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**INSTALLATION OF  
KOCH BRIDGE JOINT SYSTEMS  
ON  
BOARD OF AFFAIRS  
CONTRACT NUMBER 100725**

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CONSTRUCTION REPORT

Under the Supervision  
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<b>16. ABSTRACT</b> <p>Oklahoma Department of Transportation (ODOT) Maintenance and Bridge Engineers have been looking for a satisfactory water tight bridge joint device or system for many years.</p> <p>27 KOCH Bridge Joint Systems (KOCH BJS) have been installed on an elevated portion of I-40, located in downtown Oklahoma City. The KOCH BJS Units were installed under a bridge joint repair project. All KOCH BJS units replaced other types of "water tight" bridge joint devices which had failed.</p> <p>KOCH Bridge Joint systems are a proprietary product which has been used for 18 years in Europe, but is still relatively unknown in the U.S. KOCH BJS Units carry a two-year warranty covering materials and installation. Repairs usually consist of overlaying the KOCH BJS Units with modified asphalt. The ease with which KOCH BJS Units can be repaired give them an advantage over many bridge joint systems, which must be removed for repairs, then replaced.</p> <p>ADT in the area where the KOCH BJS Units were installed is 80,000. It was necessary to close one traffic lane at a time during installation. Some congestion did result from the lane closings, otherwise the units were installed with a minimum of interruption to motorists.</p>			
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# INTRODUCTION

The Oklahoma Department of Transportation (ODOT) has installed KOCH BRIDGE JOINT SYSTEMS (KOCH BJS) on twenty seven (27) expansion joints on I-40 in downtown Oklahoma City. The KOCH BJS units were installed on a two mile long, elevated section of I-40, and all replaced other types of watertight bridge joint devices which had failed. Twenty three (23) of the joints where the KOCH BJS systems were installed were located on the main line of the eastbound I-40 expressway and four were located on elevated entrance and exit ramps.

KOCH BJS locations are shown in Figure 1, and are listed in Table 1. Locations are numbered in west-to-east order, and are described by street location for convenience in locating any failures which may occur. Joint lengths varied with lane requirements at each location. Lengths of joints where the KOCH BJS Units were installed are listed in Table 2.

The KOCH BJS was originally known as The PAVETECH Bridge Joint System (PAVETECH BJS). The PAVETECH BJS was invented in England, and has been used in Europe for 18 years. In 1991, Koch Materials Company, of Stroud, Oklahoma, purchased the U.S. rights to the PAVETECH BJS and changed it's name to The KOCH BJS.

The KOCH BJS is a proprietary product. Installed KOCH BJS systems carry a 24 month warranty covering materials and installation. However, installation must be done by a KOCH Materials Company licensee or the warranty will not be given.

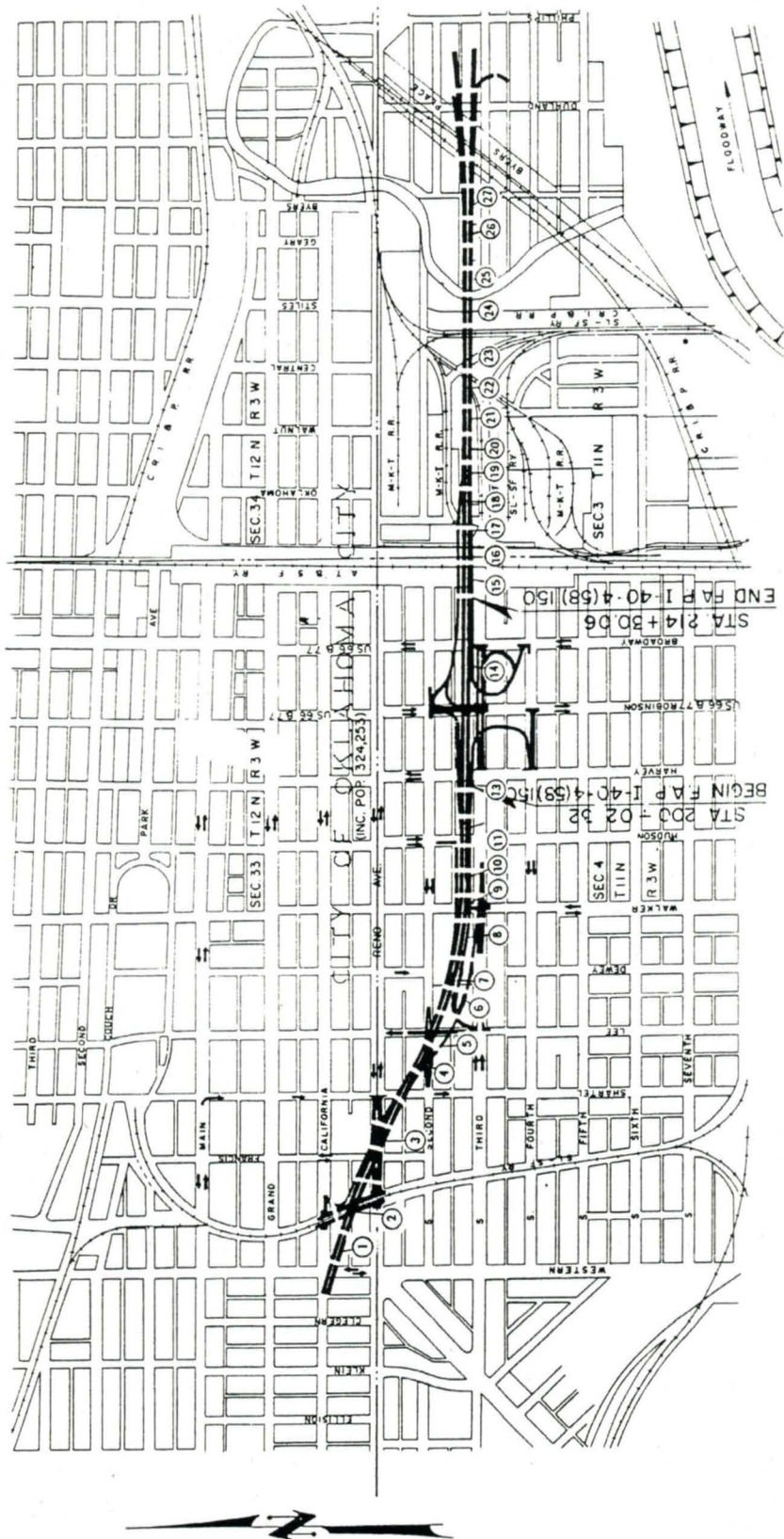


Figure 1. KOCH BJS Locations.

**Table 1. KOCH BJS Unit Locations.**

Unit Number and Location.

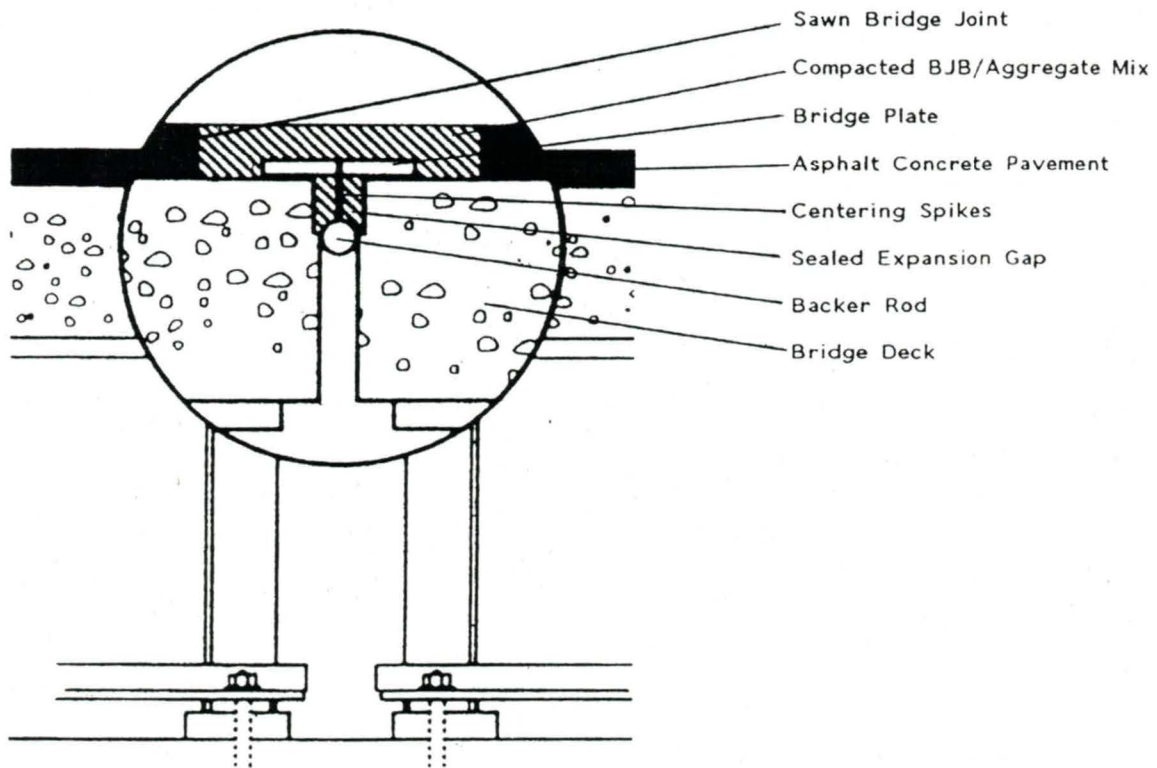
1. 200 feet east of Western Avenue Overpass.
2. 150 feet east of Classen Avenue Overpass.
3. 120 feet east of Francis Avenue Overpass.
4. 300 feet west of Lee Street Overpass.
5. 200 feet west of Lee Street Overpass.
6. Above west abutment, Walker Street Exit Ramp.
7. East end of Walker Street Exit Ramp.
8. Above west abutment, Lee Street Entrance Ramp.
9. East end of Lee Street Entrance Ramp.
10. 100 feet east of Lee Street Entrance.
11. 200 feet east of Lee Street Entrance.
12. 150 feet east of Hudson Street Overpass.
13. 100 feet west of Harvey Street Overpass.
14. 100 feet west of Broadway Avenue Overpass.
15. 100 feet east of Broadway Street Overpass.
16. 175 feet east of Broadway Avenue Overpass.
17. 300 feet east of Broadway Avenue Overpass.
18. 500 feet east of Broadway Avenue Overpass.
19. 650 feet east of Broadway Avenue Overpass.
20. 800 feet east of Broadway Avenue Overpass.
21. 1,000 feet east of Broadway Avenue Overpass.
22. 1,150 feet east of Broadway Avenue Overpass.
23. 1,250 feet east of Broadway Avenue Overpass.
24. 1,500 feet east of Broadway Avenue Overpass.
25. 1,700 feet east of Broadway Avenue Overpass.
26. 700 feet west of Lincoln Avenue Exit.
27. 500 feet west of Lincoln Avenue Exit.

**Table 2. Joint Lengths and Installation Dates.**

<u>BJS Unit</u>	<u>Joint Length</u> (feet)	<u>Date Installed</u>
1.	37.25	08-07-91
2.	37.16	08-07-91
3.	37.16	08-07-91
4.	37.33	08-07-91
5.	37.00	08-08-91
6.	18.00	08-15-91
7.	18.00	08-15-91
8.	18.00	08-15-91
9.	18.00	08-15-91
10.	37.00	08-08-91
11.	38.00	08-08-91
12.	50.00	08-09-91
13.	37.00	08-09-91
14.	49.00	08-09-91
15.	49.50	08-09-91
16.	47.25	08-12-91
17.	37.00	08-12-91
18.	37.08	08-12-91
19.	37.16	08-12-91
20.	37.00	08-13-91
21.	37.25	08-13-91
22.	37.00	08-13-91
23.	37.08	08-13-91
24.	37.16	08-13-91
25.	37.16	08-14-91
26.	37.00	08-14-91
27.	64.50	08-15-91

## DESCRIPTION

The KOCH BJS (Figure 2) consists of an asphaltic plug, a bridge plate, and a specific modified asphalt concrete. A strip of backer rod is used during installation. Specifications recommended by Koch Materials Company, covering all BJS components, are attached (Appendix A). System Components are described individually, in additional detail in the following paragraphs.



**Figure 2. Completed KOCH BRIDGE JOINT SYSTEM.**

## **Backer Rod**

The backer rod used with The KOCH BJS is a closed cell, foam joint filler. The backer rod is compressed into the joint before the other components of the system are installed. Backer rod provides support for the rest of the system during installation, rather than functioning as part of the completed system.

## **Bridge Plate**

The BJS bridge plate is an eight inch wide, one quarter inch thick, mild steel plate. Holes are drilled along the center of the plate at one foot intervals. Centering spikes are inserted in the holes during installation. The bridge plate covers the joint opening (expansion gap) to prevent the matrix of the BJS from entering the gap.

## **KOCH BRIDGE JOINT BINDER**

KOCH BRIDGE JOINT BINDER (KOCH BJB) is a thermoplastic, polymeric, modified asphalt binder. KOCH BJB is used as a coating material for all faces of the joint trench. It is also used as a sealer for the expansion joint gap above the backer rod, and as a modified asphalt binder for the material in the joint. KOCH BJB is delivered to the jobsite in 50 pound blocks, (Figure 5), which must be melted in an oil jacketed kettle before application.

## **Aggregate**

A specific granite chip aggregate is used in the modified asphalt cement of the KOCH BJS. Only two U.S. quarries have been approved as aggregate sources at this time. For applications in the western U.S., including Oklahoma, the aggregate comes from San Saba, Texas. A North Carolina quarry supplies the Eastern U.S. Koch Materials Company requires that aggregate withstand heating to 400 degrees F., and that it pass company tests designed to show that it is resistant to stripping. Aggregate is shipped to Koch Materials Company licensees in 50 pound bags (Figure 3).



**Figure 3. Bags of Granite Chip Aggregate.**

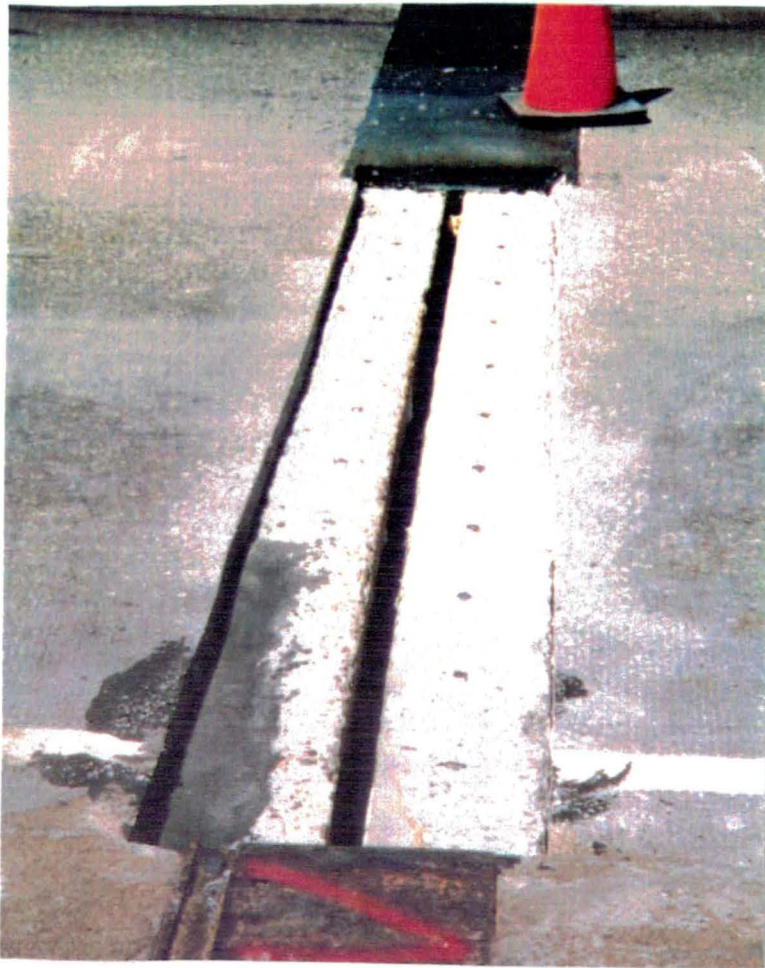
# INSTALLATION

Koch Materials Company Specifications for BJS System installation are listed in Appendix A. To insure that these specifications are followed, the 24 month warranty is given only if installation is done by company-licensed applicators. The licensee for the area covering Oklahoma is Alpha Pavement Technology Incorporated, of Amarillo, Texas. On this project, all KOCH BJS units were installed on retrofit locations. The BJS units installed here replaced other types of watertight bridge joint devices which had failed.

Work began at 10:00 AM, July 23, 1991. Installation of twenty five (25) units was completed by 3:00 PM, August 2, 1991. The remaining two (2) units were installed August 14 and 15. All installations were completed by 3:00 PM, August 15. Installation was done, one lane at a time, with the remaining lane open to traffic. The Installation operation was then moved to the other lane while traffic used the lane where installation was complete. The installation operation is described below, by component or operation, in the order the operations are carried out.

## Joint Preparation

The bridge deck surface where a BJS System will be installed is prepared as follows: A saw cut is made on each side of the expansion joint. The saw cuts run across the width of the bridge (Figure 4). Recommended distance between the two cuts is twenty inches. Cut depth varies with the amount of asphalt concrete that must be sawn through to reach the PCC bridge deck. On this project, the cut depth was approximately three inches. All material between the two saw cuts is then removed. The faces of the saw cuts and the expansion joint are cleaned with a hand-held electric grinder, as is the bridge deck surface between the cuts. The exposed faces of the saw cut, expansion gap, and bridge deck are then heated with a heat lance (Figure 5.) to remove any moisture which may be present.



**Figure 4. Bridge Joint Prepared for KOCH BJS Installation.**



**Figure 5. Heating Exposed Saw Cut, Expansion Gap, and Bridge Deck.**

## Backer Rod

The backer rod is cut from two and one half inch thick sheets of closed cell foam expansion joint filler. Width of backer rod cut for each joint varies so that backer rod width is sufficient to form a tight seal in the expansion gap. Backer rod is then forced into the expansion gap to a minimum depth of one inch (by specification). On this project, backer rod was forced approximately two inches into the expansion gap. When in the expansion gap, the backer rod forms a seal such that Koch BJB can be poured over it, forming an asphaltic plug. Positioning the backer rod deeper in the expansion gap means that the gap will be sealed to a greater depth.



Figure 6. Kettle and Blocks of BJB Before Heating.



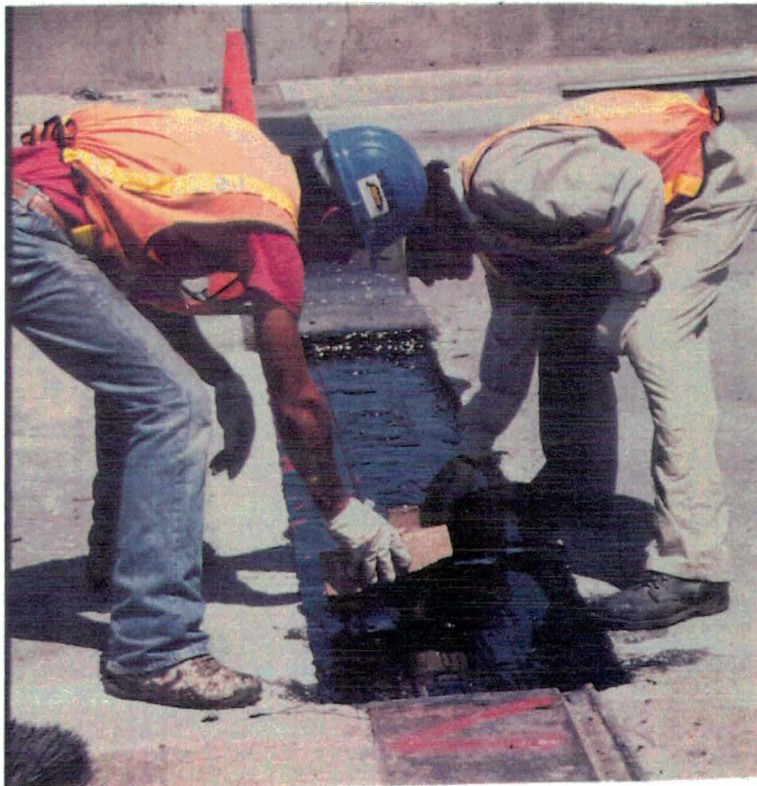
**Figure 7. Placing Backer Rod in Expansion Gap.**

## **Bridge Plate**

Before the bridge plate is installed, a seal is formed by pouring Koch BJB over the expansion gap and backer rod. After this has been done, the bridge plate is laid over the expansion gap (Figure 8) to insure plate lengths are correct before permanent installation. Koch BJB is then poured over the face of the saw cut, and the sealed expansion gap. Centering spikes are placed into holes in the plate, and the plate is placed in its permanent location. Just before each section of plate is put in place, more BJB is poured over the expansion gap and deck. This is done to further insure a good seal. When all pieces of bridge plate are in place, BJB is poured over them and the surface of the BJB is smoothed by hand (Figure 9). By this time, there is a continuous coating of BJB from the top of the backer rod to the top of the bridge plate.



**Figure 8. Placing Bridge Plate Over Sealed Expansion Gap.**



**Figure 9. Smoothing Surface of BJB Over Bridge Plate.**  
keys

## Modified Asphalt Concrete

After the bridge plate has been installed and sealed, modified asphalt concrete is laid over it. The modified AC consists of KOCH BJB binder and granite chip aggregate. Gradations for the two mix designs used (3/4 inch and 1/2 inch chip size) are given in Appendix A. The first lift of modified AC is 3/4 inch chip mix. Before laying, the KOCH BJB/granite chip mix was heated to 300 degrees F. while mixing in 1/2 cubic yard mixers (Figure 10). Mix temperature is checked with a hand-held, digital thermometer (Figure 11). The granite aggregate must be totally precoated during mixing or the mix will be considered unusable. Coating of aggregate was checked visually.

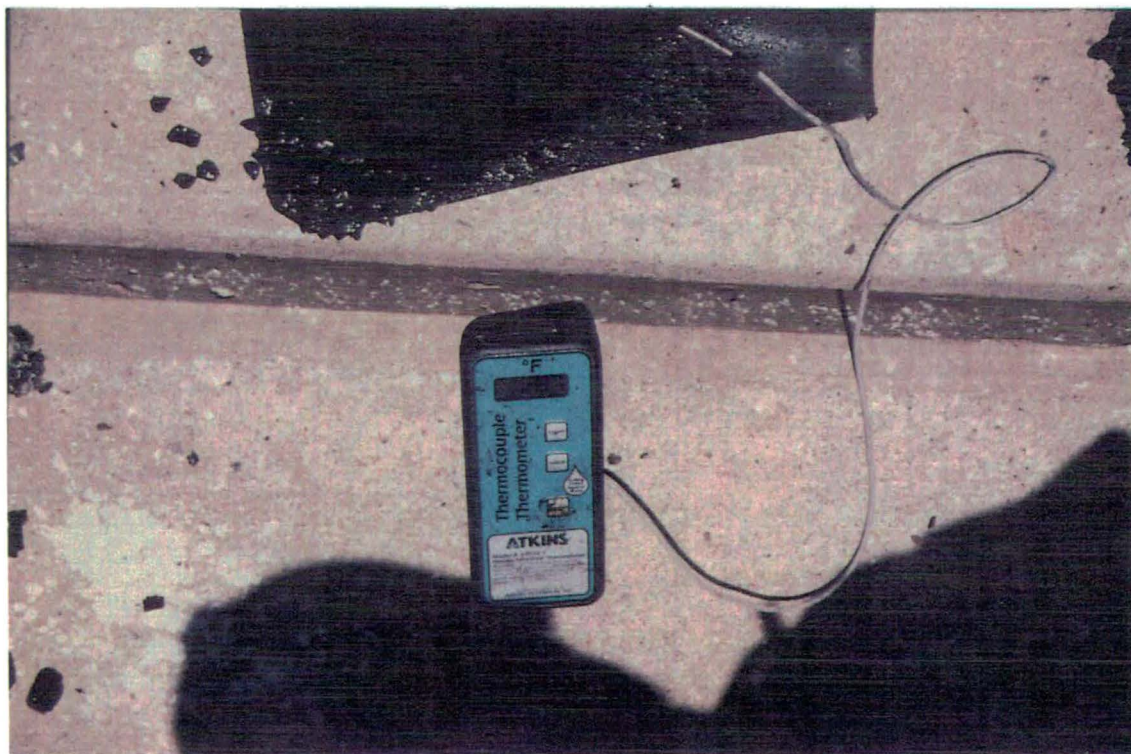
If the depth of cut is sufficient, two lifts of the 3/4 inch mix are laid. On this project, only one lift, two inches thick, was laid. A lift of 1/2 inch chip mix was laid over the 3/4 inch lift, bringing the surface of the BJS to approximately 1/2 inch above the existing pavement. The entire joint was then compacted with a two ton roller. (Figure 13). After compaction, the joint surface was flush with the existing pavement. The surface of the sealed joint was then heated to a tack consistency with a heat lance, and a thin membrane of BJB was poured over the joint.

A layer of sandblast sand was applied over the BJB membrane. Sand was applied over the membrane by pouring it beside the sealed joint and pushing it onto the membrane with a hand-operated broom .

On this project, traffic was kept off the lane where the BJS Systems were applied until the last BJS done during the days run had been completed for at least one and one half hours. Company literature indicates that lanes can be opened to traffic 15 minutes after installation is complete. A completed KOCH BJS is shown in Figure 14.



**Figure 10. Mixing BJB and Granite Aggregate in 1/2 C.Y. Mixers.**



**Figure 11. Checking AC Mix Temperature with Digital Thermometer.**



**Figure 12. Placing 3/4 Inch Modified AC Mix.**



**Figure 13. Compacting Modified AC with Two Ton Roller**



**Figure 14. Completed KOCH BJS Unit.**

## INSTALLATION COSTS

A total of 27 expansion joints were retrofitted with Koch BJS devices on this contract. The total contract cost of replacing the failed systems with Koch BJS devices was \$153,384.00. This was the bid price to replace 996 L.F. of expansion joint devices at \$154.00 per L.F. As previously mentioned, a two year warranty covering materials and installation is included. The warranty will cover the direct cost of repairs, if any are required. In most cases, repair of KOCH BJS units consists of overlaying them with additional modified asphalt concrete. Repairs under warranty are done by Koch Materials Company Licensees. It is beyond the scope of this construction report to estimate indirect costs which may be involved in repair. However, it should be noted that even if repair of the devices is done under warranty, ODOT will still be providing traffic control, and user costs due to delays to motorists will increase if repairs are required.

Traffic control on this project involved four men and the following equipment: One dump truck, one 1/2 ton pickup, two arrow boards, approximately 60 channelization cones, and six signs.

ADT here is 80,000. Work was done one lane at a time, with the remaining lane open to traffic. Work crews were required to start after the morning rush hour, and be off the road before the evening rush hour began. Although this requirement kept congestion below what it might have been, each car travelling through the project area was delayed approximately six minutes when construction was in progress. The delay was approximated by measuring the time it took to drive through the construction zone during construction and comparing this to a time measurement made after construction was completed.

## MONITORING AND REPORTING

Monitoring will include visual surveys of all 27 Koch BJS units. Surveys will be done twice a year. Both the bridge deck surfaces and the joints below the bridge will be inspected. Any failures reported or observed during the surveys will be reported. If failures are reported at times when surveys are not scheduled, a survey will be scheduled as soon as possible. Reporting will be in letter-to-the-file form unless substantial failure occurs. In that case, a "Final Report" covering the failures, and performance before failure, will be written. Surveys will continue for three years if no failures occur. At that time, a recommendation will be made on whether or not observation should be continued. If the ODOT Bridge Division decides the devices have performed well enough to be accepted, a "Final Report", will be written at that time. The "Final Report" will summarize performance to date, and will indicate that the Koch BJS has been accepted.

# **Appendix A. Specification for Installation of The KOCH BJS Bridge Joint System**



KOCH MATERIALS COMPANY

COATINGS & SEALANTS DIVISION

SPECIFICATION FOR INSTALLATION OF THE KOCH BJS BRIDGE JOINT SYSTEM

SCOPE

This work shall consist of supplying and installing a binder and aggregate system composed of specially blended, polymer modified asphalt and specific aggregate placed into a prepared expansion joint blockout. The correct material and installation will provide a flexible waterproof bridge joint which will allow for all joint movement up to 2".

MATERIAL

The bridge joint binder (BJB) shall be a thermoplastic polymeric modified asphalt, as manufactured by Koch Materials Company, and shall meet the following requirements when tested according to ASTM test methods:

	Test Method	Typical Values
Softening Point	ASTM D-36	180° F (82° C) Min.
Tensile Adhesion	ASTM D-3583	800% Min.
Ductility @ 77° F (25° C)	ASTM D-113	40 cm. Min.
Penetration	ASTM D-3407	
	77° F (25° C) 150g, 5 sec.	90 dmm Max.
	0° F (-18° C) 200g, 60 sec.	10 dmm Min.
Flow 5 h @ 140° F (60° C)	ASTM D 3407	3.0 mm Max.
Resiliency @ 77° F (25° C)	ASTM D 3407	60% Min.
Asphalt Compatibility	ASTM D-3407	Pass
Recommended Pouring Temperature		390° F (177° C)
Safe Heating Temperature		410° F (199° C)

The specified aggregate shall be a crushed, doublewashed, and dried granite. It will be supplied in both 3/4" and 1/2" sizes which meet the following requirements:

Gradations:	Sieve Size	3/4" Size % Passing	1/2" Size % Passing
	7/8	95-100	-
	5/8	30-50	100
	1/2	10-25	90-100
	3/8	0-10	40-70
	#4	-	10-20
	#8	-	0-10

The backer rod shall be a closed cell, foam expansion joint filler, capable of withstanding the elevated temperature of the polymeric binder. The backer rod shall have the following typical physical properties using a 1/2" specimen and test method ASTM D-545.

Compression, 50%	13.3 psi
Extrusion	0.1 inch
Recovery	99.21% Min.
Water Absorption, Volume %	0.246 Max.

The bridging plate shall be a mild steel plate, 1/4" thick by 8" wide, cut in 4 foot lengths. Spike holes shall be drilled, on a longitudinal centerline, at 1 foot intervals.

CONSTRUCTION PROCEDURES

The BJS System installation shall be centered over the existing expansion joint gap to the recommended width of 20 inches. Variations in the width of the joint will be determined by the site engineer and the manufacturer.

Remove all material between the saw cut, including the wearing surface, riser bars, and any old expansion joint material. This will form the bridge joint blockout. Damaged concrete on the joint table must be removed. The previous expansion joint system must be removed to a depth which will allow the BJS joint system to be installed.

The joint blockout area is prepared by cleaning and drying the blockout area, and 6 inches on either side of the joint. To accomplish this, use a hot compressed air lance capable of producing 3000° F and a directional velocity of 3000 fps.

# SPECIFICATION FOR INSTALLATION OF THE KOCH BJS BRIDGE JOINT SYSTEM

(Continued)

## CONSTRUCTION PROCEDURES

(Continued)

Heat the bridge joint binder to a minimum of 350° F in a double oil jacketed melter. The melter must be equipped with a continuous agitation system, temperature controls, and calibrated thermometers to maintain the BJB binder at the manufacturers recommended temperature.

The backer rod shall be placed into the expansion joint gap at a minimum depth of 1 inch. Pour the BJB binder into the bridge joint gap, overfilling the joint gap to allow the binder to be spread onto the joint table. The binder will form a bond breaker between the joint table and the bridging plate.

The bridging plate shall be centered and placed over the entire length of the expansion joint gap. The plate shall be secured by placing spikes through the predrilled holes into the expansion joint gap backer rod. Do not overlap the bridging plate sections.

The blackout area shall be coated on the horizontal, vertical, and bridging plate surfaces with BJB binder to form a monolithic waterproof membrane.

The specified aggregate shall be heated to 250° F to 300° F in a rotating drum mixer. The temperature of the aggregate shall be controlled by using a hand held, calibrated, digital temperature sensor. Blend the binder into the aggregate at a ratio of 74% aggregate, to 26% binder, plus or minus 2% by weight. The specified aggregate must be totally precoated prior to installation.

The Koch BJS system is a three layered installation using the specified aggregate, precoated with binder. Layers one and two (from bottom to top) are 3/4 inch aggregate and layer three is 1/2 inch aggregate. When the final 1/2 inch aggregate layer is installed, the surface shall be left high enough above the existing pavement to allow for compaction (approximately 1/2 inch). Using a 2 ton roller, or larger, compact the aggregate layers perpendicular to the joint. The three layers form an interlocking joint matrix.

The compacted joint surface must be heated with a heat lance to a tack consistency. Install a final thin membrane of binder followed immediately by an application of dry aggregate or sand. The joint will be ready for traffic 15 minutes after completion.

## MEASUREMENT

Measurement for pay purposes will be based on the lineal feet of installed Koch BJS joint system, measured horizontally along the center line of the installed joint. Payment will include labor, materials, and all specialized equipment necessary to install the system.

Traffic control, unless otherwise stated, will be the responsibility of the client.