in the willingness of some insurers to consider massive timber structures in the US and the UK due to the strength of the US International Building Code (IBC) and its recent specific development to adapt to massive timber construction methods. Under the IBC, for significant buildings all timber is encapsulated, and combustible voids are either lined, sprinkler protected, or filled. If the UK Government is looking to promote massive timber methods in the UK, the specific development of the UK's Approved Documents in the same way as the US would be one of the most beneficial things that could be done. The weakness of UK building regulation is at best irrelevant, and at worst acts as a deterrent to insurability.

Detrimental features included:

- Sleeping risks
- Green walls



> "Building the 1st floor in concrete and retaining a concrete core can greatly improve fire and water resilience"

- Offices over commercial units that involved cooking
- Use of pullable fixings such as staples / nails
- Dependency upon 'extinguishment by design' philosophy

Insurers with existing relationships with customers have, by negotiation, successfully developed meaningful solutions that satisfied both their customer's carbon reduction ambitions and their own insurance risk control needs. **In most cases the solution came from hybridisation of conventional and newer building methods and materials**. Typical solutions have included:

Location of all plant and electrical intakes in concrete core, and vertical routing of services – this:

- Replaces significant concrete usage with timber
- Reduces combustible void challenges
- Improves building stability
- Supports firefighting activities

Locating all bathrooms and kitchens within a concrete core of a massive timber building – this:

- Replaces significant concrete usage with timber
- Reduces the potential for escape of water damage
- Supports built in drain-to-safe features

Alternating CLT floors in concrete or steel framed buildings – this:

- Reduces concrete usage
- Preserves a higher level of (insurance relevant) compartmentation
- Improves building stability under fire
- Supports firefighting activities

Building with the 1st floor in concrete – this:

- Protects against accidental and deliberate fire-raising means during construction
- Improves resilience to flood

CLT panel waterproofing membrane – this:

- Reduces the potential for water damage during delivery and construction before weather proofed.

This list is not exhaustive but does demonstrate that progress can be made when both parties are happy to engage in constructive dialogue. Only in the US, with its stronger local building codes, were taller buildings (18 stories) with wood being the main structural material, deemed acceptable by some – under the IBC all visible and hidden surfaces would be lined with fire resisting board and a sprinkler system would be installed.

For some insurers the concern of construction risks outweighed all others, and for many others potential escape of water losses dominated even the fire risks.

Final Thoughts

RISCAuthority, and its membership, hope that this paper clarifies the magnitude of the changes taking place in the built environment and the challenges they present, and will ultimately lead to a collaborative framework with key stakeholders that will support both carbon neutral and resilience objectives.

Contact Us

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The accompanying insurance relevant design features spreadsheet can be found on RISCAuthority website www.RISCAuthority.co.uk

Remaining Knowledge Gap Analysis

Further research is needed on several areas related to massive timber construction, notably:

- Aging of timber composite materials
- Reaction to water of timber composite materials
- Reaction to fire of timber composite materials
- Repairability of massive timber systems
- Potential for disproportionate collapse and 'topple'
- Role of 'The Party Wall Act' in multi-occupancy buildings
- Certification of materials, methods, and structural design codes
- Suitability of local building codes
- Certification method of green wall cladding systems
- Sprinkler system standards for applications in bare wood ceiling compartments

"Insurance of massive timber buildings is simpler in countries whose building regulations, unlike the UK, embrace the benefits of property protection. Government has a substantial role to play in assisting this move to more sustainable construction methods"

References

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