Matching Load Transfer to Traffic Needs

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Current pavement design in Iowa calls for the inclusion of load transfer dowels in transverse joints in both state and local pavements. The dowels have been included to protect the pavement against faulting of the joints and other forms of distress resulting from erosion of the soils from beneath the joints. Faulting has been found to be present mostly at the outer edges of the driving lane. Iowa Highway Research Board Project TR-420 is directed at the evaluation of placing alternative numbers of dowels in the transverse joints of the pavement. A rural and an urban pavement were selected for the test sites on county highways near Creston, Iowa. The sites include subsections containing zero dowels in the transfer joint, three or four dowels in the outer wheel path only, and a full basket of dowels across the joint. This paper will discuss the results of deflection testing in both wheel paths in both pavement directions on the rural and urban sections. Fault measurements, joint opening widths, and visual distress surveys have been conducted twice per year on each of the projects. The construction projects are now one year old and we can begin to evaluate the response to load in each case. Key words: load transfer, pavements, dowels, whitetopping, portland cement concrete pavements.

INTRODUCTION

As the size and weight of vehicles using local roads has increased, so has the need for stronger pavements. In the area of portland cement concrete pavements, this need results in increased pavement depth and the need for load transfer devices across the transverse joints. The current practice for construction involves one of two alternative designs. The first assumes that aggregate interlock between adjoining slabs will carry the load across the joint. The alternative method employs the use of cylindrical dowels spaced at 12-inch intervals along and perpendicular to the transverse joint.

The addition of load transfer devices is directed at reducing differential deflection across the joint as the load passes over. This reduced deflection also aids in reducing the chance for erosion of the base, loss of slab support, and eventual slab corner cracking or faulting of the joint and loss of ride quality. The addition of the load transfer reinforcement is labor intensive and a sizable cost in the construction of the pavement. Observations of existing local road pavements indicate that faulting is most prevalent near the outer edge of the pavement versus near the centerline. The question arises in the designer's mind regarding the number of dowels required to meeting local road loading needs.

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STUDY OBJECTIVES

The research conducted under Iowa Highway Research Board Project TR-420 contained the following objectives aimed at answering the dowel location and number question:

- Evaluation of dowel location and number performance
- Evaluation of construction and installation procedures

TEST SITE LAYOUT AND VARIABLES

Two sites in Union County, near Creston, were chosen for this research. The first was located at the southeast corner of Creston and extended south from US 34 along Union County P33 (project STP-5-88(25)—5E-88) some 6.4 miles. It is referred to as the Rural test site. In this case, the pavement was constructed on an existing granular base.

The second or Urban project was located along the north and east boundaries of Creston on Union County H33 and P33 (project L-P-298—73-88). This project is approximately 1.5 miles in length. This project was constructed on an existing flexible base constructed over time to an average depth of six inches using cold mix asphaltic materials.

The variables selected for this research involved the number of dowels to be placed in the transverse joints. The options included omission of all dowels, installation of three or four dowel combinations in the outer wheel path only, and the default value of dowel across the entire transverse joint. Dowel spacing in each of the study areas was maintained at 12 inches. The joints in each project were constructed on a 6:1 skew as shown in Figure 1. In the case of the Rural project, the research team identified 20 joints each in succession containing no dowels, three dowels, four dowels, and a full dowel basket across the joint. This pattern was employed in both lanes. For the Urban project, the same plan was implemented on 10 joints in each direction with the exception of the section with no dowels. In this case, one lane contains no dowels and one lane contains full dowel baskets. Table 1 and 2 indicate the location of the various test sections on each project

TEST SITE CONSTRUCTION AND DATA COLLECTION

The projects were paved in August of 1998 by the Fred Carlson Co. Full width paving was employed on both projects. In the case of the Rural project, the base was trimmed immediately in front of the paving machine, and the concrete was placed on the granular base. The concrete was placed directly on the existing flexible pavement in the Urban project. In both cases, the dowel basket assemblies were placed immediately in front of the paving machine.

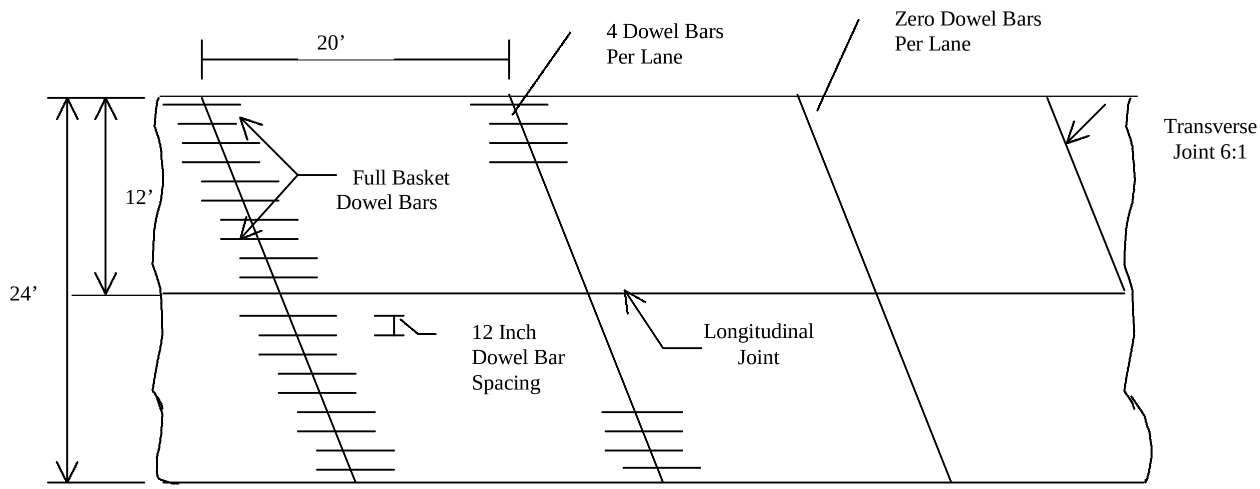

FIGURE 1 Example of joints with full basket, four, and zero dowel bars

TABLE 1 Station and Dowel Location for Urban Test Section

Beginning Station	End Station	Number of Dowels	Location	Number of Joints
72+00	73+80	No dowels	——	10
74+00	76+00	3 dowels	Outer wheel path	11
76+20	78+00	4 dowels	Outer wheel path	10
78+20	80+02	Full basket	Full joint width	10

TABLE 2 Station and Dowel Location for Rural Test Section

Beginning Station	End Station	Number of Dowels	Location	Number of Joints
178+00	181+80	No dowels	——	20
182+00	185+80	3 dowels	Outer wheel path	20
186+00	189+80	4 dowels	Outer wheel path	20
190+10	193+96	Full basket	Full joint width	20

Data being collected on each of the projects includes biannual visual distress surveys, joint faulting and opening measurements, and deflection testing of each joint by direction and both wheelpaths. Faulting is measured using a Georgia Fault Meter, and the joint openings are measured using a digital caliper. Deflection testing is accomplished by use of the Iowa DOT Roadrater. The distress surveys are conducted in accordance with the methods described in the Strategic Highway Research Program (SHRP) Pavement Distress Manual (*1*). Distress surveys were conducted on the Urban Project prior to construction. After construction, each of the data collection activities were conducted on both projects prior to opening to traffic.

TEST RESULTS TO DATE

The evaluation period for TR-420 is expected to last for five years. The initial results of the data collection have not resulted in conclusive answers to the research questions. The deflection measurements have been analyzed for the first full year and to date do not show any significant differences between test sections. The same can be said about the area bounded by the deflection basin, considering all the sensors on the Roadrater. Joint opening widths and faulting measurements are also inconclusive at this time. Each of the measurements was somewhat erratic at the time of construction and has stabilized over the first year of operation. There are no significant visual distresses other than minor spalling along the edges, as a result of shoulder construction equipment, and one transverse crack at a rural intersection as a result of pavement jointing techniques employed.

CONCLUSIONS

The conclusions that can be drawn at this time are as follows:

- Conventional pavements can be constructed employing partial dowel baskets with no change in the paving machine or labor requirements.
- To date the reduction in dowels has caused no reduction in performance (load transfer, deflection, joint opening or faulting).

REFERENCES

1. *Distress Identification Manual for the Long Term Pavement Performance Project.* Strategic Highway Research Program, Washington D.C.: National Research Council, 1993.
2. Cable, J.K. and L.I. Wosoba. *Field Evaluation of Alternative Load Transfer Device Locations in Low Volume Traffic Pavements*. TR-420, Iowa DOT and Iowa Highway Research Board, December 1999.