

## Development of a Two-way Column-supported Flat Plate in Cross Laminated Timber

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### Abstract

Chicago Horizon is a pavilion for the 2015 Chicago Architecture Biennial that is composed of a flat roof made entirely out of Cross-Laminated Timber (CLT). The application of two-way column-supported flat plate in timber (for both the gravity system and as part of the lateral-load-resisting system) is possibly unique to this structure. This paper details the analysis, design, detailing and fabrication of the structure relating each to the translation of the flat plate structural type to CLT. This paper highlights: the comparison between two conceptual options for flat plate realization; the application of fasteners at 45 degrees to provide shear reinforcement of CLT locally; and the use of the laminated timber columns moment connected to the CLT flat plate to form the pavilion's lateral-load-resisting. This unique application was developed through a close collaboration between the authors (architects, engineers and fabricators) and is the development of a new structural type in mass timber.

**Keywords:** mass timber; cross laminated timber; flat plate timber; timber moment frames

### 1 Introduction

The Chicago Horizon is the winner of the BP Prize in the Chicago Lakefront Kiosk Competition for the inaugural Chicago Architecture Biennial (2015). It is installed permanently as a public amenity and vendor kiosk in Grant Park, facing Lake Michigan. The design proposes a 56ft by 56ft (17m by 17m) flat roof made entirely out of engineered and mass timber (see Figures 1, 2 and 3). The application of

two-way column-supported flat plate in timber is possibly unique to this structure.

While common in reinforced concrete, the application of flat plate using CLT requires specific re-evaluation. CLT is limited in dimension to planks approximately 8ft wide and 50-60ft long and has anisotropic properties given its typical odd number of layers of directional lumber. In this case, the 56ft by 56ft pavilion roof was composed of two vertically stacked layers oriented perpendicular to