

# CONSTRUCTION MATERIALS & SUSTAINABILITY

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In the past, the selection of building materials for the design and construction of facilities was a decision based primarily on cost and design considerations. Will the material provide the desired life span? Is it economically feasible? Will it look good?

Today, many building owners are adding in sustainability as another factor to be considered during the materials selection process. Any newly created or renovated facility immediately makes an environmental impact: According to the U.S. Green Building Council, buildings account for 36% of total energy use, 65% of electricity consumption, and 30% of raw materials use each year. Lessening this impact as much as possible can be beneficial.

Regardless of one's personal view of whether global warming is an issue or not, the idea of sustainable design – saving energy and costs, using renewable resources, and providing healthier environments – is good for everyone. Therefore, considering those materials that can be recycled or can be created from recycled components, can be a valuable element in a sustainable design strategy. When reviewing sustainability options, owners and designers must consider the potential lifecycle of the material, energy efficiency, amount of natural ingredients compared to manufactured ingredients, waste created during the creation of the material and/or the construction process itself, energy used to either create or transport the material and future recycling options. Below, we will look at two of the most widely used construction materials – brick and concrete – and also look at glass curtain wall systems to determine how each of these options stand up to the sustainability test.

## Concrete Thinking

Benign, non-toxic, and inorganic, concrete is, overall, a solid choice as a sustainable material. Containing natural materials such as sand, gravel or crushed stone, water and air, concrete also contains Portland cement, which does require energy to be expended during the creation process. However, supplementary materials that can be added to the concrete mix such as silica, fume, and slag can replace a portion of the cement in the mix and increase the sustainability, and possibly the durability, of the product.

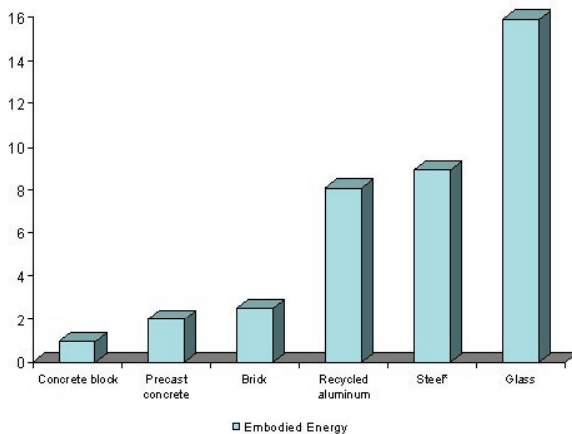
Another advantage of concrete is its ability to be recycled. New technologies are improving the ability to help separate aggregate, which is the recyclable material within concrete, from rebar and other components and enable its reuse as aggregate for new concrete. While recycled aggregate is, on the whole, less expensive to purchase than new aggregate – as with concrete composed of entirely new components – the quality and durability of concrete made with recycled aggregate is subject to the quality of the aggregate used: Poor quality going in will result in poor quality coming out.

One growing use for concrete is for the creation of precast concrete panels. These large concrete panels are formed in a plant setting, reducing the amount of debris at the site. They are then delivered to the jobsite from a plant, which, in most cases, is within 200 miles of the project – limiting the amount of energy required to ship the pieces. From a heat loss/gain perspective, precast concrete insulated sandwich wall panels offer a high "R" value, resisting the flow of heat and lowering HVAC requirements. Precast panels also have a reduced number of joints, which reduces the chances of uncontrolled air infiltration. Plus, because concrete stores heat, peak loads are shifted from mid-afternoon during the summer months to after 5 p.m., when energy loads are reduced.

## Building with Brick

Composed of clay and shale – some of the earth's most abundant materials – brick is inert and does not create any long-term environmental concern, making it another good sustainability option. It is also one of the most commonly salvaged building materials and can incorporate recycled or industrial waste aggregates in its creation. In addition, because brick is produced in nearly every state, the average shipping distance for brick is only 175 miles, minimizing the energy consumed in transporting the material.

Like concrete, brick also is beneficial for heating and cooling, particularly when used as a veneer with insulation. In this case, the material's thermal mass enables it to store heat and moderate daily temperature swings, creating a high "R" factor, optimizing energy performance and lowering HVAC needs.



Embodied energy refers to the amount of power required to construct or maintain a material. While brick and concrete have relatively low levels of embodied energy, the cement used in concrete is high in both embodied energy and carbon dioxide output (a ton of CO<sub>2</sub> is emitted for every ton of concrete created). Note that the durability of brick and concrete can offset the embodied energy impact.

\*All steel today contains some recycled content.

### Opening Up to Glass Curtain Walls

Another way to increase sustainability in a commercial building is to replace a portion of a traditional concrete wall with glass curtain wall (where appropriate). These systems are lightweight, reducing the amount of force on the foundation. In addition, glass curtain walls enable building owners to take advantage of daylight, which can reduce the lighting load and lead to a reduction in the cooling capacity required for the building.

Glass curtain walls have two primary components: the glass itself and a metal frame made of aluminum. These two materials are two of the world's most plentiful recycled materials.

- Glass.** Composed primarily of natural materials such as silica, soda ash, limestone and cullet (a post-industrial glass waste that is fed back into the float process), glass can have special glazings or coatings applied to minimize cooling and heating loads on the building. For instance, there are glazings which allow more light to be conducted through the glass but simultaneously provide greater shading capabilities, as well as a glazing which can be switched from clear to tinted by flipping a switch, resulting in dynamically controlled thermal and optimal properties. Also available are low-emittance (Low-E) coatings, which are microscopically thin,

virtually invisible, metal or metallic oxide layers deposited on a window or skylight glazing surface primarily to reduce heat loss by suppressing radiative heat flow. Low-E coatings can provide good thermal performance and still allow for clear glass.

- Aluminum frame.** Aluminum provides strength and stability to the glass curtain wall. While aluminum is generally less energy efficient than other materials and is high in embodied energy (see chart at left), frames made of aluminum offer the added benefit that the metal can be repeatedly recycled. In fact, according to the Denver Chapter of the AIA Committee on the Environment, the energy needed to recycle aluminum is only 11% of the energy required to create virgin aluminum. Furthermore, thermal breaks within the frame improve the thermal performance and help to avoid condensation problems which can occur if weeps, drainage channels and air equalization methods are not incorporated into the curtain wall design.

### Building in Sustainability

As you can see, incorporating sustainability does not have to be a difficult undertaking, especially considering that materials such as concrete, brick, glass and aluminum may already be the building materials of choice. While offering sustainability options is rapidly becoming a hallmark of good design and engineering practices, if you are not provided with this information and options on your next project, and sustainability is a goal for your company, make sure you ask your architect/engineer about all of the sustainability options available. They may be easier to incorporate than you think.

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