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DECARBONIZING TRANSPORTATION INFRASTRUCTURE: A TOOL FOR ASSESSING EMBODIED CARBON IN MOBILITY SUPPORT BUILDINGS

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Summary: The transportation sector is a significant contributor to global greenhouse gas (GHG) emissions, accounting for approximately 25% of the sectors' GHG emissions. While transportation-related operational emissions are well-documented, embodied carbon emissions, especially the ones related to transport infrastructure buildings, are often overlooked. To address this gap, this research explores the application of an embodied carbon assessment methodology to service buildings that support transportation infrastructure.

The innovative contribution of this paper lies in the development of a comprehensive embodied carbon assessment methodology tailored to service buildings, integrating material durability and lifecycle considerations, and providing a practical tool for optimizing carbon reduction strategies through informed design and material choices.

The methodology developed involves creating a database of embodied carbon data for construction materials and a tool for evaluating and comparing the carbon footprints of different material choices in service buildings. It also takes in account critical factors such as the service life and durability of materials, enabling a holistic assessment of their long-term environmental impacts.

To demonstrate its potential, this tool was adapted to assess mobility support infrastructure, such as service buildings adjacent to railway stations and airport terminals, to demonstrate its potential applicability in the transportation sector. These facilities, often disregarded yet playing a crucial role in the transportation ecosystem, are characterized by their extensive use of construction materials and long operational lifespans. A case study focused on a representative archetype for service buildings was conducted using the tool to assess the embodied carbon of representative building materials, their lifespans, and maintenance cycles. Also, alternative building refurbishment scenarios were modeled, for optimizing carbon reduction strategies over the buildings' lifecycles.

The case study results offer a quantification for embodied carbon of these infrastructures, highlighting a significant potential for carbon reduction through thoughtful material selection and design choices. The research also underscores the importance of integrating embodied carbon assessments early in planning and design stages.

The implications of this research, which go beyond the transportation sector, extend to policymakers, urban planners, architects, and civil engineers, offering critical insights that can be integrated into a framework for both operational and embodied carbon emissions to promote an integrated approach to decarbonization in transportation infrastructure.