



# Project Summary

Texas Department of Transportation

## 0-6085: Considerations for Rigid vs. Flexible Pavement Designs When Allowed as Alternate Bids

### *Background*

To provide flexibility in contractor competition and to attempt to achieve lower prices, the Texas Department of Transportation (TxDOT) has begun to explore and implement the practice of including rigid versus flexible pavement structure alternatives in plans for major highway construction projects. A few projects have already been let that offered pavement alternatives. There is concern that the alternate designs might not be truly equivalent, and that TxDOT could end up with a lesser design and not a better value. In addition to cost-effectiveness, a primary consideration in using alternate pavement designs is to ensure that both alternatives for a project result in similar performance.

One of the generally recognized ways to minimize construction cost is to allow a contractor to choose from different materials that serve an equivalent purpose. A large percentage of cost for most highway projects is in the pavement structure. A relatively minor cost savings per square yard of pavement could result in significant savings for the project. The use of rigid and flexible pavement design alternatives during the bidding process allows industry (i.e., market factors) to determine the least expensive pavement structure for a given project.

### *What the Researchers Did*

The researchers: 1) reviewed state-of-the-practice methods used for pavement type selection, 2) interviewed TxDOT personnel with experience in developing pavement structure alternatives, 3) conducted a side-by-side comparison of current TxDOT pavement design methods, 4) used the RealCost Life-Cycle Cost Analysis (LCCA) software developed by the Federal Highway Administration (FHWA) to conduct LCCA analysis with user costs for specific pavement designs, 5) developed guidelines with a protocol for considering bids for rigid versus flexible pavement designs when allowed, and 6) developed the Alternate Pavement Design Analysis Tool (APDAT) for pavement alternatives analysis.

### *What They Found*

From interviews conducted with TxDOT personnel, this research found that the following characteristics can make a pavement unsuitable for offering alternate pavement design options. The researchers recommend that these characteristics be incorporated into TxDOT's Design Summary Report (DSR). A project is not suitable for rigid versus flexible pavement design alternatives when: 1) the project involves pavement widening, 2) the project does not involve new construction or reconstruction, 3) the pavement is less than 500 feet in length, 4) the pavement is less than 5 miles in length and both connecting pavements are either rigid or flexible pavements, or 5) there are areas of the pavement where truck traffic will be stationary for long periods of time.

### *Research Performed by:*

Texas Transportation Institute (TTI),  
The Texas A&M University System

The University of Texas at El Paso (UTEP)

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From additional data analysis, researchers proposed two additional considerations that can be incorporated in the DSR revision. The first consideration states that pavement alternatives should not be used if the project's one-way truck traffic average daily traffic value range is below 300 or above 2,000. The second consideration states that pavement alternatives should not be used if the concrete pavement thickness for the project generated from the 1993 American Association of State Highway and Transportation Officials guide design procedure is less than 8 inches or 12 inches and greater. Both of these considerations should be conducted as preliminary evaluations prior to design.

If pavement for a project does not include any of the above characteristics, researchers recommend using APDAT to further explore whether to offer alternative pavement design options. If after conducting evaluations the project appears to be a candidate for alternative pavement designs, then TxDOT designers should generate alternate designs for the bid offering. After developing the flexible and rigid pavement designs using TxDOT pavement design methods and input recommendations, an LCCA analysis of both alternatives should be conducted. If the resulting difference between alternatives is more than 20 percent, researchers recommend that the engineer select the alternative with the lowest life-cycle cost. If the LCCA difference between alternatives is 20 percent or less, use of alternate pavement design is recommended for the bidding process.

User costs could be considered in the analysis but only if deeper analysis is desired. The APDAT software developed by the researchers can generate life-cycle costs without including user costs. The researchers suggest using the RealCost software developed by the FHWA if designers want to include user costs.

## What This Means

The research team developed a practical protocol and software to assist practitioners at TxDOT in generating pavement structure alternatives. The findings from this study will result in TxDOT achieving the best value for projects that utilize alternate pavement designs in the bid plans.

In order to effectively implement the recommendations of this research project, TxDOT should conduct training courses for pavement design personnel. These courses should cover the following subjects: 1) discussing TxDOT guidelines for pavement alternatives, 2) using the TxDOT PMIS mainframe system or MapZapper to generate the PMIS Multi-Year Ratings and Scores Report for well-performing pavement sections (this report, which includes maintenance costs, can be used to help determine appropriate maintenance costs and rehabilitation timing for LCCA), 3) using the TxDOT intranet web site to access pavement photos taken by TxDOT pavement data collection equipment since 2003 (these photos can be used to discern whether the PMIS data accurately reflect pavement conditions and to help determine rehabilitation timing for LCCA), 4) using the Texas Successful Flexible Pavements Database (this database might be used for determining appropriate rehabilitation timing for flexible pavement LCCA), and 5) using the APDAT and the RealCost LCCA software.

In addition, the researchers suggest that TxDOT maintain a database of projects that used pavement alternatives. TxDOT personnel can use the information in this database to determine if adjustments are needed to the department's alternative pavement guidelines. The researchers expect that adjustments would be needed as TxDOT personnel gain experience in developing pavement alternatives. This database should include the typical sections and estimates used in the set of plans, the pavement design inputs used for developing the alternate designs, life-cycle cost analyses, and the contractor's project agreement estimate.

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