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Effect of moisture condition on mechanical behavior of low strength brick masonry

Navaratnarajah Sathiparan*, Udayakumar Rumeshkumar

Department of Civil Engineering, Facility of Engineering, University of Jaffna, Ariviyal Nagar, Killinochchi, Sri Lanka

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ABSTRACT

The purpose of the research presented in this paper was to determine the influence of moisture on mechanical properties of brick, mortar and masonry. The strength of masonry structure was primarily influenced by a number of factors such as brick/block, bedding mortar, construction quality, pre/post environmental condition, etc. Among the factors affecting such behavior, the presence of moisture plays a key role in the deteriorating state of masonry structures. For this reason, in the present paper the compressive strength of bricks, cement mortars as well as compressive, shear and bond strength of masonry prisms are investigated, in oven-dry, air-dry and wet conditions. The experimental results demonstrate that moisture significantly reduces the compression strength of a brick and cement mortar; the greater the moisture content the lower compression strength. However, the compressive strength of masonry not improve in oven-dry condition, but reduce in wet condition. Moreover, shear and bond strength of masonry reduce with increase in moisture condition.

1. Introduction

Masonry was used widely as the predominant building material before materials such as concrete and steel have been introduced in construction. Brick masonry is still the most popular building material particularly in developing countries due to its easy handling and low costs in construction. Besides, brick masonry provides many additional advantages such as aesthetics, effective heat and sound isolation, fire resistance and economical construction. Due to its many advantages, brick masonry is widely used for the construction of residual houses and infill wall of concrete frame structures that are exposed to the various environmental condition. Also, masonry structures are more vulnerable to extreme natural events like earthquake, windstorms, floods, etc. Therefore, to understand the factors affect the structural behavior of masonry under the different extreme environmental condition, become a critical issue. It was found that the masonry strength was primarily influenced by a number of factors such as brick/block, bedding mortar, construction quality, pre/post environmental condition, etc. The presence of moisture plays a key role in the deteriorating state of masonry structures.

Moisture in external masonry can originate from a number of sources such as;

- Rising damp occurs when groundwater flows into the base of a construction and is allowed to rise through the pore structure [1].
- Rain, particularly when driven by strong winds, can penetrate the masonry walling, typically at mortar joints
- Moisture vapor transmission from activity within a poorly ventilated building.

With unwanted moisture intrusion, masonry units and mortar can crack. When water enters brick or mortar, thermal expansion can cause spalling in the masonry structure. Eventually, spalling can cause large sections of the masonry to crumble and fall off, potentially leading to structural damage. Other adverse impacts include deterioration in strength of masonry and deterioration of the wood or steel, which are part of the masonry structure. In addition, there are some aesthetic impacts such as efflorescence, failure or staining of interior finishes, the growth of biological organisms and worsening odors. For engineering point of view, decreases in the strength of masonry are critical to understand the safety of structure during moisture changes.

The change in moisture content caused by wetting and drying has a considerable effect on the mechanical properties of masonry [2–4]. Masonry contains a great number of voids comprising gel pores, capillary pores and flaws. At the two extremes, these voids may either be fully filled with water (wet saturated) or fully filled with air (dry). Under intermediate conditions, a mixture of water, water vapor and air may be present in the void. More often than not, brick walls are subject to strong moisture during use, and in exceptional circumstances, complete water saturation can be reached in masonry materials. The water

* Corresponding author.
E-mail address: sakthi@eng.jfn.ac.lk (N. Sathiparan).

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