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Residential carbon footprint study reveals the biggest losers

Tags: Building Green, Cost of Ownership, Energy Audits, Trends / Statistics
12/2/10 - Gary Wollenhaupt

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Mystery solved: carbon footprint culprit identified.

Which homes have the largest carbon footprint? Surprise, it's not always the most spacious. It may be the heaviest.

Over the past several years, residential architects at the FergusGarber Group in the South Bay area of San Francisco analyzed the carbon footprints of 10 of their home projects. The firm looked at both the embodied carbon dioxide within the materials as well as the operational carbon dioxide from living in the home, such as heating and ventilation and electricity use from lighting and appliances. The carbon footprint is a measure of impact on the environment resulting from energy used to manufacture materials and live in the home.

Architect Dan Garber and Lucas Morton, sustainability manager for the firm, presented their findings at the 2010 Greenbuild International Conference and Expo in Chicago. They noted the study was focused on these particular homes and did not necessarily apply to homes in other parts of the country, but the findings were generally applicable.

Embodied carbon

Morton noted that conventional wisdom is that the larger the house, the greater the carbon footprint will be. But their analysis did not find that to be always the case. One home had 7,800 square feet with an embodied carbon footprint of 416 kilograms. Another had 4,300 square feet, but 928 kilograms of embodied carbon. What's the difference? The smaller house weighed more.

The firm calculated the weight of the materials in each house. The first, larger house weighed 117,958 lbs. The second, smaller house weighed 236,336 lbs. The first house was built on a crawlspace, used standard wood framing and gypsum board construction. The second house was built on a partial basement and had stucco on both interior and exterior walls. The site was hilly so extensive concrete retaining walls were used to support the house.

Overall, embodied carbon came primarily from resource extraction and manufacturing; only a small percentage was due to transportation of materials. Some materials, such as steel and concrete, have a high level of embedded carbon so the architects have to be aware of the impact of their design.

"We found we could design a house that was twice the size of the house that was using far more dense carbon materials for the same footprint," Garber said.

Operational carbon

Garber acknowledged the temperate climate where the homes are located, which reduces the need for heating and air conditioning. One of the homes did not have air conditioning installed, which reduces energy use and carbon emissions.

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Overall, the analysis looked at the water heating, space heating and cooling, and estimated plug loads from appliance usage over a 50-year lifespan of the home.

Morton noted that the occupants of a home play a key role in managing energy usage, as well as the design of the home.

“Each house has its own features, and obviously the occupants have a dramatic influence,” he said.

The largest influence on operational carbon use was the tonnage capacity of the air conditioning system, Morton said. Surprisingly, the ratio of window area compared to floor area did not have a strong influence, due in part to the mild climate. In that climate passive solar features could allow a home to incorporate a lot of windows and still have low carbon footprint.

“Good energy design can improve the carbon footprint or poor design can have different results,” Morton said. “You could have small floor area and still have a high embodied and operational carbon footprint.

Among the homes in the study, the average was 76 percent of the carbon foot print was a result of operations, and 24 percent was the result of embodied carbon dioxide in the materials.

Garber noted that architects, builders, and homeowners have to understand some of the tradeoffs in selecting materials and designing the house. For instance, he compared concrete tile siding with cedar shakes. The concrete tiles have a higher carbon footprint initially but may last 100 years. In that time, the cedar shakes would have to be replaced five times. So the overall footprint is much higher during the lifespan of the home.

“There’s not a right or wrong answer, but in designing a house you have to consider whom you’re designing it for and what the design goals are,” Garber said. “It is really easy to do a house that has a great operational footprint and a really bad embodied foot print, and vice versa.”

Architects and builders have more influence over embodied carbon through their materials and design choices, and homeowners have much more impact on operational carbon use, Garber said. Homeowners are more interested and engaged in making wise choices.

“The tradeoffs we’re talking about are not additional costs, they are choices that we then share with our clients to make them feel empowered that they have the opportunity to change the way they are living,” Garber said.

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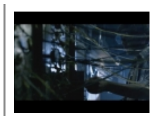

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I wonder how this new materail from Europe will score: LEED platinum PLUS???

Imagine a building product that is simple, energy saving, emission free, sustainable, Cradle
to Cradle (C2C), "green" and can be reused/recycled several times over a lifecycle of 400
years plus and at the end of its lifecycle converts back to its basic ingredients to make new
material. During its life cycle it saves energy, protects against fire, vermin and termite
attacks while providing comfortable living conditions for the inhabitants.
A new material? Not really. It's been around for over 100 years. But it has evolved, especially over the last
15 years, into a building material that fits perfectly our future needs for sustainable green buildings.
Basic ingredients: Wood Wool (excelsior) and Ordinary Portland Cement (OPC) and Water.
Authors note: OPC when used in this material has a green energy/CO2 footprint in its LCA.
If its been around for over 100 years why don’t you see a lot of it? You probably do know it as it is widely
known for applications in fire resistant and sound insulating ceiling boards. Limited use in the America's but
widely used in Europe (annual production levels of around 20 million square metres (200 million ft2)).
In Europe the production of this Wood Wool Cement Board (WWCB) has been modernized since the
invention of a rotating wood wool machine by Eltomation resulting in a much more automated and safe
production process compared to the process on hand filled excelsior machines that where customary till the
mid '90-ties. These old hand filled machines are still widely used in the US for excelsior used in erosion
mats and limited for ceiling boards where the binder is not OPC but MgO. Compared to MgO boards,
WWCB is waterproof and stable even after many years of outdoor use in all whether conditions.
WWCB in Europe is produced in a range of densities from 300kg/m3 to 1200 kg/m3 (17lb/ft3 – 68lb/ft3).
Depending on the application it is combined with a lot of different sandwich layers like EPS, PUR or gypsum
resulting in a range hundreds of different end products that can be spray- painted without loss of fire
resistant and/or sound insulating properties.
Especially the higher density products (although less sound absorbing) can be used structural as a fire
resistant and vermin proof alternative for cement backer board, CBPB or woodchip/resin products like OSB
for stick build constructions. WWCB is also mould and rot resistant and 100% waterproof. Applied as OSB
but with properties that add to the overall quality, safety and durability and thus value of the construction.
In areas where earthquakes and/or hurricanes occur WWCB with a dedicated specific weight can provide
insulating permanent shuttering for reinforced concrete multi story buildings. In Japan WWCB panels of
900 kg/m3 (50lb/cft) provide additional strength, sound and temperature insulation as well as fire resistance
to buildings. Reinforced WWCB normally used for roofing can also be used for construction of strong and
well insulated single and 2 story social houses in developing countries all over the world.
New WWCB products are the very low density (≤ 300 kg/m3 or ≤ 17lb/ft3) WWCB Large prefab wall
Elements (LE) and the earlier mentioned medium density boards (1100 kg/m3) that due to their specific
product properties appeal to builders all over the world as alternative green solutions that both fit in
conventional building concepts as well as open ways for new building concepts.
The LE prefab walls have a very high heat buffering capacity combined with an excellent R-factor of 5,3
p/m2 at 40 cm thick (R= ± 30 p/in2 at 1'4" thickness). As prefab solid SIP's they are excellent for fast and
efficient building. All the walls for a single story 100 m2 (1,000 ft2) house can be placed in just a few hours.
Reduced risk of failure cost and much faster delivery of the building to the new owner. So an energy plus
building comes into reach when building with LE's.
One should realise that all low density WWCB is applied as NON structural green insulating building
material. As the LE is 40 cm (1'4") thick, recesses on the top and sides form the mould for a reinforced
concrete, steel or wooden beam skeleton of a ringbeam and supporting columns. If the load bearing
construction is calculated according to local building regulations, the use of LE should meet less resistance
as an insulator. In Sweden it works. Over 140 houses, condo's and several office

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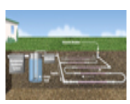
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