



## Experimental and Numerical Study to Determine the Relationship between Tensile Strength and Compressive Strength of Concrete

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### Abstract

As one of the most widely used materials in different structures, concrete is a material evaluated and categorized based on compressive strength criterion. In addition, national and international codes (INBC- part 9) and standards determine the tensile strength of concrete based on its compressive strength. The purpose of this research is to determine the relationship between compressive strength and tensile strength of C20, C30 and C40 grades. In this laboratory research, a total of 42 cubic specimens of  $150 \times 150 \times 150$  mm and 42 cylindrical specimens of  $300 \times 150$  mm were assessed under compressive and tensile tests, respectively. Based on the results of this study, the relationships presented in Ninth Article of Iranian National Building Codes, ACI-318 and Euro Code 2 have been evaluated.

*Keywords:* Concrete; Compressive Strength; Tensile Strength; Relationship.

### 1. Introduction

Despite its abundant use in building industry due to its considerable advantages, concrete has some disadvantages; so that low tensile strength is considered as the greatest deficient for concrete. According to Codes for design of concrete structures, tensile strength of concrete is ignored in the design of concrete elements. Therefore, concrete tensile strength and its effective factors are of minor importance to researchers; hence, comprehensive and extensive researches are not done in this subject. According to the American Concrete Institute (ACI-318), the tensile strength of concrete is proportional to square root of its compressive strength [1]. Recent research on the relationship between tensile and compressive strengths of concrete indicates that the tensile strength of concrete is proportional with a 0.6 to 0.8 power of its compressive strength; thus, the proposed relation in ACI-318 Code is an inappropriate relation [2-5]. In addition, the results of conducted researches show that the ratio of tensile strength to compressive strength of concrete is decreased by increasing the compressive strength of concrete. In 2007, Öttl et al. studied the correlation between tensile, flexural and compressive strength of autoclaved aerated concrete to evaluate prEN 12602 standards. The result of this research includes statistical evaluation and provides a proposal for standardization of prEN 12602 guideline [6]. In 2011, Anuradha studied the relationship between compressive and tensile strength in the geopolymer. This relationship investigated for different mixture between grade of geopolymer and the result showed that the relationship in conventional meaning was not valid for GPCs and some current relationships should use to predict tensile strength [7]. In 2013, Yan predicted the correlation between tensile and compressive strength by using SVM method. In this research, SVM and experimental method were employed to obtain compressive and tensile strength and then predict split strength [8]. In 2017, Yao investigated the relationship between compressive and splitting tensile strength of old concrete existing

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