



Project Summary

Texas Department of Transportation

Texas State University and
The University of Texas at Austin
Project 0-6749: Feasibility Study of Two-Lift
Concrete Paving

Project Snapshot	
Cost:	\$\$\$
Benefit/Cost:	++++
Realization:	Moderate
Scope of Impact:	State
Importance:	Economic/Sustainable
Stakeholders:	City/State
Challenges:	Experience/Specification
Cost Scale:	
\$ = \$0 - \$25K	\$\$\$ = \$76K - \$200K
\$\$ = \$26K - \$75K	\$\$\$\$ = > \$200K
Benefit/Cost Scale:	
+ = 1:1 - 5:1	+++ = 10:1 - 20:1
++ = 6:1 - 10:1	++++ = > 20:1
Realization of Benefit Scale:	
Short ≤ 12 months	Long ≥ 24 months
Moderate 13 months to 24 months	

Problem

Two-lift concrete paving (2LCP) involves placing two layers of concrete (wet-on-wet) instead of a single homogeneous layer, as is typically done in the United States. 2LCP offers the opportunity to optimize the use of local aggregates and recycled materials to produce an economical, durable, and sustainable pavement system with the most desirable surface characteristics (improved skid resistance and reduced noise). Challenges of 2LCP include having the proper paving equipment, pavement construction management, the right mixture proportions to use local materials in the bottom lift, which results in an economical pavement placement, and the proper proportions and materials to ensure adequate surface friction and abrasion resistance in the top lift.

Project Value

Districts including Houston, Fort Worth, and Dallas have the potential to receive great benefit from the 2LCP concept by being able to use more local materials that are not considered appropriate for traditional (single-lift) concrete pavement use. This study enables the Texas Department of Transportation (TxDOT) to use more of the presently less desirable aggregates, while increasing its efforts to provide more demand for local materials and thus stimulate local economies where concrete pavements are located.

Background

Since sustainability is becoming increasingly important in concrete paving, 2LCP is an effective tool to address economic and environmental challenges. This study is to deliver a feasibility analysis and cost assessment of this alternative method of paving with current equipment and materials, but using more of the plentiful local resources (that might not be suitable as the surface course), instead of relying on imported materials.

What the Researchers Did – A comprehensive literature review was conducted to gather previous experiences and past performances of 2LCP, particularly to justify the cost and efficiently execute the process of 2LCP.

Surveys and interviews were conducted to determine experiences of contractors and agencies with 2LCP and to determine TxDOT personnel's concerns on implementation of 2LCP. A one-day workshop regarding 2LCP was organized for a wide range of agency, construction, equipment, and TxDOT personnel with experience or interest in 2LCP. The workshop also served as a solicitation of ideas for best practices, the most cost-effective approach, concerns, and requirements associated with materials and construction of 2LCP. Information and inputs collected from literature reviews, surveys, interviews, and the 2LCP workshop were summarized to provide construction perspectives on implementation of 2LCP, including additional costs, requirements, and impacts to project scheduling of implementation of this concept.

What the Researchers Found – The learning process of constructing 2LCP and the lack of specifications are the two major issues that hinder the implementation of 2LCP in the United States. Previous experiences indicated that 2LCP can be a feasible alternative from both technical and cost perspectives. 2LCP can become a promising alternative in situations such as when high supplemental cementitious materials or low cement





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content mixes, surface durability and rapid renewal (for low pavement noise or high friction) conditions, or highly durable pavements are desired. 2LCP can also become a cost-effective (either current or long-term) alternative when high-quality aggregates for Portland cement concrete are not available (quality aggregates are scarce), recycling and sustainability are important considerations, or there are situations that traditionally require higher volumes or higher thicknesses, such as airport pavements.

Conclusion

1. 2LCP opens up opportunities not only to use local and/or recycled materials that in the past have not been suitable for concrete pavements, but also to incorporate surface techniques to address noise, safety challenges, and public demands. Districts including Houston, Fort Worth, and Dallas have the potential to receive great benefit from using locally available materials that are not considered appropriate for traditional (single-lift) concrete pavement use.
2. Challenges of 2LCP include having the proper paving equipment and pavement construction management, the right mixture proportions to ensure the use of local materials in the bottom lift to result in an economical placement, and the proper proportions and materials to ensure adequate surface friction in the top lift.
3. A case-based cost analysis showed that while 2LCP does result in increased construction costs associated with additional equipment, labor, and scheduling effort, savings from the use of lower-quality, less expensive concrete and aggregate in the bottom lift could be sufficient to offset the additional costs.
4. Case studies of recently constructed projects showed that 2LCP projects can be a viable alternative from both sustainability and economics viewpoints. The decision of whether to adopt 2LCP is determined by technical, economic, and construction considerations.

Recommendation for Implementation

1. Since 2LCP is becoming a technically and economically feasible technique, more demonstration projects are needed to promote the practice and resolve difficulties and challenges for 2LCP implementation. Demonstrations on a limited paving section that is part of an ongoing project could be contracted to show the feasibility of 2LCP. An implementation program with paving sections that include variables of materials/thickness in both lower and upper lift is needed.
2. As the technique is still relatively new, it is important to increase the public awareness of 2LCP. Researchers developed a blog for the project that includes workshop presentations and a summary of the 2LCP workshop, which could serve as a platform for discussion as well as information sharing. Presentations regarding technical and economical perspectives of 2LCP as well as construction practices from different TxDOT districts could also be helpful.
3. Laboratory and field studies to determine optimum time lag between the two lifts under different conditions, minimum bond strength, and coefficient of thermal expansion on debonding issues and/or thermal deformation are also needed.
4. Other applications such as roller compacting concrete in the bottom lift and/or pervious concrete in the top lift can also be studied to explore additional environmental and economic benefits of 2LCP.

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