Concrete Overlays for Pavement Rehabilitation

Reported by ACI Committee 325

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This report provides information on the use of concrete overlays for rehabilitation of both concrete (rigid) and asphalt (flexible) pavements. Selection, design, and construction of both bonded and unbonded overlays are discussed. The overlay categories reviewed include bonded concrete overlays, unbonded concrete overlays, whitetopping overlays, and concrete overlays bonded to asphalt (ultra-thin and thin whitetopping). Information is also provided on selecting overlay alternatives. Significant portions of this document are based on a synthesis report prepared for the Federal Highway Administration (FHWA) by Applied Pavement Technology, Inc., under contract number DTFH61-00-P-00507. The report, "Portland Cement Concrete Overlays: State of the Technology Synthesis," is available from the FHWA as publication FHWA-IF-02-045.

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CHAPTER 1—INTRODUCTION

1.1—Background

Hydraulic cement concrete overlays are used as a rehabilitation technique for both existing concrete and asphalt pavements. Concrete overlays offer the potential for extended service life, increased structural capacity, reduced maintenance requirements, and lower life-cycle costs when compared with hot-mix asphalt overlay alternatives.

Concrete overlays have been used to rehabilitate existing concrete pavements since 1913 and to rehabilitate existing asphalt pavements since 1918 (Hutchinson 1982). Beginning around the mid-1960s, many highway agencies began to search for alternative means of rehabilitating existing pavements, and the use of concrete overlays increased significantly (McGhee 1994). In the 1990s, there was an even higher increase in the use of concrete overlays, spurred by improvements in concrete paving technology. For example, the use of zero-clearance pavers, fast-track paving concepts, and high-early-strength concrete mixtures greatly increased the ability of concrete overlays to serve as a viable rehabilitation alternative.

Parallel with the increased use of concrete overlays, significant research aimed at advancing the state of the knowledge of concrete overlays was conducted. One impetus for this research was the Intermodal Surface Transportation Act (ISTEA) of 1991, which included a provision under Section 6005 allocating designated funding for the assessment of thin bonded concrete overlays and surface lamination technology. The goals of the assessment were to evaluate the feasibility, costs, and benefits of the techniques in minimizing overlay thickness, initial laydown costs, and time out of service, and also to maximize life-cycle durability. As part of this effort, the Federal Highway Administration (FHWA) participated in funding 12 test-and-evaluation projects throughout the country (Sprinkel 2000).

Other examples of ongoing studies of concrete overlays are those being conducted under the FHWA's Long-Term Pavement Performance (LTPP) program. The LTPP program is divided into two complementary studies: the General Pavement Studies (GPS) and the Specific Pavement Studies (SPS). Under GPS-9, the performance of unbonded concrete overlays is being investigated; currently, 14 projects are being evaluated. Under SPS-7, the performance of four bonded overlay projects is being studied. The long-term monitoring of these GPS and SPS projects is expected to provide valuable information on the design and construction of concrete overlays. Additional information may be obtained by visiting the LTPP website at www.tfhrc.gov/pavement/ltpp/ltpp.htm.

Resurfacing asphalt pavements with concrete overlays, a process known as whitetopping, is another example of overlay research. In particular, several studies on the use of ultra-thin whitetopping (UTW), a very thin (2 to 4 in. [50 to 100 mm]) layer of concrete bonded to an existing asphalt pavement, have been conducted. In the 1990s, this technique evolved from a radical rehabilitation concept to a mainstream rehabilitation alternative. Several studies on whitetopping overlays are currently being conducted by the FHWA. Additional information may be obtained at www.tfhrc.gov/pavement/utwweb/utw.htm.

1.2—Purpose of report

Two ACI Committee 325 reports (ACI Committee 325 1958, 1967) discussed the pioneering work by the U.S. Army Corps of Engineers to develop design procedures for concrete overlays. The equations developed by the Corps for bonded, partially bonded, and unbonded concrete-on-concrete overlays are still used. The report suggested the design of concrete overlays on flexible pavement using the flexible pavement as a stiff base.

During the 1980s and 1990s, two National Cooperative Highway Research Program (NCHRP) syntheses were prepared on concrete overlays: "Resurfacing with Portland Cement Concrete" (Hutchinson 1982), and "Portland Cement Concrete Resurfacing" (McGhee 1994). There has been considerable work, however, in the area of concrete overlays since the most recent NCHRP synthesis.There is a need to assemble and synthesize information on the selection, design, and construction of concrete overlays for pavement rehabilitation.

This report discusses the selection, design, construction, and performance of concrete overlays. It is intended to provide the current state of the technology (as of 2004) of concrete overlays of both existing concrete pavements and existing asphalt pavements.

1.3—Definitions and notation

1.3.1 *Definitions*—This section presents definitions and notations unique to this report. Additional definitions for