

Earthen Architecture in Japan: Tsuchikabe



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ABSTRACT

“Earth” is one of the most significant building materials, addressing the fundamental need for “shelter” across cultures and climates. Tsuchikabe is a traditional Japanese non-load-bearing earthen wall system constructed with the wattle-and-daub method: a lattice of bamboo or thin wooden crosspieces coated with layers of earth mixed with organic fibers such as rice straw, forming a durable, plaster-finished surface within a post-and-beam wooden framework. This precisely calibrated system emphasizes flexibility, earthquake absorption, and harmony with natural materials. Its layered construction process and passive environmental performance make it one of the most compelling case studies in sustainable vernacular building. The technique was mastered by specialist plasterers known as sakan, whose advanced trowel-finishing methods were established around AD 1600. From an environmental perspective, earthen construction offers significant ecological advantages. The building sector accounts for approximately 37% of global energy-related CO₂ emissions, while raw earth walls have embodied carbon values as low as 15-20 kg CO₂-eq/tonne, far below the approximately 830 kg CO₂-eq/tonne of ordinary Portland cement. Earthen plaster is recognized for its hygroscopic properties, which enable passive indoor humidity regulation and reduce dependence on mechanical ventilation. The incorporation of rice straw as fiber reinforcement enhances tensile strength and contributes to biogenic carbon sequestration within the wall assembly. At the end of life, earthen materials are rehydratable and fully reusable, supporting a circular material life cycle with negligible demolition waste. These characteristics position Tsuchikabe as a precedent for low-carbon construction aligned with the Paris Agreement and UN SDG 11. This paper examines Tsuchikabe as a traditional earth-based construction system through a literature review of its architectural characteristics, embodied carbon performance and circular material life cycle, highlighting its relevance as a precedent for contemporary sustainable construction.

KEY WORDS: Tsuchikabe, earthen architecture, wattle and daub, sustainable construction, vernacular building