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Report on Roller-Compacted Mass Concrete

Reported by ACI Committee 207

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Roller-compacted concrete (RCC) is a concrete of no-slump consistency in its unhardened state that is typically transported, placed, and compacted using earth and rockfill construction equipment. This report includes the use of RCC in structures where measures should be taken to cope with the generation of heat from hydration of the cementitious materials and attendant volume change to minimize cracking. Material mixture proportioning, properties, design considerations, construction, and quality control are covered.

The materials, processes, quality control measures, and inspections described in this document should be tested, monitored, or performed as applicable only by individuals holding the appropriate ACI certifications or equivalent.

Keywords: admixtures; aggregates; air entrainment; compacting; compressive strength; conveying; creep properties; curing; lift joints; mixture proportioning; monolith joints; placing; shear properties; vibration; workability.

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CHAPTER 1—INTRODUCTION

1.1—General

Roller-compacted concrete (RCC) is probably the most important development in concrete dam technology in the past quarter century. The use of RCC has allowed many new dams to become economically feasible due to the reduced cost realized from the rapid construction method. It also has provided design engineers with an opportunity to economically rehabilitate existing concrete dams that have problems with stability and need buttressing in addition to improving existing embankment dams with inadequate spillway capacity by providing a means by which they can be safely overtopped. RCC has allowed new embankment dams to optimize spillway capacity in over-the-embankment-type emergency spillways (Hansen 1992).

Fig. 1.1—RCC compaction with dual-drum, vibrating roller (Serra do Facõo Dam, Brazil, 2008).

This document summarizes the current state of the art for design and construction of RCC in mass concrete applications. It is intended to guide the reader through developments in RCC technology, including materials, mixture proportioning, properties, design considerations, construction, and quality control and testing. Although this report deals primarily with mass placements, RCC is also used for pavements (refer to ACI 325.10R) and for dam stability improvement and as embankment dam slope protection (United States Society on Dams 2003).

1.2—What is roller-compacted concrete?

ACI Concrete Terminology (2010) defines roller-compacted concrete (RCC) as "concrete compacted by roller compaction; concrete that, in its unhardened state, will support a roller while being compacted." RCC is usually mixed using high-capacity continuous mixing or batching equipment, delivered with trucks or conveyors, and spread with bulldozers in layers prior to compaction with vibratory rollers (Fig. 1.1). Because of RCC's zero-slump consistency, subsequent lifts can be placed immediately after compaction of the previous lift. RCC can use a broader range of materials than conventional concrete, and derives its strength and durability from a mixture philosophy that relies on using just enough paste volume to fill the aggregate voids and no more water content than what is needed for proper workability.

1.3—History

The rapid worldwide acceptance of RCC is a result of economics and of RCC's successful performance. A bibliography of dams constructed is available from the International Commission on Large Dams. Other listings of dams constructed can be obtained from the United States Society on Dams (2003) and from the U.S. Army Corps of Engineers (USACE), EM 1110-2-2006 (USACE 2000). During the 1960s and 1970s, applications of RCC materials led to the development of RCC in engineered concrete structures. In the 1960s, a high-production no-slump mixture that could be