CP ROAD MAP
shaping the future of concrete pavement

www.cproadmap.org

August 2015

ROAD MAP TRACK 7

PROJECT TITLE
Spirit of St. Louis Concrete Overlay

TECHNICAL WRITERS
Todd LaTorella
Executive Director
Missouri/Kansas chapter, ACPA

Robert Heine
Airport Engineer
Spirit of St. Louis Airport

EDITOR
Sabrina Shields-Cook

SPONSOR
Federal Highway Administration

MORE INFORMATION
Todd LaTorella, P.E.
ToddL@moksacpa.com
913-381-2251

Robert Heine, P.E.
Rheine@stlouisco.com
636-532-2222

The Long-Term Plan for Concrete Pavement Research and Technology (CP Road Map) is a national research plan developed and jointly implemented by the concrete pavement stakeholder community. Publications and other support services are provided by the Operations Support Group and funded by TPF-5(286).

Moving Advancements into Practice (MAP) Briefs describe innovative research and promising technologies that can be used now to enhance concrete paving practices. The June 2015 MAP Brief provides information relevant to Track 7 of the CP Road Map: 7 Concrete Pavement Maintenance and Preservation.

This MAP Brief is available at www.cproadmap.org/publications/MAPbriefAugust2015.pdf.

“Moving Advancements into Practice”

MAP Brief August 2015

Describing promising technologies that can be used now to enhance concrete paving practices

Spirit of St. Louis Airport Concrete Overlay

Introduction

The use of portland cement concrete (concrete) to resurface existing pavements, both hot-mix asphalt (HMA) and concrete, has been documented as far back as the early 1900s. Many of the early concrete overlays performed very well, but it was only in the mid-1980s that concrete overlay technology began to gain national acceptance with agencies and engineers.

Early in the 1990s, concrete overlay technology advancements made it possible for concrete overlays 2 in. to 4 in. thick over existing HMA to be used for various applications, including those subjected to heavy axle/wheel loadings. This technology was coined Ultra-thin Whitetopping (UTW) (now referred to as Bonded Concrete Overlay on Asphalt Pavements) which incorporated the design concepts of “short” concrete panel size (2 ft to 6 ft) with “bonding” to the existing prepared asphalt surface.

One of the first and largest projects in the country to incorporate UTW technology was at the Spirit of St. Louis Airport in Chesterfield, MO. The Spirit of St Louis Airport is a busy general aviation facility serving as the home base of over 100 corporate jets.

In addition, as the designated reliever to Lambert International, it accommodates a wide range of aircraft sizes and weights. The six-acre airfield apron pavements were originally constructed with asphalt in the 1960s to accommodate anticipated light aircraft.

As overflow from Lambert International increased, the apron, near the terminal and administration building frequently became the parking area for aircraft as heavy as 727s. The heavy wheel loadings eventually took a toll on the asphalt apron, causing severe deterioration. Exposure to jet fuel led to asphalt stripping, which contributed to the distress. To further aggravate the damage and constant repairs needed, the entire area was submerged under 9 feet of water during the flood of 1993. It was time to bring the apron up to the strength required.

Choosing the Concrete Overlay Alternative

In order to address the severely deteriorated condition of the airfield apron pavement and accommodate the need for additional structural capacity in areas to carry the heavy anticipated aircraft loadings, design options were developed to include both complete reconstruction and overlaying with concrete or asphalt.

After considering the options, it became apparent that a traditional overlay would require thicknesses that would make it difficult, if not impossible, to address drainage away from the existing buildings and terminal, which operated adjacent to the 45,000 sq yd apron. Working with CRD Engineering, Inc., a local design firm in St. Louis, the airport went through a feasibility study process that considered several options including a variable thickness concrete overlay.

Concrete Overlay Design

The result of the feasibility study was a design that utilized three basic thicknesses of concrete overlay (figure 1). This approach met all the design criteria and was also found to be very cost effective when compared to the remove and replace option.

The three concrete thicknesses range from 3 ½ in. to 10 in. The 10-in. thick overlay in the heavy areas accommodates aircraft

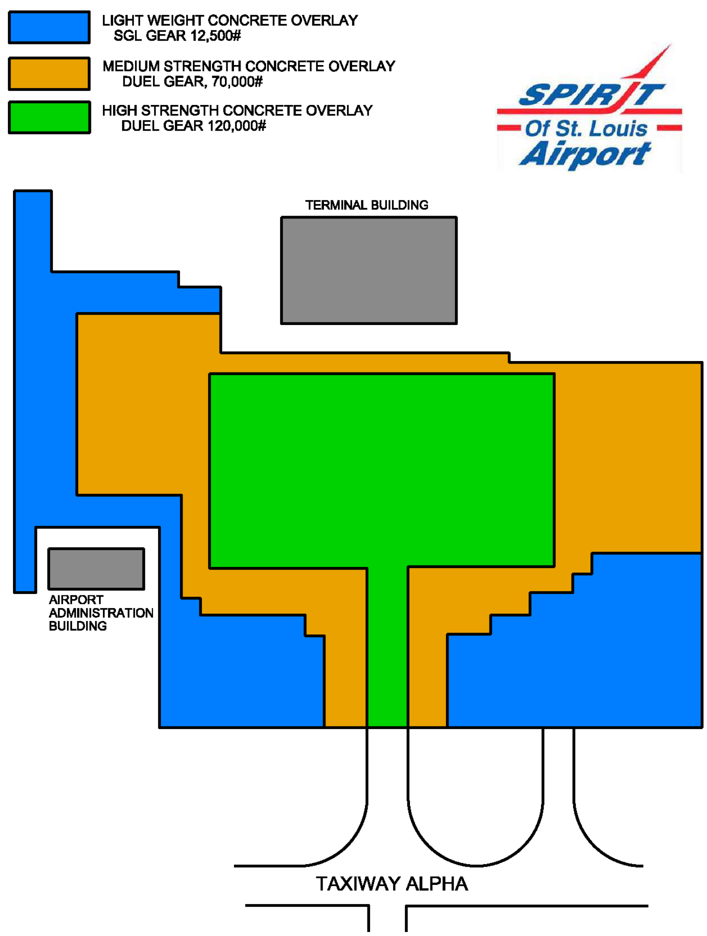

Figure 1. Map showing different overlay areas at Spirit of St. Louis Airport

up to the 120,000 lb 727s while the 8-in. overlay for the medium strength areas accommodates 70,000 lb aircraft. Both of these areas used traditional joint spacing, 12 ft 6 in., with steel transfer dowels.

The lightweight area, which handles up to 12,500 lb aircraft, departed from tradition in that a thin concrete overlay was used with a joint spacing of 4 ft 2 in. The concrete mix design for the UTW was designed to meet a minimum of 675 psi flexural strength and included 3 lbs of polypropylene fibers per cubic yard of concrete. The high flexural strength was required to address the predicted stresses and helped with strength gain during the colder winter months (overlay was placed during the winter). The addition of fiber reinforcement helped minimize the potential for shrinkage cracking and aided aggregate interlock at the joints.

The idea for the UTW for the "light-load" aircraft came from CRD Cambell president Carl Rapp. Carl had become familiar with the concept of UTW through his involvement with the Transportation Research Board Committee on Portland Cement Concrete Construction and the experimental project constructed in Louisville, Kentucky in the early 1990s. Incorporating the concepts of short joint spacing with bonding the overlay to the prepared existing asphalt surface allowed the 3 ½ in. of concrete to support the intended aircraft loadings and facility vehicle traffic.

A unique aspect of the project was that the UTW joints were required to be sealed to alleviate the potential for aircraft fuels to penetrate the overlay and "strip" the underlying asphalt (UTW joints are typically left unsealed). If this occurred, the bond would be lost between the concrete overlay and existing asphalt, eliminating the benefits of the composite section.

Concrete Overlay Construction

Prior to placement of the concrete overlays, the existing asphalt apron was cold milled to the necessary grade and air blasted to clean the surface. Cold milling the surface increased the surface area and exposed aggregate in the asphalt to enhance the bond between the concrete and asphalt necessary for the UTW.

Vee-Jay Cement Contractors, Inc., out of St. Louis constructed the concrete overlays with a slipform paver that could adapt to the varying overlays thicknesses (figures 2 and 3). Paving began on December 4, 1994, and the concrete resurfaced apron was open to aircraft traffic in 3 months. Due to the high surface to volume ratio of the UTW, twice the normal application of curing compound was used (minimum 1 gal per 100 sf).

Figure 2. Photo from original construction of the concrete overlay at Spirit of St. Louis Airport in 1994

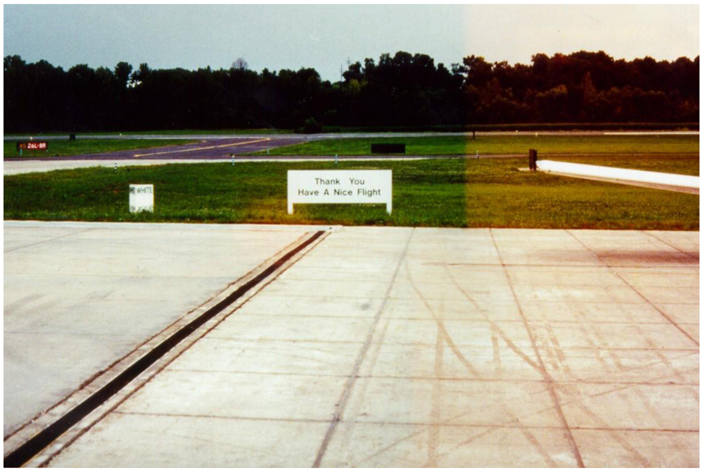

Figure 3. Photo of the completed concrete overlay at Spirit of St. Louis Airport in 1994

Concrete Overlay Performance

At the time of construction, Dick Hrabco, Director of Aviation for the Spirit of St. Louis Airport, said, "The whitetopping has tripled the life of the ramp pavement." Recent field inspection of the conventional and UTW overlays in June of 2015 (after 20 years of service) indicates that Director Hrabco's prediction was spot on.

Robert Heine, current Airport Engineer, notes that "since its completion in 1994, the apron has performed well above expectations with minimal maintenance required. In addition to initial cost savings by placing the thick overlay only where it was needed, the concrete surface has proved to be much more forgiving when it comes to aviation fueling and deicing operations. The joint sealant has also performed well. With routine maintenance by the Airport staff we expect to get many more years beyond the original 20 year design life."

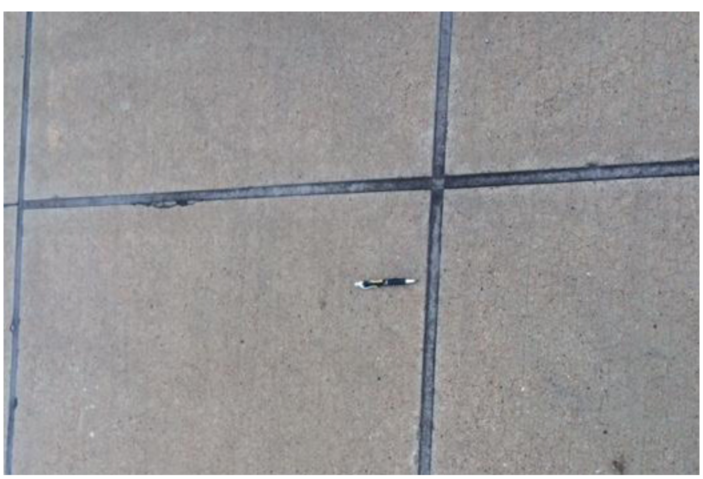

Figure 4. Current pavement condition (June 2015)

Figure 5. Current pavement condition (June 2015)

Figure 6. Typical ramp usage on a daily basis (June 2015)