Composite Glulam Timber and Concrete for the Performing Arts

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Abstract

A crucial problem when constructing performing arts facilities with world-class room acoustics is the simultaneous provision of substantive mass at the enclosure, and shaping that enclosure to geometric requirements for diffusion and reflection of sound energy. This paper describes a group of solutions whereby glulam-timber frame and concrete surface typologies are hybridized so that the primary structure and lateral system simultaneously satisfies both structural needs and acoustic requirements. The paper addresses prior typical planar (2d) uses of concrete atop flat timber decking, plus methodologies extending into nonplanar 3d applications for decking. Geometries include ruled surfaces, faceted surfaces approximating doubly-curved forms, and bipedal glulam 'tuning fork' columns. This will be illustrated: (1) by digital modeling and acoustic auralization prior to construction, (2) by full-size assembly mockups with spray-applied shotcrete for testing, and (3) through documentation of variant structures realized (fabricated and constructed) of glulam and shotcrete. The value of these investigations is that they extend the capabilities of timber members and standard straight decking into complex spatial systems with intrinsic stability, compressing structure, enclosure, and finish into a single low-carbon construction assembly. The wood systems define resonant spaces as architectural 'instruments' analogous to musical instruments played within.

Keywords: Timber, Glulam, Composite Structures, Hybrid Structures, Acoustics, Auralization, Conceptual design, Form finding, Shotcrete, Hybrid structures.

References

[1. E. Allen, W. Zalewski, D. Foxe, et al., *Form and Forces: Designing Efficient, Expressive Structures*, Wiley, 2009.

[2. Epstein Joslin Architects, Music Center at Indian Hill, https://www.epsteinjoslin.com/music-center-indian-hill Retrieved 2019. [Online].

[3. K. Hochgraf, "The Art of Concert Hall Acoustics: Current Trends and Questions in Research and Design," in *Acoustics Today*, v.15 #1, Spring 2019.

[4. Z. Van der Meulen, *Music Center with Glulam Recital Hall Taking Shape,* http://unalam.blogspot.com/2019/01/music-center-with-glulam-recital-hall.html Retrieved 2019. [Online].