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Review Article

# Shrinkage Behavior of Conventional and Nonconventional Concrete: A Review

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**Abstract**

Concrete is indeed one of the most consumed construction materials all over the world. In spite of that, its behavior towards absolute volume change is still faced with uncertainties in terms of chemical and physical reactions at different stages of its life span, starting from the early time of hydration process, which depends on various factors including water/cement ratio, concrete proportioning and surrounding environmental conditions. This interest in understanding and defining the different types of shrinkage and the factors impacting each one is driven by the importance of these volumetric variations in determining the concrete permeability, which ultimately controls its durability. Many studies have shown that the total prevention of concrete from undergoing shrinkage is impractical. However, different practices have been used to control various types of shrinkage in concrete and limit its magnitude. This paper provides a detailed review of the major and latest findings regarding concrete shrinkage types, influencing parameters, and their impacts on concrete properties. Also, it discusses the efficiency of the available chemical and mineral admixtures in controlling the shrinkage of concrete.

*Keywords:* Shrinkage; Autogenous Shrinkage; Plastic Shrinkage; Crack; Conventional Concrete; Nonconventional Concrete.

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## 1. Introduction

Through its lifespan, concrete undergoes several physical and chemical changes, which normally led to shrinkage of concrete, especially at an early age, when the initial hydration processes take place [1]. The shrinkage of concrete at an early stage of hardening may lead to the initial formation of cracks that vary in shape and size and depends on the concrete constituents and surrounding conditions, including temperature and/or the moisture state that may lead to volumetric deformation [2, 3]. Shrinkage cracking starts to form while the concrete is still in the plastic state and continues through the hardened state due to the applied stress on concrete particles. These stresses are created as a result of the consumption of the mixing water existed within the cement paste, which takes place after losing the water available within the pores [4]. The shrinkage and formation of cracks within the concrete texture are nearly inevitable. Generally, cracks occur when the tensile stress in brittle material exceeds its rapture strength [5]. However, the interaction of the factors and parameters affecting the development and propagation of cracks in concrete makes it difficult to isolate the effect of each parameter alone [6]. The main nonlinear phenomena that govern the shrinking behavior of concrete at early-age may include the evolution of stiffness properties, development of thermal strains, creep, and cracks formation [7].

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