Thin Whitetopping Application at Williamsburg Regional Airport and Other Thin Whitetopping Airport Applications.

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Biography:
Gary L. Mitchell did his undergraduate work in structural engineering at Vanderbilt University and graduate work in Civil Engineering at North Carolina State University. He is a licensed engineer in the states of North Carolina, South Carolina, Tennessee, Kentucky, and Florida. Mr. Mitchell serves on several national committees and technical advisory panels on airport pavements. Currently, Mr. Mitchell serves as Director of Airports for the Southeast Chapter of the American Concrete Pavement Association. His duties include technical support for the association members and consultants, research, training, legislative affairs, and promotion of concrete pavements at southeast airports.

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Introduction

The practice of whitetopping asphalt pavements at airports is not new. This construction procedure has been performed with good success for some time. Conventional whitetopping does not require a bond between the existing asphalt and the newly placed concrete. The existing asphalt is simply treated as a stabilized base for the concrete pavement.

In 1991 the roadway industry experimented with the construction of a bonded, ultra-thin concrete whitetopping. The concept was that by providing a bond between the old asphalt and new concrete, the process would result in a composite section. Airports too have experimented with ultra-thin whitetopping projects with excellent results. Still, questions remain about the bond – not only between the asphalt and concrete, but with the asphalt layers beneath the existing asphalt surface as well.

Thin whitetopping is one way around the bond issue. By using the existing asphalt as a base material the design is performed for the given aircraft mix expected to use the feature in question. Williamsburg County Regional Airport in Kingstree, South Carolina chose this rehabilitation procedure for its apron and taxiway. Other similar whitetopping projects were used as a model for Williamsburg County Regional Airport in planning its pavement rehabilitation.

Similar Airport Whitetopping Applications

Spirit of Saint Louis, Missouri

In 1995 the Spirit of Saint Louis Airport in St. Charles County, Missouri was the first general aviation airport in the United States to receive an ultra-thin whitetopping. The project was funded through a pilot program with the Missouri Highway Transportation Department. The original six-acre asphalt apron was designed for small general aviation aircraft but found itself being used for parking of heavy B-727 and DC-9 aircraft. The result was severe deterioration – in some cases exacerbated by jet fuel spills.

The whitetopping project contained sections consisting of a 3 ½ inch ultra-thin whitetopping as well as a conventional 10-inch thick whitetopping. The 14,000 square yard ultra-thin whitetopping was used in the light aircraft area while the 15,000 square yard thicker section served as parking area for the heavy aircraft. The project proved to be economical because demolition of the existing pavement during the rehabilitation was not needed. Whitetopping also eliminated a problem of what to do with the old pavement material.

New Smyrna Beach, Florida

New Smyrna Beach Municipal Airport in Florida was another one of the first airports to implement an ultra-thin whitetopping. The aged asphalt taxiway and apron at the airport exhibited serve fatigue cracking. The Florida Department of Transportation overlaid the apron with a 2 to 3 ½ inch ultra-thin whitetopping. Various types of fiber reinforcement were use in the concrete in a research effort.

The construction window was reduced when compared to a full reconstruction, which would have been required without the whitetopping. The apron was never fully closed during construction. Aircraft were redirected to maintenance and fueling areas that had been relocated.

Savannah-Harding County, Tennessee

The Savannah-Harding County Airport received a 4-inch ultra-thin whitetopping on an existing runway. To date, this runway is the only runway in the United States to utilize an ultra-thin whitetopping.

The 5000-ft. runway was structurally sound but suffered from extensive block cracking. Many of the cracks were wide enough to drop a soda can into. The ultra-thin whitetopping proved to be a cost-effective solution to the problem. The concrete surface not only provided maintenance free pavement, it has proven to be much more visible surface for pilots from the air.

In addition to providing a durable, low maintenance pavement, the construction schedule was minimized by whitetopping as compared to a total reconstruction. The entire runway was paved in 32 days.

Photo 1: Savannah-Harding County Airport Whitetopping from the air.

Fernandina Beach, Florida

Recently, Fernandina Beach, Florida chose to rehabilitate a runway and taxiway with a conventional thin whitetopping. The project included a life-cycle cost analysis, which shows that the whitetopping was the most cost effective rehabilitation option. This project had other unique practices implemented such as recycling the old pavement into stabilized runway shoulder reconstruction material. Perhaps the most significant innovative practice was the implementation of the first whitetopping project guarantee specification. The five inch taxiway concrete whitetopping and the six inch runway concrete whitetopping came with a ten-year guarantee, ensuring the owner no maintenance cost for the ten year period.

Williamsburg County Regional Airport

Background

In 2002 the state of South Carolina implemented a state-wide pavement management system program. The program identified the pavement condition index (PCI) for every feature at each of the states 53 general aviation airports. As part of that program Williamsburg County Regional Airport's apron and taxiway PCI's were identified as 53 and 16 respectively. Clearly, major rehabilitation for both the apron and taxiway had to be a high priority for the FAA, State and Local agencies.

Photo 2: Condition of Williamsburg County Regional Airport Apron before whitetopping

The apron and taxiway were experiencing block cracking, rutting, and fatigue (alligator) cracking. Any attempts to rehabilitate the apron and taxiway with an asphalt overlay would have been futile. Reflective cracking would have begun to surface within a couple of years. To compound the problem, the area has weak subgrade soil. The weak subgrade had exposed itself previously by causing significant problems during runway rehabilitation. So any rehabilitation scheme using an asphalt surface would have required total reconstruction from the subgrade up. This meant possibly undercutting poor material and backfilling with a suitable material. Early on the owner, engineer, State and FAA knew rehabilitation of the apron at Williamsburg County Regional Airport was going to be a major job.

Project Details

The Airport's engineer – Wilbur Smith Associates, Columbia, South Carolina – investigated various options for rehabilitation. Two feasible pavement rehabilitation alternatives became apparent. The pavement design would require a typical section consisting of nine inches of base stone with a four inch nominal surface thickness of asphalt after a complete pavement removal and subgrade improvement. Alternatively, the calculations showed a five inch nominal thickness of P-501 concrete pavement would perform over a longer period with less maintenance.

The engineer was unsure about how the cost of the rehabilitation alternatives would compare since the equivalent designs were totally different and the material prices seemed somewhat volatile at the time. Based on this uncertainty, the engineer decided to accept alternate bids and let the market dictate the ultimate decision of which alternate to build.

Contractor	*Alternative Bid Amount ($)*

Two asphalt bids and three concrete bids were received on the project. The bid tabulations are shown in Table 1. It is interesting to note that Contractor "A" submitted bids on both options and was the low bidder for both options. Additionally, two of the concrete bid were less than the minimum asphalt bid.

	Asphalt	Concrete
A	$474,770	$421,625
D	-	$521,521

Table 1: Bid Tabs for Williamsburg County Regional Airport Apron Whitetopping

The bid was awarded to Contractor "A" for the construction of approximately 7000 square yards of five-inch thick concrete whitetopping. Cost for the whitetopping proved to be about $50,000 less than the equivalent asphalt option.

Success Factors

As with any project, certain parameters are required to ensure success. Williamsburg County Regional Airport was no exception. The concrete whitetopping typical section had to be design for the appropriate aircraft traffic. For Williamsburg County, the aircraft traffic is typically small general aviation aircraft with weights of 30,000 pounds or less. Although the apron will provide for a fuel resistant surface, a fueling pad is located such that no fuel trucks were expected to use the apron.

Several large cracks up to an inch wide existed on the apron. These cracks had filled to mitigate the potential of reflective cracking and keying of the newly placed concrete. The engineer required sand to be placed over the entire apron. The sand served two purposes. First, it acted as a bond breaker for the whitetopping. Secondly, the sand filled all the existing cracks to minimize the potential reflective crack concern and eliminate any keying action of the concrete.

Photo 3: Sand use as a crack filler and to act as a bond breaker for Williamsburg County Regional Airport whitetopping.

As with any pavement design properly design joint spacing was critical for minimizing the potential for early cracking. This is especially the case for a pavement placed on a stiff base material like an existing asphalt pavement. The joint spacing for the apron pavement at Williamsburg County Regional Airport was sized at ten feet by ten feet in accordance with the new FAA criteria, which limits the joint spacing to five times the radius of relative stiffness.

The apron exhibited several areas of unevenness due to the rutting and dimpling distresses. Although concrete is usually paid for at the square yard unit cost for paving,

the concrete pay items for this project were established using a cubic yard price for the materials and a square yard price for placement. By paying for the paving under these two items, it eliminated the quantity uncertainty for the concrete materials cost. The engineer believed this resulted in an overall price reduction for the concrete.

Summary and Conclusion

Williamsburg County Regional Airport is one of a limited number of general aviation airports of its size in South Carolina that now boast a concrete apron. It joins the ranks of The Spirit of Saint Louis, MO; New Smyrna Beach, FL; Savannah, TN; Fernandina Beach, FL; and many others that have experienced successful whitetopping projects.

The construction at Williamsburg County Regional Airport was conducted with no problems. The engineer felt the whitetopping made it easier from an engineering standpoint since they did not have to deal with the poor subgrade issues they had experienced on previous projects.

Alternate bids were solicited and received and the whitetopping alternate proved to be the most economical – even before a life-cycle cost analysis. Williamsburg County Regional Airport successfully built a safe, durable, and practically maintenance free pavement for less cost than a traditional single option design by using thin whitetopping.

Photo 4: Williamsburg County Regional Airport after Whitetopping