REPORT 2012 - 05

# VERMONT AGENCY OF TRANSPORTATION

## Materials & Research Section
## Research Report

ALTERNATIVE PAVEMENT DESIGNS

RANDOLPH PARK AND RIDE

Report 2012 – 05

October 31, 2012

**Alternative Pavement Designs – Randolph Park and Ride**

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Reporting on Work Plan 2007-7

STATE OF VERMONT
AGENCY OF TRANSPORTATION

MATERIAL & RESEARCH SECTION

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16. Abstract

Previous research on alternative pavement type bidding has proven that various treatments are unique in terms of constructability, material characteristics, and associated performance. While some treatments may have higher initial costs, it is important to consider future maintenance needs as well as life cycle. Other considerations may include construction sequencing, user delays, or potential benefits to the environment. Evaluation of these variables should occur during the bid selection process to ensure the construction of the most cost effective treatment for a given location. For this investigation, three alternative pavement treatments were proposed for the construction of a park and ride located in Randolph at the intersection of VT Route 66 and Town Highway 46. The options included a conventional bituminous pavement, a porous bituminous pavement, and a porous concrete pavement. The purpose of this study is to perform a cost analysis of the bids, an examination of constructability in association with some preliminary monitoring, and summary of operations practices during an initial service period.

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**TABLE OF CONTENTS**

**ABSTRACT**

Previous research on alternative pavement type bidding has proven that various treatments are unique in terms of constructability, material characteristics, and associated performance. While some treatments may have higher initial costs, it is important to consider future maintenance needs as well as life cycle. Other considerations may include construction sequencing, user delays, or potential benefits to the environment. Evaluation of these variables should occur during the bid selection process to ensure the construction of the most cost effective treatment for a given location. For this investigation, three alternative pavement treatments were proposed for the construction of a park and ride located in Randolph at the intersection of VT Route 66 and Town Highway 46. The options included a conventional bituminous pavement, a porous bituminous pavement, and a porous concrete pavement. The purpose of this study is to perform a cost analysis of the bids, an examination of constructability in association with some preliminary monitoring, and summary of operations practices during an initial service period.

## INTRODUCTION

Alternative pavement type bidding is a process in which state agencies request multiple cost estimates for the construction of various pavement treatments, including, but not limited to, bituminous and concrete compositions. Previous research has proven that various treatments are unique in terms of constructability, material characteristics, and associated performance. While some treatments may have higher initial costs, it is important to consider future maintenance needs as well as life cycle. For instance, asphalt pavements tend to have lower initial costs but require more maintenance as compared to pavements composed of concrete. Other considerations may include construction sequencing, user delays, or potential benefits to the environment. Evaluation of these variables should occur during the bid selection process to ensure the construction of the most cost effective treatment for a given location.

According to the Wisconsin Department of Transportation, the Federal Highway Administration (FHWA) encouraged the use of alternative bidding in its innovative contracting initiative of the mid 1990s. However, FHWA has since discouraged its use somewhat due to the problems associated with bid comparisons and selection. For this investigation, three alternative pavement treatments were proposed for the construction of a park and ride located in Randolph at the intersection of VT Route 66 and Town Highway 46. The options included a conventional bituminous pavement, a porous bituminous pavement, and a porous concrete pavement. The purpose of this study is to perform a cost analysis of the bids, an examination of constructability in association with some preliminary monitoring, and summary of operations practices during an initial service period. For this analysis, a life cycle of 20 years is assumed for bituminous concrete pavement and 40 years for concrete pavement.

## PROJECT LOCATION AND SUMMARY

The proposed improvement, project number CMG PARK (21) S, for the town of the Randolph is a park and ride located at the intersection of Vermont Route 66 and Town Highway 46, approximately 60 feet easterly of the northbound interchange of I-89 at Exit 4.

Work performed under this project included the decommissioning of the pre-existing park and ride lot and the construction of a new park and ride lot including accommodation for mass transit at the facility. Work included subbase, pavement, pavement markings, stormwater treatment, lighting, landscaping, reconstruction of VT Route 66 for a left turn lane, and miscellaneous appurtenances.

## MATERIAL DESCRIPTION

As stated previously, three varying treatments were to be bid as follows:

Alternative A – 1.5" of bituminous concrete pavement (1 lift of type III which has a nominal aggregate size of ½"), 2" of bituminous concrete pavement (1 lift of type II with a nominal aggregate size of ¾"), 15" of subbase with dense graded crushed stone, 20" of sand borrow and geotextile for roadbed separator and stormwater treatment systems to accommodate an impervious surface.

Alternative B – 4" of porous bituminous concrete pavement. 2" of porous pavement choker course, a minimum of 36" of porous subbase, and geotextile for roadbed separator. The choker course shall consist of a AASHTO #57 stone. The subbase shall consist of AASHTO #2 stone.

Alternative C – 6" of porous portland cement concrete pavement, 2" of porous pavement choker course, a minimum of 34" of porous subbase and geotextile for roadbed separator. The choker course shall consist of a AASHTO #57 stone. The subbase shall consist of AASHTO #2 stone.

Alternative C, porous Portland cement concrete, was chosen for the park and ride due to cost (see Cost Analysis section) as well as its reported longevity and environmentally friendly features. Porous pavements are paved areas that produce less stormwater runoff as compared to conventional pavements through infiltration, storage and evaporation. Other known benefits include reduced spray from vehicle tires, better visibility, better traction, reduced hydroplaning and noise reduction (1). A porous asphalt or concrete wearing course is placed over a bed of uniformly graded course aggregate, woven geotextile and uncompacted soil. Uniform gradation allows for maximum porosity and therefore, maximum storage capacity. The high rate of infiltration through the porous wearing course is achieved through the elimination of fine aggregates that are generally utilized in conventional paving mixtures (2). Runoff is then stored in the underlying basin and allowed to infiltrate into the soils that reside below the basin over time as a function of soil permeability.

In addition to reducing or eliminating runoff and increasing storage capacity, porous pavements have been shown to remove or reduce runoff pollutants. Removal mechanisms include absorption, staining, and microbiological decomposition in the soil.

The entire parking area was constructed with a cross section from top to bottom consisting of:

a. 6" previous concrete wearing course

b. 2” “choker” course consisting of an AASHTO No. 57 stone (aggregate sizes from 0.1 to 1.5 inches)
c. A minimum of 34” of an AASHTO No. 2 stone (aggregate sizes from 0.75 to 3 inches)
d. A woven geotextile over subgrade

The typical cross section is provided below in Figure 1.

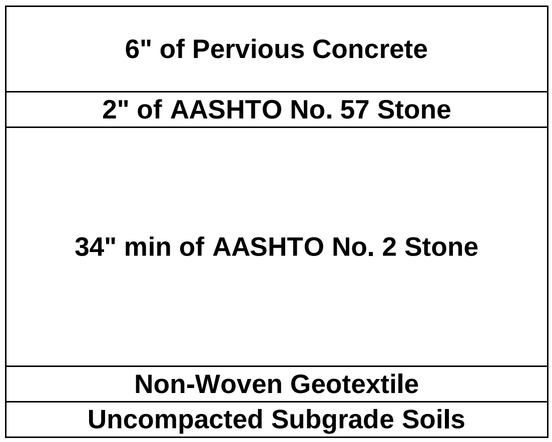


**Figure 1. Porous Portland cement concrete cross section.**

## PERFORMANCE AND OBSERVATIONS

The prime contractor for the project was E.E. Packard Enterprises, Inc. Construction began in October of 2007, with a substantial completion date of October 9, 2008, a completion date of July 15, 2009, and an acceptance date of July 29, 2009.

Placing the porous concrete began on August 13, 2008. Lanes within the parking lot were placed in an alternating pattern during the days following, occurring on August 15, 19, 21, 22, 26, and 27 and September 3, 4, 10, 17, and 19. Placements on the first three days consisted of 80 gallons of water per truck, which resulted in a seeming ‘dry’ mix. By the August 21 placement, the amount of water was increased to 180 gallons per truck, yielding a much more workable mix that seemed to finish better and eliminated segregation and cement aggregate binding issues.

Prior to the end of placing the concrete, it was noted that an area placed on the first day was showing signs of raveling (in the far rear corner of the lot). This section was removed and placed once again on September 10. A typical installation at the park and ride is shown in Figure 2, with the roller in the middle, the as-poured material on the right and the rolled material on the left.  The plastic sheeting, used for curing, is also beginning to be placed over the slab on the far left.

**Figure 2.  Placement and rolling of porous concrete.**

## COST ANALYSIS

All costs for the construction of the park and ride and associated improvements were paid for through the project.  The table below presents the bids of the three alternatives listed above from the eleven contractors that submitted bids, listed in order from lowest total project bid to highest.  Contractor 1, E.E. Packard Enterprises, won the bid due to their overall lowest total project cost.  The letting date of the contract was September 14, 2007.

It is clear to see that Alternative A, the standard bituminous concrete pavement, had the least initial costs for construction.  The two porous alternatives were roughly 50% more expensive.  Alternatives B and C, porous bituminous concrete and porous Portland cement concrete, had similar initial construction costs.  As stated earlier, a life cycle of 20 years was chosen for bituminous pavements and 40 years for PCC pavements.  With this taken into account, Alternative C provided the least long-term costs of the alternatives on a per year basis; this was a strong reason for the selection of this alternative as the construction method.

**Table 1. Results of all bids for the three alternatives.**

| Contractor | Alternative A | Alternative B | Alternative C | Total Project |
|---|---|---|---|---|
| **1** | 582,584 | 1,101,851 | 1,021,348 | 1,426,400 |
| **2** | 791,260 | 1,240,626 | 1,050,021 | 1,445,896 |
| **3** | 839,985 | 1,156,925 | 1,050,575 | 1,446,861 |
| **4** | 815,540 | 1,125,719 | 1,026,439 | 1,462,028 |
| **5** | 811,287 | 1,175,189 | 1,058,489 | 1,519,053 |
| **6** | 566,174 | 1,177,355 | 990,982 | 1,580,368 |
| **7** | 756,022 | 1,294,261 | 1,197,586 | 1,610,996 |
| **8** | 995,833 | 1,406,698 | 1,293,563 | 1,712,869 |
| **9** | 917,594 | 1,338,082 | 1,286,959 | 1,729,621 |
| **10** | 849,975 | 1,249,478 | 1,441,878 | 1,853,963 |
| **11** | 1,053,075 | 1,428,575 | 1,442,525 | 1,943,369 |
| **Average** | 816,303 | 1,244,978 | 1,169,124 | 1,611,948 |
| **Per Year Cost** | 40,815 | 62,248 | 29,228 | |

## SUMMARY AND RECOMMENDATIONS

The alternate pavement type bid process worked well for this project and led to a desirable candidate being chosen amongst them. The bids that were received along with assumed factors such as lifespan and environmental advantages led to the choice of porous Portland cement concrete being placed at the Randolph park and ride.

## REFERENCES


1. Barrett, M. and C. Shaw. Benefits of Porous Asphalt Overlay on Storm Water Quality. *Transportation Research Record: Journal of the Transportation Research Board, No. 2025*, TRB, National Research Council, Washington, D.C., 2007, pp. 127-134.

2. New Jersey Department of Environmental Protection. *New Jersey Stormwater Best Management Practices Manual*. February 1994.

Prepared By: Jennifer Fitch
Date: July 31, 2007

**STATE OF VERMONT**
**AGENCY OF TRANSPORTATION**
**MATERIALS AND RESEARCH SECTION**

# WORK PLAN FOR RESEARCH INVESTIGATION
# Alternative Pavement Designs – Randolph Park and Ride
# Work Plan No. WP-2007-7

## OBJECTIVE OF STUDY:

Alternative pavement type bidding is a process in which state agencies request multiple cost estimates for the construction of various pavement treatments, including, but not limited to, bituminous and concrete compositions. Previous research has proven that various treatments are unique in terms of constructability, material characteristics, and associated performance. And while some treatments may have higher initial costs, it is also important to consider future maintenance needs as well as life cycle. For instance, asphalt pavements tend to have lower initial costs but require more maintenance as compared to pavements composed of concrete. Other considerations may include construction sequencing, user delays, or potential benefits to the environment. These variables should be evaluated during the bid selection process to ensure the construction of the most cost effective treatment for a given location.

According to the Wisconsin Department of Transportation, the Federal Highway Administration (FHWA) encouraged the use of alternative bidding in its innovative contracting initiative of mid 1990s. However, FHWA has since discouraged its use somewhat due to the problems associated bid comparisons and selection. For this investigation, three alternative pavement treatments will be proposed for the construction of a park and ride located in Randolph at the intersection of VT Route 66 and Town Highway 46. The options are to include a conventional bituminous pavement, a porous bituminous pavement and a porous concrete pavement. The purpose of this study will be to perform a cost analysis of the bids, an examination of constructability in association with some preliminary monitoring and summary of operations practices during an initial service period . For this analysis, a life cycle of 20 years will be assumed for bituminous concrete pavement and 40 years for concrete pavement.

## LOCATION:

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Work to be performed under this project includes the decommissioning of the existing park-and-ride lot and the construction of a new park-and-ride lot including accommodation for transit interoperation at the facility. Work will include subbase, pavement, pavement markings, stormwater treatment, lighting, landscaping, reconstruction of VT Route 66 for a left turn lane, and miscellaneous appurtenances.

**MATERIAL:**

As stated previously, three varying treatments are to be bid as follows:

Alternative A – 1.5" of bituminous concrete pavement (1 lift of type III which has a nominal aggregate size of ½"), 2" of bituminous concrete pavement (1 lift of type II with a nominal aggregate size of ¾"), 15" of subbase with dense graded crushed stone, 20" of sand borrow and geotextile for roadbed separator and stormwater treatment systems to accommodate an impervious surface.

Alternative B – 4" of porous bituminous concrete pavement. 2" of porous pavement choker course, a minimum of 36" of porous subbase, and geotextile for roadbed separator. The choker course shall consist of a AASHTO #57 stone. The subbase shall consist of AASHTO #2 stone.

Alterative C – 6" of porous portland cement concrete pavement, 2" of porous pavement choker course, a minimum of 34" of porous subbase and geotextile for roadbed separator. The choker course shall consist of a AASHTO #57 stone. The subbase shall consist of AASHTO #2 stone.

**COST:**

All costs for the construction of the park and ride and associated improvements will be paid for through the project. In addition to collecting the overall cost of the selected alternative, the total cost for each treatment, as displayed in the bids, will be acquired.

**SURVEILLANCE AND TESTING:**

1. During construction, the selected pavement treatment is to be monitored during production and placement. The contractor and plant location will be recorded along with any other pertinent information. On the project site, all application procedures are to be noted including adherence to specifications, construction sequence, compaction efforts and any other applicable construction considerations. Specific investigation of alternate

practices in placement of the wearing surface for any selected porous pavement will be included.

2. Following construction, a windshield survey is to be performed on an annual basis for a period of 24 months. During the inspection, any observed pavement distresses will be noted with special attention to raveling and pop-out. Other distresses to note include severe rutting, and thermal and fatigue cracking. A visual examination of the condition of the stormwater treatment system and its operating components will be recorded in the resulting reports.
3. In addition, an analysis of received bids will be performed. Analysis of unit costs among all bids, in addition to the selected bidder will enable a full assessment of factors in the pricing.

**STUDY DURATION:**

The duration of this study will be no more than two years or until final conclusions can be drawn from the observations and retroreflectivity readings.

**REPORTS:**

An initial report will be prepared once installation is complete. A final report will be published once the evaluation is complete.

Reviewed by: ______________________________

William E. Ahearn, P.E.
Materials and Research Engineer
Date:

**Approved by Material and Research on Date (WEA-08/03/2007)**
**Approved by Federal Highway Administration on Date (CPJ-08/08/2007)**