Research Report

KTC-89-2

# MODULAR EXPANSION JOINTS AND DECK DRAINS

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16. Abstract

Inspections were conducted on bridge modular expansion joints and deck drains to assess their performance. Forty-four modular expansion joints were inspected including 38 Wabo-Maurer and 16 Acme joints. Twenty-three elastomeric dams were also inspected for comparative purposes including 21 Transflex dams and 2 Fel-Span units. The joints were rated using a quantitative subjective rating system developed by Penn DOT.

Both the modular expansion joints and the newer expansion dams were performing satisfactorily. Both types of joints leaked and experienced a number of minor hardware problems. some of the joints may warrant repairs to restore their complete function.

Deck drains and drain outlet piping systems were inspected. The deck drains inspected included those having square and rectangular inlets, pipe drains, and scuppers (edge drains).

All types of deck drains appear susceptible to clogging. Large scuppers performed well. Also, simple straight drop pipes were less clog prone than complex piping systems. Recommendations are provided to minimize clogging problems.

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TABLE OF CONTENTS

# INTRODUCTION

Expansion joints and deck drains are key elements of bridge decks. Their performance may affect deck durability and motorist safety. Subtask 8 of study KYHPR-85-107 (Long-Term Monitoring of Experimental Features) was conducted to assess the service performance of those items. Between April through August 1987, Kentucky Transportation Center (KTC) personnel inspected those features on 20 bridges throughout the state. This report presents results of those inspections.

## Background

Modular expansion joints consist of prefabricated assemblies employing one or more compressible neoprene modules in an attempt to provide watertight seals between exposed steel load bearing components of the joints. Typically, modular joints are manufactured to accommodate increased joint movement by adding module seals and steel load bearing components. Longer support bars are also employed to span the increased joint gap.

Another common type of watertight joint seal is the elastomeric dam. They consist of steel-reinforced neoprene segments. The segments are fitted together along a joint and bolted to the bridge deck. Lateral movement is accommodated by deformation of the neoprene body.

The primary functions of modern expansion joints are to:

1. Accommodate all movements of a structure,
2. Withstand all loadings,
3. Provide good riding qualities,
4. Not present a danger to cyclists or other types of traffic,
5. Not impart undue stress to a structure unless the structure is designed accordingly,
6. Be reasonably silent and vibration free,
7. Provide reliable service throughout the expected temperature range,
8. Resist corrosion,
9. Ease maintenance and repair, and
10. Prevent corrosion damage to portions of the structure below the joint (1).

Modular expansion joints have been promoted as replacements for conventional sliding plate joints and finger dams. Manufacturers' justification for their extra cost is their watertight feature.

The Kentucky Transportation Cabinet used modular expansion joints on an experimental basis between 1972 and 1981. They were not widely employed after that period.

Deck drains may enhance deck durability by providing for the rapid removal of water from the deck. Water on a deck may cause hydroplaning or freeze and increase the potential for accidents.

Deck drains typically consist of gratings, inlet boxes, and piping systems. The Transportation Research Board Synthesis of Highway Practice 67 "Bridge Drainage Systems" and Section 24 "Bridge Drainage" of the Federal Highway Administration, "Bridge Inspector's Training Manual 70" provide excellent summaries of bridge drainage systems.

## MODULAR EXPANSION JOINTS

In 1980, KTC personnel inspected watertight bridge expansion joints on 19 bridges. A KTC report published in 1981 contained a qualitative evaluation of both modular expansion joints and elastomeric dams (2). At the time of those inspections, most of the modular joints were less than 5 years old. KTC personnel reinspected the expansion joints on many of those bridges in 1987. The results of those recent inspections were compared with the findings included in the 1981 report.

Bridges included in the 1987 inspections were: US 27 over the Kentucky River, Garrard-Jessamine counties; I-275 over the Ohio River, Campbell County; I-275 over KY 17, Kenton County; I-471 over the Ohio River, Kenton County; US 25-US 42 over the Ohio River, Kenton County; US 421 over Martins Fork, Harlan County; KY 770 over the Laurel River, Laurel County; KY 225 over the Cumberland River, Knox County; I-64 (Riverside Parkway), Jefferson County; Jefferson Freeway over Ramp 6, Jefferson County; Ramp 2 over Jefferson Freeway, Jefferson County; and US 31 over the Ohio River, Jefferson County. All of the joints on those bridges were included in the 1981 report.

There was one difference between the 1980 and 1987 KTC visual inspections of the expansion joints. The 1980 inspections were qualitative. However, in 1987, a quantitative subjective rating system was used to rate each joint.

The subjective rating system uses a scale from 0 (failure) to 5 (excellent). The joint rating parameters were:

1. General appearance,
2. Condition of anchorage,
3. debris accumulation,
4. Surface damage,
5. Noise under traffic, and

6. Need for maintenance.

The subjective weighted rating scale (0-5 points) used defined values to judge joint attributes. The specific values used were:

| | |
|---|---|
| Poor ..................... | Less than 3.50 |
| Fair ..................... | 3.51 to 3.84 |
| Satisfactory ................ | 3.85 to 4.19 |
| Good ..................... | 4.20 to 4.59 |
| Excellent .................. | 4.60 or greater |

KTC investigators used a weighted rating system developed by Penn DOT to derive overall ratings of joints (3). The specific rated attributes were multiplied by percentages established by Penn DOT to yield a weighted rating. The percentages were:

| | |
|---|---|
| General Appearance | 9 percent |
| Condition of Anchorage | 26 percent |
| Debris Accumulation | 9 percent |
| Watertightness | 27 percent |
| Surface Damage | 12 percent |
| Noise under Traffic | 8 percent |
| Need for Maintenance | 9 percent |
| | 100 percent |

The prime performance attributes, anchorage condition and watertightness, possessed the highest rating weights.

The 1987 field inspections included 77 expansion joints on 16 bridges. The test group included 54 modular expansion joints (38 Wabo-Maurer and 16 Acme units). Twenty-three elastomeric dams (21 Transflex and 2 Fel-Span units) were also inspected. KTC personnel compared the performance of the two types of joints. Tables 1-4 provide descriptive data about those joints.

## Modular Joints

The 1987 inspections revealed that most of the modular expansion joints were performing satisfactorily. Superficially, many of those joints appeared to be in similar conditions as when first reported in 1981. Both inspections revealed some common joint problems. Tables 5 and 6 present results of the 1987 inspections and subjective weighted ratings of the modular expansion joints.

The 1981 KTC report revealed several typical problems for modular expansion joints. Those included: 1) punctured module seals, 2) uneven module seal spacing, 3) rotating separation beams, 4) debris accumulation, 5) vertical and horizontal misalignment, 6) leakage and 7) noisy joints. None of the 65 Wabo-Maurer joints inspected in 1980 leaked. Some of the 19 Acme Acma joints inspected at that time leaked.

The 1987 inspections revealed several additional problems. Those included: 1) damaged or broken steel separation beams, 2) corrosion at the ends of joints, 3) rust stains on the concrete along the joint edges, and 4) chipping of concrete along the joint edges.

The earlier report noted that several Wabo-Maurer D-780 joints on the I-471 bridge had water in the module seals. The report did not explain why the water was present. During a 1987 inspection on the bridge, KTC personnel noted water pumping from the end of a large Wabo-Maurer D-1040 joint. Either a puncture or the detached module end cover allowed water to enter the module. In 1980, none of the joints on that bridge leaked. The large joint inspected in 1987 leaked (as did many of the D-780 joints). That suggests the presence of water in the cavities of module seals may be a precursor of joint leakage.

Thirty-seven percent of the joints inspected in 1987 had torn or loose module seals (Figure 1). All of those joints leaked. In several instances, module seals separated from joints and protruded above the top of the separation and edge beams. Normal traffic or snowplows tore many of those protruding module seals. The separation of the module seals from the joint may be due to faulty hardware that imparts excessive vibrations to the seal-to-joint bond.

The 1981 report mentioned that uneven spacing (compression) of module seals was a common problem. Uneven module seal spacing either indicates incorrect installation or, more likely, improper joint function. The 1981 report also noted the similar phenomena of joint rotation. Forty-one percent of the modular expansion joints inspected in 1987 exhibited uneven module seal compression or rotation.

Rotation is a slight turning or bending of a separation beam in the direction of traffic. With clockwise rotation, the module seal on the right side of the beam compressed and the module seal on the left side of the beam expanded. The beams normally rest upright. They are welded to support bar joists that span joints. The rotation indicates the separation beams are bending or breaking the weld attaching them to the support bar joist. However, beams that rotated did not produce vehicle-induced impact noise expected due to a fractured weld.

Accumulation of debris may lead to damage of neoprene membrane seals or other joint hardware. That was a frequent problem. The debris usually consisted of sand and small gravel. Those might not prove troublesome, except in gutter areas. Heavy debris buildup in the gutter might hinder drainage and promote corrosion of joint hardware.

The 1981 KTC report noted horizontal and vertical misalignment problems. The 1987 inspections revealed those problems on 13 percent of the joints. Vertical misalignment caused joint noise under traffic. The 1987 inspections revealed horizontal misalignments (variable module seal spacings along a joint) up to 1/2-inch difference for the larger joints. In several instances, steel separation beams had an irregular sweep along the length of the joint. That resulted in a varying module spacing along a joint (Figure 2). Horizontal misalignment may inhibit the watertight seal between the separation beams and modules resulting in joint leakage.

At the time of the 1980 inspections, a few of the modular expansion joints (all Acme units) leaked. Only 15 percent of all modular expansion joints inspected in 1987 were watertight. In several cases, joint leakage promoted corrosion of superstructure steel below the joints.

Twenty percent of the modular expansion joints inspected in 1987 were noticeably noisy under traffic. Excessive vertical misalignment caused the noise in a few cases. In other cases, joints emitted a metallic slapping sound possibly from loose joint hardware.

One modular expansion joint on the US 27 bridge over the Kentucky River had a deformed steel separation beam bent upward. A snowplow blade probably snagged on the separation beam. A joint on the Riverside Parkway had a broken weld on a separation beam.

The 1987 inspections revealed rust stains on the deck concrete along the edges of several modular expansion joints. Probably, water had penetrated under the edge of the joints and caused corrosion of the joint edge beam.

Concrete was chipping slightly along the edges of several modular expansion joints. A loose joint anchorage may cause that problem. However, the 1987 inspections did not reveal any perceptively loose anchorages.

Most of the modular expansion joint problems detected during both the 1980 and 1987 inspections were tolerable. All of the joints inspected in 1987 were serviceable and not in need of immediate attention. Seventy-eight percent of the modular expansion joints needed cleaning. Fifty percent warranted repair or possibly replacement to restore complete joint function.

The 1987 inspections revealed that the overall condition of the modular joints was satisfactory. At the time of those inspections, the average joint age was 10.5 and 12.5 years respectively, for the Wabo-Maurer and Acme joints. The surface appearance of many of the joints remained unchanged from their first inspections in 1980. However, some joints are beginning to exhibit more signs of service-related distress. Common joint problems include debris accumulation, leakage, torn or loose modules, irregular module compression and damaged hardware.

Poor workmanship during fabrication or erection may cause some modular joint problems such as irregular module compression or joint misalignment. The 1980 inspections revealed many of those problems. At that time, most of the modular joints were less than 5 years old.

The main limitation of modular joints was their tendency to leak. Twelve of the joints leaked extensively and may warrant remedial work (probably involving replacement or reattachment of module seals). The leakage problem is probably service related. The dramatic increase in the number of leaking joints from 1980 to 1987 supports that belief.

Watson-Bowman Company now markets the Wabo-Maurer joints (and owns the rights to the now defunct Acme Company). That firm may be able to supply parts. If desired, the firm can also provide labor and supervision to rehabilitate both brands of modular joints.

A Watson-Bowman representative stated those modular joints have expected service lives of 10-15 years before needing repairs to restore their function. Based upon the KTC inspections, that probably is a realistic estimate. It appears that none of the joints KTC personnel inspected have had extensive repairs.

Elastomeric Dams

The 1987 inspections revealed that most of the elastomeric dams were performing satisfactorily. Some Transflex joints of older design on the US 31 (Clark Memorial) Bridge in Louisville were in poor condition. The 1981 report noted the deterioration of those joints. They probably warrant replacement. Though most of the elastomeric dams had minor problems, their overall performance was satisfactory. Tables 7 and 8 present the results of the inspections and the subjective weighted ratings of elastomeric dams.

The 1980 inspections included 20 Transflex and four Fel-Span joints. At that time, problems detected included: 1) distress of concrete abutting joints, 2) loss of edge sealant, 3) misaligned sections, 4) surface damage, 5) leakage, 6) debris accumulation, and 7) loss of hole plugs. The 1987 inspections revealed two additional problems, loss of joint hardware and loose fasteners.

Distress (chipping) of concrete next to an expansion dam may lead to leakage. Seventeen percent of the expansion dams inspected in 1987 had chipping problems and all leaked.

Edge sealants were missing or disturbed in 39 percent of the elastomeric dams inspected in 1987. All of those leaked.

Twenty-two percent of the expansion dams inspected in 1987 had loose or misaligned sections. All of those joints leaked.

The 1981 report noted the susceptibility of expansion dams to surface damage (Figure 3). In 1987, 61 percent of those joints had surface abrasions or gouges in the rubber wearing surface. Probably, snowplowing caused most of those flaws.

The 1981 report noted that 44 percent of the elastomeric dams inspected in 1980 leaked. The 1987 inspections revealed that 83 percent of the elastomeric dams leaked.

The 1981 report mentioned the loss of stud covers only on the US 31 (Clark Memorial) bridge. In 1987, stud covers were missing from joints on all the bridges inspected (Figure 4). The 1987 inspections revealed that several joints having missing stud covers also had missing or loose joint retention nuts.

Most of the newer Transflex joints inspected have performed well. Thirty-four percent of the joints needed cleaning. Some of those joints needed minor maintenance such as resealing, tightening fasteners, or replacement of missing hardware. Fifty-two percent required repair or replacement to restore complete joint function. However, most of them were still serviceable and not in need of immediate attention.

Weighted Subjective Joint Ratings

The 38 Wabo-Maurer joints inspected in 1987 had an average subjective weighted rating of 4.08. The small Wabo-Maurer D-520 joints (which had 5.2 inches of horizontal movement) had an average subjective weighted rating of 4.22. The intermediate D-780 joints (which had 7.8 inches of horizontal movement) had a weighted rating of 3.94. The larger D-1040, D-1300, and D-1560 joints (which had 10.4, 13.0, and 15.6 inches of horizontal movement, respectively) had a combined average rating of 4.08. For those joints, size was not a significant factor in the overall rating.

KTC personnel compared the weighted subjective ratings of the Wabo-Maurer units to joint age, total vehicles per lane (over the life of a bridge), and joint length. The comparisons showed inverse relationships using linear regression analyses. However, R-square coefficients revealed low correlations between the weighted subjective ratings and those variables. In part, that was due to the low number of test joints.

The 16 Acme joints had an average weighted subjective rating of 4.14. The small Acme 2M400 joints had an average subjective weighted rating of 4.15. The intermediate size 3M600 joints had an average subjective weighted rating of 4.05. The large 6M1200 joints had an average subjective weighted rating of 4.16. The weighted subjective ratings showed inverse relationships with joint age and total vehicles per lane. However, the subjective weighted rating increased with joint length showing that it was not a factor in joint deterioration.

All data comparisons for the Acme joints provided low R-square correlations. That was also due to the low number of test joints.

The average weighted subjective rating for the 21 Transflex joints was 3.80. The low ratings of joints on the Clark Memorial bridge affected that average. The subjective weighted ratings of the Transflex units exhibited inverse relationships with joint age and total vehicles per lane, but not with joint length.

The two Fel-Span joints had an average subjective weighted rating of 3.80.

The average ratings for Wabo-Maurer and Acme joints were 4.08 and 4.14, respectively. Penn DOT ratings for those types of joints were 4.04 and 3.91, respectively (4). The average subjective rating for the Transflex joints was 3.80 compared to 3.67 for the Penn DOT ratings. Those ratings are very similar considering the KTC and Penn DOT inspectors did not receive instructions on rating the joints by a common source. Also, KTC personnel did not compare service histories of modular joints employed by the two highway departments.

The Transflex and Fel-Span joint inspections provided comparisons with modular expansion joints. The subjective weighted ratings of newer Transflex joints compared favorably to modular expansion joints. However, they exhibited a susceptibility to surface damage. Most of the damage was probably caused by snowplowing. Also, many of those joints leaked.

Penn DOT inspections of various bridge deck joints provided the highest ratings for finger dams (an average subjective weighted rating of 4.36). Finger dams equipped with rigid or flexible troughs can provide a watertight joint. In September 1987, a committee met to review the National Cooperative Highway Research Program synthesis Topic 10-16 "Bridge Expansion Devices". They concluded that finger dams with troughs may be the best overall joint system (5). Maryland DOT has employed finger dams with flexible fiberglass troughs for several years with satisfactory service. However, the troughs fill with debris and require occasional cleaning.

It is unlikely that any type of expansion joint will be maintenance free. The question exists whether one type of joint offers more benefits than others (or is more cost effective). While finger dams may be more reliable and less expensive than modular joints, they are not maintenance free. They occasionally require maintenance tasks such as re-anchoring to the deck and straightening of the fingers.

## DECK DRAINS

KTC personnel conducted inspections of conventional deck drainage systems to determine their performance and identify problems. Types of drains inspected included drains and scuppers (edge drains). Drainage from those units flowed through short straight pipes (drop drains), elaborate piping systems, or simple openings.

Inspections of the various deck drain systems revealed all of them were susceptible to clogging (at least to some extent). KTC investigators inspected several bridges having square and rectangular inlet drains. The square inlet drains should remove all debris that passes through a grate. The rectangular grates have longer basins that allow small debris to collect and gradually pass through an outlet pipe (Figure 5). Maintenance cleaning eventually removes larger debris retained in the basin. Pipe drains do not have inlet boxes. They consist of a pipe embedded in the deck with a slight recess tapered in the deck to route drainage into the pipe. Scuppers or edge drains consist of openings cast into barriers, and possibly curbs if sidewalks are present. They allow water to spill over the scupper exit hole outside the barrier.

Inspections revealed that regardless of size (9" x 9" to 1'-9" x 2'-2" grates), all square inlet drains were susceptible to clogging. The clogging was caused by a mixture of large and fine debris. Smaller drains could gradually become clogged by fine debris. Some square inlet boxes had the gutter recessed into the barrier to provide an opening to accept larger debris. Those were also susceptible to clogging.

Typically, large debris would accumulate in the inlet box basin and bridge the drain outlet. Such debris included paper, wire, rags, cans, and sticks. Eventually, the larger debris retained sand, soils and other fine debris that clog a drain. Steeper slopes on the drain inlet box side walls and larger outlet pipes might reduce the debris accumulation that clogs those drains.

KTC personnel inspected several small truss and prestressed concrete bridges that used scuppers. The truss bridges had small scuppers that did not provide adequate drainage. They were undersized. Debris build up near the scupper inlets exhibited that deficiency.

KTC personnel inspected several prestressed concrete bridges that employed larger scuppers (2'-0" x 3"). Inspections revealed that those scuppers were performing well (Figure 6). Partial blockages of scupper holes did not hinder their function. The scupper outlets lacked spouts and the draining water stained the exterior barrier walls. However, that was a minor problem.

In most instances, the short straight pipe drop drains performed satisfactorily. Inspections revealed a few clogged drop drains. The inspectors noted several cases of soil erosion under the drop drain outlets. In one case, flow from a drop drain located over an unprotected soil embankment caused erosion on the slope.

Drainage pipe systems are used over roadways or facilities that do not permit free waterfall. Those piping systems normally carry water vertically and horizontally. Typically, they feed into buried drainage systems. Normally, 6-inch steel pipes carry the drain water.

During several inspections, KTC investigators detected rust stains on drain pipes revealing loose joints or fractures (Figure 7). Probably, most of those problems relate to water trapped in the drain pipes that froze and caused loose joints or fractures. KTC inspectors found abrupt pipe transitions (angles and connections that may promote clogging). It is desirable to use 18-inch minimum radii for all pipe bends (6).

The inspections revealed several problems related to clogging. At one location, inspectors noted a vertical drain pipe detached from an inlet box. The vertical pipe fed into a horizontal pipe run at a tee. KTC personnel observed a broken pipe hanger on the horizontal pipe next to the tee. The broken hanger allowed the pipe system to detach from the drain inlet box (Figure 8). Clogging may have promoted that failure.

In a second case, inspectors noted a vertical drain pipe attached to a pier with a hole cut in the pipe near ground level. The hole was intended either to remedy a clogging problem in the drain system below the ground or to unclog the vertical pipe.

In several cases, torch-cut access holes in pipes revealed the need for additional cleanout plugs. In other cases, it was obvious that maintenance crews could not clean drain pipes without a snooper.

## DISCUSSION AND CONCLUSIONS

The modular expansion joints inspected during this study are performing most of their primary functions satisfactorily with up to 15 years of service. Many of them leak to various extents. Some have hardware problems that do not significantly inhibit their overall performance.

Eventually, the modular expansion joints will need repairs. Most of the joints inspected will not require major maintenance or replacement for at least 5 to 10 years. A majority of the joints presently needing remedial work could be repaired to restore their complete function. Most of those joints leak resulting in corrosion of underlying steel beams.

The continued use of modular expansion joints on new bridges must be weighed against their disadvantages, high cost and tendency to eventually leak.

All types of deck drains inspected exhibited clogging problems due to debris buildup. KTC personnel inspected several bridges having more than a quarter of all drains clogged. Vegetation was found growing in fine debris that clogged some of the drains. In those cases, the clogging problem probably existed for an extended time.

Most of the clogged drains noted during the inspections fed into pipe systems. Many of the pipe systems inspected have deficiencies. They include sharp bends, short free falls from inlet boxes, and inadequate cleanout plugs. Simple straight drop-pipe outlets are less prone to clogging.

Maintenance personnel do not have good access to suspended drain pipes. They need snoopers for much of that cleanout work. Even then, it would be difficult to perform work requiring temporary removal of heavy steel pipe using a snooper.

Larger outlet and drain pipes and inlet boxes having steeper walls would decrease clogging problems. Revised designs for piping systems should also reduce clogging problems. Design improvements include straighter pipe runs, longer initial pipe free falls from inlet boxes, larger pipe sizes, larger radius pipe bends, and better located, more accessible cleanout ports.

Poor maintainability probably promotes clogged drains more than a lack of maintenance. Providing access walkways to suspended drainage pipes at elevated locations would enhance maintenance work. At those locations, it would be desirable to use PVC or fiberglass pipe. Those pipes are easier to handle during cleaning operations than heavy steel pipe.

For smaller bridges, scuppers work well when sized sufficiently large. A slight increase in the slope of scupper outlets would promote better drainage. Also, adding a spout to scupper outlets would prevent staining of the exterior barrier wall. Treating the concrete in the outlet area with a sealant might extend its durability. Otherwise, the scuppers do not need improvement.

## RECOMMENDATIONS

1. Modular expansion joints that leak severely and lead to corrosion of underlying steel beams should be repaired. The Transflex joints which are in poor condition on the US-31 bridge at Louisville should be replaced.

2. During installation of modular expansion joints, inspectors should make measurements to ensure the joints have consistent module spacings. They should also check alignment of the top of the joint and deck riding surface.

3. Bridges incorporating experimental finger dams with flexible and rigid troughs should be considered for future use. The experimental rigid troughs should be sized larger than past applications.

4. Bridges incorporating experimental open joints with drainage diversion and special protection of underlying bridge components under joints should be considered for future use.

5. Designs of commercial inlet and scupper components need to be revised for most new bridges. The design revisions should include

steeper slopes on the basins and larger outlet pipes to reduce clogging. Standards for the design of piping systems should be revised to include features that promote proper function. The present scupper design should be revised to provide a steeper outlet and a spout on the barrier outer wall.

6. The I-64 Riverside Parkway in Louisville is to be retrofitted to remedy drainage problems. It would be desirable to monitor the drainage system before and after modification to determine the performance of the revised details.

7. Where drop pipe outlets are over land within 25 feet of the ground, a small pile of rock should be placed under the outlet. The rocks will diffuse the water stream and prevent erosion. The rock pile should be grouted if the outlet is located over an embankment.

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5. "Bridge Drainage Systems", National Cooperative Highway Research Program Synthesis of Highway Practice, Transportation Research Board, Washington, DC, Volume 67, December 1979, pp 34.

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TABLE 1. WABO MAURER EXPANSION JOINTS

| JOINT NO. | TYPE | LOCATION | COUNTY | BRIDGE NO. | MILE-POINT | ADT | SKEW (°) | LENGTH* (feet) | DATE INSTALLED |
|---|---|---|---|---|---|---|---|---|---|
| 1 | D-520 | US 25 over Ohio River - Southmost joint in northbound approach span | Kenton | 06-MP-059-0025-B00049 | 13.47 | 14,494 | 0.0 | 42.5 | 1974 |
| 2 | D-520 | I 471 over Ohio River - Southmost joint in northbound approach span (over road) | Campbell | 06-MP-019-0471-B00039 | 0.01 | 64,102 | 0.0 | 50.3 | 1976 |
| 3 | D-520 | I 471 over Ohio River - Joint between main span and approach span in northbound lane | Campbell | 06-MP-019-0471-B00039 | 0.01 | 64,102 | 0.0 | 50.3 | 1976 |
| 4 | D-520 | I 471 over Ohio River - Joint in north approach span of northbound bridge | Campbell | 06-MP-019-0471-B00039 | 0.01 | 64,102 | 0.0 | 50.3 | 1976 |
| 5 | D-520 | I 471 over Ohio River - Northmost joint in north approach of southbound lane | Campbell | 06-MP-019-0471-B00039 | 0.01 | 64,102 | 0.0 | 50.3 | 1976 |
| 6 | D-520 | I 471 over Ohio River - Joint between south approach and bridge on southbound bridge | Campbell | 06-MP-019-0471-B00039 | 0.01 | 64,102 | 0.0 | 50.3 | 1976 |
| 7 | D-520 | I 471 over Ohio River - Joint in south approach of southbound bridge | Campbell | 06-MP-019-0471-B00039 | 0.01 | 64,102 | 0.0 | 50.3 | 1976 |
| 8 | D-520 | I 64 Riverside Parkway - Second joint north of 9th St ramp over I 64 northbound lane | Jefferson | 05-MP-056-0064-B00293 | 3.69 | 41,989 | 0.0 | 88.6 | 1976 |
| 9 | D-520 | I 275 over Ohio River - First joint in south end of bridge in northbound lane | Campbell | 06-MP-019-0275-B00040 | 73.0 | 47,046 | 11.0 | 52.9 | 1979 |
| 10 | D-520 | I 275 over Ohio River - Fourth joint from south end of bridge in northbound lane | Campbell | 06-MP-019-0275-B00040 | 73.0 | 47,046 | 11.0 | 52.9 | 1979 |
| 11 | D-520 | I 275 over Ohio River - First joint from southbound lane from north end of bridge | Campbell | 06-MP-019-0275-B00040 | 73.0 | 47,046 | 11.0 | 52.9 | 1979 |
| 12 | D-520 | I 275 over Ohio River - Fourth joint in southbound lane from north end of bridge | Campbell | 06-MP-019-0275-B00040 | 73.0 | 47,046 | 11.0 | 52.9 | 1979 |
| 13 | D-780 | US 25 over Ohio River - Southmost joint on north approach span | Kenton | 06-MP-059-0025-B00049 | 13.47 | 14,494 | 0.0 | 42.5 | 1974 |
| 14 | D-780 | US 25 over Ohio River - Second southmost joint on north approach span | Kenton | 06-MP-059-0025-B00049 | 13.47 | 14,494 | 0.0 | 42.5 | 1974 |
| 15 | D-780 | US 25 over Ohio River - Northmost joint from north approach span | Kenton | 06-MP-059-0025-B00049 | 13.47 | 14,494 | 0.0 | 42.5 | 1974 |
| 16 | D-780 | I 471 over Ohio River - Second joint from south on north approach span | Campbell | 06-MP-019-0471-B00039 | 0.01 | 64,102 | 0.0 | 50.3 | 1976 |
| 17 | D-780 | I 471 over Ohio River - Second from end, southbound approach of southbound bridge | Campbell | 06-MP-019-0471-B00039 | 0.01 | 64,102 | 0.0 | 50.3 | 1976 |
| 18 | D-780 | I 64 Riverside Parkway - WB lane, third joint north of 9th St, ramp over I 64 WBL | Jefferson | 05-MP-056-0471-B00293 | 3.69 | 41,989 | 0.0 | 88.6 | 1976 |
| 19 | D-780 | I 64 Riverside Parkway - WB lane, fourth joint north of 9th St, ramp over I 64 WBL | Jefferson | 06-MP-056-0471-B00293 | 3.69 | 41,989 | 0.0 | 88.6 | 1976 |
| 20 | D-780 | I 64 Riverside Parkway - Last joint at the end of 9th St ramp entering I 64 WB | Jefferson | 06-MP-056-0471-B00293 | 3.69 | 41,989 | 0.0 | 88.6 | 1976 |
| 21 | D-780 | I 64 Riverside Parkway - First joint west of 9th St ramp, eastbound lane | Jefferson | 06-MP-056-0471-B00293 | 3.69 | 41,989 | 0.0 | 88.6 | 1976 |
| 22 | D-780 | I 64 Riverside Parkway - First joint on 9th St exit ramp off EB lane I 64 | Jefferson | 06-MP-056-0471-B00293 | 3.69 | 41,989 | 0.0 | 88.6 | 1976 |
| 23 | D-780 | I 64 Riverside Parkway - Joint at the entrance of 9th St ramp EBL | Jefferson | 06-MP-056-0471-B00293 | 3.69 | 41,989 | 0.0 | 88.6 | 1976 |
| 24 | D-780 | I 64 Riverside Parkway - Next joint west of 9th St ramp EBL | Jefferson | 06-MP-056-0471-B00293 | 3.69 | 41,989 | 0.0 | 88.6 | 1976 |
| 25 | D-1040 | I 64 Riverside Parkway - First joint past 9th St ramp over I 64 WBL | Jefferson | 06-MP-056-0471-B00293 | 3.69 | 41,989 | 0.0 | 88.6 | 1976 |
| 26 | D-1040 | US 25 over Ohio River - Third joint at south cantilever | Kenton | 06-MP-059-0025-B00049 | 13.47 | 14,494 | 0.0 | 42.5 | 1974 |
| 27 | D-1040 | US 25 over Ohio River - North end of bridge on main span | Kenton | 06-MP-059-0025-B00049 | 13.47 | 14,494 | 0.0 | 42.5 | 1974 |
| 28 | D-1040 | US 27 over Kentucky River - North joint on southbound bridge | Garrard/ Jessamine | 07-MP-040-0027-B00028 | 16.28 | 8,859 | 0.0 | 39.5 | 1974 |
| 29 | D-1040 | US 27 over Kentucky River - South joint on southbound bridge | Garrard/ Jessamine | 07-MP-040-0027-B00028 | 16.28 | 8,859 | 0.0 | 39.5 | 1974 |
| 30 | D-1040 | US 27 over Kentucky River - North joint on northbound bridge | Garrard/ Jessamine | 07-MP-040-0027-B00028 | 16.28 | 8,859 | 0.0 | 39.5 | 1974 |
| 31 | D-1040 | US 27 over Kentucky River - South joint on northbound bridge | Garrard/ Jessamine | 07-MP-040-0027-B00028 | 16.28 | 8,859 | 0.0 | 39.5 | 1974 |
| 32 | D-1300 | US 25 over Ohio River - Joint between south approach and main span | Kenton | 06-MP-059-0025-B00049 | 13.47 | 14,494 | 0.0 | 42.5 | 1974 |
| 33 | D-1300 | I 275 over Ohio River - Second joint from south end of bridge in northbound lane | Campbell | 06-MP-019-0275-B00060 | 73.0 | 47,046 | 11.0 | 52.9 | 1979 |
| 34 | D-1300 | I 275 over Ohio River - Third joint from north end of bridge in southbound lane | Campbell | 06-MP-019-0275-B00040 | 73.0 | 47,046 | 11.0 | 52.9 | 1979 |
| 35 | D-1560 | I 471 over Ohio River - Joint between north approach and main span in southbound lane | Campbell | 06-MP-019-0471-B00039 | 0.01 | 64,102 | 0.0 | 50.3 | 1976 |
| 36 | D-1560 | I 471 over Ohio River - Joint between south approach and main span in northbound lane | Campbell | 06-MP-019-0471-B00039 | 0.01 | 64,102 | 0.0 | 50.3 | 1976 |
| 37 | D-1560 | I 275 over Ohio River - Second joint from north end, southbound lane | Campbell | 06-MP-019-0275-B00040 | 73.0 | 47,046 | 11.0 | 52.9 | 1979 |
| 38 | D-1560 | I 275 over Ohio River - Third joint from sound end, northbound lane | Campbell | 06-MP-019-0275-B00040 | 73.0 | 47.046 | 11.0 | 52.9 | 1979 |

* Curb-to-curb

TABLE 2. ACME ACMA MODULAR II EXPANSION JOINTS

| JOINT NO. | TYPE | LOCATION | COUNTY | BRIDGE NO. | MILE-POINT | ADT | SKEW (°) | LENGTH* (feet) | DATE INSTALLED |
|---|---|---|---|---|---|---|---|---|---|
| 39 | 3M600 | I 275 over Licking River - First joint from south end of bridge, southbound lane | Kenton | 06-MP-059-0275-B00052 | 77.56 | 49,476 | 0.0 | 51.2 | 1972 |
| 40 | 3M600 | I 275 over Licking River - Second joint from south end of bridge, southbound lane | Kenton | 06-MP-059-0275-B00052 | 77.56 | 49,476 | 0.0 | 51.2 | 1972 |
| 41 | 3M600 | I 275 over Licking River - Fourth joint from south end of bridge, southbound lane | Kenton | 06-MP-059-0275-B00052 | 77.56 | 49,476 | 0.0 | 51.2 | 1972 |
| 42 | 3M600 | I 275 over Licking River - First joint from north end of bridge, northbound lane | Kenton | 06-MP-059-0275-B00052 | 77.56 | 49,476 | 0.0 | 51.2 | 1972 |
| 43 | 3M600 | I 275 over Licking River - Third joint from north end of bridge, northbound lane | Kenton | 06-MP-059-0275-B00052 | 77.56 | 49,476 | 0.0 | 51.2 | 1972 |
| 44 | 3M600 | I 275 over Licking River - Fourth joint from north end of bridge, northbound lane | Kenton | 06-MP-059-0275-B00052 | 77.56 | 49,476 | 0.0 | 51.2 | 1972 |
| 45 | 3M600 | I 275 over KY 17 - First joint from south end of bridge, southbound lane | Kenton | 06-MP-059-0275-B00063 | 79.80 | 52,200 | 17.0 | 53.5 | 1977 |
| 46 | 3M600 | I 275 over KY 17 - Third joint from south end of bridge, southbound lane | Kenton | 06-MP-059-0275-B00063 | 79.80 | 52,200 | 17.0 | 53.5 | 1977 |
| 47 | 3M600 | I 275 over KY 17 - Second joint from north end of bridge, northbound lane | Kenton | 06-MP-059-0275-B00063 | 79.80 | 52,200 | 17.0 | 53.5 | 1977 |
| 48 | 3M600 | I 275 over KY 17 - Fourth joint from north end of bridge, northbound lane | Kenton | 06-MP-059-0275-B00063 | 79.80 | 52,200 | 17.0 | 53.5 | 1977 |
| 49 | 6M1200 | I 275 over Licking River - Third joint from south end of bridge, southbound lane | Kenton | 06-MP-059-0275-B00052 | 77.56 | 49,476 | 0.0 | 51.2 | 1972 |
| 50 | 6M1200 | I 275 over Licking River - Second joint from north end of bridge, northbound lane | Kenton | 06-MP-059-0275-B00052 | 77.56 | 49,476 | 0.0 | 51.2 | 1972 |
| 51 | 2M400 | I 275 over KY 17 - First joint on north end of bridge, northbound lane | Kenton | 06-MP-059-0275-B00063 | 79.80 | 52,200 | 17.0 | 53.55 | 1977 |
| 52 | 2M400 | I 275 over KY 17 - Third joint from north end of bridge, northbound lane | Kenton | 06-MP-059-0275-B00063 | 79.80 | 52,200 | 17.0 | 53.55 | 1977 |
| 53 | 2M400 | I 275 over KY 17 - Second joint from south end of bridge, southbound lane | Kenton | 06-MP-059-0275-B00063 | 79.80 | 52,200 | 17.0 | 53.55 | 1977 |
| 54 | 2M400 | I 275 over KY 17 - Fourth joint from south end of bridge, southbound lane | Kenton | 06-MP-059-0275-B00063 | 79.80 | 52,200 | 17.0 | 53.55 | 1977 |

* Curb-to-curb

TABLE 3. GENERAL TIRE TRANSFLEX EXPANSION JOINTS

| JOINT NO. | TYPE | LOCATION | COUNTY | BRIDGE NO. | MILE-POINT | ADT | SKEW (°) | LENGTH* (feet) | DATE INSTALLED |
|---|---|---|---|---|---|---|---|---|---|
| 55 | 200A | US 31, Clark Memorial Bridge over Ohio River-Second joint from south end of bridge | Jefferson | 05-MP-56-031E-B00136 | 17.81 | 18,050 | 0.0 | 38.0 | 1967 |
| 56 | 200A | US 31, Clark Memorial Bridge over Ohio River-Third joint from south end of bridge | Jefferson | 05-MP-56-031E-B00136 | 17.81 | 18,050 | 0.0 | 38.0 | 1967 |
| 57 | 200A | US 31, Clark Memorial Bridge over Ohio River-Fourth joint from south end of bridge | Jefferson | 05-MP-56-031E-B00136 | 17.81 | 18,050 | 0.0 | 38.0 | 1967 |
| 58 | 200A | US 31, Clark Memorial Bridge over Ohio River-Fifth joint from south end of bridge | Jefferson | 05-MP-56-031E-B00136 | 17.81 | 18,050 | 0.0 | 38.0 | 1967 |
| 59 | 250A | Access Rd. to KY 1426 over Levisa Fork - Joint on west end of bridge | Pike | 12-RP-098-1426-B00175 | 4.80 | 1,000** | 0.0 | 44.0 | 1981 |
| 60 | 400A | Access Rd. to KY 1426 over Levisa Fork - Joint on east end of bridge | Pike | 12-MP-098-1426-B00175 | 4.80 | 1,000** | 0.0 | 44.0 | 1981 |
| 61 | 400 | US 31, Clark Memorial Bridge over Ohio River-First joint from south end of bridge | Jefferson | 05-MP-056-031E-B00136 | 17.81 | 18,050 | 0.0 | 38.0 | 1967 |
| 62 | 400 | US 31, Clark Memorial Bridge over Ohio River-Sixth joint from south end of bridge | Jefferson | 05-MP-056-031E-B00136 | 17.81 | 18,050 | 0.0 | 38.0 | 1967 |
| 63 | 650 | US 421 over Martins Fork & L&N RR,Br 1-First joint from south end of bridge | Harlan | 11-MP-048-0421-B00131 | 17.12 | 17,366 | 40.0 | 98.6 | 1974 |
| 64 | 650 | US 421 over Martins Fork & L&N RR,Br 1-Second joint from south end of bridge | Harlan | 11-MP-048-0421-B00131 | 17.12 | 17,366 | 40.0 | 98.6 | 1974 |
| 65 | 650 | US 421 over Martins Fork & L&N RR,Br 2-First joint from south end of bridge | Harlan | 11-MP-048-0421-B00132 | 17.51 | 17,366 | 25.0 | 65.0 | 1974 |
| 66 | 650 | US 421 over Martins Fork & L&N RR,Br 2-Second joint from south end of bridge | Harlan | 11-MP-048-0421-B00132 | 17.51 | 17,366 | 25.0 | 65.0 | 1974 |
| 67 | 650 | US 421 over Martins Fork & L&N RR,Br 2-Third joint from south end of bridge | Harlan | 11-MP-048-0421-B00132 | 17.51 | 17,366 | 25.0 | 65.0 | 1974 |
| 68 | 650 | KY 770 over Laurel River, First joint from east end of bridge | Laurel | 11-MP-063-0770-B00096 | 0.59 | 4,588 | 0.0 | 30.0 | 1976 |
| 69 | 650 | KY 770 over Laurel River-Second joint from east end of bridge | Laurel | 11-MP-063-0770-B00096 | 0.59 | 4,588 | 0.0 | 30.0 | 1976 |
| 70 | 650 | KY 676 over Kentucky River-West end of eastbound lane | Franklin | 05-MP-037-0676-B00074 | 1.519 | 2,000 | 16.0 | 86.3 | 1980 |
| 71 | 650 | KY 676 over Kentucky River-West end of westbound lane | Franklin | 05-MP-037-0676-B00074 | 1.519 | 2,000 | 16.0 | 86.3 | 1980 |
| 72 | 650 | KY 676 over Kentucky River-East end of westbound lane | Franklin | 05-MP-037-0676-B00074 | 1.519 | 2,000 | 16.0 | 86.3 | 1980 |
| 73 | 650 | KY 676 over Kentucky River-East end of eastbound lane | Franklin | 05-MP-037-0676-B00074 | 1.519 | 2,000 | 16.0 | 86.3 | 1980 |
| 74 | 650 | Ramp Two over Jefferson Freeway and Preston St - Second joint from east end of ramp | Jefferson | 05-MP-056-0841-B00327 | 1.93 | 1,000 | 0.0 | 38.0 | 1981 |
| 75 | 650 | Ramp Two over Jefferson Freeway and Preston St - Third joint from east end of ramp | Jefferson | 05-MP-056-0841-B00327 | 1.93 | 1,000 | 0.0 | 38.0 | 1981 |

TABLE 4. FEL-SPAN EXPANSION JOINTS

| JOINT NO. | TYPE | LOCATION | COUNTY | BRIDGE NO. | MILE-POINT | ADT | SKEW (°) | LENGTH* (feet) | DATE INSTALLED |
|---|---|---|---|---|---|---|---|---|---|
| 76 | T-40 | KY 225 over Cumberland River, north end | Knox | 11-MP-061-0225-B00078 | 11.19 | 1,410 | 5.0 | 34.1 | 1978 |
| 77 | T-40 | KY 225 over Cumberland River, south end | Knox | 11-MP-061-0225-B00078 | 11.19 | 1,410 | 5.0 | 34.1 | 1978 |

* Curb-to-curb

** Assumed, no present count

TABLE 5. CONDITION EVALUATIONS -- WABO MAURER EXPANSION JOINTS

| JOINT NO. | TYPE | INSPECTION DATE | RATINGS* GENERAL APPEARANCE | CONDITION OF ANCHORAGE | DEBRIS ACCUMU-LATION | WATER TIGHT-NESS | SURFACE DAMAGE | NOISE UNDER TRAFFIC | MAINTE-NANCE NEEDS | WEIGHTED RATING | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | D-520 | 4/29/87 | 4.20 | 4.60 | 3.50 | 3.50 | 4.60 | 4.50 | 4.25 | 4.15 | Leaking, needs cleaning |
| 2 | D-520 | 4/30/87 | 3.80 | 4.60 | 3.80 | 4.19 | 3.50 | 4.60 | 3.50 | 4.12 | Seal damaged, leaking, needs cleaning, needs repair |
| 3 | D-520 | 4/30/87 | 4.50 | 4.60 | 3.80 | 4.40 | 4.60 | 4.60 | 4.50 | 4.41 | Needs cleaning, ends rusting |
| 4 | D-520 | 4/30/87 | 3.80 | 4.60 | 3.80 | 3.49 | 3.50 | 4.60 | 3.50 | 3.93 | Rotating, seal damaged, leaking, needs cleaning, needs repair |
| 5 | D-520 | 4/30/87 | 3.50 | 4.60 | 3.50 | 3.49 | 3.50 | 4.60 | 3.50 | 3.89 | Rotating, seal damaged, leaking, needs cleaning, needs repair |
| 6 | D-520 | 4/30/87 | 3.50 | 4.60 | 3.80 | 4.20 | 4.60 | 4.50 | 3.85 | 4.22 | Misaligned, leaking, needs cleaning |
| 7 | D-520 | 4/30/87 | 4.20 | 4.60 | 3.50 | 4.19 | 4.60 | 4.60 | 4.19 | 4.33 | Leaking, needs cleaning |
| 8 | D-520 | 6/02/87 | 3.80 | 4.60 | 3.85 | 3.00 | 4.00 | 4.30 | 3.60 | 3.84 | Rotating, seal damaged, leaking, needs cleaning, needs repair |
| 9 | D-520 | 5/18/87 | 4.40 | 4.60 | 4.00 | 4.60 | 4.60 | 4.30 | 4.30 | 4.45 | Good joint, needs cleaning |
| 10 | D-520 | 5/18/87 | 4.50 | 4.60 | 4.00 | 4.00 | 4.60 | 4.60 | 4.50 | 4.38 | Rust along joint, needs cleaning |
| 11 | D-520 | 5/18/87 | 4.50 | 4.60 | 3.80 | 4.60 | 4.60 | 4.60 | 4.00 | 4.47 | Good joint, needs cleaning |
| 12 | D-520 | 5/18/87 | 4.50 | 4.60 | 4.00 | 4.60 | 4.60 | 4.50 | 4.20 | 4.50 | Good joint, needs cleaning |
| 13 | D-780 | 4/29/87 | 3.50 | 4.60 | 4.00 | 3.00 | 4.50 | 4.50 | 3.50 | 3.92 | Rotating, seal damaged, leaking, needs cleaning, needs repair |
| 14 | D-780 | 4/29/87 | 3.50 | 4.60 | 4.00 | 3.00 | 4.50 | 4.50 | 3.50 | 3.91 | Rotating, seal damaged, leaking, needs cleaning, needs repair |
| 15 | D-780 | 4/29/87 | 4.00 | 4.60 | 3.80 | 3.00 | 4.60 | 4.60 | 3.50 | 3.95 | Misaligned, leaking, needs cleaning, needs repair |
| 16 | D-780 | 4/30/87 | 4.40 | 4.60 | 3.80 | 4.19 | 4.60 | 4.19 | 4.00 | 4.21 | Uneven module spacing, leaking, needs cleaning |
| 17 | D-780 | 4/30/87 | 4.20 | 4.60 | 3.50 | 4.50 | 4.60 | 4.60 | 4.19 | 4.42 | Uneven module spacing, leaking, needs cleaning |
| 18 | D-780 | 6/02/87 | 4.00 | 4.00 | 3.80 | 3.00 | 3.90 | 4.00 | 3.50 | 3.66 | Rotating, warped in middle, rust along joint, concrete chipping along joint, needs cleaning, needs repair |
| 19 | D-780 | 6/02/87 | 4.00 | 4.00 | 3.80 | 3.00 | 3.90 | 4.00 | 3.50 | 3.66 | Misaligned, rotating, warped in middle, rust along joint, concrete chipping along joint, needs cleaning, needs repair |
| 20 | D-780 | 6/02/87 | 4.20 | 4.60 | 3.85 | 3.00 | 4.60 | 4.60 | 4.20 | 4.05 | Leaking, needs cleaning |
| 21 | D-780 | 5/27/87 | 3.00 | 4.60 | 4.00 | 3.00 | 2.00 | 4.60 | 3.50 | 3.57 | Seal damaged, leaking, needs cleaning, needs repair |
| 22 | D-780 | 5/27/87 | 4.25 | 4.60 | 4.25 | 4.60 | 4.60 | 4.60 | 4.60 | 4.53 | Leaking, needs cleaning |
| 23 | D-780 | 5/27/87 | 3.50 | 4.60 | 3.85 | 3.80 | 3.50 | 3.85 | 3.50 | 3.95 | Uneven module spacing, seal damaged, leaking, needs cleaning, needs repair |
| 24 | D-780 | 5/27/87 | 3.00 | 4.60 | 4.00 | 3.50 | 2.80 | 3.80 | 3.00 | 3.48 | Seal damaged, leaking, needs cleaning, noisy, loose components, needs repair |
| 25 | D-1040 | 6/02/87 | 3.49 | 4.60 | 4.50 | 3.00 | 3.50 | 3.85 | 3.00 | 3.52 | Uneven module spacing, seal damaged, loose components, needs repair |
| 26 | D-1040 | 4/29/87 | 3.80 | 4.60 | 3.50 | 3.00 | 4.50 | 4.50 | 4.00 | 3.93 | Uneven module spacing, leaking, needs cleaning, needs repair |
| 27 | D-1040 | 4/29/87 | 4.00 | 4.60 | 3.50 | 3.50 | 4.60 | 4.50 | 4.20 | 4.12 | Leaking, ends rusting, needs cleaning, needs repair |
| 28 | D-1040 | 5/01/87 | 3.50 | 4.60 | 4.19 | 3.00 | 3.00 | 4.20 | 3.50 | 3.68 | Seal damaged, leaking, noisy, needs repair |
| 29 | D-1040 | 5/01/87 | 3.50 | 4.60 | 3.80 | 3.80 | 3.50 | 4.20 | 3.50 | 3.97 | Seal damaged, leaking, needs repair |
| 30 | D-1040 | 5/01/87 | 2.00 | 4.60 | 3.80 | 3.50 | 2.00 | 4.20 | 3.00 | 3.41 | Leaking, needs repair, beam damage, needs cleaning |
| 31 | D-1040 | 5/01/87 | 3.80 | 4.60 | 4.00 | 4.19 | 3.50 | 3.80 | 3.50 | 4.07 | Seal damaged, leaking, noisy, needs cleaning, needs repair |
| 32 | D-1300 | 4/29/87 | 4.20 | 4.60 | 3.50 | 3.00 | 4.00 | 4.40 | 4.20 | 3.92 | Rotating, leaking, needs cleaning |
| 33 | D-1300 | 5/18/87 | 4.60 | 4.60 | 4.20 | 4.60 | 4.60 | 4.60 | 4.50 | 4.53 | Good joint, needs cleaning |
| 34 | D-1300 | 5/18/87 | 4.50 | 4.60 | 4.00 | 4.60 | 4.60 | 4.60 | 4.50 | 4.54 | Misaligned, needs cleaning |
| 35 | D-1560 | 4/30/87 | 4.20 | 4.60 | 3.80 | 4.40 | 4.60 | 4.40 | 4.20 | 4.36 | Rotating, ends rusting, needs cleaning |
| 36 | D-1560 | 4/30/87 | 4.50 | 4.60 | 3.50 | 4.60 | 4.60 | 5.00 | 4.50 | 4.53 | Good joint, needs cleaning |
| 37 | D-1560 | 5/18/87 | 4.20 | 4.60 | 4.20 | 3.50 | 4.50 | 3.80 | 3.50 | 3.87 | Leaking, noisy, loose components, needs repair |
| 38 | D-1560 | 5/18/87 | 4.50 | 4.60 | 4.50 | 4.60 | 4.60 | 4.60 | 4.60 | 4.59 | Good joint |

| | | | |
|---|---|---|---|
| *Poor | less than 3.50 | Good | 4.20-4.59 |
| Fair | 3.50-3.84 | Excellent | 4.60 or greater |
| Satisfactory | 3.85-4.19 | | |

TABLE 6. CONDITION EVALUATIONS -- ACME EXPANSION JOINTS

| JOINT NO. | TYPE | INSPECTION DATE | RATINGS* GENERAL APPEARANCE | CONDITION OF ANCHORAGE | DEBRIS ACCUMU-LATION | WATER TIGHT-NESS | SURFACE DAMAGE | NOISE UNDER TRAFFIC | MAINTE-NANCE NEEDS | WEIGHTED RATING | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 39 | 3M600 | 5/19/87 | 3.80 | 4.60 | 3.89 | 3.50 | 4.20 | 3.80 | 3.50 | 3.95 | Rotating, seal damaged, leaking, noisy, needs repair |
| 40 | 3M600 | 5/19/87 | 4.15 | 4.60 | 4.50 | 3.50 | 3.50 | 3.50 | 3.50 | 3.95 | Rotating, seal damaged, leaking, noisy, loose components, broken beam, needs repair |
| 41 | 3M600 | 5/19/87 | 4.00 | 4.60 | 4.00 | 4.00 | 4.60 | 3.85 | 3.50 | 4.19 | Misaligned, seal damaged, leaking, noisy, needs cleaning needs repair |
| 42 | 3M600 | 5/19/87 | 4.20 | 4.60 | 4.00 | 4.00 | 4.50 | 4.50 | 4.20 | 4.29 | Uneven module spacing, leaking, poor weld, needs cleaning |
| 43 | 3M600 | 5/19/87 | 3.50 | 4.60 | 4.00 | 3.50 | 3.80 | 3.80 | 3.50 | 3.91 | Rotating, seal damaged, leaking, noisy, loose components needs cleaning, needs repair |
| 44 | 3M600 | 5/19/87 | 4.50 | 4.60 | 4.50 | 4.00 | 4.20 | 4.20 | 4.20 | 4.32 | Misaligned, leaking, poor weld fit-up |
| 45 | 3M600 | 5/20/87 | 4.20 | 4.60 | 4.25 | 3.70 | 4.00 | 4.00 | 3.50 | 4.07 | Rotating, seal damaged, leaking, loose components, needs repair |
| 46 | 3M600 | 5/20/87 | 4.20 | 4.60 | 4.00 | 3.85 | 4.60 | 4.60 | 3.50 | 4.21 | Rotating, seal damaged, leaking, needs cleaning, needs repair |
| 47 | 3M600 | 5/20/87 | 4.50 | 4.60 | 4.00 | 3.80 | 4.50 | 4.50 | 3.50 | 4.24 | Leaking, noisy, loose components, needs repair |
| 48 | 3M600 | 5/20/87 | 4.20 | 4.60 | 4.10 | 3.85 | 4.50 | 4.50 | 4.20 | 4.26 | Leaking, needs cleaning |
| 49 | 6M1200 | 5/19/87 | 4.00 | 4.60 | 4.00 | 3.85 | 4.20 | 4.00 | 3.80 | 4.11 | Leaking, rust along joint edge, needs cleaning |
| 50 | 6M1200 | 5/19/87 | 4.30 | 4.60 | 4.00 | 4.00 | 4.00 | 4.50 | 3.80 | 4.28 | Uneven module spacing, leaking, needs cleaning |
| 51 | 2M400 | 5/20/87 | 4.00 | 4.60 | 4.00 | 3.85 | 4.00 | 4.50 | 4.00 | 4.15 | Leaking, needs cleaning |
| 52 | 2M400 | 5/20/87 | 4.50 | 4.60 | 4.00 | 3.85 | 4.50 | 4.50 | 4.00 | 4.26 | Leaking, rust along outer edge, needs cleaning |
| 53 | 2M400 | 5/20/87 | 4.19 | 4.60 | 4.19 | 3.70 | 4.50 | 4.50 | 3.50 | 4.16 | Rotating, seal damaged, leaking, needs cleaning, needs repair |
| 54 | 2M400 | 5/20/87 | 3.80 | 4.00 | 4.50 | 3.80 | 4.00 | 4.00 | 4.00 | 3.82 | Misaligned, leaking, bolts missing, concrete chipping along joint |

| | | | |
|---|---|---|---|
| *Poor | less than 3.50 | Good | 4.20-4.59 |
| Fair | 3.50-3.84 | Excellent | 4.60 or greater |
| Satisfactory | 3.85-4.19 | | |

TABLE 7. CONDITION EVALUATIONS -- GENERAL TIRE TRANSFLEX EXPANSION JOINT

| | | | RATINGS* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| JOINT NO. | TYPE | INSPECTION DATE | GENERAL APPEARANCE | CONDITION OF ANCHORAGE | DEBRIS ACCUMU-LATION | WATER TIGHT-NESS | SURFACE DAMAGE | NOISE UNDER TRAFFIC | MAINTE-NANCE NEEDS | WEIGHTED RATING | REMARKS |
| 55 | 200A | 5/26/87 | 3.80 | 3.70 | 4.00 | 2.80 | 3.80 | 3.80 | 3.50 | 3.50 | Misaligned, seal damaged, leaking, bolts missing, needs repair |
| 56 | 200A | 5/26/87 | 3.00 | 3.50 | 3.80 | 3.00 | 3.00 | 2.80 | 2.00 | 3.09 | Joint condition bad, needs to be replaced |
| 57 | 200A | 5/26/87 | 3.85 | 3.50 | 4.00 | 3.50 | 3.85 | 3.85 | 3.00 | 3.61 | Misaligned, leaking, anchorage loose, surface wear, needs cleaning, needs repair |
| 58 | 200A | 5/26/87 | 2.00 | 1.00 | 3.50 | 0.00 | 1.00 | 2.00 | 0.05 | 1.09 | Seal torn, needs to be replaced |
| 59 | 250A | 8/20/87 | 4.10 | 4.60 | 4.10 | 3.80 | 4.00 | 4.60 | 3.50 | 4.14 | Surface wear, surface abrasion, leaking, stud covers missing, needs repair |
| 60 | 400A | 8/20/87 | 4.20 | 4.60 | 4.10 | 4.60 | 4.50 | 4.60 | 4.60 | 4.51 | Surface wear, surface abrasion, leaking |
| 61 | 400 | 5/26/87 | 3.85 | 3.50 | 4.25 | 3.80 | 3.80 | 4.50 | 3.50 | 3.80 | Loose sections, leaking, stud covers missing, sealer missing needs cleaning, needs repair |
| 62 | 400 | 5/26/87 | 3.50 | 3.80 | 4.00 | 3.40 | 3.40 | 3.50 | 3.00 | 3.55 | Part of joint missing, leaking, stud nuts loose, stud covers missing, needs repair |
| 63 | 650 | 5/29/87 | 4.10 | 4.60 | 4.50 | 3.50 | 4.00 | 4.60 | 3.80 | 4.12 | Part of joint missing, leaking, concrete is chipping along joint, steel is showing |
| 64 | 650 | 5/29/87 | 3.80 | 4.50 | 4.50 | 3.50 | 4.19 | 4.60 | 3.80 | 4.08 | Part of joint missing, leaking, stud covers missing, sealer missing |
| 65 | 650 | 5/29/87 | 3.80 | 4.59 | 4.50 | 3.55 | 3.00 | 4.50 | 3.85 | 3.97 | Part of joint missing, surface abrasion, leaking, stud covers missing |
| 66 | 650 | 5/29/87 | 3.50 | 4.50 | 4.20 | 4.00 | 3.50 | 4.55 | 3.50 | 4.05 | Part of joint missing, surface abrasion, leaking, stud covers missing, needs repair |
| 67 | 650 | 5/29/87 | 3.80 | 4.00 | 4.50 | 3.50 | 3.50 | 4.59 | 3.80 | 3.87 | Leaking, sealer missing, stud covers missing, concrete chipping along joint |
| 68 | 650 | 6/01/87 | 3.70 | 4.59 | 4.00 | 2.80 | 4.10 | 4.50 | 4.00 | 3.85 | Misaligned, surface abrasion, leaking, sealer missing, stud covers missing, needs cleaning |
| 69 | 650 | 6/01/87 | 3.80 | 4.50 | 4.20 | 3.00 | 3.50 | 4.19 | 3.50 | 3.78 | Surface abrasion, leaking, sealer missing, stud covers missing, needs repair |
| 70 | 650 | 5/26/87 | 3.95 | 4.00 | 3.50 | 3.00 | 3.50 | 4.20 | 3.80 | 3.63 | Surface wear, surface abrasion, leaking, sealer missing, stud covers missing, needs cleaning |
| 71 | 650 | 5/26/87 | 3.40 | 3.50 | 4.00 | 3.00 | 3.50 | 3.50 | 3.50 | 3.41 | Loose sections, surface wear, leaking, stud covers missing, needs cleaning, needs repair |
| 72 | 650 | 6/03/87 | 3.80 | 4.50 | 4.00 | 4.60 | 4.19 | 4.50 | 4.20 | 4.35 | Surface wear, surface abrasion, stud covers missing, needs cleaning |
| 73 | 650 | 6/03/87 | 4.20 | 4.59 | 4.00 | 4.20 | 4.10 | 4.59 | 4.20 | 4.30 | Stud covers missing, debris accumulation due to construction |
| 74 | 650 | 6/03/87 | 4.50 | 4.25 | 4.60 | 4.50 | 4.60 | 4.60 | 4.60 | 4.48 | Good joint, surface wear |
| 75 | 650 | 6/03/87 | 4.25 | 4.60 | 4.50 | 4.50 | 4.50 | 4.60 | 4.50 | 4.52 | Good joint, surface wear |

| | | | |
|---|---|---|---|
| *Poor | less than 3.50 | Good | 4.20-4.59 |
| Fair | 3.50-3.84 | Excellent | 4.60 or greater |
| Satisfactory | 3.85-4.19 | | |

TABLE 8. FEL-SPAN EXPANSION JOINTS

| JOINT NO. | TYPE | INSPECTION DATE | RATINGS*: GENERAL APPEARANCE | CONDITION OF ANCHORAGE | DEBRIS ACCUMU-LATION | WATER TIGHT-NESS | SURFACE DAMAGE | NOISE UNDER TRAFFIC | MAINTE-NANCE NEEDS | WEIGHTED RATING | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 76 | T-40 | 6/01/87 | 3.80 | 4.00 | 4.10 | 3.50 | 3.80 | 4.00 | 3.50 | 3.80 | Leaking, stud covers missing, sealant missing, concrete chipping along joint, needs repair |
| 77 | T-40 | 6/01/87 | 3.80 | 4.00 | 4.10 | 3.50 | 3.80 | 4.00 | 3.50 | 3.80 | Leaking, stud covers missing, sealant missing, concrete chipping along joint, needs repair |

| | | | |
|---|---|---|---|
| *Poor | less than 3.50 | Good | 4.20-4.59 |
| Fair | 3.50-3.84 | Excellent | 4.60 or greater |
| Satisfactory | 3.85-4.19 | | |

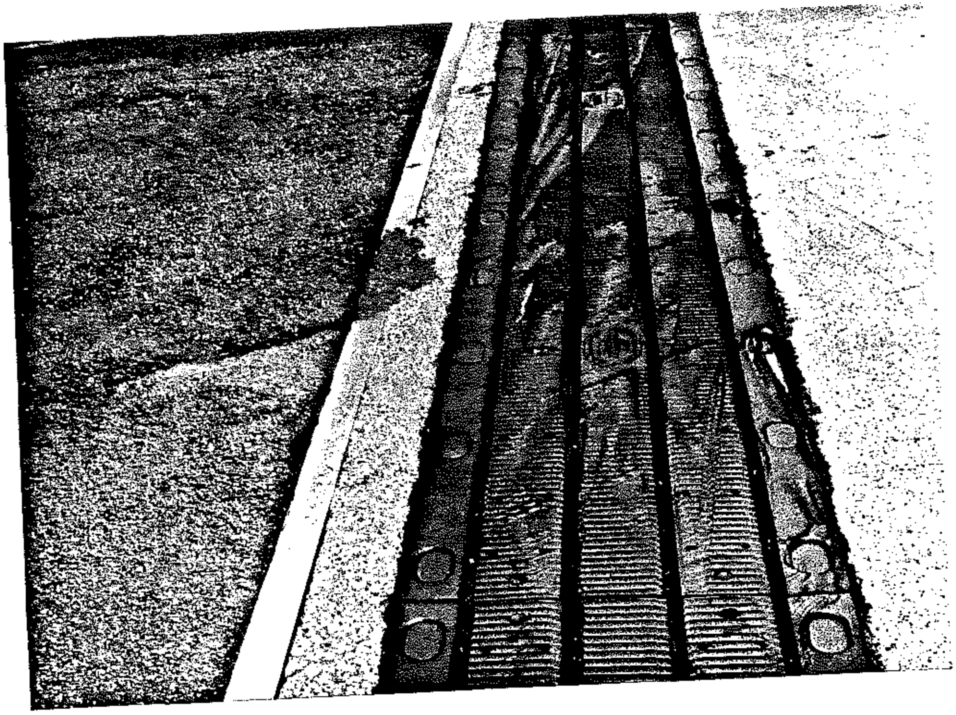

Figure 3. A Transflex 650 Joint Exhibiting Surface Abrasions and Gouges.

Figure 4. Missing Stud Cover on Transflex 650 Joint on the US 421 Bridge over the Cumberland River.

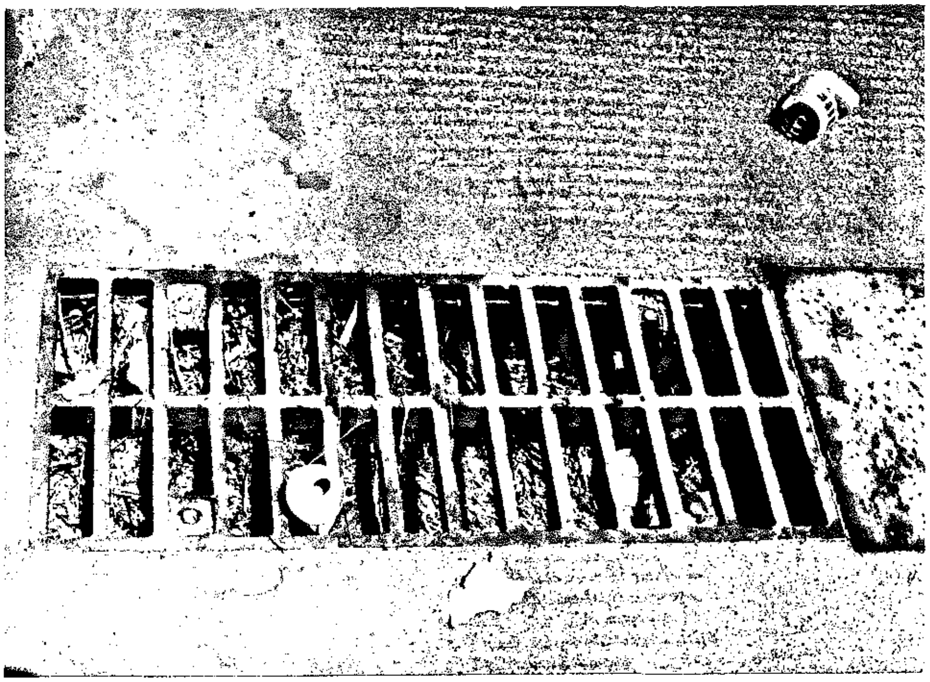

Figure 5. Rectangular Drain Inlet Box Filled with Loose Debris on the US 27 Bridge over the Kentucky River at Camp Nelson.

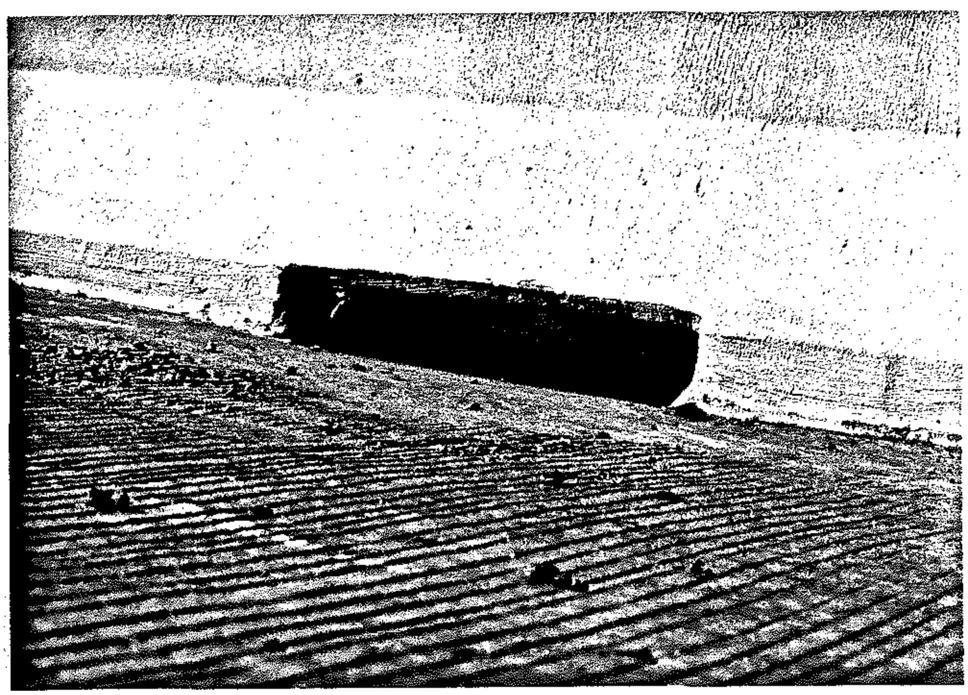

Figure 6. Scupper (Edge Drain) in Good Condition.

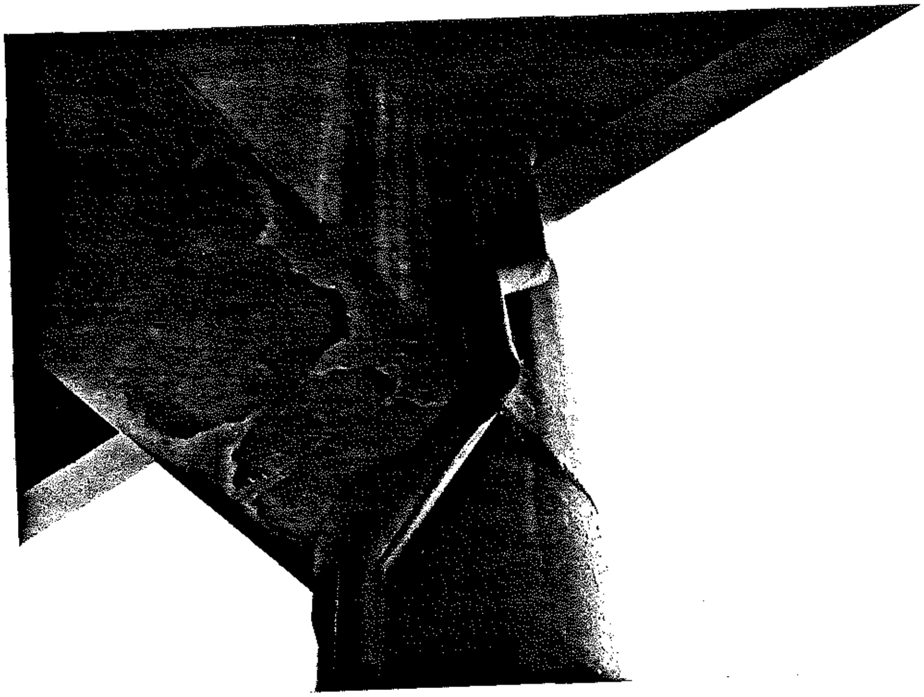

Figure 7. Broken Drain Pipe.

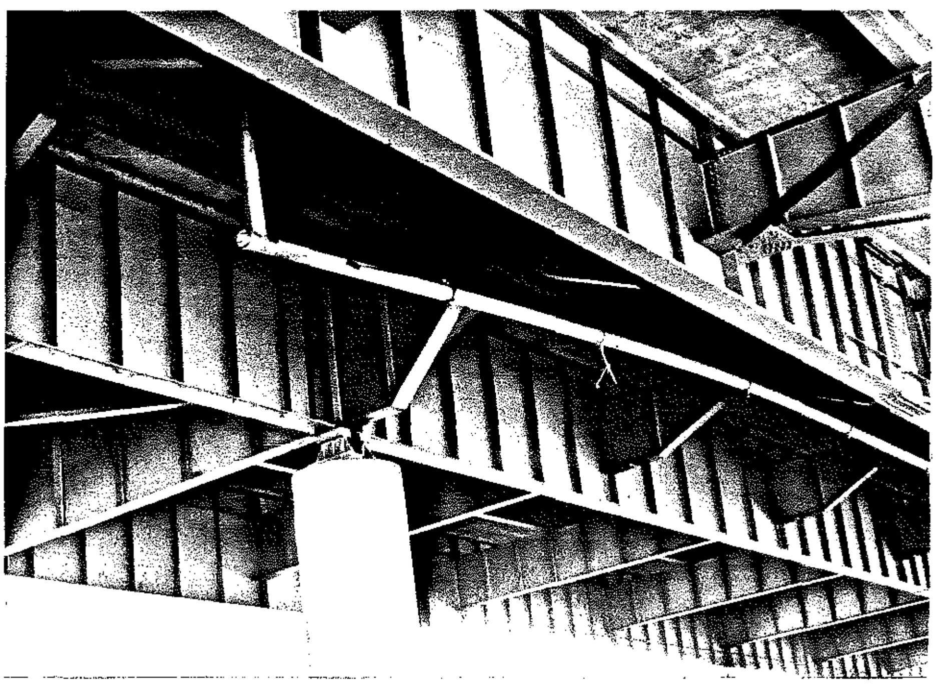

Figure 8. Sagging Drain Pipe Caused by Broken Hanger.

COMMONWEALTH OF KENTUCKY
**TRANSPORTATION CABINET**
FRANKFORT, KENTUCKY 40622

MILO D. BRYANT
SECRETARY
AND
COMMISSIONER OF HIGHWAYS

WALLACE G. WILKINSON
GOVERNOR

April 12, 1990

Mr. Paul E. Toussaint
Division Administrator
Federal Highway Administration
330 West Broadway
Frankfort, Kentucky 40602-0536

Dear Mr. Toussaint:

Subject: IMPLEMENTATION STATEMENT
Research Study KYHPR 85-107
Long-Term Monitoring of Experimental Features
Subtask 8, "Modular Expansion Joints and Deck Drains"

The Kentucky Transportation Cabinet has or will take the following steps to implement the information gained during the subject study.

The Division of Maintenance will continue to monitor the condition of modular expansion joints as part of their routine bridge inspection activity. Those joints exhibiting unsatisfactory performance will be removed and replaced with another type of expansion device, usually finger dams.

The Division of Bridges will review the use of modular expansion joints on new bridges. Due to their tendency to leak and to their high initial cost compared to other types of joints, it is unlikely that they will be widely used in the future.

The Division of Maintenance is reviewing the performance of deck drainage systems on a per case basis. Those needing modification will be reworked during rehabilitation for the particular structures. The Division of Bridges will review deck drainage plans for new structures and attempt to eliminate shortcomings discovered during this study.

The objectives of this study were met in that the Divisions of Maintenance and Bridges have been informed of the performance of those bridge features and provided with recommendations for future actions.

Sincerely,

O. G. Newman, P. E.
State Highway Engineer

Figure 1. Loose Module Seal on Wabo-Maurer D1040 Joint on the US 27 Bridge over the Kentucky River at Camp Nelson.

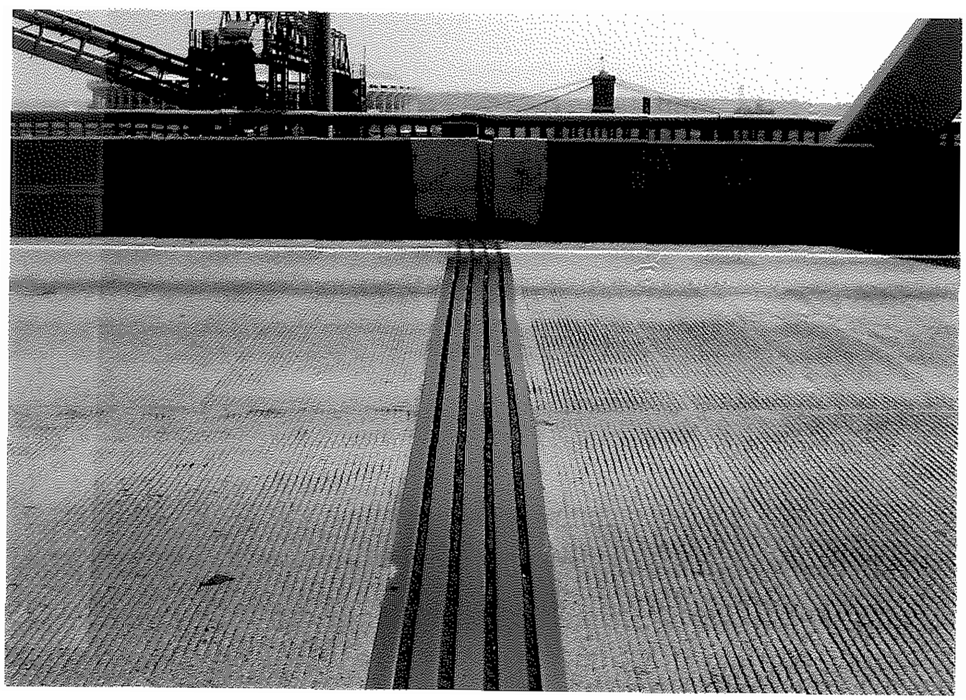

Figure 2. Irregular Horizontal Misalignment on Wabo-Maurer D1040 Joint on US 25 Bridge over the Ohio River at Covington.

Figure 3. A Transflex 650 Joint Exhibiting Surface Abrasions and Gouges.

Figure 4. Missing Stud Cover on Transflex 650 Joint on the US 421 Bridge over the Cumberland River.

Figure 5. Rectangular Drain Inlet Box Filled with Loose Debris on the US 27 Bridge over the Kentucky River at Camp Nelson.

Figure 6. Scupper (Edge Drain) in Good Condition.

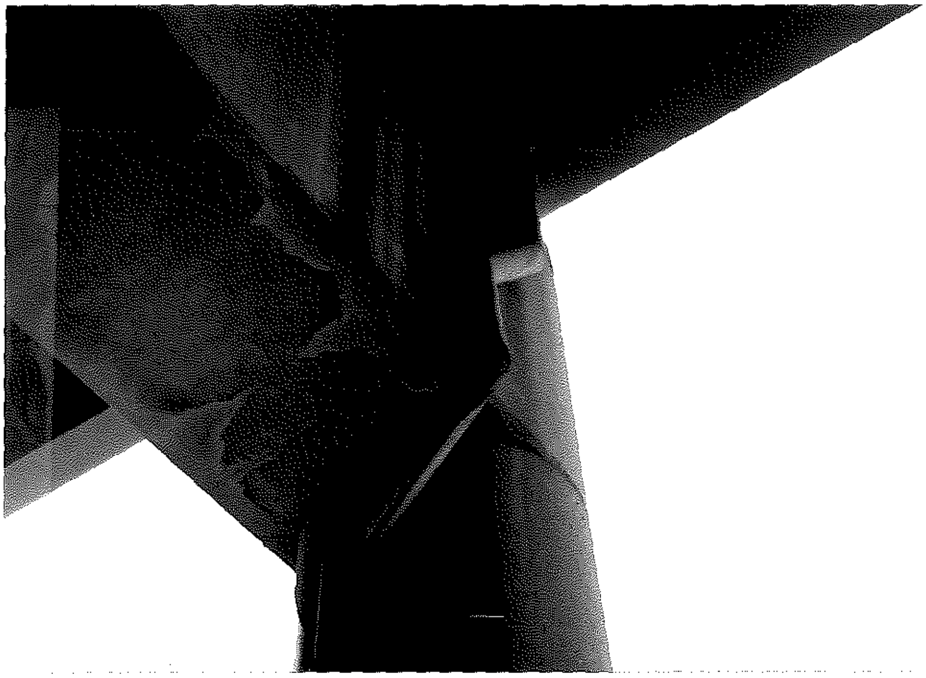

Figure 7. Broken Drain Pipe.

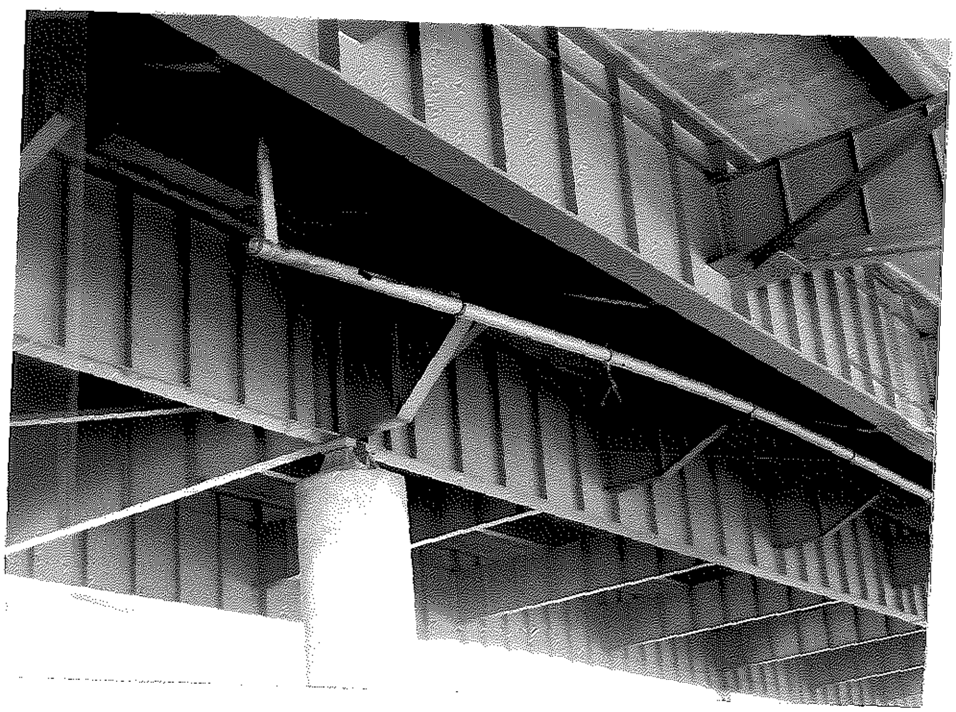

Figure 8. Sagging Drain Pipe Caused by Broken Hanger.