



South Carolina  
Department of Transportation



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## SUMMARY REPORT

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Department of Transportation  
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## Investigation Into Improvement of Bridge Approaches in South Carolina

A study was performed to evaluate the in-service performance of bridge approach slabs in South Carolina. The South Carolina Department of Transportation (SCDOT) has been recognized for maintaining some of the smoother highways in the nation, yet the rideability of road-to-bridge transitions is relatively poor as a result of a bump that develops at the end of the bridge between the abutment and approach embankment. Tasks performed for this study included a review of existing literature on bridge approaches, a survey of bridge maintenance engineers in South Carolina, and a field inspection of selected approach slabs within the state. A total of 25 bridges located in 11 different counties were visited to visually and quantitatively assess approach slab performance.

A review of the literature suggests that the use of approach slabs is an effective method of improving vehicle ride characteristics in areas where differential settlement develops between bridge approach embankments and bridge abutments. Approach slabs do not eliminate differential settlement but frequently shift the location of the bump to the roadway end of the approach slab. The three most common problems observed with approach slabs are settlement, void development between the slab and the supporting fill material, and erosion of the fill material. Some of the alternative design and construction methods investigated in the literature to mitigate the bump include tensile reinforcement of the approach embankment, placement of controlled low-strength materials instead of compacted earth backfill, and the installation of deep cement mixed columns.

A survey of SCDOT Bridge Maintenance Engineers revealed that they are generally satisfied with the condition of bridge approach slabs in their district. One of the seven districts indicated that 50% of approach slabs are in poor condition. The most frequently cited problems are consistent with the literature and include slab settlement, void development and erosion of fill. These problems are most likely caused by the lack of adequate backfill compaction and placement of sub-standard fill materials. Settlement is most commonly counteracted by placing an asphalt overlay of the approach slab; mud jacking is employed less frequently. Neither of these rehabilitation methods is considered highly effective.

Results of the field investigation showed that more than 60% of road-to-slab transitions had observable faulting and more than 70% had observable concrete spalling. Faulting and spalling of the slab-to-deck transitions were less severe and occurred at less than 40% of bridge approaches. Observed cracking of the approach slab consisted of minor map and shrinkage cracks. Cracking of the asphalt pavement adjacent to the approach slab was observed at more than 60% of bridge approaches. Surface roughness was quantified by calculating the Mean Roughness Index (MRI) from longitudinal elevation profiles measured with a walking Dipstick Profiler. MRI values correlate well with the magnitude of faulting at both ends of the slab. MRI values were higher in all but five cases when calculated for the entire road-to-bridge transition (as opposed to the approach slab only). Three of these five exceptions include the only three approach slab asphalt overlays investigated.

This study concluded that bumps develop primarily at the transition from the road to the approach slab and that rutting of asphalt pavement adjacent to the approach slab contributes significantly to the bump. Using MRI values calculated from Dipstick-measured elevation profiles, the majority (75%) of bridge approaches with approach slabs in this study can be considered uncomfortable to riders traveling at speeds in excess of 62 mph. Approach slabs with asphalt overlays tend to increase surface roughness, and bridge approaches with integral abutments tend to reduce the surface roughness. Recommendations for further investigation include modification of slab lengths, increased quality control of backfill material and compaction, use of controlled low-strength materials as alternative backfill, and non-destructive evaluation of void development beneath approach slabs.

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