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# Use of recycled plastic water bottles in concrete blocks

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**Abstract**

The purpose of this study is to examine the possibility of using plastic bottles in concrete block. The plastic bottles were used to create voids at equal distance between them in the masonry units. Concrete was placed around each bottle to encase it in the masonry units. The study utilized 500-mL plastic bottles placed inside concrete masonry units and analyzed the compressive strength. The testing for compressive strength was determined according to the ASTM C140 standard. Results from this study were deemed reasonable due to the testing of concrete cylinders as a control of compressive strength for the concrete blocks from Oman's market. This study shows 57% difference in the strength by using plastic bottles compared to local concrete blocks. This proves the necessity for further research regarding concrete mix design, amount of cement and properties of local concrete blocks as well as other technical and non-technical aspects to determine the appropriate mix design and feasibility in the production industry.


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*Keywords:* concrete blocks, plastic bottles, recycled materials

## 1. Introduction

Concrete masonry unit or concrete block is an important and common member in building construction in Oman. Usage of plastic water bottles are increasing rapidly in Oman and this country is facing the challenge of overflowing of landfills and impacts of disposal of plastic water bottles. Moreover the plastic bottles can provide thermal insulation that can reduce the consumption of electricity for cooling which is highly important since Oman has

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subtropical dry hot desert climate. This research intends to study the possibility of using recycled plastic water bottles within the local concrete blocks for the purpose of building construction with the focus of verifying the compressive strength. Hollow concrete block is a significant kind of masonry units existing for the builders and its application for masonry construction is increasing continuously. (Ahmad et al, 2014) Hollow concrete blocks may be used, as alternatives to bricks and traditional stones in construction and buildings. Due to its smaller weight and ease of transfer compared to bricks. Moreover it provides an advantage of uniform quality as well as speeding in construction and the largest durability. On one hand economically, they are less expensive, and consume less cement and less involvement of laborers. In addition, they can be used, in different places. Such as the interior walls, exterior walls bearing, and columns, the compound walls, and retaining walls etc. (Maroliya, 2012) several researches completed particularly to study the compressive behavior of concrete blocks mixed with other materials, commencing with 'High-Performance Concrete Masonry-Block Mix Design' by Amiri et al. This research was conducted on concrete block masonry design in 1994. This study looked at 41 different kinds of concrete mix designs and assessed the compressive strength of concrete with different types of aggregates. Amiri et al study determined that use of a minimum void gradation and a maximum aggregate size 1/4 inch (6.4 mm) allow a high-performance of lightweight to reduce the cost of concrete masonry block . Chandrakeerthy investigated on four test methods concerning properties of cement blocks to study the relationship of variables and properties with compressive strength at 1991. Chandrakeethy's study suggests the implementation of one part cement to one part sand capping with plywood packing. Compressive behavior of concrete with vitrified soil aggregate was tested by Palmquist et al through examination of 10 batches at four different coarse aggregate volume fractions with three different combinations of vitrified and natural coarse aggregates. Results show that compressive strength decreases when volume fraction of vitrified soil aggregate increases. (2001). Researches by Ahmad et al (2014) to compare masonry hollow concrete block and masonry brick and Maroliya (2012) on load carrying capacity of hollow concrete block masonry wall confirmed that the strength of hollow concrete block masonry wall is lower than brick masonry wall but the cost of construction of hollow concrete masonry wall is less. Stahl et al (2002) used recycled wood aggregate to prepare lightweight concrete masonry blocks and control the outcome to meet the conditions of ASTM C129.Trial cylinders and blocks were tested and found to be complying with the standard in terms of weight, compressive strength and durability. However economic performance was not studied.

The idea of using plastic bottles in concrete building construction was originated by Andreas Froses in Eco-Tec in 2001 where PET bottles are installed within the walls along with mortars to shape a structure (Froese, 2014). The Engineers without Borders at Kansas State University have worked on a method to use plastic bottles in wall construction of concrete walls. These plastic bottles were installed horizontally with concrete as mortar between them and also in the sides. Further tests were conducted to examine the compressive strength of concrete masonry units with plastic bottle cores. Results of the tests according to ASTM C140 showed that compressive strength is reasonable however further studies suggested to confirm the validity incase used in developing countries (Wonderlich et al, 2014)

Oman is facing challenges with regards to solid waste management and recycling. Since potable water mains do not exist in Oman consuming bottled water is greatly common and therefore waste plastic bottles management is a major challenge. Moreover hollow concrete blocks are vastly used in building construction in and thermal insulation of walls is another challenge that is faced in the hot dry climate of Oman. Using plastic bottles inside hollow concrete blocks may be a solution to some of the stated challenges. This study attempts to verify this method within the local concrete block products with the focus of testing the compressive strength for the purpose of initial validation of this method in Oman.

## 2. Methodology

The method of study designed for this research included tests for eight concrete blocks, seven concrete cylinders and six hollow concrete blocks from Oman's market. In Each block eight plastic bottles (500ml) was positioned. Main purpose is to control the concrete masonry to meet the ASTM C140 requirements. The compressive strength test was conducted for three times. First test was after 7days, the second time after 14 days and the last after 28 days. Further on the compressive strength of cylinders, bottle blocks and hollow concrete markets were demonstrated.