RCC (Roller Compressed Concrete) Skid Resistance with CNS (CAM 110 & SA CAM 110)

Using the testing evaluation from base line RCC testing and TDOT (Tennessee Department of Transportation) related to RCC surface and skid resistance for driving surfaces. The evaluation conducted during the University of Tennessee at Chattanooga (Department of Civil and Chemical Engineering College of Engineering and Computer Science) - EFFECTS OF COLLOIDAL NANO-SILICA ON ROLLER COMPACTED CONCRETE.

Introduction

Roller compacted concrete (RCC) has been a pavement solution for several years. RCC is a Portland cement concrete that is produced at near-zero slump, typically delivered to the project site in dump trucks, and typically placed with conventional or specially modified asphalt paving equipment. This method of placement is conducive to paving large areas quickly. RCC's mechanical properties including high compressive strength and high fatigue resistance have made it the paving material of choice in areas of heavy equipment or heavy truck traffic such as ports, lumber yards, recycling centers, and railroad yards. RCC has seen some use as a pavement for roadways but surface quality has been regarded as inferior to asphalt and conventional concrete. Various admixtures and surface treatments have been examined for improving surface quality in RCC with mixed results.

Colloidal nano-silica (CNS) has been shown to fundamentally change the void structure of concrete when utilized as an integral admixture and also when applied to the surface of the concrete as spray application. Additionally, CNS has been demonstrated by several research teams to increase compressive strength, increase abrasion resistance, and reduce permeability, all desirable properties for RCC pavements.

Because laboratory produced RCC cannot mimic accurately the compaction effort of project equipment, a field study was chosen to investigate the effects of CNS in RCC.

Surface Quality Analysis

The following table refers to the average of the cores examined from each of the four areas of interest as shown in figure 2.

Table 3: Surface Analysis Results

Area of Study	Avg. Largest Void (mm2)	Avg. Void Size (mm2)	Average % Voids (area of voids/total area)	% Surface Quality Improvement
Control – No Integral/ No Spray Applied	**150.48**	**1.03**	**29.1**	**---**
No Integral, Spray Applied	**123.03**	**0.75**	**19.4**	**33%**
Integral, No Spray Applied	**150.48**	**0.67**	**20.1**	**31%**
Integral & Spray Applied	**150.48**	**0.70**	**17.0**	**42%**

The RCC containing the integral CNS was observed to behave differently in the field from the outset, with noticeably fewer surface cracks and imperfections at an early age. Surface analysis utilizing ImageJ software for void/imperfection location and measurement demonstrated that the surface of the RCC either treated with the spray-applied CNS or having the integral CNS had less surface imperfections than the untreated control. Surface analysis showed that the lowest percentage of surface imperfections was achieved when both the integral and spray-applied CNS was used.

Compressive strength and density improvements were seen with all treatments of CNS over the control, with the greatest positive impact on compressive strength being the RCC containing the integral CNS and treated with the spray-applied material.

Friction factor (like a coefficient of friction): $f = F/L$

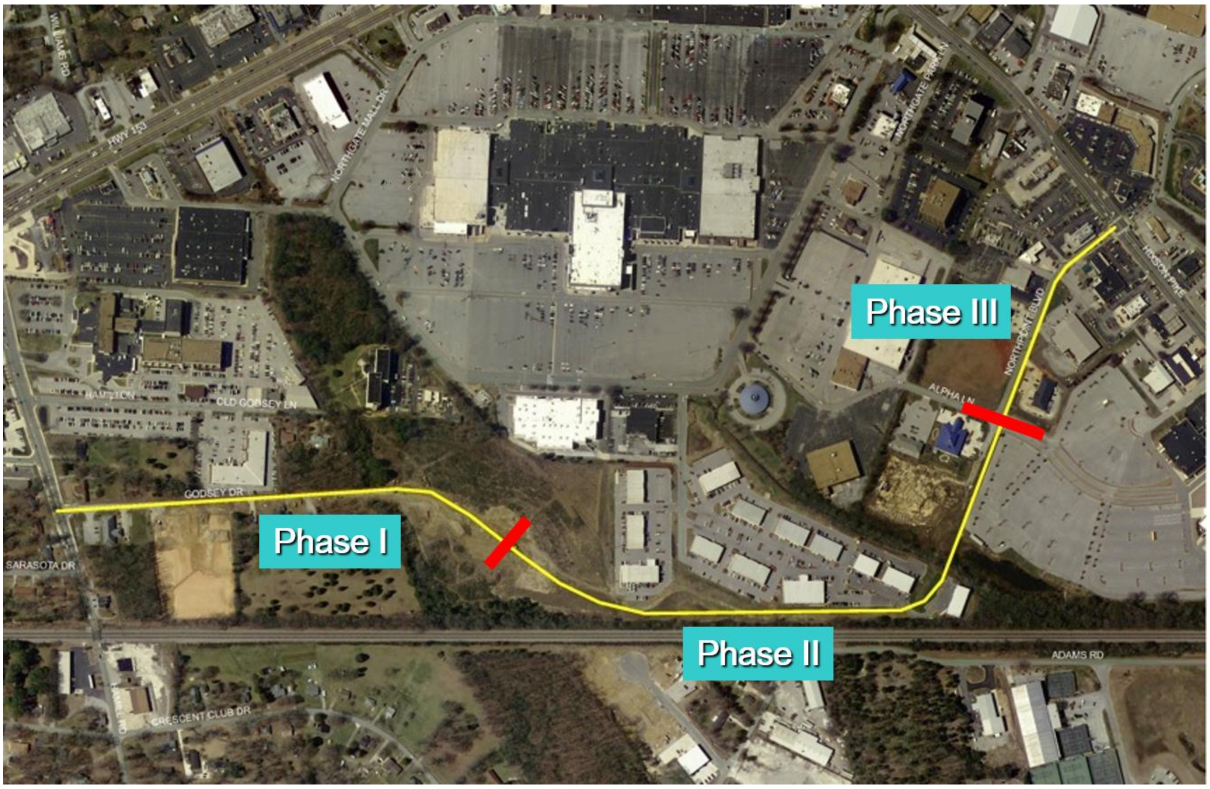
Skid number: $SN = 100(f)$

where: F = frictional resistance to motion in plane of interface

L = load perpendicular to interface

Figure 1 Formula for Friction testing evaluation

Based on these test road production for Type 1 roadways to 120km running speeds were placed and have shown safe operational performance along with reduced maintenance cost, the improvement of surface condition along with consistent quality production when using Integral and Spray applied CNS (CAM 110 and SA CAM 110) provide the needed improvement in RCC to allow these placements.



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