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Product Warning – Some “Sustainable” Building Materials May Not Be Safe

As the design and construction industries in California and Nevada embrace sustainable building codes and initiatives, there has been a corresponding rush to utilize new “sustainable” or “green” building products. CMACN is dedicated to sustainable building practices, including building products that incorporate recycled materials. However, sustainable building products, whether new or traditional, must meet ASTM requirements for material properties, and meet building code requirements for structural integrity and fire safety before they can be used in building construction.

Recently, the market has seen an infusion of “sustainable” building materials that claim to possess the same physical, structural, and aesthetic properties of traditional building materials. Most of these products contain some sort of recycled material bound together by resins, cement, or proprietary chemicals. Most of these products claim to meet the requirements of the ASTM Standard of the traditional material that the “new” material is proposed to replace. The product brochures, and webpages for these materials claim that the same design and construction techniques used with traditional materials apply directly to their new material. Designers, owners and building officials are cautioned to investigate these claims before using, or approving, these products.

As an example, recycled carpet is being bound with plastic resins to form a “brick.” The manufacturer claims that the new sustainable product performs exactly as traditional brick; and further, that traditional mortar and building techniques are used to build with these new “bricks.” Unfortunately, several vital physical characteristics have been ignored by the manufacturer. For structural integrity, a brick needs to absorb water from the mortar. This interaction has two effects: it creates the brick/mortar bond that is necessary for both water penetration resistance and structural performance; and, it decreases the mortar water/cement ratio prior to the plastic set of the mortar, hence increasing the mortar’s final strength. A resin-based material does not absorb water from the mortar, thus the intended bond is not created, nor is the expected strength of the mortar attained. Just as important from a safety standpoint, fire ratings for traditional brick cannot be directly or automatically applied to a new resin-based material.

Similarly, compressed soil is being marketed as a “sustainable” replacement for concrete masonry materials. The promoters of compressed earth materials claim that their new “earthen block products meet the relevant ASTM C 90 requirements.” The promoters seem to think that they can choose the characteristics outlined in C 90 that are “relevant.” Compressed soil units are made from “a soil composite using pre-consumer quarry by-product,” in other words, the soil overburden and washings from the mining and production of sand and aggregates.

The design and construction industry are being duped by promoters of compressed soil materials. ASTM C 90 is the *Standard Specification for Loadbearing Concrete Masonry Units*, not the *Standard Specification for Compressed Soil Products*. ASTM C 90 contains minimum requirements that help assure quality performance. As such, ASTM C 90 is very specific as to the materials that are permitted in concrete block, as well as the material properties of those ingredients: hydraulic cement (cementitious materials conforming to ASTM C 150, C 595, C 1157, C 618, or C 618), water, and aggregates (conforming to ASTM C 33 or C 331), with or without the inclusion of other materials. “Soil” is not specified in ASTM C 90 as an acceptable aggregate for loadbearing units (unless it meets ALL the requirements of ASTM C 33 or C 331).

Units conforming to ASTM C 90 must meet specific physical requirements. They must have a minimum compressive strength of 2,000 psi (average of three units), they must conform to linear shrinkage requirements, and they must meet maximum water absorption requirements. Promoters of compressed soil products generally tout their materials as meeting the compressive strength requirement of ASTM C 90. It is interesting to note that some species of wood will also meet this minimum compressive strength requirement, but we would not say that “wood meets the requirements of ASTM C 90.” Compressed soil units do not meet the requirements of ASTM C 90, and therefore cannot be casually substituted for traditional concrete masonry material.

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Two of the more troubling facets of compressed soil units are the claims that existing concrete masonry code requirements, design equations, and construction techniques can be directly applied to compressed soil; and the inference that compressed soil units will have the same fire resistance as concrete masonry.

For decades, research and testing methods have been developed and performed to document the physical properties of concrete masonry construction. Test protocols for concrete masonry follow the appropriate ASTM testing standards. Reinforced concrete masonry is designed to behave as a composite matrix of concrete masonry units, grout and steel reinforcement. The interaction of concrete masonry units, mortar, grout, and reinforcing steel have been studied, and equations developed to safely design and construct loadbearing concrete masonry structures to resist seismic and wind loads. Compressed soil units have not been subjected to this rigorous evaluation. It is unknown whether the existing equations used to design concrete masonry structures even apply to these materials. The interaction of a compressed soil unit with traditional grout, mortar, and reinforcing steel is unknown. The seismic and wind load failure modes are unknown. These unknowns are very dangerous, particularly in seismically active California and Nevada. We are unaware of any full scale walls having been constructed and loaded to failure to determine if these soil based products perform as traditional concrete masonry units; we are unaware of any assemblages that have been constructed and then dissected to determine the interaction of the compressed soil, grout, mortar, and reinforcing steel; and, no new ASTM Standards have been developed for compressed soil materials.

ASTM Committee C-15 Position on Usage of C-15 Standards: “C-15 does not endorse usage of its standards for masonry units to validate new products made from materials that are not within the materials and manufacture limits defined for each standard. Even though these new units may meet the physical property limits of these existing standards, C-15 does not recognize claims that units made from materials or through processes outside the current scope of these standards will perform in a satisfactory manner. Only testing and performance correlations of the physical properties of the new masonry units made from a new material can provide true indicators of performance and durability for a masonry unit of that material.”

ASTM Committee C-15’s Recommendation for Non-Traditional Masonry Materials Seeking Validation: “In an attempt to identify material compositions and appropriate physical property requirements for these new products, C-15 has in-place a task group to identify appropriate indicators of performance for masonry units made of non-traditional materials. This was established in response to requests of a material manufacturer of masonry units made primarily of recycled carpet. ASTM Committee C-15 welcomes manufacturers of masonry units composed of non-traditional materials to join its efforts in providing appropriate physical property requirements and performance indicators of their products. This way, consumers are better able to compare materials and assess those products best suited for the life and serviceability of their projects.”

In addition to its superior structural performance, concrete masonry construction also provides excellent fire protection. The fire resistance ratings of concrete masonry walls are commonly determined by a standard, code-approved, calculation method. This calculated fire resistance method is based on extensive research and testing of concrete masonry walls. Fire testing of wall assemblies is conducted in accordance with the *Standard Test Methods for Fire Tests of Building Construction and Materials*, ASTM E 119, which measures four performance criteria: resistance to the transmission of heat through the wall assembly; resistance to the passage of hot gases through the wall sufficient to ignite cotton waste; load-carrying capacity of loadbearing walls; and resistance to the impact, erosion and cooling effects of a hose stream on the assembly after exposure to the standard fire. Using the calculation method, the aggregates used to manufacture the concrete masonry unit are used to determine the fire rating for a wall assemblage. Soil is not included in the types of aggregate used to calculate concrete masonry fire ratings. The promoters of compressed soil products need to perform tests equivalent to ASTM E 119 to determine the fire resistance capacity of their material before it is incorporated into a fire resisting structure.

Designers, owners and building officials need to be very vigilant in determining the physical characteristics of “sustainable” building materials promoted as replacements for traditional building materials. Test reports and the results of legitimate studies should be obtained and reviewed prior to accepting any building material used in a loadbearing structure.

Traditional concrete masonry products can contribute to LEED[®], and other green rating systems, as can newly introduced “sustainable” products. However, the physical characteristics of traditional concrete masonry products are well known, and design provisions well tested. Some “sustainable” building materials may not be safe.

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