EXPANSION JOINT SYSTEMS FOR THE TRANSITION SPANS

Bridge No. 90/25

WA-RD 356.1

Post Construction Report
July 1994

Washington State Department of Transportation

Washington State Transportation Commission
Planning and Programming Service Center
in cooperation with the U.S. Department of Transportation
Federal Highway Administration

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

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16. ABSTRACT

For floating bridge construction, the transition span from shore to the floating portion of the structure is subject to longitudinal movement in combination with horizontal and vertical rotation. These large movements pose special problems for the expansion joint system at both ends of the transition span. The expansion joint system selected for these conditions must accommodate the wide range of movements involved and remain watertight, corrosion free, durable, require little or no maintenance, and have a useful life of 25 to 30 years.

The purpose of this experimental project is to gain knowledge about the effectiveness of the modular expansion joint system over time and to obtain knowledge about field installation techniques and structural performance. Due to weld cracking in similar expansion joints used in the existing SR 90 Third Lake Floating Bridge, it was deemed prudent to require a five-year warranty on the expansion joints on this project. The state will monitor the performance during the warranty period.

The evaluation of warranty provisions for these expansion joint systems has been FHWA approved as Special Experimental Project No. 14. This experimental project is a part of FHWA's program of encouraging innovative concepts in contracting procedures.

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BRIDGE NO. 90/25

Lacey V. Murrow Bridge Replacement Expansion Joint Systems for the Transition Spans

by

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POST CONSTRUCTION REPORT

Experimental Project WA

Prepared for the Washington State Department of Transportation
in cooperation with the United States Department of Transportation
Federal Highway Administration

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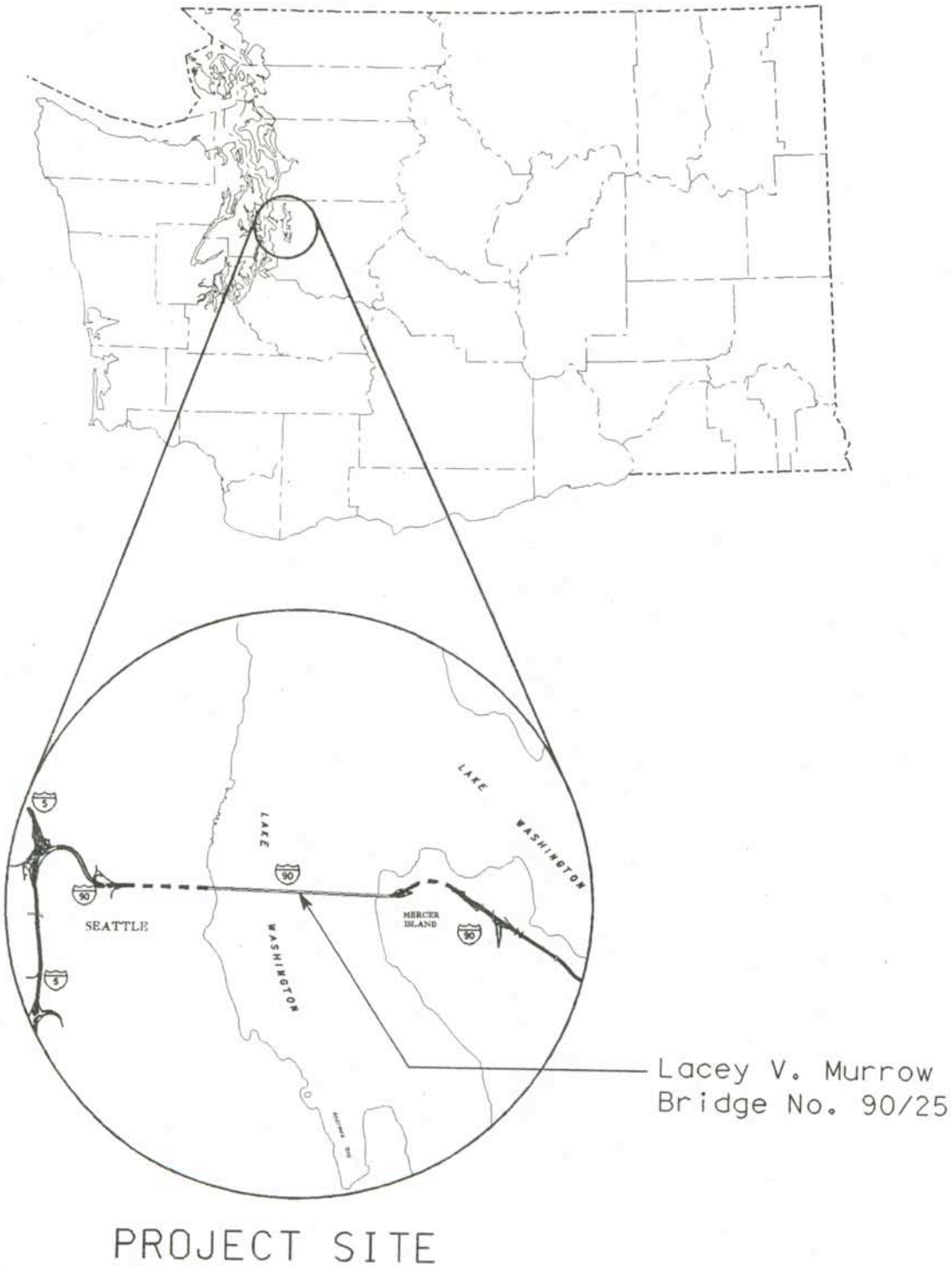
VICINITY MAP



PROJECT SITE

Introduction

Bridge expansion joints pose a special problem in the Washington State Department of Transportation's (WSDOT) Bridge Deck Management System. These devices are subject to repeated heavy dynamic loading and, in many cases, premature failure has occurred. Construction is also a problem. The ability to place concrete with good consolidation around the expansion joint requires good field quality control. Concrete air voids behind the expansion joint are sometimes found, and epoxy injection is necessary. Delaminations from corrosion-related salt contamination are also a common problem.

It is the policy of WSDOT, as part of the Bridge Deck Management System, to make expansion joints watertight. This will allow surface water to run off the deck to the bridge or roadway drain inlets. Expansion joints that are not watertight allow water to run onto the substructure. This enhances the potential for corrosion in locales where deicing salts are used and causes unsightly staining of substructures everywhere.

For floating bridge construction, the transition span from shore to the floating portion of the structure is subject to longitudinal movement in combination with horizontal and vertical rotation. These large movements pose special problems for the expansion joint system at both ends of the transition span. The expansion joint system selected for these conditions had to accommodate the wide range of movements involved and remain watertight, corrosion free, durable, require little or no maintenance, and have a useful life of 25 to 30 years.

The purpose of this experimental project is to gain knowledge about the effectiveness of the modular expansion joint system over time and to obtain knowledge about field installation techniques and structural performance.

It was considered prudent to require a five-year warranty on the expansion joints on this project for the following reasons:

1. A better product should be obtained if the manufacturer was made responsible for defects that occurred during a five-year service period.

2. Obtaining a product that would be free of service defects is critical for this bridge because in-service repairs are very difficult due to the heavy traffic.

3. In-service weld cracking in similar movement expansion joints occurred in the existing SR 90 Third Lake Floating Bridge. A warranty should help to avoid these problems.

4. Through an extended warranty, WSDOT will be able to have the contractor/manufacturer take corrective actions on in-service defects at no cost to the state.

The state will monitor the performance of the joints annually during the warranty period. See Appendix D for the schedule of inspections and reporting.

The evaluation of warranty provisions for these expansion joint systems has been FHWA approved as Special Experimental Project No. 14. This experimental

project is a part of FHWA's program of encouraging innovative concepts in contracting procedures.

Study Site

Contract 4016, SR 90, Lacey V. Murrow Bridge Replacement, contains the plans and specifications for construction of the modular expansion joint systems for the transition spans. The expansion systems are located at Piers 8 and 9 and at Pontoons A and T. The range of joint movements and rotations were shown on the plan sheets. See Appendix A. Total longitudinal movement at Piers 8 and 9 is 12 inches; at Pontoons A and T, 36 inches. The contractor, per specifications, was given the option of selecting one of four alternative expansion system suppliers.

The contractor submitted details of the expansion joint system, along with installation and waterproofing plans, to the state for approval prior to fabrication of the joint. In addition, the contractor designed all structural support elements, including all springs and bearings. The design included a fatigue analysis and laboratory testing for over 2 million cycles for all elements.

A total of 107 lineal feet of expansion joint was used at Piers 8 and 9. A total of 115 lineal feet was used at Pontoons A and T.

Installation Procedures

General

The contractor originally selected the expansion joint system by the Watson Bowman ACME Corporation, but due to specification limitations, later selected the system by The D. S. Brown Company. See the section concerning "Project

Problems" for a more complete discussion of the reasons for the later selection. The installation procedures described here are for the Brown/Maurer Swivel Joint DS-960B located at Pontoons A and T. The Brown/Maurer Swivel Joint DS-320B installation procedures at Piers 8 and 9 are similar.

Delivery

The DS-960B swivel expansion joints were delivered to the jobsite as a fully assembled unit. The expansion joint was shipped at a gap opening of 50°F and held in place during shipment by means of shipping and lifting brackets. There are four lifting points on the swivel joint. The outer lifting brackets are located inward, approximately 3' 3" from the start of upturn. The interior lifting brackets are located at approximately quarter spans. These two brackets were not symmetrical about the centerline of the joint. This affected the length of cables used to pick up the joint.

Upon arrival at the jobsite, the joints were lifted off the truck into the blockout.

Installation

For long term durability, it is very important that modular expansion joints be installed and set properly. This required very careful inspection by WSDOT field personnel.

Blockout Preparation

The blockout was cleared before lowering the joint. All dirt, debris, and formwork were removed. Reinforcing steel required in the blockout was kept at a minimum to avoid interference when setting the joint. Certain reinforcing bars were placed prior to final setting of the joint (i.e., bars

under support boxes). These bars had to be designed for this specific joint, which required a small change order to pay for the additional reinforcing.

Joint Opening Pontoon A (Westerly Transition Span)

The expansion joint was set and shipped with the joint opening for an average temperature of 50°F and normal lake level of 8.02'. At the time the expansion joint was installed, the average temperature was 50°F, but the lake level was 8.50'. According to the expansion joint gap setting table on shop drawings, a lake level of 8.50' would warrant contracting the expansion joint opening 1/4". We (WSDOT, General/Rainier, and D. S. Brown representatives) decided not to contract the expansion joint the 1/4", but leave the opening as shipped to the site.

Joint Opening Pontoon T (Easterly Transition Span)

This expansion joint was also delivered with the opening set in regard to normal lake level of 8.02' and a three day water/air average temperature of 50°F. However, when the expansion joint was ready to be installed in the blockout, the average temperature was 60°F, and the lake level was recorded at 8.90'. As shown on the joint opening table in the shop drawings, this would warrant contracting this expansion joint 1/2" for lake level and contracting the expansion joint 2" for the water/air average temperature.

Also, due to pontoon creep, Headquarters Bridge division directed the contractor to contract the expansion joint an additional 1-1/2". That totalled 4" the expansion joint would have to be contracted before securing and pouring back with concrete.

The contractor decided the easiest way to contract the expansion joint was to first install the expansion joint in the blockout, then use the deck bulkheads on both sides of the blockout to give resistance to movement of the expansion joint and use portapowers to contract the expansion joint the required 4".

Locating Support Anchorage

After placing the joint in proper alignment with barriers and reference lines, the support bracket anchorage was located. These anchors are located at the support boxes and in between the boxes. Shop drawings show the details. Once located, 5/8" x 4" deep holes were drilled for expansion anchors.

Setting Elevations

After anchoring the brackets to the bottom of the blockout, the elevation was adjusted. This was accomplished by using hydraulic jacks to raise the box to the proper elevation. The top of the box was kept parallel with the roadway surface. Once the proper elevations were achieved, the concrete was poured. The joint at the East Transition Span was set at high lake elevation. This resulted in a minor traffic bump at normal lake elevation. Some minor future adjustments may be required.

Formwork

After the joint was anchored firmly in place, formwork was installed to create the vertical face of the joint. Special attention was taken to ensure that there would be no intrusion of foreign material (concrete) inside of the support boxes.

Reinforcing Steel

Required reinforcing steel was placed in the blockout area per modified contract plans.

Concrete Placement

Concrete was properly placed to WSDOT specifications. Care was taken to ensure proper consolidation of concrete in the blockout areas. Voids in the blockouts and especially under the support boxes were avoided. Immediately following initial curing of concrete, formwork was removed and consolidated concrete under the support boxes was inspected.

Quality Assurance

A D. S. Brown field representative was on site during the installation, as directed in the contract Special Provisions.

Project Problems

Product Requirements

The specifications for these modular expansion joints required a laboratory fatigue testing/analysis program, which has never been required in the United States, but is used in some European countries. The Special Provisions named four suppliers and their specific systems for the small and large modular expansion joints. Only one of the named suppliers, the D. S. Brown Company, had designed and tested its systems for fatigue stresses.

In addition to the stringent fatigue stress requirements, the Special Provisions required a design load using the simultaneous action of two HS 25 wheel loads,

plus 60 percent impact, and two horizontal tractive forces equal to 33 percent of the maximum wheel loads including impact. This requirement could not be satisfied by any of the suppliers. The impact value was reduced to 30 percent. The Addendum for the 30 percent impact was approved by FHWA.

The Special Provisions named the system to be provided by each supplier. Due to the height restrictions at Piers 8 and 9, the D. S. Brown Company could not provide the required swivel joist system. The system for these two joints, the smaller of the four, had to be revised to a multiple support bar system.

As previously stated, four suppliers and their systems were specified in the Special Provisions. These suppliers were not contacted prior to advertising this contract to see if they could meet the contract requirements. This will be done on projects of this nature in the future.

Incentive for Early Completion

To expedite the early completion of the project for the traveling public, an $18,500/day incentive for early completion was included in the contract. This incentive for early completion minimized the time available for a laboratory fatigue testing program. Adequate testing time probably was not available. Only one of the specified suppliers, D. S. Brown Company, had designed and fatigue tested its systems. If the state had insisted that the originally selected manufacturer, Watson Bowman ACME Corp., supply the modular expansion joints, the contractor may not have completed the project in the time frame that it was completed. This would have delayed the availability of the facility to the traveling public.

Contract Ambiguities

There was a difference of opinion between Watson Bowman ACME Corp. representatives and state personnel concerning Paragraph 3.01D of the Special Provisions (see Appendix B), which describes applying vertical and horizontal loads for design of the joints.

Watson Bowman ACME Corp. representatives interpreted the "and" in this paragraph to mean that the vertical and horizontal loads would be applied separately. The state intended the vertical and horizontal loads to be applied simultaneously.

The Watson Bowman ACME Corp. then declared that they could not meet the contract specifications and withdrew from the project.

To assure a timely completion of the project, WSDOT (with FHWA concurrence) issued a change order accepting the modular expansion joints of the D. S. Brown Company. Additional compensation was also awarded in order to fast-track shop plans and fabrication.

Joint Performance

It has been reported that the easterly transition span joint has a rough ride. A complete inspection is scheduled for September 1994. Minor adjustments may have to be made.

Conclusions and Recommendations

- Before final contract documents are prepared for advertisement of projects involving large movement modular joints, it is essential to contact all

prospective joint suppliers and ensure that they can meet the contract specifications.

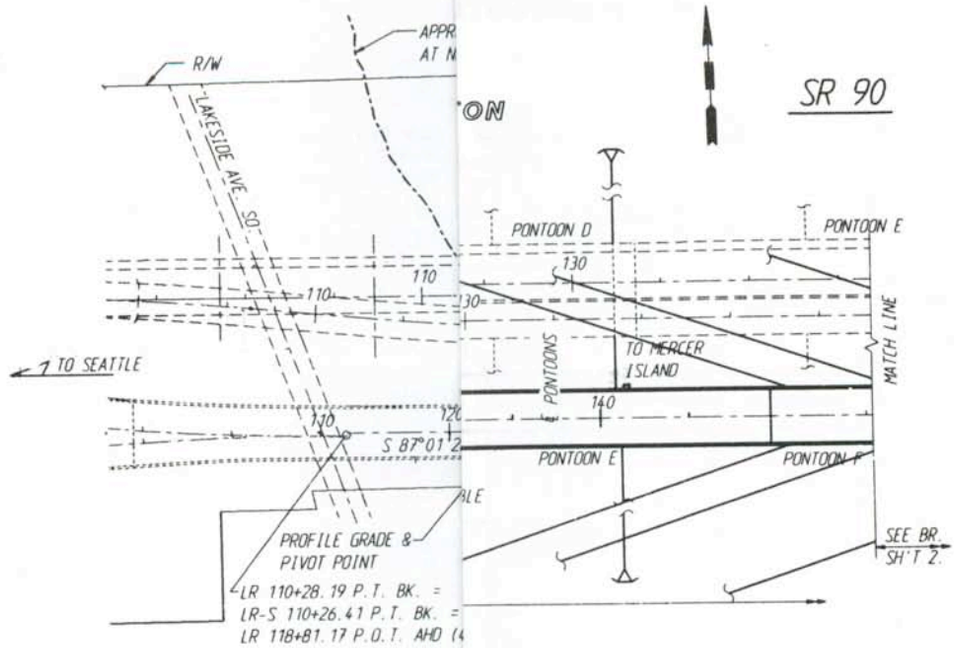
- The requirement for a fatigue testing procedure on modular joints, if such a procedure has not already been accomplished by the supplier, is not compatible with the objectives of incentive pay clauses for early completion.

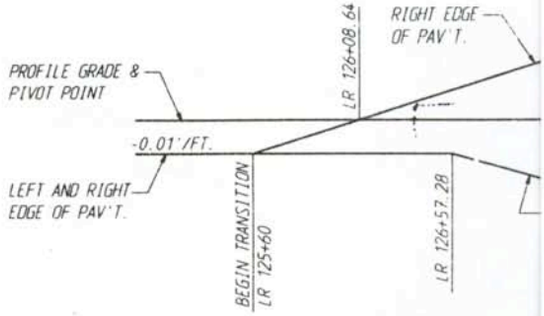
- Design requirements need to be stated clearly in the special provisions.

- Most problems with installation were solved in the field. Installation of large expansion joints on floating bridges are complex due to all of the potential variables affecting joint movement. All installation procedures need to be carefully thought out in design and construction.

- The total contract cost per linear foot at Piers 8 and 9 was $1,900. The total contract cost per linear foot at Pontoons A and T was $5,800. These prices include the bid item and costs of all change orders.

Appendix A
Bridge General Layout





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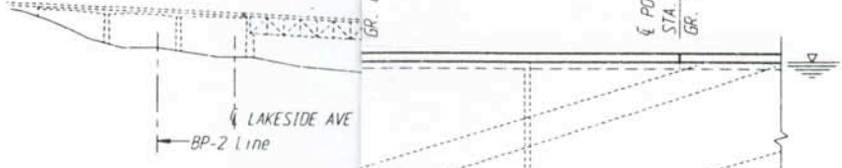


DATUM

CITY OF SEATTLE

CONCRETE FLOATING PONTOON

LOADING: HS-25 OR TWO 24K AXLES @ 4' C'TRS.

Bridge Design Engr.	10/91		
Supervisor			
Designed By CFE/AWB	6/91		
Checked By R.D. BRAXMEYER	6/91		
Detailed By J. PLESHA	6/91		
Bridge Plan. Engr.			
Prelim. Plan By		9-23-91	1 ANCHOR TYPE, ADD MAC & MISC.
Architect/Specialist R. MAYS	6/91	DATE	REVISION

SEP-91

SR 90

LACEY V. MURROW BRIDGE REPLACEMENT

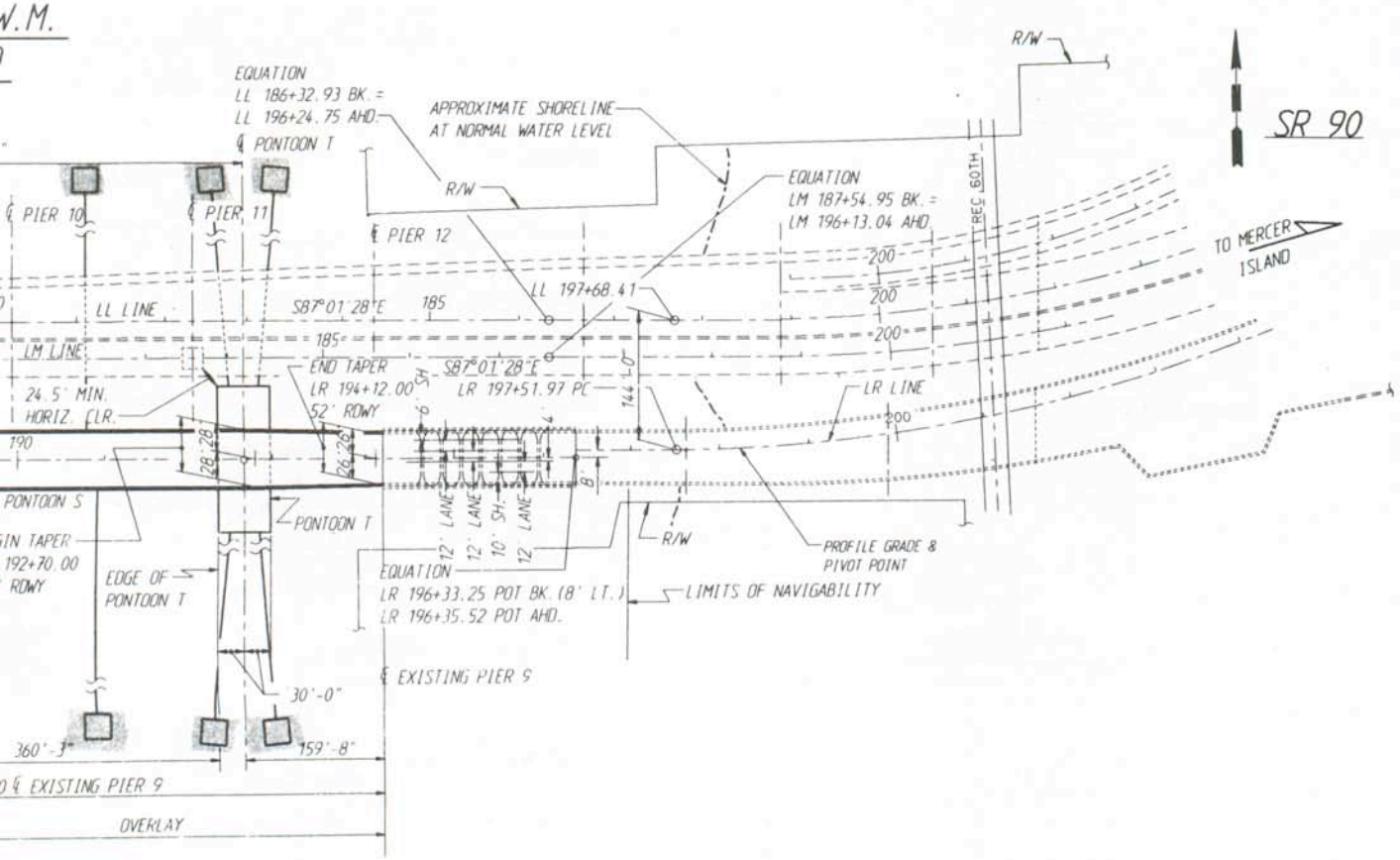
LAYOUT

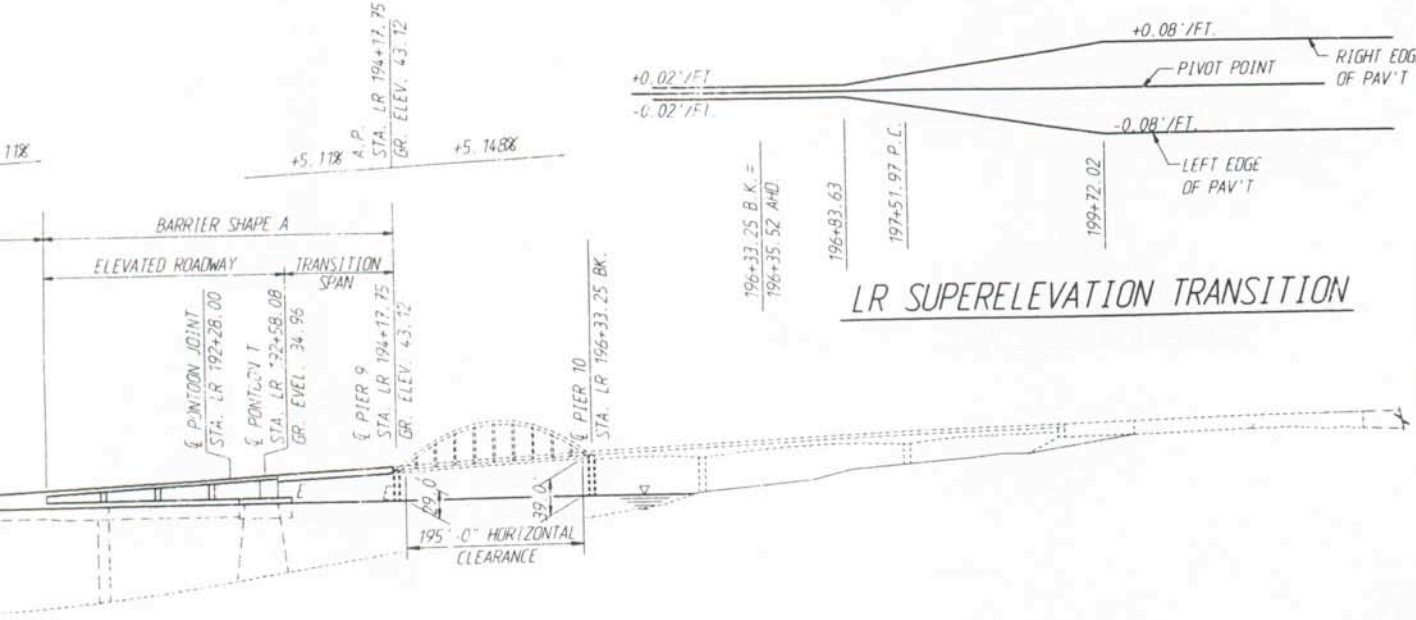
BRIDGE SHEET NO. A1

SHEET 96 OF 334 SHEETS

SR 90 JOB NO. 7046 SHEET A1

C.S. 1704 - PROJECT #L0790A - DIST. #1 - MP 1.92 TO MP 3.21 - SR 90 - LACEY V. MURROW BRIDGE NO. 90/25S REPLACEMENT





CONCRETE FLOATING
PONTOON

LOADING HS-25
OR
TWO 24^{K} AXLES @ 4' C'TRS.

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30-SEP-91

Washington State
Department of Transportation

SR 90

LACEY V. MURROW BRIDGE REPLACEMENT

LAYOUT

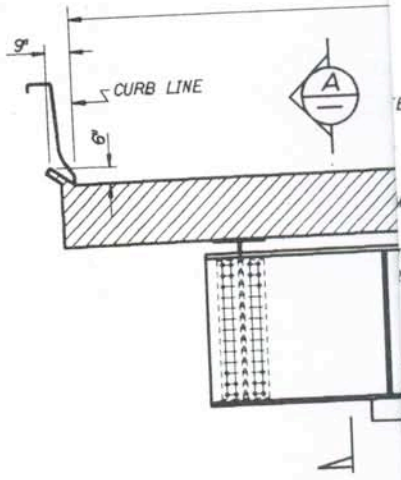
BRIDGE SHEET NO. A3

SHEET 98 OF 334 SHEETS

C.S. 1704 - PROJECT #L0790A - DIST. #1 - MP 1.92 TO MP 3.21 - SR 90 - LACEY V. MURROW BRIDGE NO. 90/25S REPLACEMENT

Appendix B
Plan Details

TYPES:



EM MODIFIED

BAR

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FOR APPROVAL

ENGINEER.

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URER AND
YSTEM.

4"

BLOCKOUT A

EXPAN

SUPPORT PL
FOR EXP. JC

* DIMENSION AT NORMAL WATER LEVEL ELV. 8.02 AND NO WIND OR WAVE.

Bridge Design Engr. Myron Lien 10/91		
Supervisor		
Designed By J. A. VANLUND 7/91		
Checked By J. E. DODSON 7/91		
Detailed By L. L. House 7/91		
Bridge Projects Engr.		
Preliminary Plan By	9/91	1 EDITORIAL
Architect/Specialist	DATE	REVISION

SR 90

LACEY V. MURROW BRIDGE REPLACEMENT

EXP. JOINT SYS. PIERS 8 & 9

BRIDGE SHEET NO. L15

SHEET 304 OF 334 SHEETS

SR ____ JOB NO. ____ SHEET ____

DOT FORM 221-013 Revised 11/83

THE EXPANSION SYSTEM SHALL BE ONE OF THE FOLLOWING TYPES:

ROBEK LR12 MULTIPLE SUPPORT BAR SYSTEM MODIFIED BY TECHSTAR, INC. FINDLAY, OH.

BROWN/MAURER SWIVEL JOIST DS 960B BY D. S. BROWN COMPANY, NO. BALTIMORE, OH.

WABO - MAURER D - 3600 MULTIPLE SUPPORT BAR SYSTEM MODIFIED BY WATSON BOWMAN ACME, INC. AMHERST, NY.

VSL/HONEL 1412.80 36" MR MODIFIED MULTIPLE SUPPORT BAR SYSTEM BY VSL CORPORATION, CAMPBELL, CA.

THE EXPANSION JOINT SYSTEM SHALL MEET THE REQUIREMENTS OF THE SPECIAL PROVISIONS AND THE JOINT DESIGN PARAMETERS.

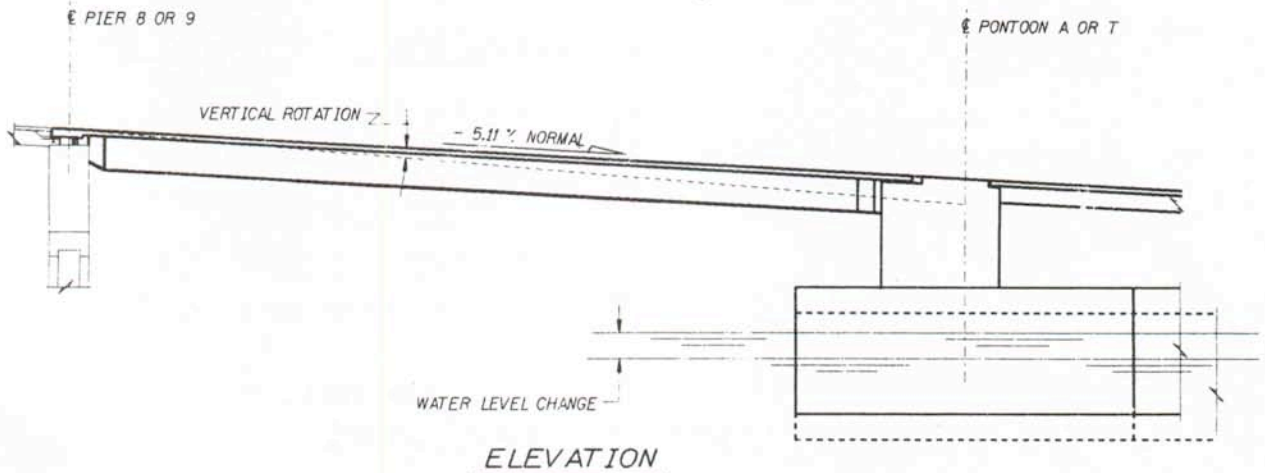
THE CONTRACTOR SHALL SUBMIT DETAILS OF THE EXPANSION SYSTEM TO BE USED, TOGETHER WITH INSTALLATION AND REINFORCING STEEL REQUIRED AND WATERPROOFING PLANS, TO THE ENGINEER FOR APPROVAL PRIOR TO FABRICATION OF THE JOINT.

A TABLE OF JOINT SETTINGS WILL BE SUPPLIED BY THE ENGINEER.

BLOCKOUT REINFORCING STEEL SHOWN IS A MINIMUM. ADDITIONAL REINFORCING MAY BE REQUIRED BY THE JOINT MANUFACTURER AND SHALL BE CONSIDERED PART OF THE EXPANSION JOINT SYSTEM.

JOINT DESIGN PARAMETERS

BLOCKOUT DIMENSION AT 50° F = 1,3'-0" X 2'-0"	
LONGITUDINAL MOVMENT : (INCLUDES EXTRA FOR HORIZONTAL ROTATION)	± 1'-6"
HORIZONTAL ROTATION FROM TRANSV. PONTOON DISPL. :	± 0.6°
VERTICAL ROTATION FROM WATER LEVEL CHANGE. :	0.3° (UP)
	1.5° (DOWN)
LIVE ROAD REACTION :	0.2° (DOWN)



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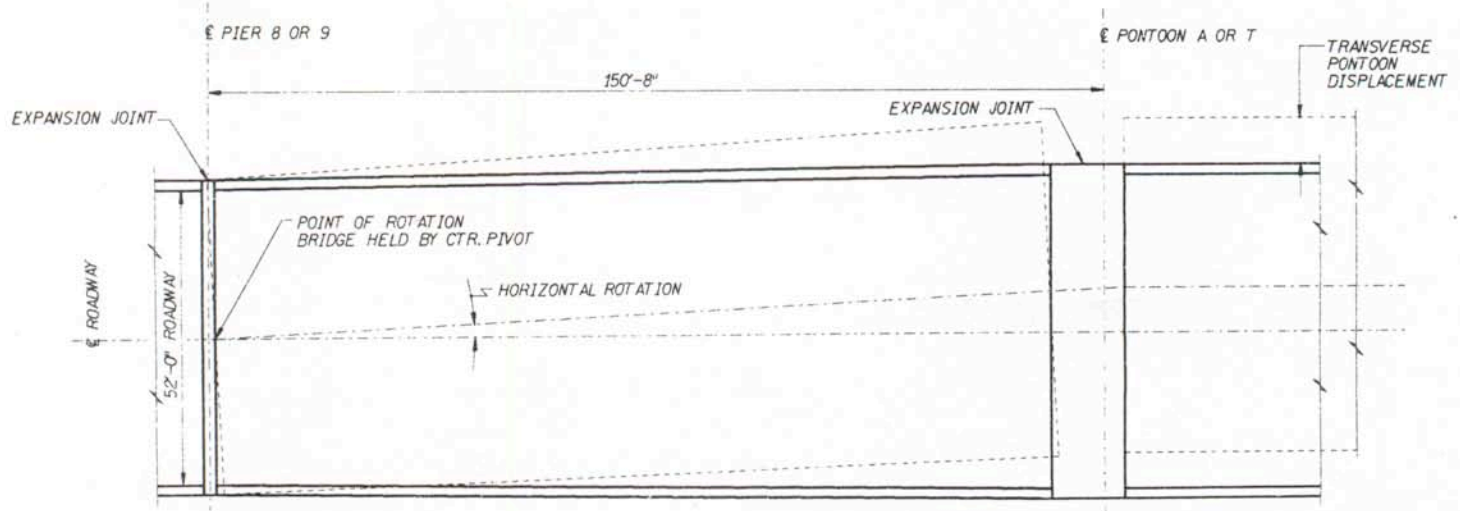

PLAN

STRUCTURES OFFICE

10.3.91

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Washington State Department of Transportation

SR 90

LACEY V. MURROW BRIDGE REPLACEMENT

EXPANSION JOINT SYSTEM PONTOONS A & T

BRIDGE SHEET NO. L16

SHEET 305 OF 334 SHEETS

Appendix C
Specifications

Payment

The unit contract price per each for "Fabric Pad Bearings - Elevated Roadways" shall be full pay to perform the work as specified.

EXPANSION JOINT SYSTEM STRIP SEAL
June 11, 1990

Description

The expansion joint system(s) shall be as shown and noted in the Plans.

Construction Requirements

The expansion joint system(s) shall be installed in accordance with the manufacturer's written recommendations. The Contractor shall submit, with his working drawing submittal, the manufacturer's written installation procedure.

The Contractor shall submit for approval working drawings of the expansion joint system(s) proposed for use in this project in accordance with the provisions of Section 6-03.3(7).

The working drawings of the expansion joint system(s) shall show details of the system(s), including materials and dimensions, method of installation, and method of sealing the system(s) to prevent leakage of water through the joint.

After the joint system(s) is installed, the joint area shall be flooded with water and inspected, from below the joint, for leakage. If leakage is observed, the joint system shall be repaired, at the expense of the Contractor, as recommended by the manufacturer and approved by the Engineer.

The metal components shall be AASHTO M 183 or M 222 steel and shall be protected against corrosion by one of the following methods:

1. Zinc metallized in accordance with the Special Provision **METALLIC COATINGS**.

2. Hot-dip galvanized in accordance with AASHTO M 111.

3. Paint in accordance with the Special Provision **APPLICATION OF PAINT** except only one final coat of Vinyl Gray Finish shall be applied. The color of the final coat shall be Washington Gray (revised).

   The surface embedded in concrete shall be painted only with a shop coat of inorganic zinc silicate paint.

Payment

The lump sum contract price for "Expansion Joint System - Strip Seal" shall be full pay for performing the work as specified.

EXPANSION JOINT SYSTEMS FOR THE TRANSITION SPANS

General Requirements

1.01 Description

A. This item of work shall consist of furnishing materials, services, labor, tools, equipment, and incidentals necessary to design, fabricate,

inspect, test, and install the expansion joint system for the transition span as specified.

B. The expansion joint system consists of a modular, multiple seal joint that will allow longitudinal movement in combination with horizontal rotation and vertical rotation as shown and noted in the Plans.

C. The expansion joint system at Piers 8 and 9 shall be one of the following types:

1. BROWN/MAURER SWIVEL JOIST DS-320B by The D.S. Brown Co., North Baltimore, OH.

2. WABO MODULAR D-1200 MULTIPLE SUPPORT BAR SYSTEM MODIFIED as specified per 1.01F by Watson Bowman ACME Corp., Amherst, NY.

3. ROBEK LR4 MULTIPLE SUPPORT BAR SYSTEM MODIFIED as specified per 1.01F by TechStar, Inc., Findlay, OH.

4. VSL/HONEL 1404.80 12" M.R. MODIFIED MULTIPLE SUPPORT BAR SYSTEM by the VSL Corporation, Campbell, CA.

D. The expansion joint system at Pontoons A and T shall be one of the following types:

1. BROWN/MAURER SWIVEL JOIST DS-960B by The D.S. Brown Co., North Baltimore, OH.

2. WABO MODULAR D-3600 MULTIPLE SUPPORT BAR SYSTEM MODIFIED as specified per 1.01F by Watson Bowman ACME Corp., Amherst, NY.

3. ROBEK LR12 MULTIPLE SUPPORT BAR SYSTEM MODIFIED as specified per 1.01F by TechStar, Inc., Findlay, OH

4. VSL/HONEL 1412.80 36" M.R. MODIFIED MULTIPLE SUPPORT BAR SYSTEM the VSL Corporation, Campbell, CA.

E. The expansion joint system shall be continuous across the full width of the roadway and continue up into the traffic barriers as shown in the Plans.

F. Positive Mechanical Equidistant Control Mechanism. The systems specified under C. and D. above shall include a positive mechanical equidistant control mechanism. This mechanism shall be durable, noiseless, maintenance-free and shall ensure equidistance between seals. The use of cables or spring systems is not acceptable. Details for the mechanism shall include design calculations and shall be submitted to the Engineer for approval 60 days prior to the Shop Plan Submittal. The SWIVEL JOIST and HONEL systems have an acceptable positive mechanical equidistant control mechanism.

1.02 Submittals

A. Shop plans

1. The Contractor shall submit details of the expansion joint system to be used together with installation and waterproofing plans to the Engineer for approval prior to fabrication of the joint. The shop plans shall be submitted in accordance with Section 6-03.3(7). These drawings shall include but not be limited to the following:

   a. Plans, elevation and section of the joint system for each movement rating and roadway width showing dimensions and tolerances.

   b. Complete details of all components and sections showing all materials incorporated into the expansion joint system.

   c. All ASTM, AASHTO, or other material designations.

   d. Method of installation including but not limited to sequence, setting (relative to temperature and level of lake), anchorage during setting, and installation at curbs.

   e. Corrosion protection system.

   f. Recommendations of storage of joint system and details of temporary support of joint for shipping and handling.

   g. Design calculations for all structural support elements including all springs, bearings, and the positive mechanical equidistant control mechanism. The design calculations shall include a fatigue analysis for all structural elements, connections, and splices in accordance with Section 3.01F of these Specifications. All welded splices shall be shown on the shop plans.

   h. Welding procedures shall be in accordance with Section 6-03.3(25).

B. Certificates of Compliance

At the time of shop plan submittal, the Contractor shall submit to the Engineer the following test reports, certifications, and samples for review, testing, and approval.

1. Manufacturer's certificate of compliance with the AISC Quality Certification Program, Category III, Major Steel Bridges.

2. Certification that welding inspection is made by personnel qualified and certified as welding inspectors under AWS QC1, Standard for Qualification and Certification of Welding Inspectors.

3. Certification that personnel performing nondestructive testing (NDT) are qualified and certified as NDT Level III under the American Society for Nondestructive Testing (ASNT) Recommended Practice SNT-TC-1a.

4. Manufacturer's certificate of compliance for the polytetrafluorethylene (TFE) sheeting, TFE fabric, and elastomer.

5. Certified mill test reports for all steel and stainless steel in the expansion joint assemblies.

6. Certified test reports confirming that the TFE and stainless steel coefficient of friction requirements are met.

7. Certified test reports confriming that the springs and bearings meet the design load requirements.

8. Samples of the TFE sheet, size 2" x 3" x 1/8", from the production material.

C. Guarantee

1. The Contractor shall provide a five year written guarantee for the operation and durability of the expansion joints. Broken welds or bolts, cracks in steel members, fatigue, loss of precompression in springs or bearings, debonded TFE, breakdown of corrosion protection, and leakage shall constitute unsatisfactory operation and durability of the joints. Replacement or repair of any joint parts within the first five years, commencing from the date of completion of the contract per Section 1-8.5, shall be covered under the guarantee. The Contractor shall replace or repair any joint parts within the period of the guarantee at the Contractor's expense.

1.03 Shipping and Handling

A. The expansion joint system shall be delivered to the job site and stored in accordance with the manufacturer's recommendations and as approved by the Engineer.

B. Damage to the joint system during shipping or handling will be cause for rejection of the joint system.

C. Damage to the corrosion protection system shall be repaired to the satifaction of the Engineer.

D. No seals shall be cut except as recommended by the manufacturer and approved by the Engineer.

Material Specifications

2.01 Structural Steel

A. Structural steel shall conform to the requirements of AASHTO M 183, AASHTO M 223 Grade 50 or AASHTO M 222. Aluminum components shall not be used.

2.02 Stainless Steel

A. Stainless steel shall conform to ASTM A 240 Type 304.

2.03 Polytetrafluorethylene (TFE)

A. TFE shall be 100% virgin teflon, woven TFE fabric, or dimpled TFE conforming to the requirements of Section 18.8.1 of the AASHTO Standard Specifications for Highway Bridges, 14th edition and Interims through 1991.

2.04 Expansion Joint Seals

The maximum size of the expansion joint strip seals shall be 3 inches or 80 mm "Box" seals or seals utilzing double webs will not be acceptable.

Property	Test Method	Range of Values
Hardness, Durometer A	ASTM D2240	55 ± 5
Tensile Strength	ASTM D412	2000 minimum
Elongation at break	ASTM D395	250
Compression Set, at 72 hr. at 212° F.	ASTM D395	40%

2.05 Bolts, Nuts, Washers

A. Bolts and other hardware shall conform to the requirements of AASHTO M 164 Type 1 or 2 and shall be galvanized in accordance with AASHTO M 232 and Section 9-06.5(3).

2.06 Other Materials

A. Other materials shall meet the requirements of the Standard Specifications and this Special Provision.

Design Requirements

3.01 General

A. The expansion joint seals shall not protrude above the top of the joint nor deeper than 4 inches with the joint in any position. Split extrusions may be used at upturns at all curbs.

B. The expansion joint system shall be designed to be repairable and all moving parts shall be replaceable.

C. The expansion joint system shall be watertight and shall be designed to resist AASHTO HS 25 wheel loads plus impact and horizontal tractive forces defined below. An HS 25 wheel load is 25% greater than an AASHTO HS 20 wheel load.

D. Application of Wheel Loads - Static Analysis

The transverse seal separation beams, including edge beams, shall be designed for the simultaneous action of two HS 25 wheel loads plus 60% impact and two horizontal tractive forces equal to 33% of the

maximum wheel loads including impact. These loads, spaced 6 feet apart, shall be applied at the roadway surface as a rectangle with a 9 inch length in the direction of traffic and a 22.5 inch width perpendicular to the direction of traffic. The effect of the roadway grade, lake level drop, lake level rise, and transverse moments shall be accounted for in the design. The horizontal component of the wheel load due to grade and lake level drop shall be added to the horizontal tractive forces described herein.

E. The allowable design stress for structural steels shall be as shown in Table 10.32.1A of the AASHTO Standard Specifications for Highway Bridges, 14th Edition and Interims through 1991.

F. Fatigue Analysis

To ensure that the expansion joint shall have an infinite fatigue life, a fatigue analysis with supporting test data on fatigue stress ranges and fatigue properties of the structural members, connections, and splices shall be performed. The fatigue stress ranges utilizing the wheel loads described in "Application of Wheel Loads - Static Analysis" shall not exceed the allowable fatigue stress range for over 2,000,000 cycles as given in Table 10.3.1A, Division I, AASHTO Standard Specifications for Highway Bridges, 14th Edition and Interims through 1991. Alternate wheel loads and allowable fatigue stress ranges may be used providing:

1. The absolute magnitude of the wheel load (e.g. sum of positive and negative loads along the same axis) is not less than the wheel loads described in D. above and,

2. The alternate wheel loads and allowable fatigue stress ranges are substantiated by independent testing and,

3. The expansion joint shall have an infinite fatigue life and be crack-free.

G. TFE shall be designed in accordance with Section 15.2 of the AASHTO Standard Specifications for Highway Bridges, 14th Edition and Interims through 1991.

Fabrication

4.01 General

A. The expansion joints shall be fabricated in accordance with the dimensions, shapes, designs, and details shown in the approved shop plans and in conformance with the Standard Specifications and the Special Provisions.

B. All the transition span expansion joints shall be fabricated by the same manufacturer.

4.02 TFE Sliding Surface

A. The TFE shall be recessed and bonded under controlled conditions and in accordance with the written instructions of the manufacturer of the TFE.

B. After completetion of the bonding operation, the TFE surface shall be smooth and free from bubbles.

4.03 Stainless Steel Sliding Surface

A. The stainless steel sliding surface shall be polished to a mirror finish of 20 microinches (RMS) or less.

B. The stainless steel sheet shall be seal welded all around to the steel backing plate by the tungsten-arc welding process in accordance with the current AWS specifications. The stainless steel sheet shall be clamped down to have full contact with the steel backing plate during welding. The welds shall not protrude beyond the sliding surface of the stainless steel.

4.04 Corrosion Protection

A. All steel surfaces, except the surfaces under stainless steel or those to be bonded to TFE or those in direct contact with the seal, shall be protected against corrosion by one of the following methods:

1. Zinc metallized in accordance with the Special Provision **METALLIC COATINGS**.

2. Hot-dip galvanized per AASHTO M 111, Zinc Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strip.

3. Painted in accordance with the Special Provision **APPLICATION OF PAINT**. The color of the final coat shall be Washington Gray (revised). The surfaces embedded in concrete shall be painted only with a shop coat of inorganic zinc silicate paint.

4.05 Installation

A. To aid in assuring proper installation of each expansion joint system in the field, the Contractor shall have available the services of a qualified installation technician, who is employed full time by the manufacturer of the expansion system to be installed in this project. Recommendations made by the expansion joint manufacturer's installation technician, on or off the job site, and approved by the Engineer shall be adhered to by the Contractor. The Contractor shall take precautions to protect the joint systems from damage.

B. The expansion joint system shall be water tested after installation. Leaks shall be repaired to the satisfaction of the Engineer.

C. Special care shall be exercised at all times to ensure protection of the expansion joint system. Prior to installation of the joint, the blockout and supporting system shall be protected from damage and

construction traffic. After installation of the joint system, construction loads shall not be allowed on the joint. The Contractor will be required to bridge over the joints in a manner approved by the Engineer.

D. All forms and debris that tend to interfere with the free action of the expansion joint system shall be removed.

4.06 Watertightness

A. After the joint has been installed and completed, the joint shall be flooded for a minimum of one hour to a minimum depth of three inches. If leakage is observed, the joint system shall be repaired at the Contractor's expense. The repair procedure shall be recommended by the manufacturer and approved by the Engineer.

4.07 Inspection

A. Three levels of inspection must be satisfied before the expansion joints are accepted. These are: Quality Control Inspection, Quality Assurance Inspection, and Final Inspection. The manufacturer shall provide for both Quality Control and Quality Assurance Inspection. The Contractor shall provide for the Final Inspection. The three levels of inspection are described below:

1. Quality Control Inspection

During the fabrication process, the manufacturer shall provide full time Quality Control Inspection to ensure that the materials and workmanship meet or exceed the minimum requirements of the contract. Quality Control Inspection shall be the responsibility of the manufacturer's quality control department.

2. Quality Assurance Inspection

Quality Assurance Inspection shall be performed by an Independent Inspection Agency provided by the manufacturer. The Independent Inspection Agency, the proposed Quality Assurance Inspection Program, and the forms to be used for the Quality Assurance Inspection Program shall be subject to the Engineer's approval prior to the start of fabrication. Quality Assurance Inspection is not required to be full time inspection, but shall be done at all phases of the manufacturing process prior to and during assembly of the expansion joints.

3. Final Inspection

Upon arrival at the job site and prior to installation, the expansion joints will be inspected by the Engineer. The Contractor shall provide a clean, dry enclosed area for the Final Inspection of the expansion joints.

B. The expansion joints must satisfy each of the three levels of inspection before they will be accepted. Expansion joints which fail any one of the three levels of inspection shall be replaced or repaired to the satisfaction of the Engineer. Any proposed corrective procedure shall

be submitted to the Engineer for approval before corrective work is begun.

Payment

5.01 The lump sum contract price for "Expansion Joint Systems - Transition Spans" shall be full compensation for all materials, labor, tools, equipment, testing, inspection, services, and incidentals necessary to furnish and install the expansion joint systems as specified.

SPECIAL FORMWORK FOR ELEVATED ROADWAY CANTILEVERS

Descripton

The Contractor is advised of special design requirements for the formwork for the cantilevers on the Elevated Roadway Deck.

These requirements are in addition to the requirements of the Standard Specifications.

Construction Requirements

The formwork shall support the slab cantilevers without inducing torsional loads into the wide flange beams of the Elevated Roadways.

The formwork shall be designed to prevent differential deflection between the roadway deck and the wide flange beams.

Payment

All cost for providing special formwork shall be included in the lump sum cost for "Roadway Deck-Elevated Roadways".

DRAINAGE SYSTEM

Description

This item of work shall consist of installing roadway drains and piping on the transition spans and pontoons A, B, S and T.

Materials

All materials shall be as shown and noted in the Plans.

The epoxy grout shall be three parts dry sand to one part epoxy by volume. The epoxy shall be Type I or II Grade 2 Class A, B or C and conform to Section 9-26. The sand shall be dry and conform to Section 9-03.1(2).

Construction Requirements

The paved invert shall be installed under dry conditions in the field or in the fabrication shop.

Payment

The lump sum contract price for "Drainage System" shall be full pay for performing the work as specified.

Appendix D
Testing and Analysis Costs

Expansion Joint System Testing and Analysis Costs

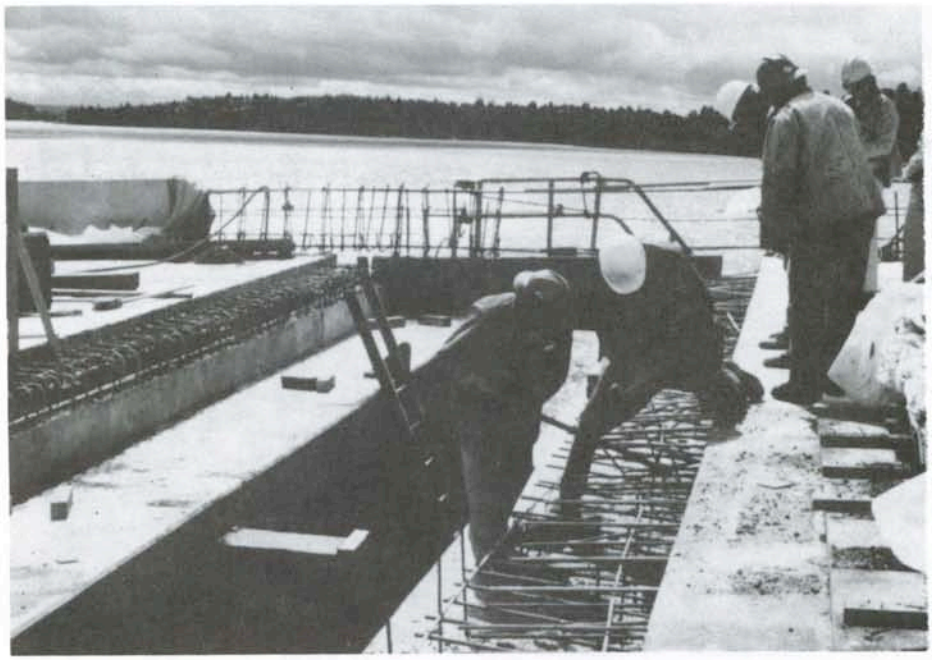
Responsible Unit	Work Item	Post Construction	Year** 1	2	3	4	5	Totals
Bridge Branch	Visual rating $90/hour*	(4 hours) $360	(4 hours) $382	(4 hours) $404	(4 hours) $429	(4 hours) $455	(4 hours) $482	$2,512
District 1 Maintenance	Traffic Control $100/hour	(2 hours) $200	(2 hours) $212	(2 hours) $225	(2 hours) $238	(2 hours) $252	(2 hours) $268	$1,395
District 1 Project Engineer	Reporting $30/hour	(40 hours) $1,200						$1,200
Bridge Branch	Analysis and Reporting $30/hour	(40 hours) $1,200	(4 hours) $127	(4 hours) $135	(4 hours) $143	(4 hours) $151	(40 hours) $1,606	$3,362
		$2,960	$721	$764	$810	$858	$2,356	$8,469
								-2,960
Total Contract Funding		$2,960	Total Evaluation Funding					$5,509

*3 men at $30/hour

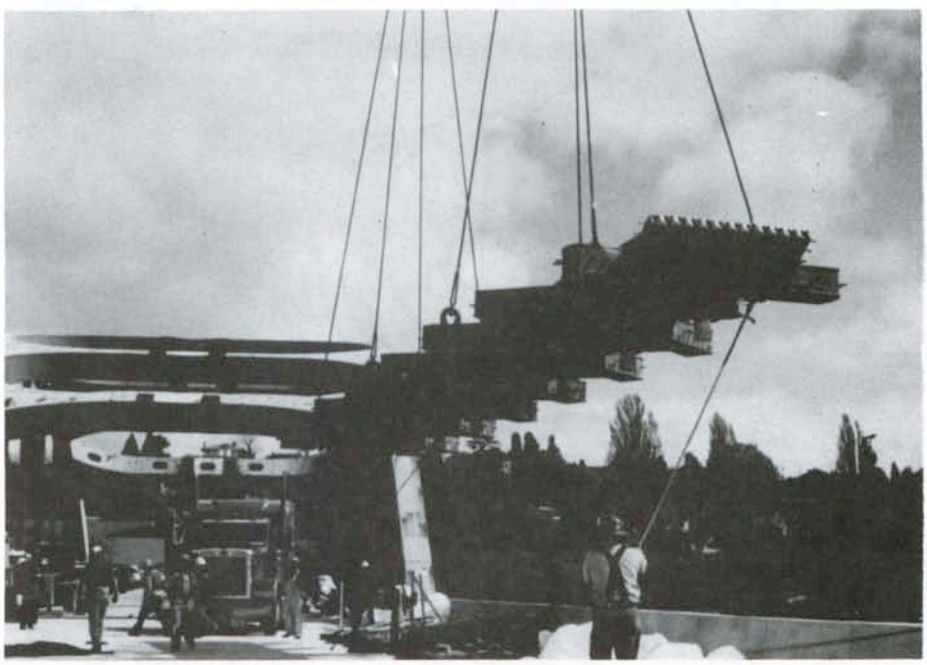
**6 percent annual inflation rate assumed

12:586

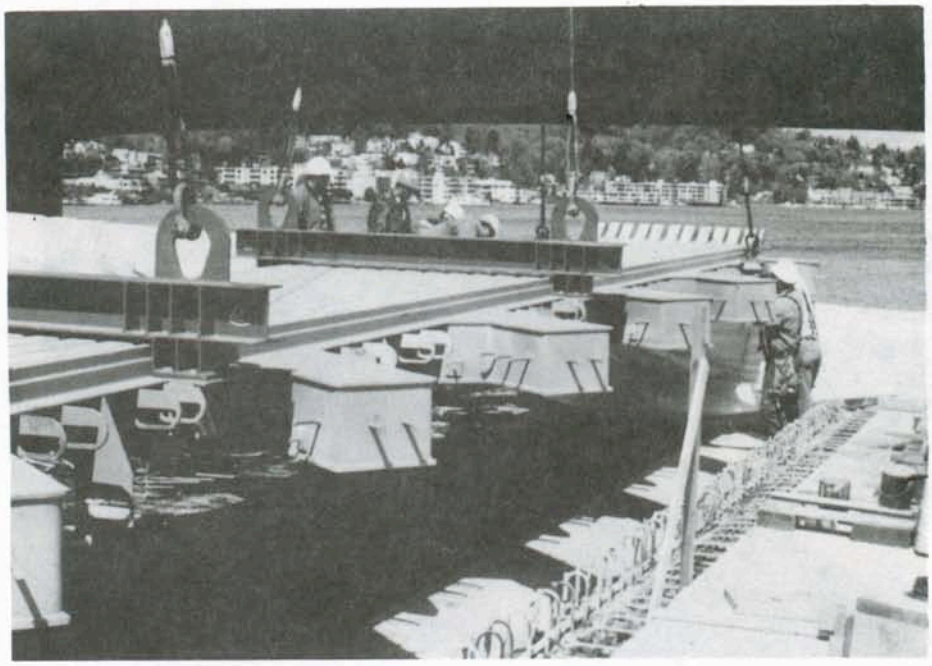
Appendix E
Project Photographs



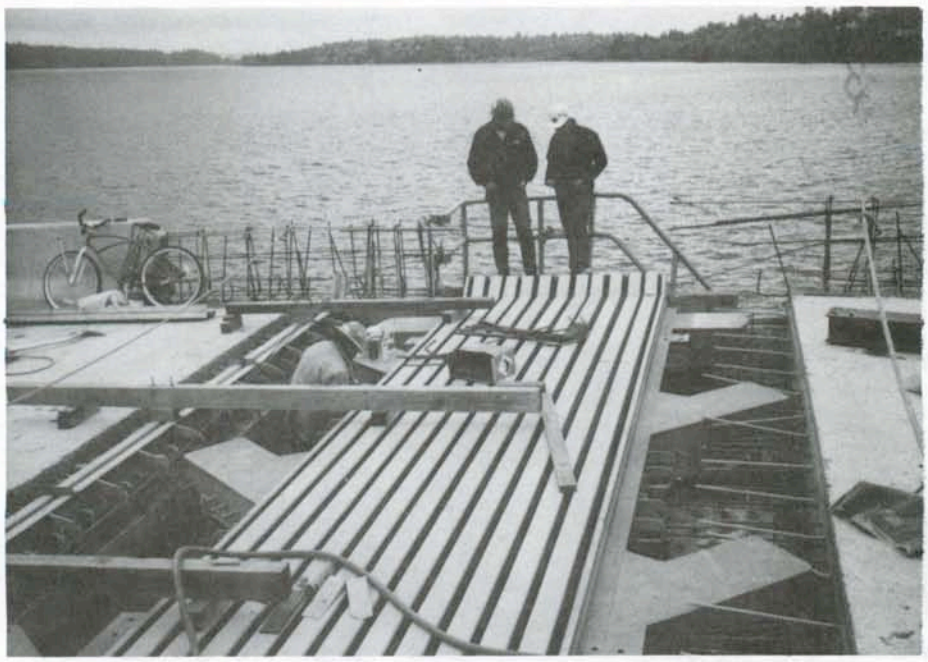
Pontoon Expansion Joint Blockout



Unloading Pontoon Expansion Joint



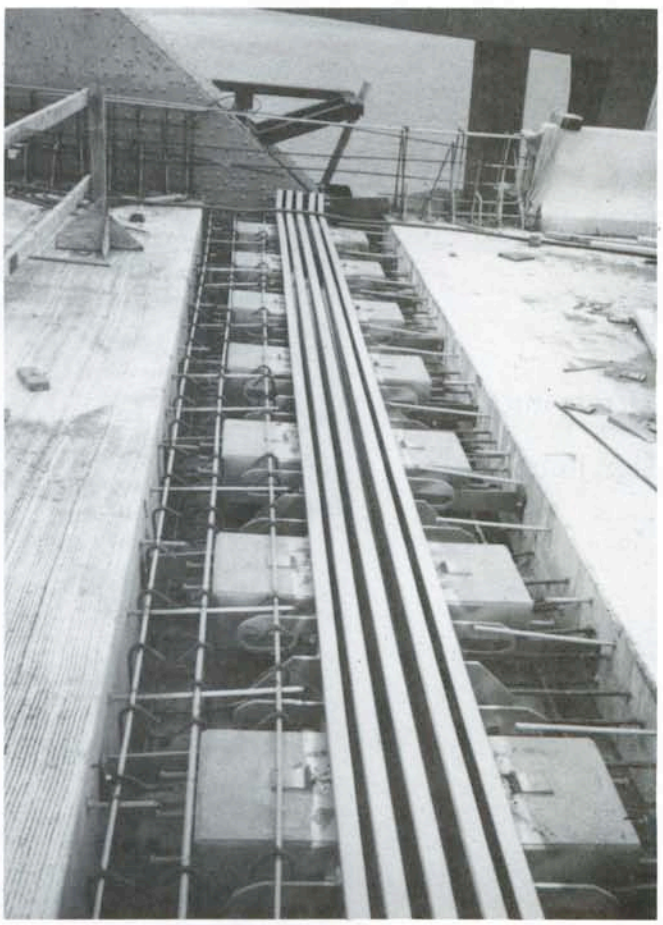
Lowering Pontoon Expansion Joint into Blockout

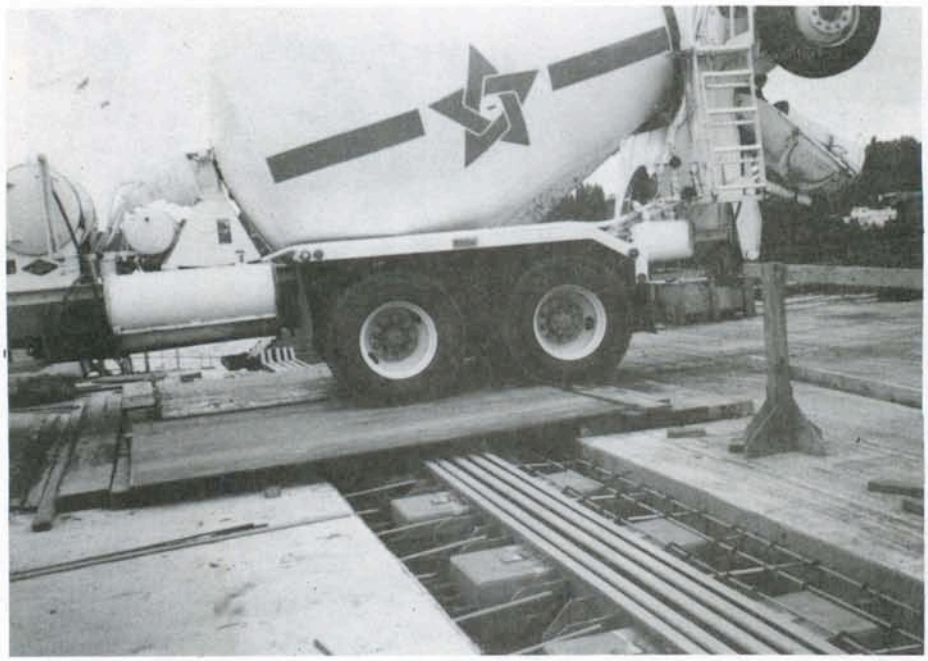


Pontoon Expansion Joint in Blockout

Pouring Concrete into Pontoon Expansion Joint Rebar

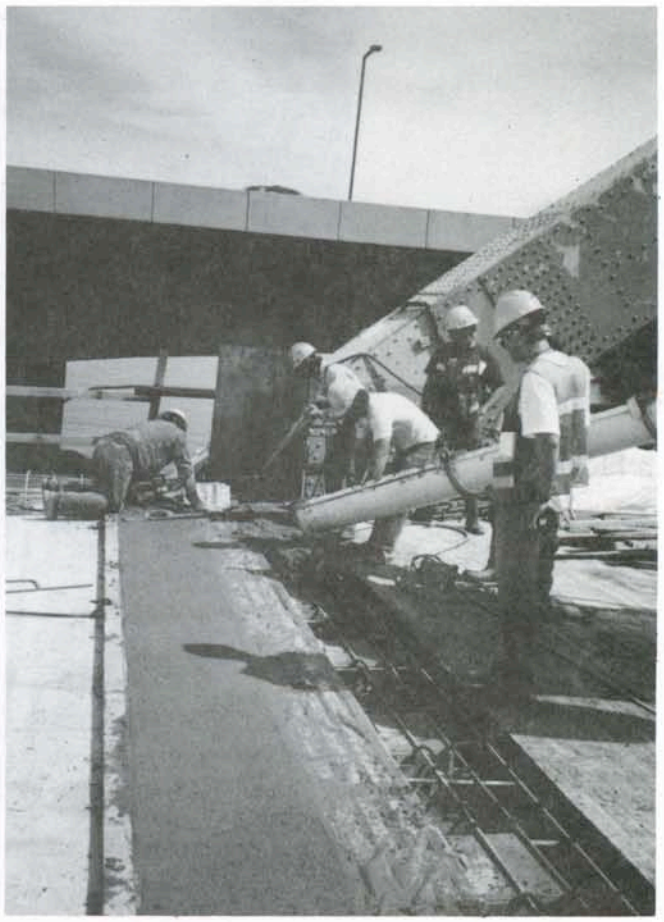
Pier Expansion Joint in Blockout

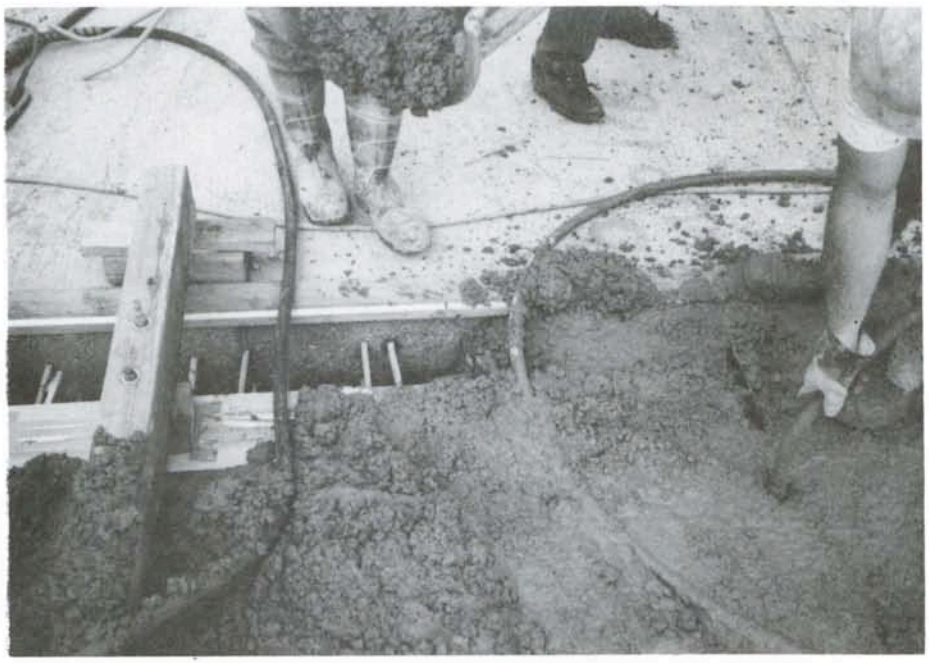




Concrete Truck Passing Over Pier Expansion Joint

Pouring Concrete into
Pier Expansion Joint Rebar





Vibrating Poured Concrete