

Monocoque Systems: The Reuniting of Divergent Agencies for Wood Construction

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Abstract : Construction and design are inexorably linked. Traditional building methodologies, including those using wood, comprise a series of material layers differentiated and separated from each other. This results in the separation of two agencies of building envelope (skin) separate from the structure. However, from a material performance position reliant on additional materials, this is not an efficient strategy for the building. The merits of traditional platform framing are well known. However, its enormous effectiveness within wood-framed construction has seldom led to serious questioning and challenges in defining what it means to build. There are several downsides of using this method, which is less widely discussed. The first and perhaps biggest downside is waste. Second, its reliance on wood assemblies forming walls, floors and roofs conventionally nailed together through simple plate surfaces is structurally inefficient. It requires additional material through plates, blocking, nailers, etc., for stability that only adds to the material waste. In contrast, when we look back at the history of wood construction in airplane and boat manufacturing industries, we will see a significant transformation in the relationship of structure with skin. The history of boat construction transformed from indigenous wood practices of birch bark canoes to copper sheathing over wood to improve performance in the late 18th century and the evolution of merged assemblies that drives the industry today. In 1911, Swiss engineer Emile Ruchonnet designed the first wood monocoque structure for an airplane called the Cigare. The wing and tail assemblies consisted of thin, lightweight, and often fabric skin stretched tightly over a wood frame. This stressed skin has evolved into semi-monocoque construction, in which the skin merges with structural fins that take additional forces. It provides even greater strength with less material. The monocoque, which translates to 'mono or single shell,' is a structural system that supports loads and transfers them through an external enclosure system. They have largely existed outside the domain of architecture. However, this uniting of divergent systems has been demonstrated to be lighter, utilizing less material than traditional wood building practices. This paper will examine the role monocoque systems have played in the history of wood construction through lineage of boat and airplane building industries and its design potential for wood building systems in architecture through a case-study examination of a unique wood construction approach. The innovative approach uses a wood monocoque system comprised of interlocking small wood members to create thin shell assemblies for the walls, roof and floor, increasing structural efficiency and wasting less than 2% of the wood. The goal of the analysis is to expand the work of practice and the academy in order to foster deeper, more honest discourse regarding the limitations and impact of traditional wood framing.

Keywords : wood building systems, material histories, monocoque systems, construction waste

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