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# Self-compacting concrete in pavement construction: Strength grouping of some selected brands of cements

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## Abstract

This paper investigates strength properties of some selected cement brands for self-compacting concrete application in pavement construction. Three brands each of Portland limestone cement grades, CEM II/A-L 42.5 (Brand A), CEM II/B-L 32.5 (Brand B) and CEM II/B-L 32.5 (Brand C), were used. Rheological test was carried out using the L-Box, V-Funnel and slump cone while compressive and flexural strength tests were carried out, on the hardened concrete, at 3, 7, 14, 21 and 28 days. Brand A exhibited the highest compressive strength right from 3rd day test and maintained this performance through maturity (the 28th day test). Also Brand A had the highest flexural strength of 4.54 MPa, as against 4.5 MPa specified for road construction, at 28 days, while Brand B and Brand C exhibited strengths that were lower. Although Brand C showed good rheological properties, it exhibited the lowest strength properties among the cement grades. These findings engender implication that cement grade lower than 42.5 should be discouraged in pavement construction.

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Keywords: Self-compacting concrete, cement brand, cement grade, rigid pavement, strength grouping, mechanical strength

## 1. Introduction

Concrete is one of the most utilized construction materials [1-4]. There are several types and applications of concrete in the construction industry. Self-compacting concrete (SCC) is a special type of high strength and high performance concrete used for construction purpose that requires no mechanical vibration, for even without this mechanical vibration, SCC is flowable as well as deformable [3,5], and by these, it has revolutionized concrete

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placement [6]. The use of SCC in civil engineering applications has been on the rise since more than 20 years ago, especially, through its adoption in the construction of bridges, tunnel and structures [7]. However, recent trend is now geared towards its application in road construction, the industry for which SCC has been indicated to hold positive future prospects due to its enormous advantages [8].

The uses of SCC in the construction of rigid pavements (such as traffic lanes and bridges, high-ways and airports runways) are now evidence in major areas [7]. However, problems arise from the consideration that most of the SCC pavements are found to be susceptible to different forms of cracking and other structural defect [8]. This challenge is connected to the fact that strength is one of the most important attribute of concrete pavement and concrete structures and this same attribute applies to SCC, largely because the strength of concrete depends on the quality and quantity of cement, the strength giver in concrete. The cement in concrete binds the fine aggregate (usually sand) and coarse aggregate (gravel, crushed granites etc) together to form a rigid/solid mass that is capable of sustaining loads [9]. Among others, the most important quality of cement that affects the strength of concrete structures largely depends on the grade or the strength class of cement since the strength of concrete largely determines the safety, strength and structural integrity of concrete structures [9]. This cement grade or cement grades: grade 33, grade 43, and grade 53 which are also referred to as cement strength classes 32.5MPa, 42.5MPa and 52.5MPa respectively [10]. In Nigeria, the branded class of cement is the Portland Limestone Cement instead of OPC that is usually employed by many as the branded grade [10].

Although, several works has been done on cement brands (OPC and Portland Limestone Cement) on the strength properties of steel-reinforced concrete applications [11-18] and of normal concrete for structures, there is dearth of study on the strength grouping of Portland limestone cement in SCC production for pavement construction. This study, therefore, investigated the strength properties of some selected grades and brands of Portland limestone cement for SCC in pavement construction.

Nomenclature		
SCC	Self-compacting concrete	
Brand A	CEM II/A-L 42.5 (High early strength) grade of Portland-limestone cement	
Brand B	CEM II/B-L 32.5 (High early strength) grade of Portland-limestone cement	
Brand C	CEM II/B-L 32.5 (Normal early strength) grade of Portland-limestone cement	

#### 2. Methodology

#### 2.1. Experimental material

The research experiment was designed for M30 grade of concrete. Locally available aggregates of size 25 mm and 4.75 mm for both coarse and fine aggregate were used in the experimental work. Portable water free from toxins and deleterious materials was used all through the research [11]. Mix ingredients, and proportions were according to [17]. The selected cement for this study were tagged Brand A, Brand B and Brand C, which are different brands of Portland-limestone cement, CEM, but of the group belonging to the type of common cement called Portland-composite cement designated as CEM II. This cement brand is different from the Ordinary Portland Cement (OPC) because of the single secondary major constituent, which is limestone, as well as in terms of setting time and quantities required to achieve the same strength [9]. As available in Nigeria open market and which are used for this study, Brand A is grade 42.5 of CEM II/A-L 42.5 (High early strength) while Brand B is CEM II/B-L 32.5 (High early strength) and Brand C is CEM II/B-L 32.5 (Normal early strength).

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