Design and Construction of a Fly Ash Geopolymer Cement Concrete Residential Building

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ABSTRACT

This paper details the development of a geopolymer cement concrete used for the purpose of constructing continuously insulated, double-wythe, precast concrete wall panels for a single-family residential building. The benefits of concrete, such as thermal mass and durability, have been difficult to justify in residential construction due to the large ecological footprint of Portland cement. Geopolymers, sourced from the waste material fly ash, offer an alternative to Portland cement as a binder that can be produced with greatly reduced carbon emissions. The resulting concrete material has the possibility to expand the material palette that is appropriate for residential construction and has the potential to widely improve the energy performance of single family housing. In order to demonstrate these benefits, a precast concrete house was designed with advanced energy conservation features. A geopolymer cement concrete mixture was designed and prepared within the facility of a concrete precaster. Some challenges arose related to the particulars of mixing, placing and curing geopolymer cement concrete and their solutions are described. Many successes were also realized with regards to structural performance of the concrete, and predicted energy performance and livability of the house. These benefits are described in this paper.