Reducing the Carbon Footprint of Floor Systems

THE IMPACTS ON FOSSIL FUEL USE AND GLOBAL WARMING OF RAISED WOOD VERSUS SLAB-ON-GRADE FLOORS

A life cycle assessment of two alternative floor systems – one wood, the other concrete slab-on-grade – confirms that wood is considerably less fossil fuel dependent and contributes far less to global warming than concrete.

Fossil fuel use and global warming are widely regarded today as critical environmental issues. The common denominator of both concerns is carbon dioxide (CO_2), a "greenhouse effect" gas that is emitted into the atmosphere when fossil fuels such as oil and coal are burned for energy, or when organic materials decay. Once emitted, CO_2 traps heat in the atmosphere and in sufficient quantities can contribute to global warming and climate change.

Whether the causes and scope of global warming are scientifically settled, as some contend, or still open to debate, as others maintain, one thing is clear – efforts to reduce fossil fuel consumption and to mitigate global warming are national and international policy realities that will increasingly affect the selection and use of building materials and design and construction practices. This reality is evidenced by the proliferation of green building standards that set ambitious guidelines for energy use, both in material manufacture and building performance; by international efforts to establish and meet global emission reduction goals, such as the Kyoto Protocol[1]; and by national cap and trade legislative proposals.

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Wood as a material choice can play a highly beneficial role in addressing fossil fuel consumption and global warming concerns. For example:

- Wood in forests, particularly in young vigorous forests, absorbs carbon dioxide, making growing forests an efficient carbon sink.
- Once harvested and converted to wood products, wood fiber has a carbon sequestering or storage effect. Sustainably managed forests, as opposed to unmanaged decaying forests, thus provide a net reduction in carbon dioxide emissions.
- Compared with other materials, wood requires less energy to extract, process, transport, construct and maintain over time.
- Wood is a far better insulator than concrete and steel and can thus reduce energy consumption of buildings during their operational life.
- Wood is both recyclable and divertible from the waste stream to be burned in energy recovering boilers. The energy so produced substitutes for fossil fuel energy.

The case for the environmental merits of wood has been substantially supported and confirmed in recent years by the life cycle assessment (LCA) method, which is now widely recognized as the most scientifically credible and accurate measure of the environmental impacts of various building materials. By quantifying those impacts from "cradle to grave" – extraction, manufacturing, transportation, installation, use, maintenance, and disposal or recycling – LCA provides a common basis for objectively assessing and comparing the environmental credentials of dissimilar building designs and materials.

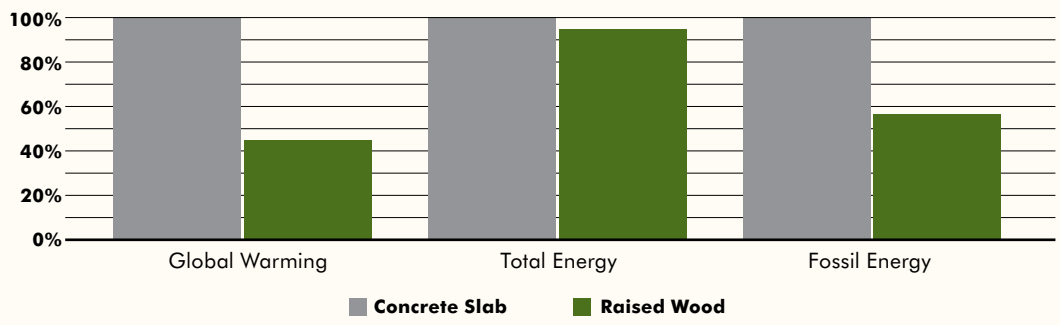
A recent life cycle analysis compared the fossil fuel consumption requirements and greenhouse gas emission levels of two comparable floor systems – one a concrete slab-on-grade floor, the other a raised wood floor. The two floor systems were for a 2,500-square-foot single-story residential dwelling located in Atlanta, Georgia.

The assessment covered both cradle-to-gate manufacturing effects (from extraction of raw materials to product manufacture to completion of the structure) and cradle-to-grave effects (up to and including structure demolition). The cradle-to-grave analysis encompassed two end-of-life treatment scenarios – landfill, where applicable, and combustion with energy recovery. Two secondary data sources (U.S. Life Cycle Inventory Database and Ecoinvent[2]) were used to model the production of upstream materials and energy sources prior to their delivery and use by the manufacturers. Both databases were uploaded to SimaPro v7.18 – the primary LCA modeling software used for the project. Additional data were drawn from the Athena Institute's *Impact Estimator for Buildings* software (www.athenaSMI.org) and used to complete the analysis.

As shown in Figure 1, the global warming impacts on a cradle-to-gate basis of the wood floor was less than half that of the concrete slab. Total energy consumption on a cradle-to-gate basis was comparable for the two floor systems; however, the fossil energy requirement for the concrete slab was nearly double that of the wood floor. This is due in large measure to the utilization of biomass energy in the manufacturing of wood products.

FIGURE 1

Cradle-to-Gate Comparison: Global Warming, Total Energy, Fossil Energy

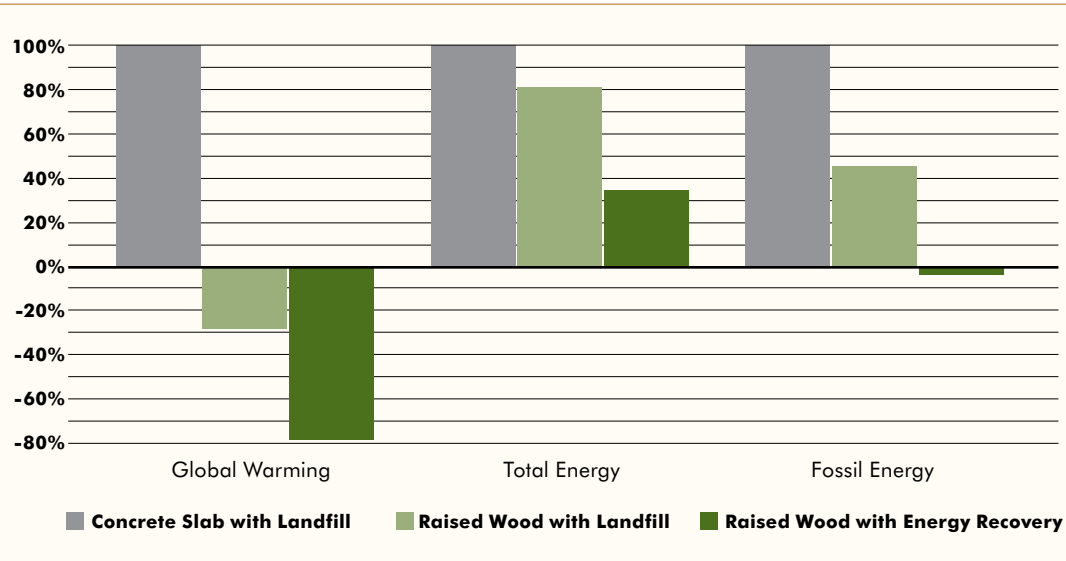


The differences in energy consumption and global warming impacts between the two floor systems are even more dramatic on a full cradle-to-grave basis, as shown in Figure 2. For the wood floor system, the life cycle with both possible end-of-life scenarios (landfill and energy recovery through diversion from the waste stream to boiler incineration) yields negative global warming carbon emissions. In the landfill case, the positive results for wood are due in part to the wide use today of modern landfill technologies for capturing methane, a potent greenhouse gas. Wood's lignin content and the imperfect conditions for anaerobic microbacteria (decay) that exist in landfills also cause the majority of carbon in wood to remain intact.

Total energy use is also less for the wood than for the concrete floor system under both the landfill and energy recovery scenarios. And fossil fuel energy use is substantially less with the wood system under both end-of-life treatments.

FIGURE 2

Cradle-to-Grave Comparison: Global Warming, Total Energy, Fossil Energy[3]



The life cycle assessment conclusions in this study that support the comparatively low fossil fuel and global warming impacts of wood have been corroborated by many other LCA studies, including most notably analysis by the Consortium for Research on Renewable Industrial Materials (www.corrim.org). For more information on raised wood floor construction and the benefits of building with raised wood floors, go to www.raisedfloorliving.com. Information is also available on the APA website at www.apawood.org.

1 The Kyoto Protocol is a protocol to the United Nations Framework Convention on Climate Change (UNFCCC) aimed at fighting global warming. UNFCCC is an international environmental treaty with the goal of stabilizing greenhouse gas concentrations in the atmosphere.

2 The U.S. Life Cycle Inventory Database (USLCI) is a public/private partnership developed by the U.S. Department of Energy and the National Renewable Energy Laboratory. Ecoinvent is a life cycle inventory database of the Swiss Ecoinvent Centre (formerly Swiss Centre for Life Cycle Inventories).

3 The impacts of the two systems in the cradle-to-grave comparison do not account for differences in operational energy use over the life of the structure.

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