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Embedded Energy in Buildings

By Gilbert Woolley

For the past 30 years we have been harangued and implored to reduce use of energy and raw materials: drive less, turn down the thermostat, insulate; recycle paper, cans and bottles; use renewable materials and fuels. These are all necessary and beneficial. But there is one major use of energy that has received little attention: the energy "embedded" in construction materials. This is the energy used to turn wet clay into hard baked bricks, limestone into lime and cement, to melt and process steel, copper and aluminum used in a building. The raw materials for roofing shingles, vinyl siding, cable insulation and plastic piping is derived from oil or natural gas. Even the insulation added to reduce energy losses has an energy content.

To this must be added the energy used to mine the clay, lime and sand, to harvest trees and to transport these materials from mine, quarry and forest to the factories where they are processed, and finally to the construction site. For a typical house in Massachusetts, this embedded energy may exceed the energy used to heat, cool and light it over a fifteen year period. So, how can some of this energy be saved?

There are significant differences in the energy embedded in various materials. In general, lighter construction embeds less energy than more solid masonry construction. However, masonry has a much longer potential life and has other advantages, like rot and insect resistance. In poor countries materials salvaged from demolition of buildings are often recycled, but in the US the cost of labor to separate the wood, cables and pipes from the concrete, plaster and bricks is usually greater than the value of the materials salvaged and the demolition debris is hauled away to a landfill, adding transportation energy and compounding another dilemma of modern life: shortage of landfill space.

The optimal way to save embedded energy (and in the long run to save money) is to make buildings last longer. Often, demolition is not necessary. Rooms can be added to houses; factories and warehouses are turned into office space; pricey condos and apartments; unused churches are transformed into restaurants and schools into apartments. Such re-use by the private sector is usually motivated by cost savings. Local examples show how apparently unpromising buildings can be "recycled". The computer design and prototype manufacturing workshops of Digital Equipment Corporation were located in a 150-year-old mill in Maynard. This mill was fitted out with the latest methods of communication, including fiber optics cables throughout the million square foot, 21 building complex. The old windows were double glazed, air-conditioning added and roofs well insulated. Just over the border from Newton in Watertown, "HighTech" Boston Scientific has refurbished an old water mill on the Charles River. These old buildings are often better built and have finer esthetics than recent construction.

If you are planning remodeling or an addition to your home, ask your architect to incorporate the existing building into the new design. A building is just a shell and the conveniences of modern life can be added to it. In Europe and Asia, buildings are still in active use that are 500, 1000 and more, years old. Even in the US buildings more than 200 years old can be found at many older universities, such as Harvard, and in historic sites like Faneuil Hall and Quincy Market. There are many examples of imaginative use of old buildings, impressive structures that escaped being been torn down in the name of "urban renewal".

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