

UTW In California and Nevada
A 13-Year Performance Perspective of Performance Based on Joint Spacing, Thickness, and Traffic Loading
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Background

In excess of eighteen ultrathin whitetopping projects have been constructed in southern California and Nevada (Table 1). Of the eighteen surveyed for this paper, ten were constructed with notable variances to the recommendations contained in “Whitetopping – State of the Practice” (Ref. 1):

- Very wide joint spacings (up to 15’ by 19’)
- Surface preparation of the existing asphalt pavement (no milling)

The first known ultra-thin whitetopping project in California or Nevada was constructed June 1992 at the Poway Mortuary in Poway, California. The 4” UTW was constructed over an existing asphalt pavement that was broom swept and slightly dampened. The concrete was a “fast-track” mix containing synthetic fibers and having 24-hour design strength of 3,000 psi and a 28-day strength of 4,000 psi. Joints were sawed using several Soff-cut early entry saws forming individual panels ranging from 10-ft by 10-ft to 10-ft by 19-ft. As shown in Photograph A, for unknown reasons sawcutting was omitted from three panels at the rear of the building. The concrete cracked within days of being placed.

Most of the early projects were constructed in the Coachella Valley between Palm Springs and Thermal, CA using a locally developed specification requiring a 4,000-psi concrete, a 0.48 water/cement ratio, and 10’ joint spacings (Ref. 2). Eight of the 10 projects listed in Table 2 were constructed using this specification.

Beginning in 1998, UTW projects, except for the Coachella Valley, have been constructed following the joint spacing and asphalt preparation recommendations of the ACPA (Ref. 1). The typical asphalt concrete thickness on non-arterial streets and parking lots in southern California is generally a maximum of 4”, which precludes removing more than 1” of asphalt for surface preparation. In many instances, the only surface preparation is sweeping the surface clean of dirt as the surface already rough from losing volatiles and fine aggregate. Along the curb face, a thickened, full-depth concrete edge may be constructed the width of the typical panel.

Concrete strength requirements have increased commensurate with the need for early opening to traffic. A mix that attains 400-psi flexural strength in four hours has been used for the Los Angeles County Fairgrounds main entrance and the truck scale at the Alamo truck stop in Reno, NV. These mixes typically have minimum tested 28-day compressive and flexural strengths of 8,500 psi and 800 psi, respectively. Other projects used a variety of mixes, but all required an ultimate design of 4,000 psi and incorporated some type of polypropylene fibers.

The eighteen UTW projects were visually surveyed using the US Army Corps of Engineer Micropaver protocol to develop a Pavement Condition Index number (Ref. 3). Note that since the joints in UTW are only sawed and not sealed, there was no deduction taken for the lack of sealing in the observed joints.

Observations

Of the ten projects having wide joint spacings, the two that have the highest equivalent single axle loads and lowest PCI’s also are subjected to regular truck traffic. The Indio Heights Center is a strip center on the westerly edge of Indio, CA. Semi-tractor delivery trucks and trash trucks have severely impacted a small section of UTW at the back of the stores (Photograph B). The public parking areas are not notably distressed. For comparison, Photographs C and D of the Palm Springs Library parking lot show the wide joint spacings and minimal panel distress, respectively.

While the asphalt surfaces of the ten projects constructed with wide joint spacings were not milled, random soundings of the pavements disclosed no delamination of the UTW and asphalt concrete pavement.

None of the panels were noted to be curled and no faulted joints were noted.

The eight UTW projects constructed using conventional joint spacings are subjected to varying amounts of truck, bus, and car traffic. The Alamo truck stop UTW spans both the truck scale exit and a fuel island lane (Photograph E). While this project exhibited minimal cracking, the cracks were concentrated on the scale side of the pavement (Photograph F). It was noted that from a dead start, the tractor/trailer's start is not uniformly smooth and even. The initial forward motion creates a bobbing or bouncing effect. For a tractor transitioning from the scale to a solid surface, the bouncing effect is magnified and creating distress in the wheel path. No such distress was observed in the fuel lane UTW.

Discussion

Of all eighteen projects, the lowest PCI was recorded for the Poway Mortuary (PCI = 80). This rating is not the direct result of this being the oldest pavement or the some of the widest joint spacings. Overall, the UTW is in excellent condition except for the joints that were not initially cut at the back of the building. As shown in Photograph A, the concrete created its own joints where joints were not constructed. These cracks were noted within one week of construction and have remained stable in width since 1992 with no evidence of faulting or debonding. The balance of the surveyed UTW projects have "Excellent" ratings (PCI > 85).

For parking lots subjected to primarily car traffic with a daily package truck delivery, the use of wider joint spacings does not appear to have degraded the pavement performance. Further, the estimated minimum service for any pavement in this survey is at least 25 years with minimal to no interim maintenance. UTW failure could occur at entry/exit points to parking lots, warehouses, or stores due to asphalt concrete pavement being too thin to properly construct an UTW section or a loss of support from the underlying soil.

The graphical comparison of the PCI to the accumulated ESAL's for the ten projects with wide joint spacings illustrates excellent performance (Figure 1). The single outlier is the mortuary. Had the sawn joints been continued into the last three panels, the cracks most likely would not have occurred and the PCI would be significantly higher. As previously noted, the cracks are stable in width and length and the UTW is not delaminated from the underlying asphalt concrete pavement.

The lack of any observed UTW delamination from the existing asphalt concrete pavements that were only prepared by brooming and slightly dampening indicates that bonding between concrete and asphalt does not require a milled surface. It appears that a weathered and worn asphalt concrete pavement that has lost its volatiles and has large amounts of an exposed aggregate surface will provide sufficient bonding area between the two materials.

The two highest ESAL's were recorded on deceleration lanes at intersections. The westbound lane of Sunset carries a high volume of construction materials trucks (aggregate, masonry units, asphalt). The four deceleration lanes at Spring Mountain and Valley View are subjected to wall-to-wall trucks (over-road semi's, local delivery, ready-mix, refuse, etc.) and seemingly endless streams of cars. With joints spaced in accordance with ACPA's EB210P, the UTW is functioning as planned.

Conclusions

Ultrathin whitetopping is providing excellent service as a pavement rehabilitation method at both conventional and longer than conventional joint spacings. As illustrated by these eighteen projects, UTW in a wide variety of

climatic conditions – mild coastal, extremely hot desert, and cold weather, is providing significantly longer periods between pavement maintenance cycles without compromising pavement integrity.

When UTW is used for parking lots subjected only to light traffic (cars and a daily package delivery service), it is reasonable to

- a) Not mill the existing asphalt pavement prior to placing concrete, and
- b) Double the joint spacing if the concrete thickness is at least 3-inches.

None of the ten large panel projects was constructed using a milled asphalt surface; the surfaces were swept and dampened. The surface texture of weathered asphalt that has lost its surface volatiles is essentially as rough as if it had been milled. Further, no evidence of curling or joint faulting was noted and random sounding disclosed no delaminations of any panels. With wider than conventional joint spacings, attention should be paid the entry/exit points to warehouses or stores and other truck-related venues. At these locations premature pavement distress in the form of shoving of the asphalt concrete pavement or to premature cracking of the concrete if the edges are not thickened.

UTW pavements subjected to heavy truck traffic should be jointed at the dimensions recommended by the ACPA. As shown by the data in Table 3, high strength concrete positively bonded to an asphalt concrete load-bearing subgrade will provide long, cost-effective service.

In summary, Portland cement concrete when used for an ultrathin whitetopping will provide significantly longer periods between pavement maintenance cycles without compromising pavement integrity. Longer joint spacings are reasonable when the UTW is primarily exposed to automobile traffic with minimal package delivery trucks. Wider joint spacings will benefit the general contractor, the equipment manufacturers, and the owner. Also, the asphalt concrete pavement surface does not need to be milled provided the surface is uniformly worn. As David Britton, Principal Engineer, City of Santa Monica, noted, “UTW will last two to three times longer than asphalt and can be placed by a city maintenance work crew. It has a better life-cycle cost than asphalt concrete” (Ref. 4).

References

1. “Whitotopping – State of the Practice”, EB210P, American Concrete Pavement Association.
2. “Coachella Unified School District Ultrathin Whitotopping Specification”, undated.
3. “O&M: Paver, Concrete Surfaced Airfields Pavement Condition Index (PCI)”, UFC 3-270-05, March 15, 2001.
4. David Britton, City of Santa Monica, private correspondence.



Photograph B Indio Heights Center – Cracking at truck unloading/loading area



Photograph C Palm Springs Library Parking Lot



Photograph D Largest Crack in Palm Springs Library Parking Lot



Photograph E Alamo Truck Stop – UTW extends from scale and from pump island adjacent to scale



Photograph F Alamo Truck Stop – Corner breaks in UTW in portion extending from scale

Table 1 General Information

Project	Thickness, in	Area, sf	ESAL - PCI - % Distress						Age, yr
			2002			2005			
			ESAL	PCI	% Dist.	ESAL	PCI	% Dist.	
Palm Springs Pavillion	3.5	219,298	2,156	100	0	5,430	98	1	5
Alpine Community Church	4	5,120	4,726	99	3	5,989	98	5	10
Bobby Duke Middle School	3.5	12,500	2,540	94	6	6,177	94	7	10
Palm Springs Library	3.5	46,512	3,940	97	7	7,959	96	7	5
Mizel Senior Center	3.5	22,151	5,378	98	2	8,584	96	3	8
Valley View Elementary	3.5	9,900	9,545	97	4	10,272	97	6	10
Peter Pendleton School	3.5	34120				11,633	97	3	6
John Kelly School	3.5	29670				12,495	99	1	7
LA County Fairground, South Rd	3.5	6788	7,048	99	1	18,945	96	1	5
Fifth Avenue at Marine St	3.5	6338	10,674	99	2	20,027	98	2	7
Poway Mortuary	4	18,878	19,558	80	12	25,900	80	12	13
Indio Heights Center	4	105,000	23,075	94	3	31,728	91	4	11
Alamo Truck Stop	3	2100				52,603	99	1	2
LA County Fairground, Main Gate	4	3360				58,002	97	2	3
Charleston Bus Stop, WB	4	1824				132,708	97	10	1
Charleston Bus Stop, EB	4	2160				132,708	94	13	1
Spring Mountain and Valley View	3					1,597,575	94	1	2
Sunset at Boulder Highway	3	8694				1,680,001	96	0	4

Table 2 Oversize Panels vs. PCI

Project	Thickness, in	Panels								
		No.	Average				2005			
			Area, sf	Joint Spacing, ft		Joint Spacing, ft	ESAL	PCI	% Dist.	
Indio Heights Center	4	1,050	100			10	10	31,728	91	4
Poway Mortuary	4	142	135	11.6	11.6			25,900	80	12
		77				10	10			
		7				17	10			
		6				19	10			
		25				15	10			
		4				10	19			
		10				10	19			
		13				10	18			
John Kelly School	3.5	464	64			8	8	12,495	99	1
Peter Pendleton School	3.5	341	100			10	10	11,633	97	3
Valley View Elementary	3.5	99	100			10	10	10,272	97	6
Mizel Senior Center	3.5	607	30	5.5	5.5			8,584	96	3
		459				4	4			
		148				10	10			
Palm Springs Library	3.5	569	81	10.0	8.1			7,959	96	7
		360				10	8			
		165				10	8			
		24				11	8			
		20				10	12			
Bobby Duke Middle School	3.5	125	100			10	10	6,177	94	7
Alpine Community Church	4	80	64			8	8	5,989	98	5
Palm Springs Pavillion	3.5	2,344	93	9.5	9.8			5,430	98	1
		900				9.5	8			
		1,444				9.5	11			

Table 3 Conventional UTW Panel Sizes

Project	Thickness, in	Panels						
		No.	Average			2005		
			Area, sf	Joint Spacing, ft		ESAL	PCI	% Dist.
LA County Fairground, Main Entry	4	210	16	4	4	58,002	97	2
Charleston Bus Stop, West Bound	4	114	16	4	4	132,708	97	10
Charleston Bus Stop, East Bound	4	135	16	4	4	132,708	94	13
LA County Fairground, South Road	3.5	566	12	4	3	18,945	96	1
Fifth Avenue at Marine St	3.5	604	11	3	3.5	20,027	98	2
Alamo Truck Stop	3	233	9	3	3	52,603	99	1
Spring Mountain and Valley View	4	792	9	3	3	1,597,575	94	1
Sunset at Boulder Highway	3	966	9	3	3	1,680,001	96	0

Pavement Condition Index v. Accumulated ESAL

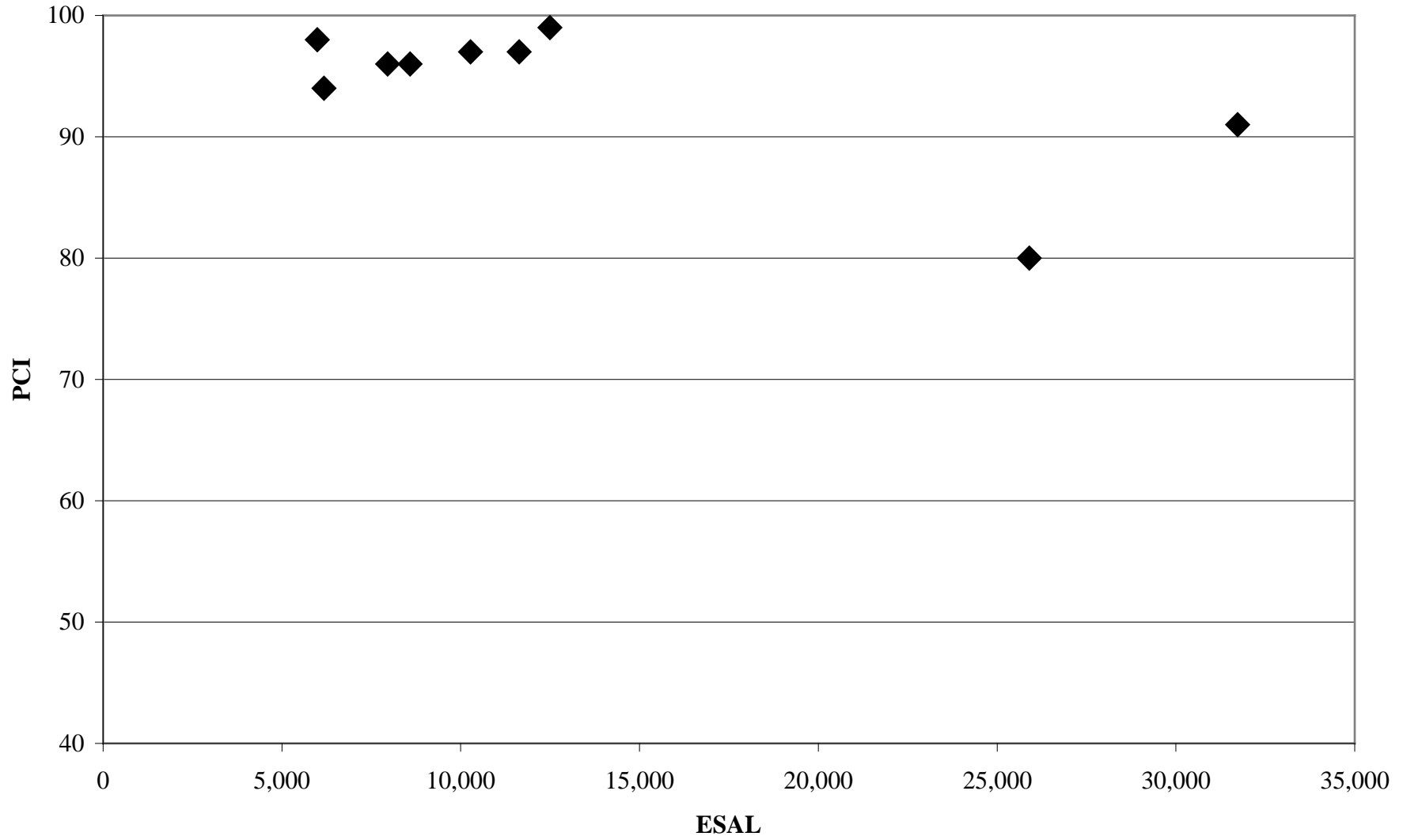


Figure 1 PCI v. Accumulated ESAL's - Oversize Panel Spacing