EXPERIMENTAL INSTALLATION OF CHROME-ALLOY-STEEL DOWELS

I 196 from the Grand River to Fuller Ave., Grand Rapids
Federal Designation I 196-5 (47) 72

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On December 17, 1962, the potential highway applications of low alloy steels were reviewed at a meeting attended by Department and Bethlehem Steel Company representatives. Among topics discussed was the problem of dowel bar corrosion in concrete pavement joints. In this connection, the Bethlehem staff recommended a 3-percent chromium steel alloy for use in dowel bars, stating that this material eroded at two-fifths the rate of structural steel and pitted only about one-fifth as deep. C. B. Laird stated that the Department would consider using a five-mile section of Interstate highway for field evaluation of this type of dowel bar.

Subsequently, a construction project was selected by the Office of Construction, and inclusion of the chrome-alloy dowel bars on an experimental basis was approved by the Bureau of Public Roads. Supplemental specifications covering the dowel bars were prepared by the Research Laboratory Division.

Project Location and Description

The construction project consists of 4.908 miles of I 196 from the Grand River to Fuller Avenue in Grand Rapids (Fig. 1). All transverse contraction, expansion, and construction joint load transfer assemblies

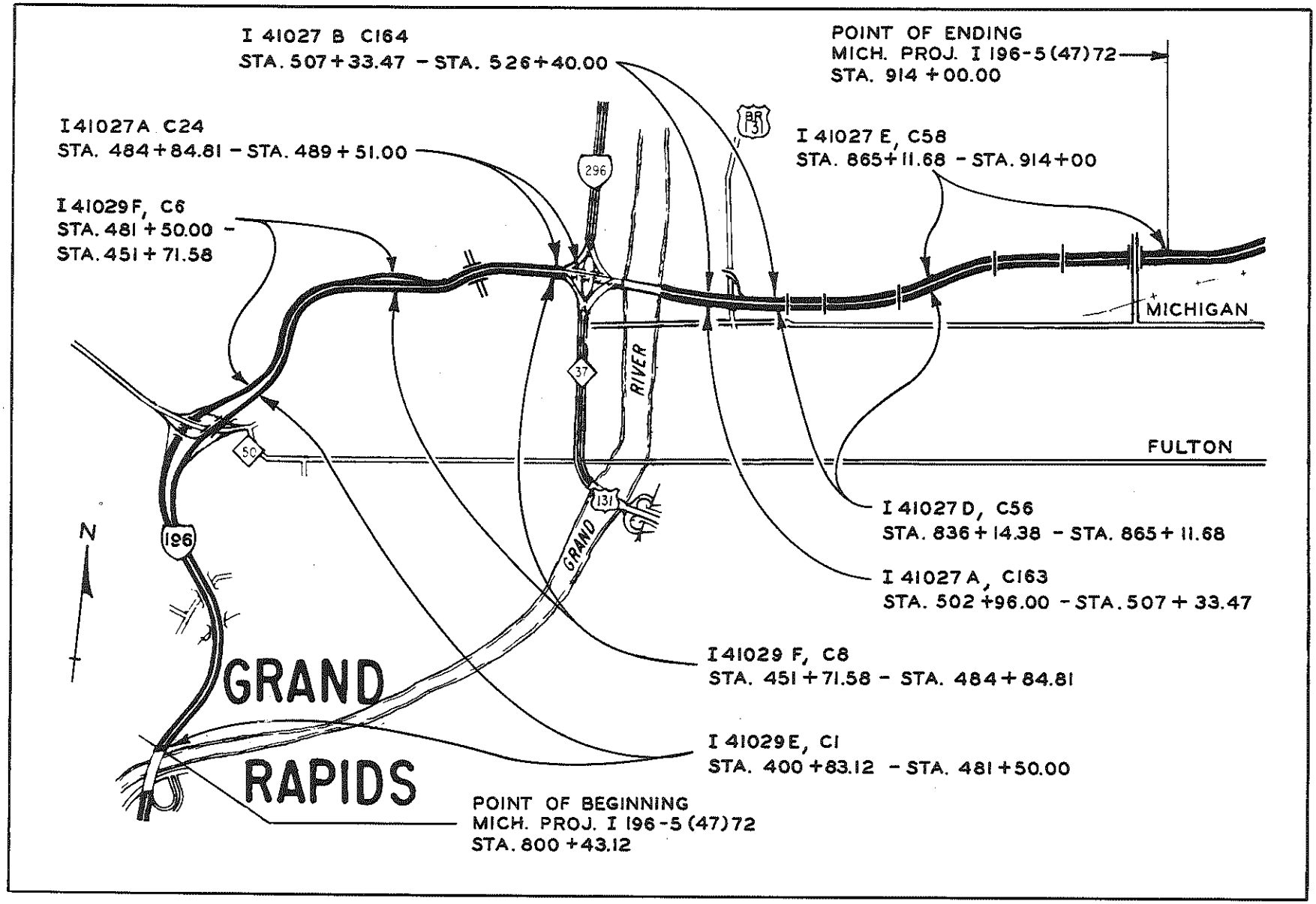

Figure 1. Locations of contracts containing experimental dowel bars.

contained chrome-alloy-steel dowel bars, with the assembly frame fabrication conforming to the Standard Plan for Dowel Bar Assemblies for Load Transfer at Transverse Joints (E-4-A-130E). Construction was performed in accordance with the requirements of the 1963 Standard Specifications.

The paving was done by Carl Goodwin and Son, Inc., during the summer and early fall of 1964, under the supervision of Project Engineer David Moody. The chrome-alloy-steel dowel bars were supplied by the Copperweld Steel Co., Aristoloy Steel Division, of Warren, Ohio, to the Universal Form Clamp Co., of Chicago, which fabricated the assemblies containing the experimental dowel bars.

Dowel Bar Requirements

Dowel bar requirements are specified in Section 7.16.03g of the 1963 Standard Specifications and supplements. Testing for chemical and physical properties of dowels for this project was performed by the Robert W. Hunt Co., Engineers, of Chicago, under contract to the Department. Samples from steel lots or heats representing approximately 15,000 dowels of 1-1/4 in. diam and 18-in. length were selected in Chicago from Jones & McKnight, Inc. (supplier) and the Universal Form

Clamp Co. (fabricator), with the following results:

	Constituent	Michigan Specifications		Hunt Co. Samples	
				Lot 31501	Lot 86723
Chemical Composition	Carbon, percent	0.18-0.23		0.22	0.23
	Manganese, percent	0.65-0.90		0.67	0.76
	Phosphorus, percent	0.025 max.		0.007	0.007
	Sulphur, percent	0.025 max.		0.021	0.014
	Silicon, percent	0.20-0.35		0.34	0.25
	Chromium, percent	3.00-3.50		3.03	3.32
	Property	ASTM A-15 Specification		Hunt Co. Samples	
		Intermediate Grade	Hard Grade	Lot 31501	Lot 86723
Physical Properties	Tensile Strength, psi	70,000-90,000	80,000 (min)	156,000	162,000
	Yield Point (min) psi	40,000	50,000	107,250	97,600
	Percent Elongation in 8 in. (min)*	$\frac{1,300,000}{\text{tensile strength}}$ -4%**	$\frac{1,100,000}{\text{tensile strength}}$ -4%	3.75	14.37
	Bond Test, 90°	waived	waived	Satisfactory	Satisfactory

* 1-1/4 in. diam plain bars
** But not less than 12 percent

Field Installation

On August 28, 1964, installation of load transfer assemblies containing chrome-alloy steel dowels was observed by Research Laboratory representatives. According to Mr. Moody, approximately 75 percent of the first shipment of dowel bar assemblies failed in the resistance welds between side wires and longitudinal wires. A complaint to the manufacturer corrected this problem to the extent that in subsequent shipments the rejections were reduced to approximately 3-to-4 percent. Horizontal alignment of the dowels was checked by Department inspectors before the assemblies were distributed on the grade. Through August 28, no assemblies had been rejected due to horizontal dowel alignment exceeding permissible tolerances. During assembly installation on the grade, a gage was used to ensure that the dowels were parallel to the

pavement surface. The physical dimensions of an assembly were measured, and conformed to the minimum dimension requirements specified in Standard Plan E-4-A-130E. Typical contraction and expansion joint assembly installation is shown in Fig. 2.

Six samples of chrome-alloy-steel dowel bars (Laboratory Sample No. 64 MR-310) were selected from damaged assemblies at the construction site, in case further testing and analysis becomes desirable during future performance ratings.

Performance Evaluation

The evaluation plan proposed by the Research Laboratory Division consists of comparing the performance of the experimental dowel bars with performance of standard steel dowel bars. Therefore, a control section of standard pavement will be required for comparative performance ratings. From the standpoint of traffic volume and climatic conditions, Control Section I 41029A, C35, etc. (2.6 miles on I 196, immediately west of the experimental project) would be suitable. Both projects were constructed during essentially the same period and opened to traffic on December 14, 1964.

The evaluation will consist of visual inspection of selected dowel bars, along with photographic recording of their condition. Expansion joint samples will be exposed by removing the sealer and joint filler material above the dowel bars. For contraction joint samples, the ex-

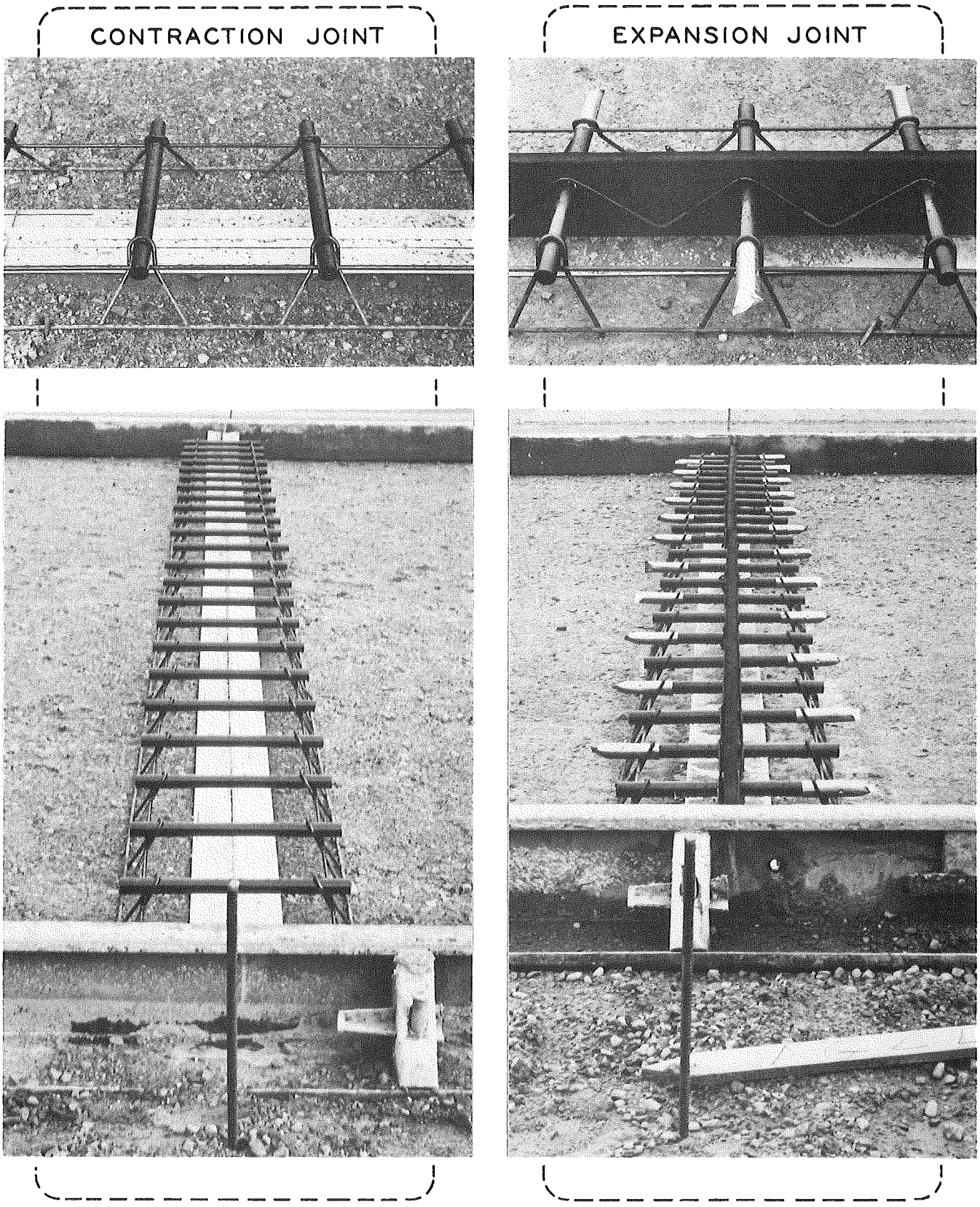

Figure 2. Typical dowel bar assembly installations on I 196.

posures will consist of coring to the dowel bar depth and patching with epoxy mortar after inspection.

Since it is anticipated that considerable time will be required to cause serious corrosive deterioration of the dowel bars, the first performance inspection will be made after five years of service. Should that inspection indicate no significant difference in performance, additional inspections will be made at appropriate intervals until dowel conditions permit conclusions regarding comparative performance.