Quantification of Greenhouse Gas Emission from Construction Materials Used in Urban Cultural Heritage Buildings in Sri Lanka

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Anthropogenic activities have a significant impact on the natural environment. The majority of greenhouse gas emissions that contribute to the climate crisis are emitted by buildings. Adaptive reuse of buildings has been highlighted as a sustainability concept that is primarily applied with historical structures and one of the strategies for reducing the environmental effect of building constructions. This study calculated the embodied carbon savings from adaptive reuse of Sri Lanka's urban cultural heritage buildings. The sample consists of five purposively selected historic buildings from the Dutch era. During the site visits, the materials and techniques used in construction during the Dutch era, as well as floor plans and measurements of building elements, were collected. The floor plans were drawn up and the material quantities were estimated. The greenhouse gas emission from construction materials was calculated using the estimated material quantities and the emission factor values. The selected five cases revealed that the average greenhouse gas emission of Dutch era historic buildings is 432.26 kg $CO_{2\text{-eq}}$ m^{-2}. The main building materials used during the Dutch era were granite, clay, limestone, and timber. Granite is the primary source of greenhouse gas emissions (40.93%), while clay contributes 34.56%. The greenhouse gas emissions of construction materials used in Dutch era historic structures are lower than those of modern constructions using new materials, according to the findings of this study and previous literature on embodied carbon assessment of modern buildings. As a consequence, the findings of this study may indicate that adaptive reuse of urban cultural heritage buildings is more environmentally friendly than new construction since it prevents additional high greenhouse gas emissions. This may also aid in the development of initiatives to promote the concept of adaptive reuse of urban cultural heritage buildings in Sri Lanka while reducing environmental effect.

Keywords: *Adaptive Reuse, Construction Materials, Cultural Heritage Buildings, Environmental Impacts, Greenhouse Gas Emission*