

# Concrete Overlay Field Application Program

## Concrete Overlay Cost: Frequently Asked Questions

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### Introduction

The need for engineered preservation and rehabilitation strategies for maintaining the nation's highway pavements has never been greater. To advance the use of concrete overlays as cost-effective solutions for a wide variety of pavement conditions, the Federal Highway Administration (FHWA) and the National Concrete Pavement Technology Center (National CP Tech Center) are implementing the Concrete Overlay Field Application Program. The objective is to increase awareness and knowledge of and strengthen confidence in concrete overlay applications among state departments of transportation (DOTs), cities, counties, contractors, and engineering consultants.

### Types of concrete overlays

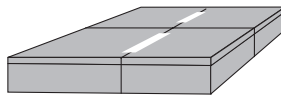
Concrete overlays are categorized as either bonded or unbonded, depending on how the existing pavement is considered in the thickness design procedure (see Figure 1). Both types of concrete overlays take advantage of the equity investment in the existing pavement structure. Comprehensive guidance on the selection, design, and construction of concrete overlays is provided in the *Guide to Concrete Overlays, 2<sup>nd</sup> Edition*, which is available from the National CP Tech Center.

#### Bonded Overlay Systems (Resurfacing/Minor Rehabilitation)

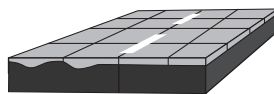
In general, bonded overlays are used to add structural capacity and/or eliminate surface distress when the existing pavement is in good structural condition.

Bonding is essential, so thorough surface preparation is necessary before resurfacing.

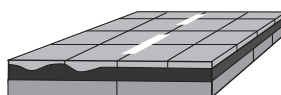
##### Bonded Concrete Overlays of Concrete Pavements –previously called bonded overlays–



##### Bonded Concrete Overlays of Asphalt Pavements –previously called ultra-thin whitetopping–



##### Bonded Concrete Overlays of Composite Pavements

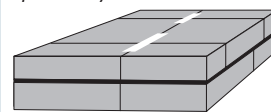


#### Unbonded Overlay Systems (Minor/Major Rehabilitation)

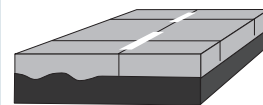
In general, unbonded overlays are used to rehabilitate pavements with some structural deterioration.

They are basically new pavements constructed on an existing, stable platform (the existing pavement).

##### Unbonded Concrete Overlays of Concrete Pavements –previously called unbonded overlays–



##### Unbonded Concrete Overlays of Asphalt Pavements –previously called conventional whitetopping–



##### Unbonded Concrete Overlays of Composite Pavements

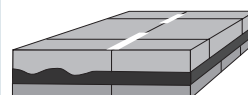


Figure 1. Types of concrete overlays (from Guide to Concrete Overlays, 2nd Edition)

### Cost data sources and description

Since the beginning of the Concrete Overlay Field Application Program in 2009, construction cost has been a common question from state DOT personnel who are inexperienced with concrete overlays.

To answer this question, bid tabulations from six state DOTs that are currently utilizing concrete overlays as an integral part of their pavement rehabilitation strategy were reviewed. The cost information comes from 33 projects with bid dates ranging from August 2008 through September 2009 (see Figure 2).

The overlay costs are inclusive of furnishing concrete, placing the overlay, and all costs associated with joints. Tabular cost data are provided on page 4.

All types of overlays of various thicknesses and project sizes are represented in the sample of overlay costs (see Table 1). Of the four bonded overlay projects represented by the bid tabulation data, only one project was a bonded overlay on an existing concrete pavement.

### How much does a concrete overlay cost?

An analysis of the sampled bid tabs reveals that the average cost for concrete overlays is \$2.99 per square yard per inch of thickness (bonded overlays = \$3.32/yd<sup>2</sup>/in. and unbonded overlays = \$2.94/yd<sup>2</sup>/in.). This \$0.38 per square yard per

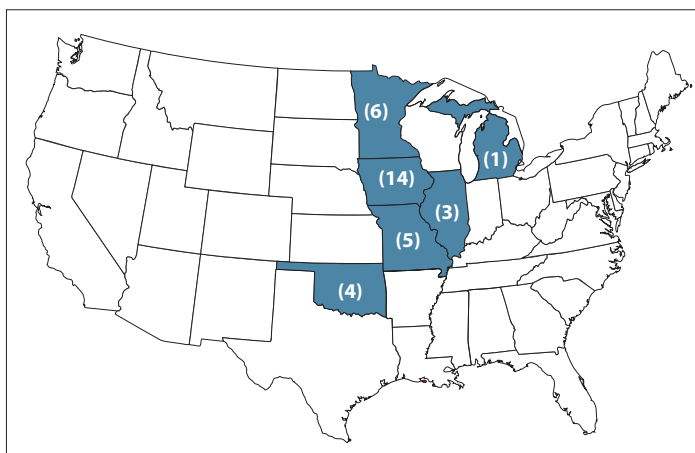


Figure 2. States and number of projects (n) included in bid tab sample

Table 1. Variation of sampled overlay projects

Overlay Type	Range of Nominal Thickness (in.)	Range of Project Size (yd <sup>2</sup> )	Number of Projects
Bonded	5 to 7	40,759 to 117,952	4
Unbonded	4 to 11	21,155 to 279,940	29

inch difference in costs for bonded and unbonded overlays is negligible when compared to the total variability of the cost data set. Therefore, to simplify the remaining cost discussions contained in this technical brief, no distinction will be made between bonded and unbonded overlay costs.

Figures 3, 4, and 5 illustrate additional details of the overlay cost data. These average costs including furnishing concrete, placing the concrete overlay, dowels, tie bars, curing, sawing joints, and sealing joints. Items that are not included in the average costs are pre-overlay repairs and separation layer for unbonded overlays.

A typical cost for an asphalt separation layer used with unbonded overlays is \$3.00 per square yard. Alternatively, a geotextile separation layer may be used, which typically costs approximately \$2.00 per square yard.

### What variables will impact the cost of concrete overlays the most?

As with any concrete pavement, the cost of concrete material has a large influence on the overall cost of a concrete overlay.

Labor costs for a thin overlay are similar to the labor costs for a full-depth pavement. Also, labor costs vary from state to state; estimated costs for concrete overlays should be adjusted for local wages.

Another factor that should be considered when comparing costs is the nature of the work. For example, the amount of handwork on a concrete overlay has a large impact on the average productivity; thus, per unit labor and overhead costs will be higher for projects that have limited quantities of slipformed concrete overlay placement.

Project sequencing and traffic control are cost factors that should also be considered. In many cases, concrete overlays can be constructed under traffic, eliminating the need for temporary detours.

### How can I compare the cost of concrete overlays with other rehabilitation methods?

Assuming that in-place asphalt has a density of 112 lb/yd<sup>2</sup>/in. (149.3 lb/ft<sup>3</sup>), we can mathematically convert the bid tab prices for a concrete overlay to an equivalent price per ton for an asphalt overlay.

An example is shown below using actual costs from the first row of tabulated data on page 4:

$$1. \text{ Calculate the total cost of the overlay } (18,875 \text{ yd}^3 \cdot \$66.34/\text{yd}^3) + (101,093 \text{ yd}^2 \cdot \$3.52) = \$1,608,015$$

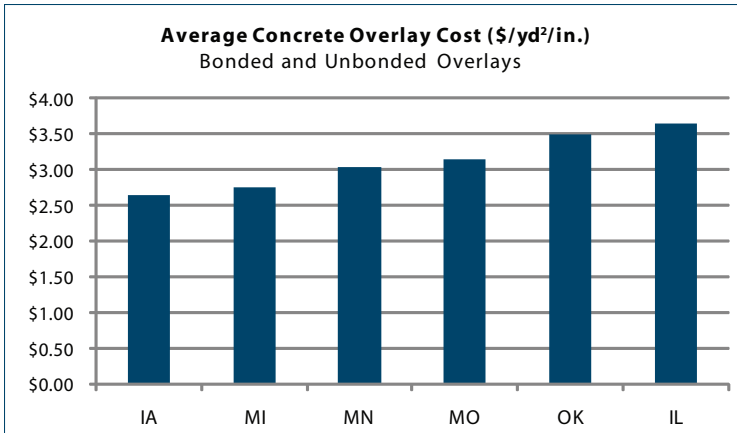


Figure 3. Average concrete overlay cost per square yard per inch thickness by state

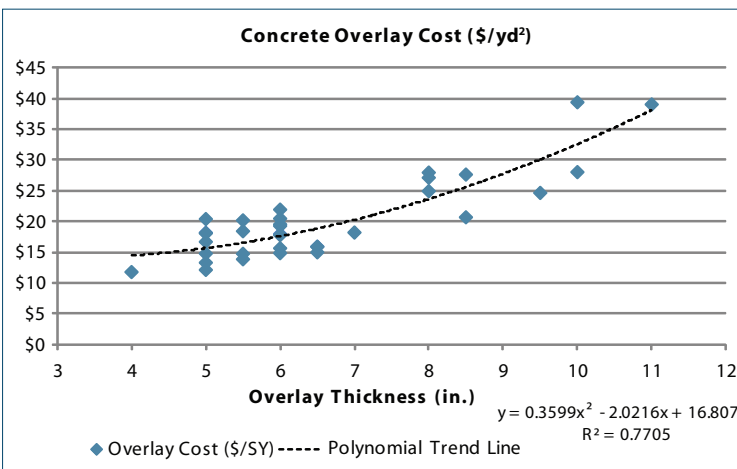


Figure 4. Concrete overlay cost by thickness

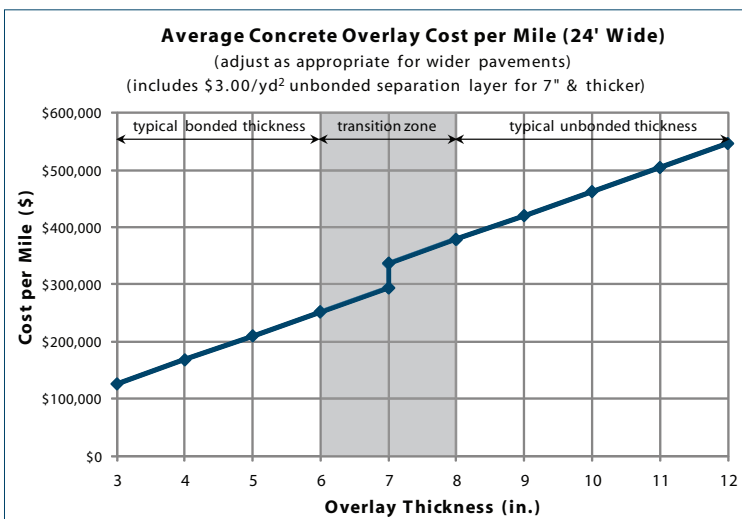


Figure 5. Average cost per mile for concrete overlays

2. Calculate the equivalent tons that would be required for the project ( $[101,093 \text{ yd}^2 \cdot 6.50 \text{ in.} \cdot 112 \text{ lb/yd}^2/\text{in.}] \div 2,000 \text{ lb/ton} = 36,798 \text{ ton}$ )
3. Calculate the equivalent concrete overlay cost per ton ( $\$1,608,015 \div 36,798 \text{ ton} = \$43.70 \text{ per ton}$ )

Following these three steps, a valid comparison can be made between the cost of a concrete overlay and the cost of an asphalt alternative. The average equivalent price per ton of the bid tab data presented in this report is \$54.54 for concrete overlays.

Additionally, some state DOTs have also implemented alternate bids between concrete and asphalt overlays. Of the 33 projects included in the bid tab sample data on page 4, six were alternate bids that were all awarded as concrete overlays.

### Why are concrete overlays paid for with square yard and cubic yard pay items?

Measuring and paying for concrete overlays by both cubic yard and square yard recognizes that the underlying surface may be irregular and that the concrete thickness cannot be controlled to the same precision as a pavement that is placed on a prepared subbase.

When a cubic yard pay item is used, the contractor does not have to pass on the cost of risk associated with an unknown concrete quantity overrun to the state DOT. This approach is similar to that used for asphalt overlays, which are typically paid for by the ton.

### Whom do I contact to learn more about having my state DOT participate in the concrete overlay field application program?

Dale Harrington of Snyder and Associates is the lead concrete overlays researcher for the National Concrete Pavement Technology Center; he can be reached at (515) 964-2020 or dharrington@snyder-associates.com.

Note: For all figures, overlay costs include furnishing concrete, concrete overlay placement, dowels, tie bars, curing, joint sawing, and joint sealing and exclude pre-overlay repairs and separation layer placement (except as noted in Figure 5).

**Concrete Overlay Bid Tab Data (sorted by type and thickness)**

Bid Date	State	Overlay Type	Nominal Overlay Thickness (in.)	Calculated Overlay Thickness (in.)	Cubic Yards (yd <sup>3</sup> )	Furnish Materials		Placement		Total Cost (\$/yd <sup>2</sup> /in.)	Equivalent Per Ton Cost @ 112 lb/yd <sup>2</sup> /in. (\$/ton)
						Furnish Concrete (\$/yd <sup>3</sup> )	Square Yards (yd <sup>2</sup> )	Overlay Placement (\$/yd <sup>2</sup> )	Total Cost (\$/yd <sup>2</sup> )		
21-Apr-09	IA	Bonded Overlay on PCC	6.50	6.72	18,875.00	\$ 66.34	101,093.00	\$ 3.52	\$ 15.91	\$ 2.37	\$ 43.70
6-Aug-08	IL	Bonded Whitetopping	5.00	5.00	7,618.00	\$ 97.00	54,852.00	\$ 4.70	\$ 18.17	\$ 3.63	\$ 64.90
10-Aug-09	IL	Bonded Whitetopping	5.00	5.27	17,274.00	\$ 97.85	117,952.00	\$ 6.06	\$ 20.39	\$ 3.87	\$ 72.82
6-Aug-08	IL	Bonded Whitetopping	6.00	6.00	6,793.00	\$ 97.00	40,759.00	\$ 4.30	\$ 20.47	\$ 3.41	\$ 60.91
	MN	Unbonded over PCC	5.00	5.00			152,086.00	\$ 14.77	\$ 14.77	\$ 2.95	\$ 52.75
	MN	Unbonded over PCC	6.00	6.00	18,446.33	\$ 66.80	110,678.00	\$ 4.50	\$ 15.63	\$ 2.61	\$ 46.53
28-Apr-09	IA	Unbonded Overlay	5.00	5.18	7,365.00	\$ 66.76	51,216.00	\$ 3.69	\$ 13.29	\$ 2.57	\$ 47.47
21-Apr-09	IA	Unbonded Overlay	5.50	5.54	29,569.00	\$ 55.16	192,078.00	\$ 5.35	\$ 13.84	\$ 2.50	\$ 44.94
16-Jun-09	IA	Unbonded Overlay	5.50	5.78	7,650.00	\$ 69.00	47,638.00	\$ 3.65	\$ 14.73	\$ 2.55	\$ 47.83
17-Feb-09	IA	Unbonded Overlay	6.00	6.00	6,346.00	\$ 85.00	38,073.00	\$ 3.78	\$ 17.95	\$ 2.99	\$ 53.42
3-Apr-09	MI	Unbonded Overlay	6.00	6.46	38,409.00	\$ 70.00	213,981.00	\$ 5.20	\$ 17.76	\$ 2.75	\$ 52.87
28-Apr-09	IA	Unbonded Overlay	7.00	7.42	7,490.00	\$ 72.00	36,317.00	\$ 3.35	\$ 18.20	\$ 2.45	\$ 46.43
24-Apr-09	MO	Unbonded Overlay	8.00	8.00	46,726.00	\$ 69.65	210,267.20	\$ 11.65	\$ 27.13	\$ 3.39	\$ 60.55
23-Jan-09	MO	Unbonded Overlay	8.00	8.25	26,839.10	\$ 70.00	117,115.80	\$ 8.90	\$ 24.94	\$ 3.02	\$ 55.67
24-Apr-09	MO	Unbonded Overlay	8.00	8.43	26,162.80	\$ 81.00	111,738.30	\$ 9.00	\$ 27.97	\$ 3.32	\$ 62.42
20-Jan-09	MO	Unbonded Overlay	8.50	8.75	45,992.10	\$ 75.05	189,224.80	\$ 9.40	\$ 27.64	\$ 3.16	\$ 58.07
16-Jun-09	IA	Unbonded Overlay	9.50	9.60	14,530.00	\$ 69.00	54,480.00	\$ 6.25	\$ 24.65	\$ 2.57	\$ 46.34
19-Mar-09	OK	Unbonded Overlay	10.00	10.01	29,850.00	\$ 95.00	107,355.00	\$ 13.00	\$ 39.41	\$ 3.94	\$ 70.38
26-Jun-09	MO	Unbonded Overlay	10.00	10.04	31,689.40	\$ 55.00	113,637.30	\$ 12.70	\$ 28.04	\$ 2.79	\$ 50.07
17-Feb-09	IA	Unbonded Overlay	11.00	11.25	22,826.00	\$ 85.00	73,045.00	\$ 12.50	\$ 39.06	\$ 3.47	\$ 63.41
16-Dec-08	IA	Whitetopping	4.00	4.41	13,862.70	\$ 73.50	113,056.63	\$ 2.75	\$ 11.76	\$ 2.66	\$ 52.51
19-May-09	IA	Whitetopping	5.00	4.97	18,175.65	\$ 67.81	131,708.31	\$ 2.75	\$ 12.11	\$ 2.44	\$ 43.24
15-Sep-09	IA	Whitetopping	5.00	5.00	2,938.00	\$ 98.00	21,155.00	\$ 4.45	\$ 18.06	\$ 3.61	\$ 64.50
22-Jan-09	OK	Whitetopping	5.00	5.31	12,790.00	\$ 86.00	86,700.00	\$ 4.00	\$ 16.69	\$ 3.14	\$ 59.60
19-Mar-09	OK	Whitetopping	5.50	5.49	27,400.00	\$ 86.00	179,700.00	\$ 5.30	\$ 18.41	\$ 3.35	\$ 59.78
22-Jan-09	OK	Whitetopping	5.50	5.67	11,447.00	\$ 101.75	72,653.00	\$ 4.15	\$ 20.18	\$ 3.56	\$ 65.52
	MN	Whitetopping	6.00	6.00			194,057.00	\$ 19.26	\$ 19.26	\$ 3.21	\$ 57.32
13-Mar-09	MN	Whitetopping	6.00	6.00	22,994.50	\$ 69.80	137,967.00	\$ 3.20	\$ 14.83	\$ 2.47	\$ 44.15
	MN	Whitetopping	6.00	6.00	6,793.17	\$ 101.00	40,759.00	\$ 5.10	\$ 21.93	\$ 3.66	\$ 65.28
	MN	Whitetopping	6.00	6.00	9,064.17	\$ 87.75	54,385.00	\$ 4.90	\$ 19.53	\$ 3.25	\$ 58.11
28-Apr-09	IA	Whitetopping	6.50	6.79	4,812.00	\$ 69.00	25,509.00	\$ 2.85	\$ 15.87	\$ 2.34	\$ 43.59
28-Apr-09	IA	Whitetopping	6.50	6.87	21,576.20	\$ 62.00	113,137.00	\$ 3.15	\$ 14.97	\$ 2.18	\$ 41.14
21-Jan-09	IA	Whitetopping	8.50	8.63	67,132.00	\$ 60.80	279,940.00	\$ 6.10	\$ 20.68	\$ 2.40	\$ 43.45

<b>Count (n)</b>	33										
<b>Minimum</b>	4.41	2,938.00	\$ 55.00	21,155.00	\$ 2.75	\$ 11.26	\$ 2.18	\$ 41.14			
<b>Maximum</b>	11.25	67,132.00	\$ 101.75	279,940.00	\$ 19.26	\$ 39.41	\$ 3.94	\$ 72.82			
<b>Average</b>	6.72	20,304.39	\$ 77.61	108,615.56	\$ 6.49	\$ 20.13	\$ 2.99	\$ 54.54			
<b>Standard Deviation</b>			\$ 14.01		\$ 4.10		\$ 0.50	\$ 8.88			

**About the National Concrete Pavement Technology Center**

The mission of the National Concrete Pavement Technology Center is to unite key transportation stakeholders around the central goal of advancing concrete pavement technology through research, tech transfer, and technology implementation.

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