

Project No:	220278
Document No:	MZ-220278-03-DSN-01-ISS02
Date:	13/07/2023
Issue No:	02

## 100 Gray's Inn Road – Cross-Laminated Timber (CLT) Structure

100 Gray's Inn Road is a new-build office development proposed in Central London, which will be approximately 35m high. The building will be constructed using a cross-laminated timber (CLT) structure. CLT structures are considered to be a higher fire risk than other types of construction, as ultimately the timber is combustible.

The Fire Safety strategy for the development (ref: MZ-220278-04-FSS-01-ISS01, dated: 30/05/2023) recognises the additional risk associated with the CLT structure and provides a performance based design (PBD) for the whole building. As part of the performance based design a Qualitative Design Review (QDR) was undertaken with relevant parties including Building Control, Sweco, and a specialist fire engineering consultant, IGNIS.

Detailed fire engineering calculations were then performed by IGNIS, which are contained in the report "Project: 100 & 88 Gray's Inn Road / 127 Clerkenwell Road, London (UK) Fire Design of Structural Timber – Design for burnout (analysis of likely auto-extinction) and radiation to neighbouring buildings", Version 0, dated 11/04/2023 by IGNIS.

From the IGNIS report; *IGNIS performed the auto-extinguishment analysis (sometimes referenced as "burnout calculations") for the office parts of the building, partially made of the exposed CLT structure. The approach is a performance-based design, quantifying the contribution of the combustible structural material to the fire and the performance of the structure in the fire situation.*

*Structural timber is a combustible material that may be considered outside of the prescriptive design approach. The traditional fire resistance framework has been developed for compartments where the combustible materials can be quantified, typically covering only the movable fire load (fuel load). In this reference case, the fire will decay when the fuel load is consumed. This basis led to the determination of a standard fire resistance period of 60 min (e.g. REI60) by default with a modification for lower or higher consequence classes (e.g. REI30 or REI90). If there is a structural fuel load on top of the mobile fuel load, decay of the fire in a reasonable time is not automatically given anymore.*

*Consequently, any design in line with prescriptive building regulations would require a non-combustible environment. A verification that the traditional fire safety framework and its assumptions is applicable for combustible environments (i.e. timber structures with exposed surfaces) would require either:*

- A design based on encapsulation of the combustible structural elements throughout the entire fire duration than is created within the compartment. When the temperature is finally low enough, combustion and pyrolysis will stop; or*
- As an alternative to the encapsulation route, an analysis of auto-extinguishment can be done showing that the structural resistance is sufficient to prevent collapse. Considering the entire duration of a fire event, the structural resistance should be longer than the duration of the fire.*

*Consequently, in line with the current fire resistance framework, the exposure of timber members is possible if likely auto-extinguishment can be demonstrated. Then, a similar safety level as for non-combustible (NC) environments is reached. A PBD approach allows for:*

- (1) the consideration of exposed structural timber, and for*
- (2) a verification of auto-extinguishment,*

- (3) *the determination of the effect of the fire on structural elements (e.g. assessing the member temperature) or on non-structural elements (e.g. by time-equivalency) and*
- (4) *the consumed structural fuel at the time when the fire reaches burnout.*

*Following the simplified visualisation by the structural timber association (STA), the design scenarios assumed for the structural design result from the very unlikely (<5% according to BS PD 7974-7) case of sprinkler failure after the ignition of a potentially severe fire event. The PBD approach quantifies the contribution of the structural timber (additional fuel load and additional heat release rate, HRR, respectively).*

*Since the contribution of the structural timber is a function of the fire development itself, an iterative process is required, which starts with an initial simulation of the fire due to the mobile fire load (NC reference case). The simulation provides the time-dependent exposure of the structural timber as the output. On this basis, the heat release of the structural timber can be calculated. In the next fire simulation iteration, this (time dependent) additional heat release rate is considered. This process is continued as long as there is an additional contribution of the structural timber from one iteration to the next, i.e. until convergence is found. If no convergence can be found, auto-extinction is not reached.*


The results of the burnout calculations indicate that a fire within the building will be auto-extinguished in 92 minutes and the report has concluded that no additional fire protection (other than that stated in the IGNIS report) needs to be applied to the CLT structure or to the floors to achieve compliance within regards to Part B3 of the Building Regulations.

The increased risk of the CLT structure has also been factored into the overall fire strategy design with the following measures include to ensure the risk to the life safety of the occupants is minimal:

- Sprinkler protection throughout the building;
- An L1 fire detection and alarm system;
- Simultaneous evacuation upon confirmation of a fire.

Based on the analysis performed by IGNIS, provided that the CLT structure remains within the scope and range covered by the IGNIS study, and provided that it is ensured that the Fire Strategy is implemented during design and construction, Maze Fire would be satisfied that a CLT structure is a suitable form of construction.

## Quality Management

Version	Date	Information about the proposal	
01	11/07/2023	Reason for issue:	First issue
		Prepared by:	Alex Manning Associate
		Reviewed By	Mark Jones Associate
02	13/07/2023	Reason for issue:	Minor amendment
		Prepared by:	Alex Manning Associate 
		Reviewed By	Mark Jones Associate 

### Validity

This document is formulated on the basis of the information and experience available at the time of preparation. It is applicable to the above-mentioned project only in accordance with the client's instructions. It is only valid provided no other modifications are made other than those for which a formal opinion has been sought and given by Maze Fire Consulting Limited.

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