IN-LB	Inch-Pound Units
SI	International System of Units

Compaction of Roller-Compacted Concrete—Report

Reported by ACI Committee 309

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Roller-compacted concrete (RCC) is an accepted and economical method for the construction of dams and pavements. Achieving adequate compaction is essential to the development of the desired properties in the hardened material. The compaction depends on many variables, including the strength of the subbase, materials used in RCC, mixture design proportions, mixing and transporting methods, discharge and spreading practices, compaction equipment and procedures, and lift thickness. The best performance characteristics are obtained when the concrete is reasonably free of segregation; well-bonded at construction joints; and compacted at, or close to, maximum density.

This report summarizes experience in compaction of RCC in various applications and offers guidance in the selection of equipment and procedures for compaction, as well as for quality control of the work. Compaction equipment and procedures should be appropriate for the work. In dam or massive concrete applications, large, self-propelled, smooth, steel-drum vibratory rollers are most commonly used. The frequency and amplitude of the roller should be suited to the mixture and lift thickness required for the work. Other roller parameters, such as static mass, number of drums, diameter, ratio of frame and drum mass, speed, and drum drive influence the rate and effectiveness of the compaction equipment. Smaller equipment, and possibly thinner compacted lifts, are required for areas where access is limited.

Pavements are generally placed with paving machines that produce a smooth surface and some initial compacted density. Final density is obtained with vibratory rollers. Rubber-tired rollers can also be used where surface tearing and cracks would occur from steel-drum rolling. The rubber-tired rollers close fissures and tighten the surface.

Inspection during placement and compaction is also essential to ensure the concrete is free of segregation before compaction and receives adequate coverage by the compaction equipment. Testing is then performed on the compacted concrete on a regular basis to confirm that satisfactory density is consistently achieved. Corrective action should be taken whenever unsatisfactory results are obtained. Roller-compacted concrete offers a rapid and economical method of construction where compaction practices and equipment are a major consideration in both design and construction.

Keywords: compaction; consolidation; dams; pavements; roller-compacted concrete.

CONTENTS

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CHAPTER 1—INTRODUCTION

1.1—Introduction

Roller-compacted concrete (RCC) has become an accepted material for constructing dams and pavements, rehabilitating and modifying existing concrete dams, and providing overflow protection of embankment dams and spillways. The production of RCC provides a rapid method of concrete construction similar in principle to soil-cement and other earthwork construction. Roller-compacted concrete technology developed considerably in the 1980s, after early research by Cannon (1972), Dunstan (1977), and Hall and Houghton (1974), and the development of the roller-compacted dam (RCD) method in Japan in the 1970s. Also in the 1980s, RCC found application in roadways and parking areas, and was developed as a heavy-duty paving material for log sorting yards, tank hardstands, railroad sorting yards, and other industrial pavements. Detailed information on the use of RCC in mass concrete and paving applications is contained in ACI 207.5R (Report on Roller-Compacted Mass Concrete) and ACI 327R (Guide to Roller-Compacted Concrete Pavements), respectively.

1.2—Scope

This report discusses the equipment and special construction procedures associated with the compaction of RCC, including characteristics of the mixture relevant to compaction and the effects of compaction on the desired properties of RCC. These properties include various strength parameters, watertightness, and durability. Differentiation is made between RCC used in massive concrete work and that used in pavements. The discussion also includes provisions for measurement of compaction. This report does not cover soil-cement or cement-treated base.

1.3—Description of RCC construction

Roller-compacted concrete gets its name from the heavy vibratory steel drum and rubber-tired rollers used to compact it into final form. Fresh RCC is stiffer than typical zero-slump conventional concrete, with a consistency that is stiff enough to remain stable under vibratory rollers, yet plastic enough to permit adequate mixing and distribution of paste and placement without segregation. RCC pavements are usually placed in lifts of 6 to 8 in. (150 to 200 mm) with a 4 in. (100 mm) minimum and 10 in. (250 mm) maximum. For RCC dams, multiple lifts of concrete, generally 1 ft (300 mm) thick, are often continuously placed and compacted to construct a cross section that is a conventional concrete gravity dam. Variations in placing and compaction methodology have evolved in the past 20 years. For example, the sloping layer method (SLM) is to place five to 10 consecutive lifts on slopes ranging as steep as 20 horizontal to one vertical (H:V) to as flat as 50H:1V instead of horizontal lifts. Another RCC placing method, used primarily in Japan, is to spread three or more thin (approximately 9 in. [230 mm]) layers with a bulldozer before compacting them into one thick lift with a vibratory roller. One significant difference between an RCC dam and a conventional concrete dam is RCC dams are continuously placed from one abutment to the other, or within a series of larger (than typical dam) monoliths. A horizontal construction joint is produced between each lift in the RCC dam. In paving applications, individual lanes of concrete are placed adjacent to each other. The procedure is similar to asphalt-paving techniques. In some instances, two or more lifts of RCC are quickly placed and compacted to construct a thicker monolithic pavement section for heavy-duty use. Roller-compacted concrete is an economical, fast construction candidate for many pavement applications (Cannon 1972).

Several steps are required to achieve proper compaction of RCC construction:

1. A trial mixture should be developed to determine the water content necessary for optimal Vebe consistency