Small-scale testing for feasibility of rubblized concrete foundations

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Abstract

Affordable, sustainable housing plays an essential role in providing equal opportunity for individuals within most communities in the United States, (e.g., in the area of eastern Washington State). In particular, a lack of family residences presents a challenge for the City of Spokane, and low-income residents. Moreover, building materials reuse is an important sustainability issue and concrete waste from demolition of residential buildings presents a challenge. This paper presents preliminary results for development of rubblized concrete foundations. Initial tests were conducted on scaled pseudo-soil/concrete materials to observe the relative stiffness of the proposed system for potential use in planning subsequent phases of testing, including full-scale testing. Initial results of this early testing confirms that a reinforced rubblized footing will likely have an overall stiffness (in terms of response to loading) that is measurably less than that of a conventional reinforced concrete footing.

Keywords: rubblized concrete, gravel footing, alternative foundation, reinforced footings.

1 Introduction

For every human in the world there is one ton of concrete produced every year. Due to the abundance of this building material, the negative impacts of traditional concrete have progressively grown into a pressing concern for engineers. The cement manufacturing industry emits significant amounts of carbon dioxide equivalents. In fact, if the cement industry were a country, then it would be the third largest emitter at 8% of total global emission and making it the third-largest source of carbon emissions in the United States **[1, 2]**. One of the reasons for the high carbon exhaust is the mass amounts of raw materials necessary for cement production, the intensive production heating process, and transportation and construction emissions. While there are a number of infrastructure and building applications that necessitate the use of concrete, increasingly, the engineering profession is looking to replace concrete with more sustainable building materials (e.g., concrete walls and slabs with cross-laminated timber panels) wherever possible and realizing significant savings **[3, 4]**.

In an effort to improve sustainability and reduce construction cost (thereby improving affordability), this research proposes a novel method for alternative residential foundations: reuse of concrete, by rubblization, that is then encased in geotextile material, potentially with reinforcement added. As an initial step in developing this type of alternative foundation system—complete with appropriate design parameters and guidance—this paper presents the literature review of related topics, introduces a preliminary experimental program, discusses preliminary results and outlines the ongoing research and next steps.

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