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Concrete: The Natural Alternative for Building Construction

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ABSTRACT

Concrete, along with its most essential ingredient portland cement, utilizes some of the earth's most abundant materials for its raw materials - limestone, clay, sand and gravel. These materials also are highly local or regional which minimizes energy and fuel requirements for handling and transportation costs when compared to other building materials. Industrial and consumer wastes are productively recycled as raw materials in cement and concrete manufacture. Hazardous wastes are used as fuels in cement manufacture which not only removes potentially harmful materials from the environment but recovers the energy that is available within them thereby conserving scarce fossil fuels. Structures built of concrete are more durable, require less maintenance, need less energy to heat and cool them and are more resistant to the ravages of fire, wind and insects. Concrete promotes a healthier indoor atmosphere since it is practically inert and requires no preservatives. In addition, concrete is created on an as needed basis resulting in less construction waste. It does not decay and can be recycled by grinding to be reused as coarse aggregate. When used in pavement, concrete due to its light color and reflective properties helps reduce heat island effects in communities saving energy for air conditioning , reduces smog, and improves living conditions. Pervious Portland Cement Pavement effectively "treats" stormwater and replenishes our drinking water supply with high quality, purified water. Considering the entire picture, concrete certainly is a very "green", environmentally friendly building material.

Keywords: Sustainable, green building material, concrete, cement, pervious pavement, cool communities, environmentally friendly, recyclable, thermal mass, energy efficient, durable.

Discussion

The true measure of a product's environmental impact is "sustainability - providing for the present but not at the expense of the future". This means looking at the total picture: expenditure of resources, impacts of production, distribution, use, longevity, maintenance and ultimate disposal. In this regard concrete stands head and shoulders above all other building materials. Aside from resolving the dilemma of dwindling resources, concrete structures are safer, more durable, require less maintenance, need less energy to heat and cool them and are more resistant to the ravages of fire, wind and insects.

Concrete is produced from some of the earth's most abundant raw materials. Portland cement, which makes up about 12% of concrete, is manufactured from limestone, clay and sand. Sources of aggregates are just as plentiful: sand, gravel, crushed stone and harmless consumer waste products like fly ash, slag and recycled polystyrene. Additionally wastes, many of which are classified as hazardous, are utilized as fuel in the manufacture of portland cement. This removes potentially harmful materials from the environment while conserving scarce fossil fuels. Wastes commonly used as fuel include scrap tires, used motor oil, industrial solvents and sludge.

According to U.S. government figures, the manufacture of portland cement - the only energy intensive component of concrete - uses even less energy than the production of lumber and wood products in this country. Additionally, energy requirements for handling and transporting concrete are extremely low. Concrete is produced locally, often in the very same community in which it is used. In contrast, other building products - like lumber and steel - are routinely shipped hundreds and even thousands of miles from production to jobsite.

On the jobsite, concrete is used on an "as needed" basis eliminating the waste inherent in sheet goods and dimensional framing. It is also safe for both the earth's environment and that of the building's occupants. It is completely inert, non-toxic, waterproof, fire resistant, does not rot or rust, is termite and insect proof and requires no special coatings or preservatives. It is completely recyclable, can be ground up and reused as aggregate in concrete or as pavement subbase material. It is also an energy efficient material utilizing its property of thermal mass to mitigate temperature swings keeping buildings cool in the summer and warm in the winter.

Energy efficiency also extends to concrete pavements where its light color and reflective nature can reduce the number of street lights by one-third, according to a North Carolina study, saving kilowatts and taxpayer dollars. The reflective nature also keeps concrete pavements and communities cooler. Computer modeling has shown that concrete pavements, in conjunction with light colored roofs and buildings along with strategic planting of trees, can reduce the heat island effect of a community by as much as 10ºF. Several pilot projects are currently underway across the country to physically test the computer findings. One is Jordan Commons in Homestead, Florida which is a 200 unit, 44 acre community being built by Habitat For Humanity. Temperatures and energy consumption (which is anticipated to be cut in half) will be monitored by the Florida Solar Energy Center.

Another product, portland cement pervious pavement, provides an environmentally sound alternative of improving the quality of stormwater runoff and recharging the aquifer. Pervious pavement is a discontinuous mixture of coarse aggregate, portland cement, admixtures and water which allows for the passage and storage of stormwater while remaining structurally adequate for parking and traffic areas. The product also serves as an anti-pollution measure. With a void structure of 15-25%, pervious

pavement offers bacteriological treatment of the pollutants much like a trickling filter sewage treatment plant and offers more filtration media before reaching the groundwater level than do conventional methods. In addition, concentration of pollutants in one spot (i.e. retentions ponds and exfiltration systems) is greatly reduced.

Over the past few years, the concrete industry has been rapidly developing new products and technologies that allow concrete - whether cast-in-place, masonry, precast structures or concrete pavement - to perform better, be handled more easily and cost less to install. Many more products are available than discussed in this paper. Some you have heard about or will be hearing about in other segments of today's conference.

Concrete is no longer just a utilitarian material. The boundless ranges of shapes, sizes, textures and colors that concrete may take gives to concrete the distinction of accommodating any form into which it is molded. Architectural expression is truly limited only by the imagination of the designer. That combined with all the environmental benefits point to concrete as not being gray at all. It's "green".

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