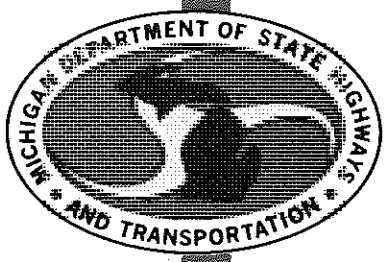
EVALUATION OF VARIOUS BRIDGE DECK JOINT SEALING SYSTEMS

Final Report



TESTING AND RESEARCH DIVISION
RESEARCH LABORATORY SECTION

EVALUATION OF VARIOUS BRIDGE DECK JOINT SEALING SYSTEMS

Final Report

F. J. Bashore
D. E. Branch
A. W. Price

A Category 2 Project Conducted in Cooperation
With the U. S. Department of Transportation,
Federal Highway Administration

Research Laboratory Section
Testing and Research Division
Research Project 72 F-128
Research Report No. R-1121

Michigan Transportation Commission
Hannes Meyers, Jr., Chairman; Carl V. Pellonpaa,
Vice-Chairman; Weston E. Vivian, Rodger D. Young,
Lawrence C. Patrick, Jr., William C. Marshall
John P. Woodford, Director
Lansing, July 1979

INTRODUCTION

Since 1972, the Research Laboratory has been involved in a Category 2 (NEEP 11) research project evaluating various bridge expansion joint sealing systems. We have been inspecting eight different systems installed on over 250 bridges, totaling more than 350 joint installations. These were installed either under contract or by the Department's Maintenance Division and may be categorized into three general types: metal-reinforced polychloroprene pads (Transflex, Waboflex, and FelSpan); metal-supported and anchored modular polychloroprene compression seals; and metal-supported and/or anchored polychloroprene or EPDM continuous elements (Delastiflex, Type 190-Michigan modified Wabo-Maurer, Wabo-Maurer Strip Seal, and Onflex).

Each joint is inspected twice yearly to determine its general appearance and condition, ride and noise qualities, movement, damage, and debris intrusion. We also inspect as many joints as possible during wet weather to determine the number of leaks at each joint and their possible source.

As the number of years of service increases, we are constantly seeing new problems arising with many of the systems. Our inspections and recommendations, as well as design changes by the manufacturers, have resulted in several improvements to the systems. Many of these improved designs have been in service only a short time; therefore, insufficient data are available to draw definite conclusions as to their effectiveness.

Ratings and Observations

Tables 1 through 8 in the Appendix list the structures and present detailed information on the expansion joint devices, including the latest inspection ratings up to December 1977. A summary of the tabular information is given with the discussions of the various joint systems.

The following explanations and definitions are given to aid in interpreting the data in the tables and the following summaries.

Joint

Theoretical Movement - Joint movement based on 1/8 in. movement per 10 ft of deck length per 150 F temperature variance.

Model - When defined numerically, it may indicate the amount of movement the system is capable of handling (e.g., Fel Span T30 handles 3 in. of movement). For a modular compression seal system, the word indicates the number of compression seals used.

Depth, in. - The depth of the joint system's wearing surface below the top of the adjacent bridge deck surface.

Ratings

General Appearance - A visual rating of the sealing system (not necessarily an indication of ability to perform).

a) Good: only minor irregularities.

b) Fair: irregularities such as small voids in mastic, slight dirt intrusion, slight misalignment of sections, numerous missing stud hole plugs, slight wear due to traffic, or minor damage by snow removal equipment.

c) Poor: serious irregularities such as excessive wear or damage; joints in material improperly abutted, sealed, or aligned; excessive dirt intrusion; or large voids in mastic.

Joints in System - Joints formed by the abutting of sections in the sealing system.

a) Good: closely abutted, no misalignment, and properly sealed allowing no leakage.

b) Fair: closely abutted, some voids in mastic, slight misalignment, slight dirt intrusion, or minor leakage through no more than two joints in system.

c) Poor: not closely abutted, considerable misalignment, major voids in mastic, extensive dirt intrusion, or moderate to extensive leakage.

Intruded Debris - Incompressible materials present between seal and concrete or armor and/or within joints in material.

Leaks - Passage of water through joint area.

a) Slight: moisture visible on underside of joint area but not to the extent of dripping.

b) Significant: water observed dripping from joint area.

c) U: unable to inspect (over headwall, etc.).

Damage - Visible wearing (other than normal 'polishing' by tires), tearing, or displacement (problems primarily caused by snow removal equipment) of any portion of the expansion joint system. A "severe" rating

indicates an impairment of the system to reject incompressibles and/or water.

Ride

1) Quality - Smoothness of ride over joint.

   a) Good: smooth ride.
   b) Fair: slight discomfort.
   c) Poor: considerable discomfort.

2) Noise

   a) Quiet: little noise generated.
   b) Moderate: significant but not excessive noise.
   c) Noisy: excessive noise generated.

JOINT SYSTEM SUMMARIES

Summary of 'Transflex' Installations

The Transflex system is a metal-reinforced polychloroprene pad-type joint device (Fig. 1). Six-foot pads are butt jointed with tongue-and-groove ends sealed with a flexible sealant. A sealant is spread on the concrete seat in the nonmovable portion of the pad and the pad is bolted down by use of the studs. Adjacent pads are jacked horizontally against the previous pad and bolted down. The stud wells are sealed with a molded polychloroprene plug. We are currently using four different series capable of movements of 2 to 6.5 in.

Our inspection of Transflex devices includes 62 bridges with 81 joints. Detailed information obtained from these inspections is included in Table 1 of the Appendix. The following is a summary of the table followed by a discussion of the major problems we have encountered with the Transflex system.

General Appearance:	44 good, 33 fair, 4 poor
Joints in System:	55 good, 18 fair, 8 poor
Intruded Debris:	81 none
Leaks:	8 none, 19 yes, 28 significant, 26 undetermined
Damage:	13 none, 68 yes (22 severe)
Ride	
Quality:	53 good, 15 moderate, 9 rough, 4 undetermined
Noise:	67 quiet, 8 moderate, 2 noisy, 4 undetermined

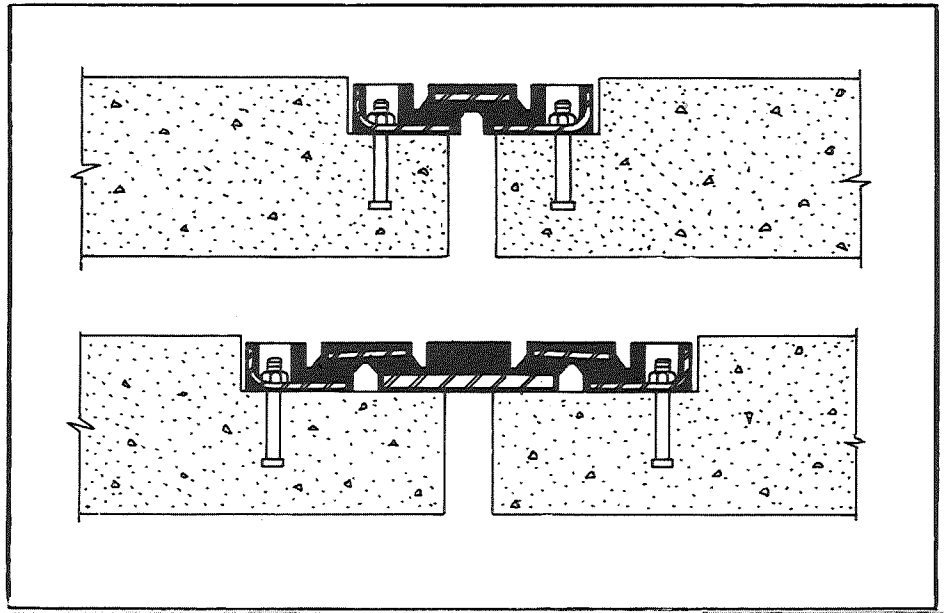
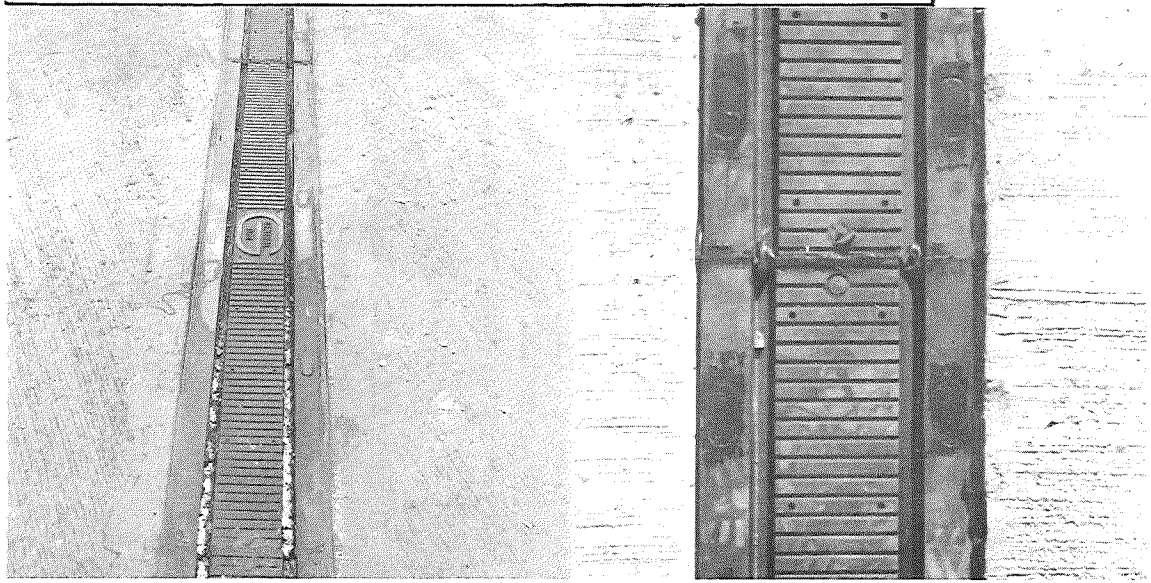
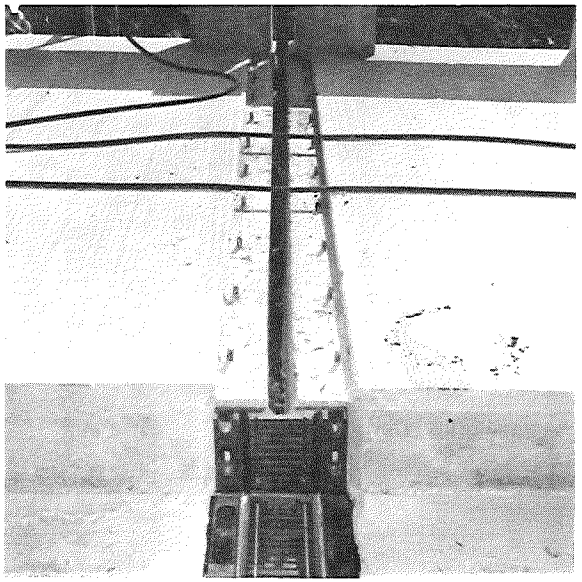


Figure 1. The drawing at left shows Transflex 200A and 250 (upper) and Transflex 400A and 650 (lower). Photos show (left to right) a Transflex 200A installation, a view of the sealed joint between two 200A pads, and the curb and sidewalk area of a Transflex 200A during installation.





Leakage at the tongue-and-groove area is a common problem with this system. Application of a flexible sealant in the tongue-and-groove area, together with tight jacking together of adjacent pads would reduce the extent of this problem. Factory vulcanizing two pads together would reduce the number of joints that must be sealed in the field.

Leakage between the pad and concrete is also a problem, and our latest specifications require that the vertical groove along the edge of the pad be sealed with a flexible epoxy and that a bedding epoxy be placed under the nonmovable portion of the pad.

Field butt splices (the 6-ft pad is cut to shorter lengths to complete installations) are also a major problem since it is nearly impossible to create a positive seal in this area. The best solution to this problem is a careful layout of the system to reduce the number of field splices to a minimum and ensure that they are placed in compression with a flexible-epoxy sealant between the ends. In addition, this splice should be located in an area away from the gutter.

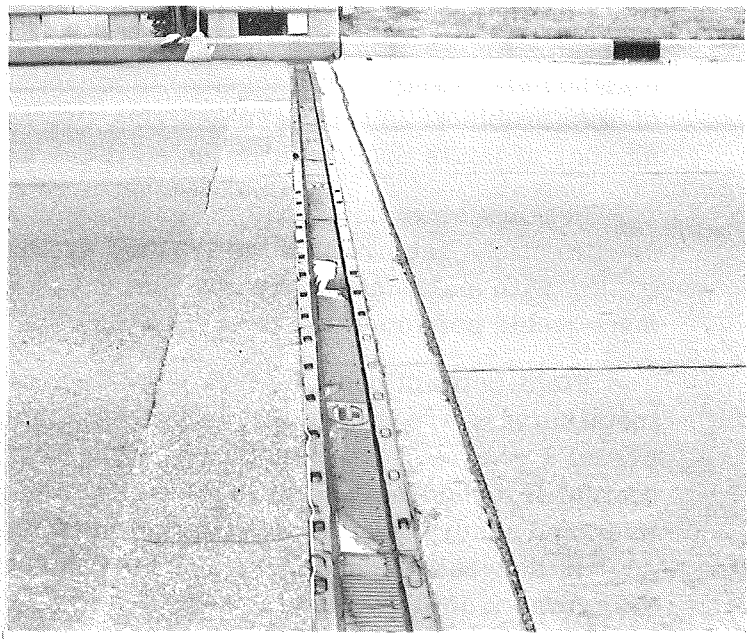
Most stud well plugs are lost when exposed to traffic use (Fig. 2). This allows corrosion of the studs and nuts which will eventually cause the pads to loosen. Our specifications have been changed to require that the stud wells be filled with a flexible epoxy.

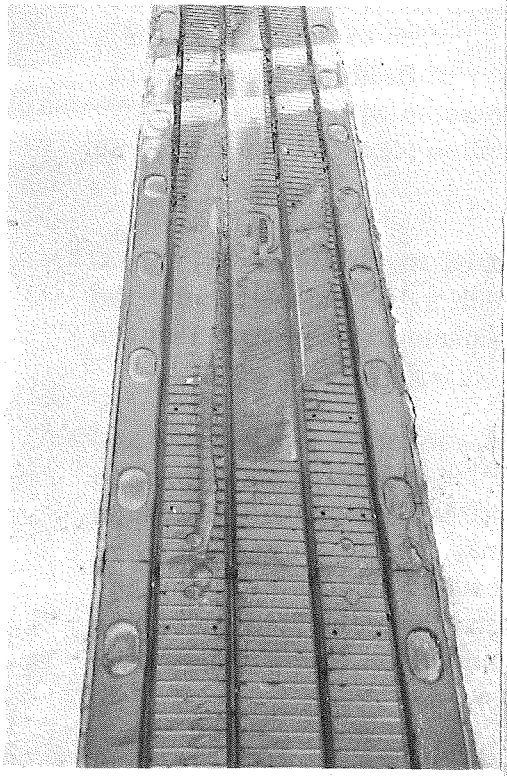
Damage to the system by snow removal equipment is frequent and sometimes severe. Even when properly installed about 1/4 in. below the adjacent deck surface, the system is susceptible to damage. The high placement of the steel reinforcement plate (only 3/16 in. below the polychloroprene wearing surface on the 200A) has caused serious problems including exposed steel and even complete delamination of the steel and polychloroprene (Fig. 2). Skewed joints which come close to the angle of the snow removal blade are particularly vulnerable.

Curb and gutter sections are also particularly vulnerable to damage and are frequently a source of leakage. Figure 2 also shows a curb and gutter installation that, though good in appearance, was found to be leaking. Factory prefabricated curb and gutter sections would be a major improvement.

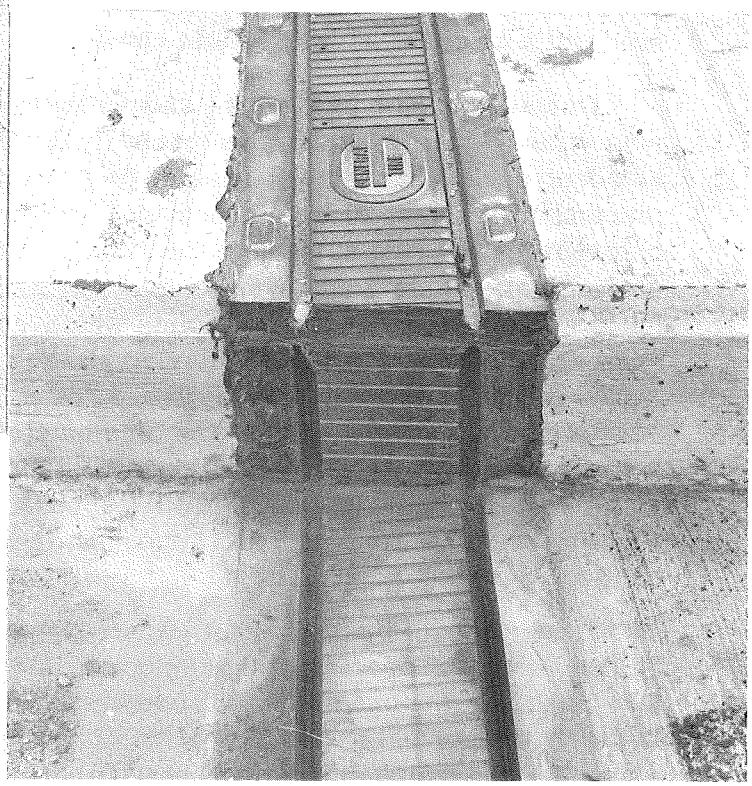
A majority of bridges along one stretch of freeway in Detroit have developed a severe problem that is unique to this area. Some pads have tilted and closed toward one side which eventually led to delamination and tearing between the polychloroprene portion of the seal and the steel reinforcing (Fig. 3). The damage does not appear to have been caused by snow removal equipment as adjacent pads have tilted and delaminated in opposite directions.

Loss of stud well plugs and severe snow removal equipment damage, totally exposing steel.





Snow removal equipment damage to a Transflex 400.



Although good in appearance this seal at a curb area was found to leak (Transflex 250).

Figure 2. Some problems encountered with the Transflex joint system.

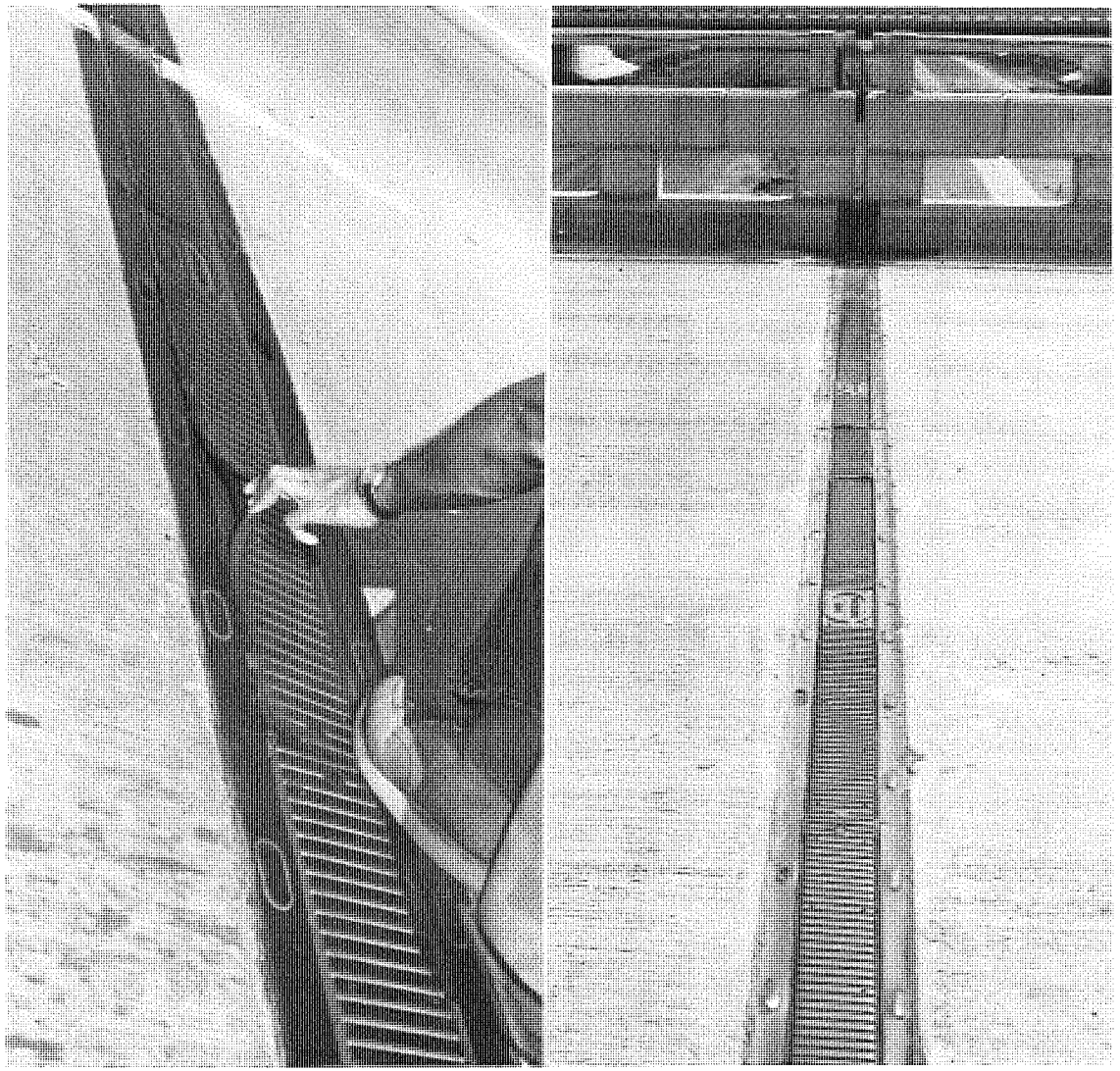


Figure 3. In some Detroit area bridges the polychloroprene has delaminated (left) from the steel reinforcing, and some pads (right) are found to be tilting in opposite directions, and also delaminating.

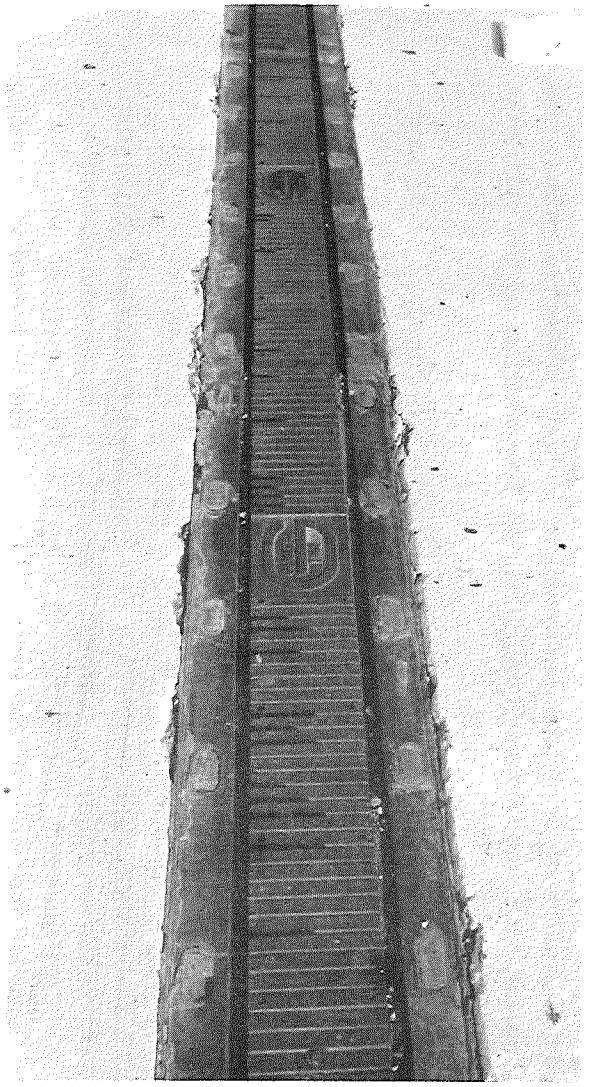


Figure 4. Edge spalling of the bridge deck adjacent to the Transflex pad.

Spalling of the deck material adjacent to the joint system is an increasing problem, but has not seriously affected the function of the system at this time (Fig. 4).

Horizontal and vertical misalignment of pads is the final problem encountered with this system. The misalignment has been due to poorly formed block-outs as well as poor workmanship. Misalignment to the degree of not allowing the system to properly seal the joint against moisture has been encountered.

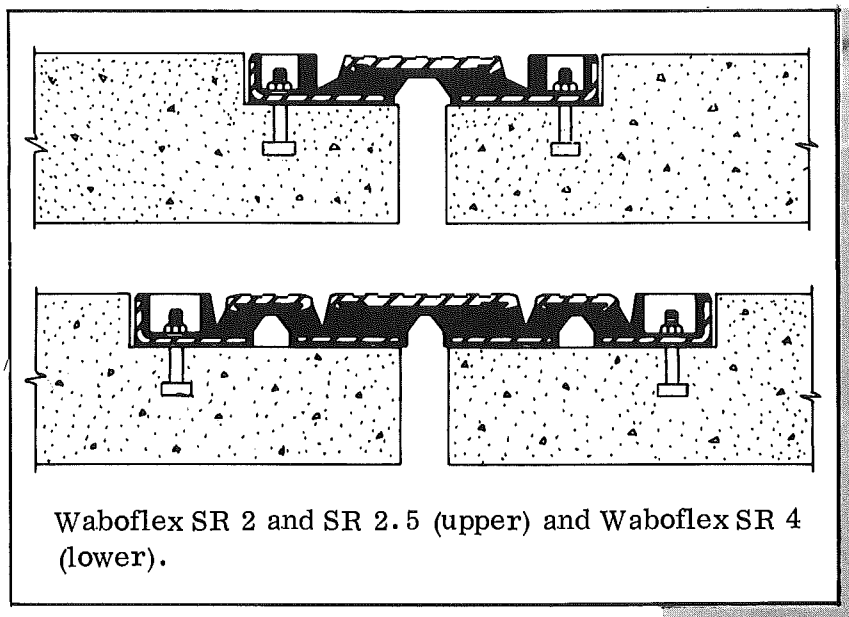
Summary of 'Waboflex SR' Installations

The Waboflex system consists of 6-ft long steel reinforced polychloroprene pads with an aluminum armor on the top with tongue-and-groove ends (Fig. 5). An uncured rubber tape or a high solids lubricant adhesive is placed between the pad and the concrete and the pad is bolted down using studs. The next pad is installed in the same manner, except that it is jacked tightly against the previous pad. The stud wells are sealed with a molded polychloroprene plug. The movement range for Waboflex seals inspected is from 2 to 4 in.

Table 2 in the Appendix contains detailed information from the inspection of 51 joints on 32 bridges. The following is a summary of the table as well as a discussion of this system's problems.

General Appearance:	17 good, 28 fair, 6 poor
Joints in System:	23 good, 14 fair, 14 poor
Intruded Debris:	47 none, 4 yes
Leakage:	25 significant, 26 undetermined
Damage:	36 none, 15 yes (2 severe)
Ride	
Quality:	48 good, 1 rough, 2 undetermined
Noise:	42 quiet, 4 moderate, 3 noisy, 2 undetermined

Extensive leakage is the most serious problem encountered with this system. Leaks develop at the tongue-and-groove ends, but could be reduced by proper cleaning, sealant application, and jacking tightly into place. Extensive leakage (up to 100 percent of the length) also occurs between the pad and the concrete seat. This problem appears to be caused by the bedding materials recommended by the manufacturer. The high solids adhesive (70 percent solids) shrinks and cracks upon loss of solvent thus allowing passage of water between the pad and concrete (Fig. 6). The creep allowed by the uncured rubber bedding material reduces the vertical compression initially created by the studs thus allowing the pad to move horizontally (Fig. 6). Latest specifications require that an epoxy bedding



Waboflex SR 2 and SR 2.5 (upper) and Waboflex SR 4 (lower).

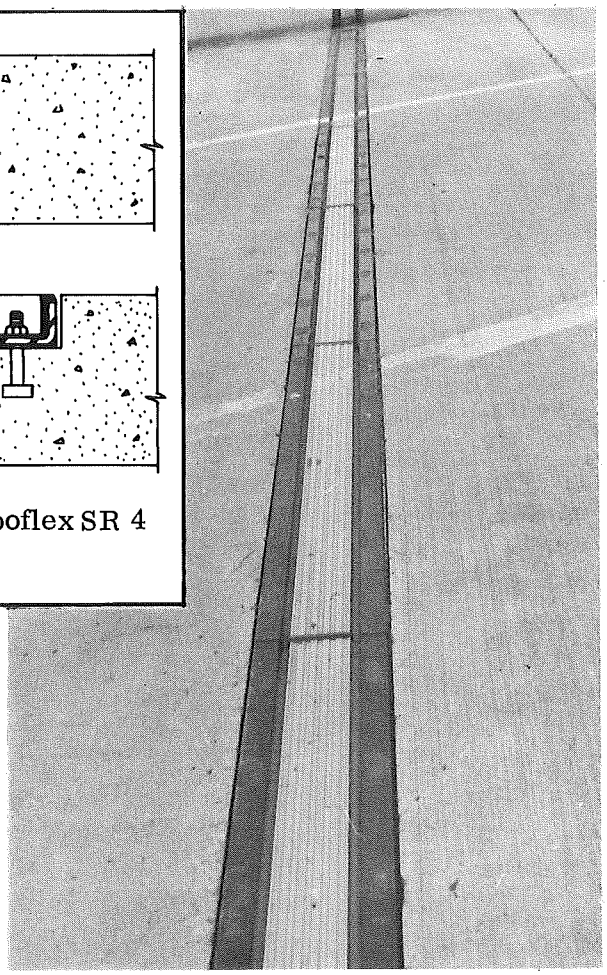
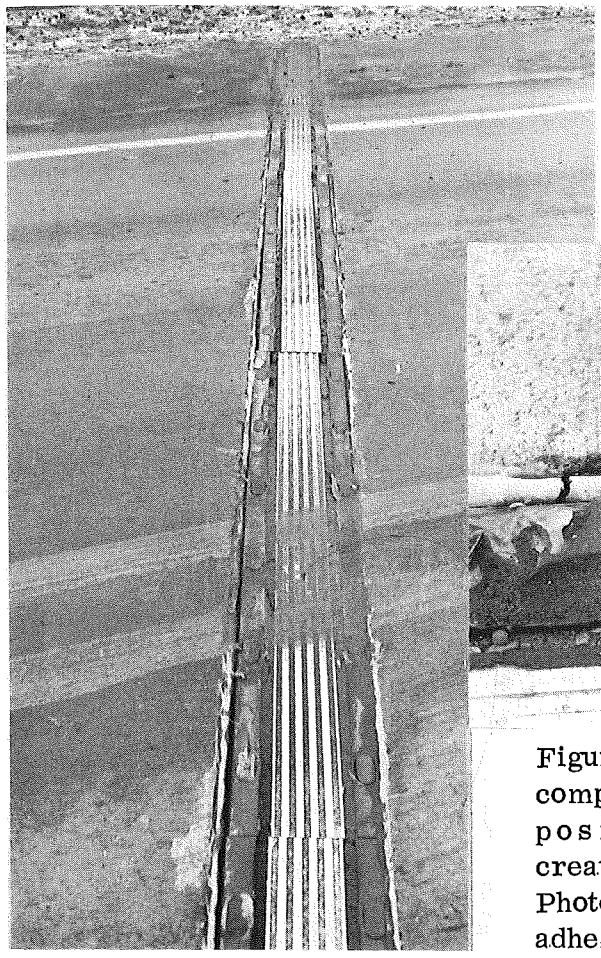


Figure 5. The drawing (above) depicts the Waboflex sealing systems; the photo at right shows a Waboflex SR 2 installation.



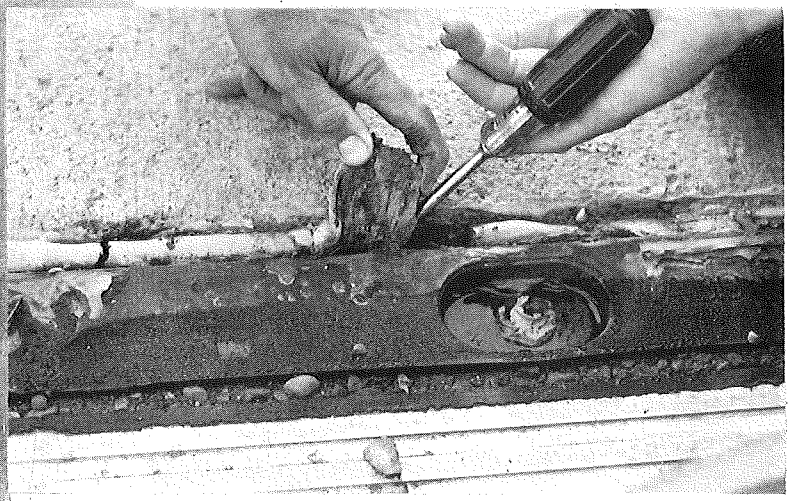


Figure 6. The photo at left shows the vertical compression not sufficient to hold the pad in position, thus misaligning horizontally and creating a gap at the edges when joint opens. Photo above shows the high solids lubricant-adhesive has cracked and lost adhesion.

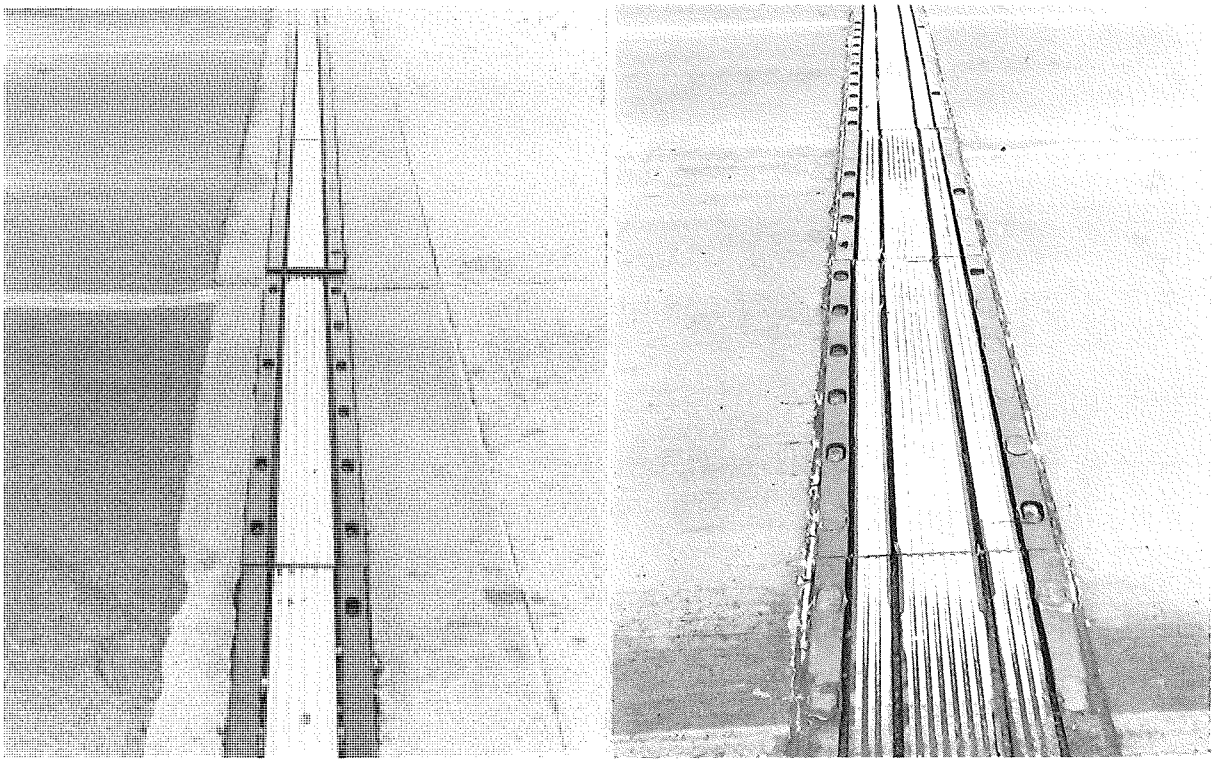


Figure 7. Waboflex installations showing vertical misalignment between pads (left) and missing stud well plugs (right).

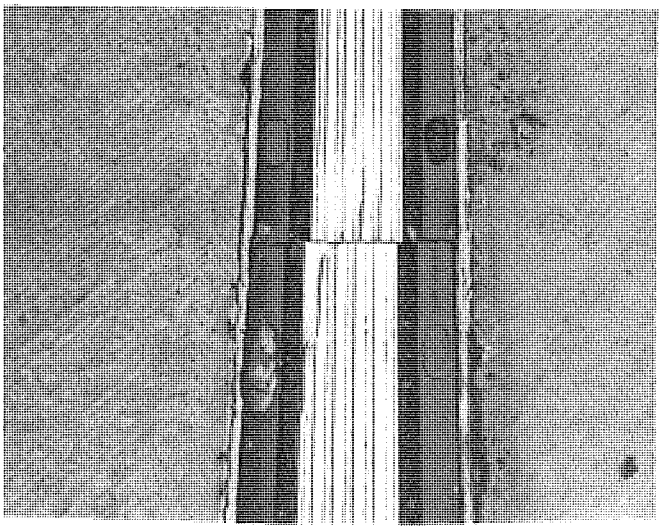


Figure 8. Minor snow removal equipment and horizontal misalignment.

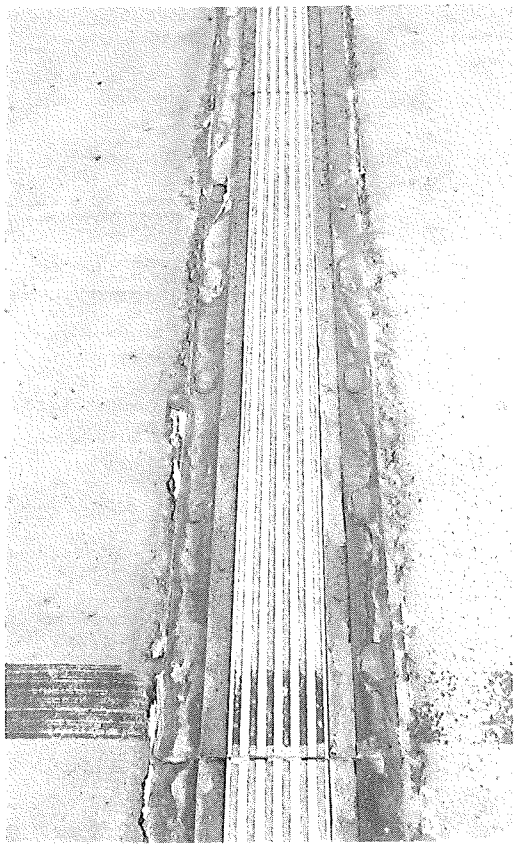


Figure 9. Deck edge breakdown adjacent to joint pad.

compound be used and that the cavity between the pad and vertical concrete face be sealed with a flexible epoxy. Loss of the molded polychloroprene stud well plugs has been a major problem with this system (Fig. 7). Latest specifications require that the stud well be filled with a flexible epoxy to protect the stud from corrosion.

Vertical misalignment of pads is also a problem and is primarily due to poorly formed block-outs. Figure 7 also illustrates this problem, and in this instance the vertical misalignment is great enough to completely separate the adjacent pads.

Damage by snow removal equipment is usually not too severe on this system. A typical example of this type of damage is shown in Figure 8.

Edge attrition of the deck material adjacent to the joint system also occurs (Fig. 9). The attrition has not reached the point of affecting the performance of the joint system at this time.

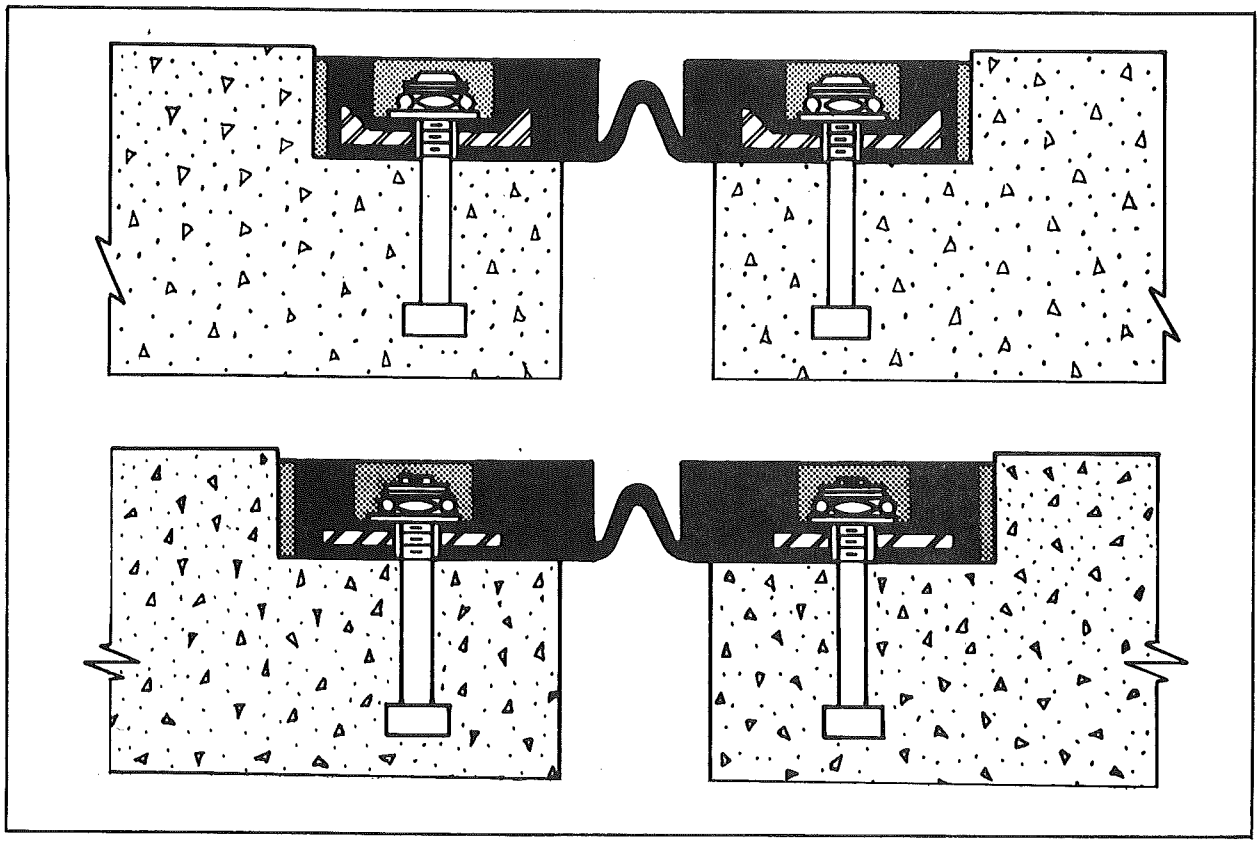
Summary of 'Fel Span' Installations

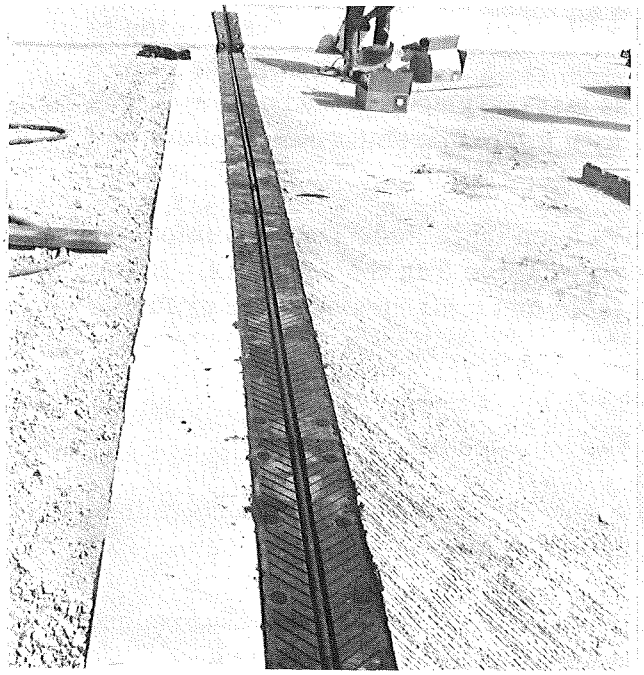
This system consists of 4-ft long steel reinforced polychloroprene pads with overlapping ends (Fig. 10). An epoxy bedding compound is placed on the concrete seat and the pad is tightened down using cast-in-place studs. A flexible epoxy is spread on the flap of the pad and the second pad is laid in the same manner as the previous with the undercut end going on top of the flap end of the previously laid section (Fig. 10). Curb sections have a flap portion which is placed beneath the last pad placed in the roadway. The movement range is from 2 to 4 in., with a fabric-reinforced 'convolution' providing the movement capability.

Seventy bridges with 90 joints have been inspected. Detailed information from these inspections is included in Table 3 in the Appendix. Below is a summary of the ratings from the table and a discussion of the system's problems.

General Appearance:	63 good, 23 fair, 4 poor
Joints in System:	41 good, 22 fair, 27 poor
Intruded Debris:	88 none, 2 yes
Leaks:	6 none, 19 yes, 21 significant, 44 undetermined
Damage:	66 none, 24 yes (5 severe)
Ride	
Quality:	80 good, 8 moderate, 1 rough, 1 undetermined
Noise:	84 quiet, 5 moderate, 1 undetermined

The primary shortcoming with the Fel Span seal is the failure of the joints in the system in the convolution area to maintain a watertight seal.





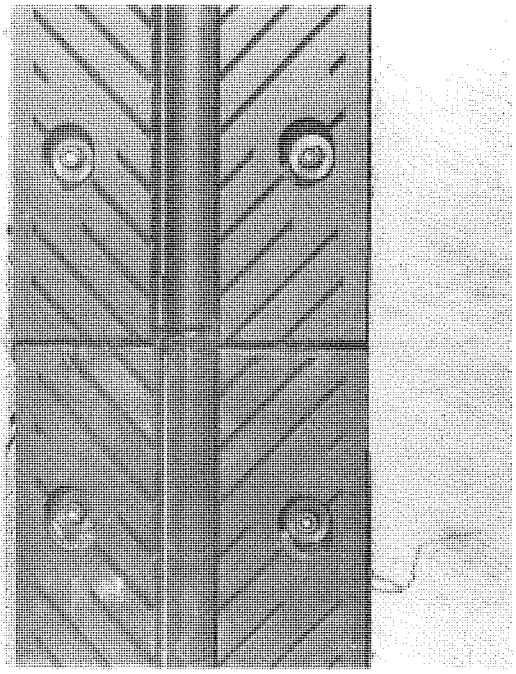


Figure 10. The drawing shows the Fel Span T20 (upper) and Fel Span T30 and T40 (lower). The left-hand photo shows the Fel Span T20 during installation; the right-hand photo shows a Fel Span T30 interconnect joint prior to filling side and stud wells with epoxy.

Partial or complete sealing failure at the convolution interconnect is common, especially after the joint has experienced several temperature cycles (Fig. 11). Failure at these joints allows the passage of water and dirt through the system.

Part of the sealing failure has been due to poor field workmanship, but the biggest problem is an adhesion failure between the adhesive and the convolution. In an attempt to reduce this problem the manufacturer has redesigned the joint by molding 'Vel Cro' material into the interconnect surfaces (Fig. 11) and are furnishing an epoxy nitrile sealant.

Laboratory fatigue tests on this new interconnect system were terminated after 5,000 cycles with no failure, whereas similar tests on the old design caused failure in as few as 17 cycles. We are hopeful that this new design will substantially reduce or eliminate the leakage problem, but we do not have enough field data to properly evaluate the new system at this point.

Susceptibility to damage by snow removal equipment is a problem with this system; however, few seals have been damaged severely due to the deeper placement of the steel reinforcement. Severe damage, when occurring, usually takes place in the area of the stud well thus exposing the studs (Fig. 12).

On many of the vertical curb sections the pad was bent to fit the contour of the curb. This stress on the polychloroprene pad caused severe cracking. The manufacturer has repaired several of these sections as shown in Figure 13.

Summary of 'Modular Compression Seal' Installations

The modular compression seal consists of standard polychloroprene bridge compression seals installed between steel elements (Fig. 14). The system is assembled in the shop and cast-in-place. If 4-in. seals are used, the device shown in Figure 14 is capable of 4.5 in. of movement.

Table 4 in the Appendix includes the detailed information obtained from the inspection of 21 joints on 10 bridge structures. Following is a summary of the data obtained from our field observations.

General Appearance:	18 good, 3 fair
Joints in System:	none
Intruded Debris:	19 none, 2 yes
Leaks:	3 yes, 18 significant
Damage:	16 none, 5 yes
Ride	
Quality:	20 good, 1 moderate
Noise:	20 quiet, 1 moderate

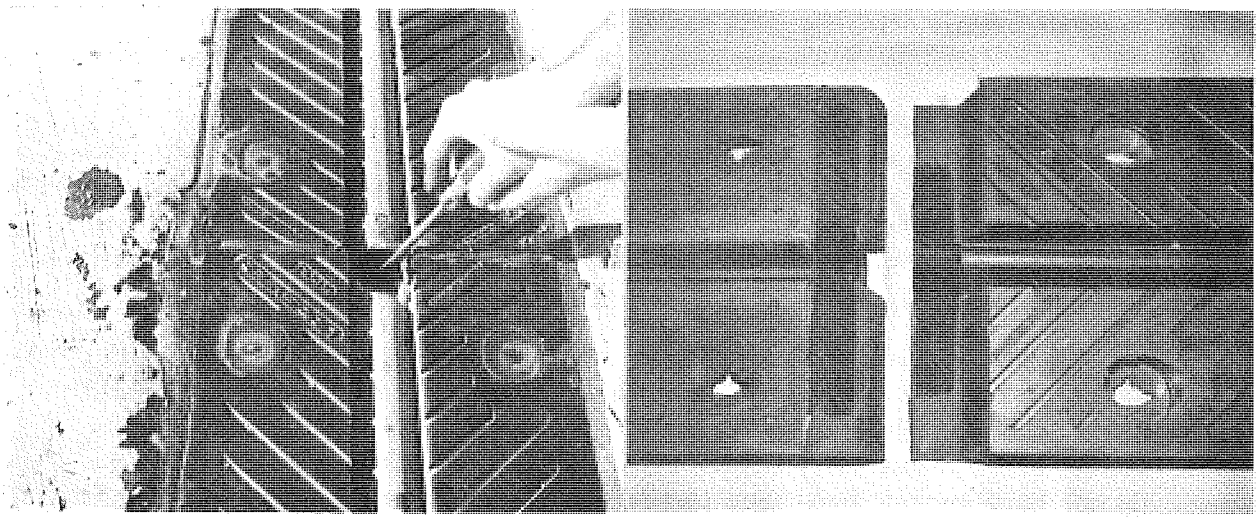


Figure 11. Loss of adhesion at the convolution interconnect (left) allowed free passage of water through this area. The new interconnect system (right) consists of molding Vel Cro into the polychloroprene flap and butt ends.

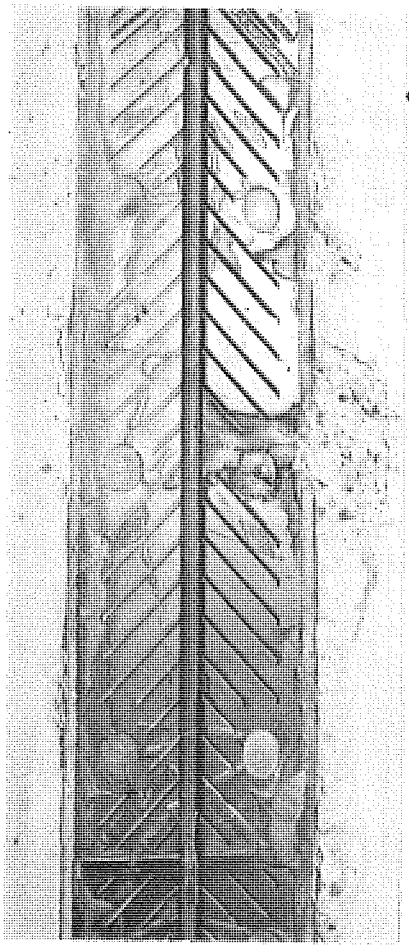


Figure 12. Snow removal equipment damage to the stud well area.

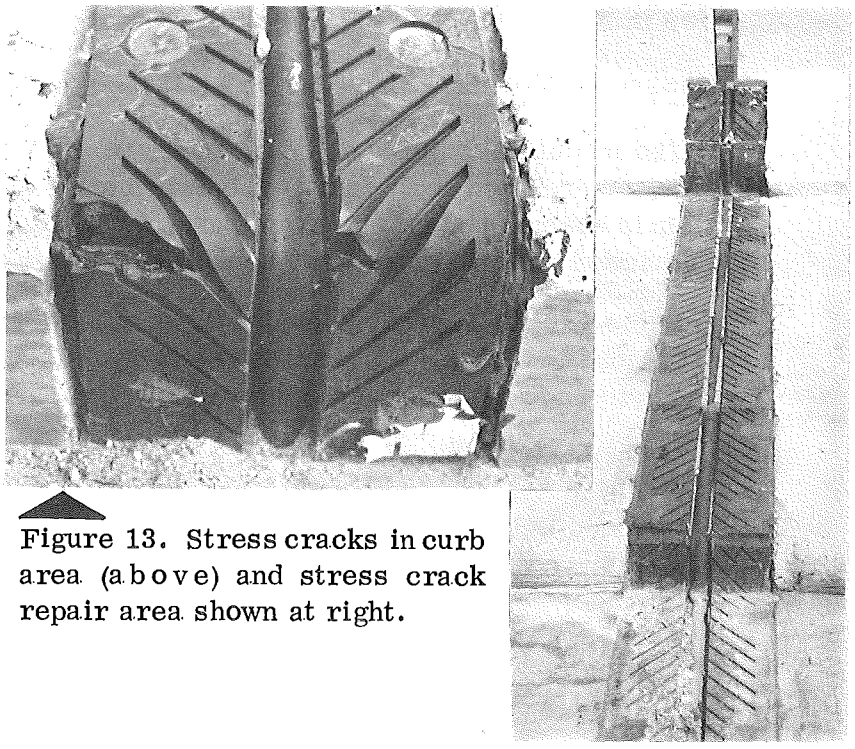
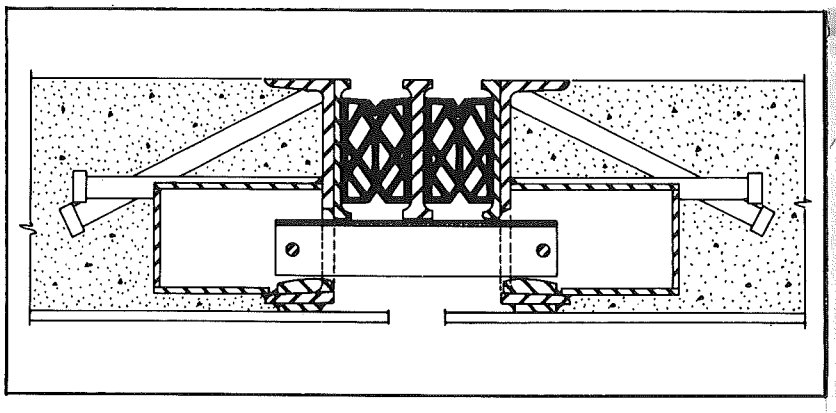


Figure 13. Stress cracks in curb area (above) and stress crack repair area shown at right.



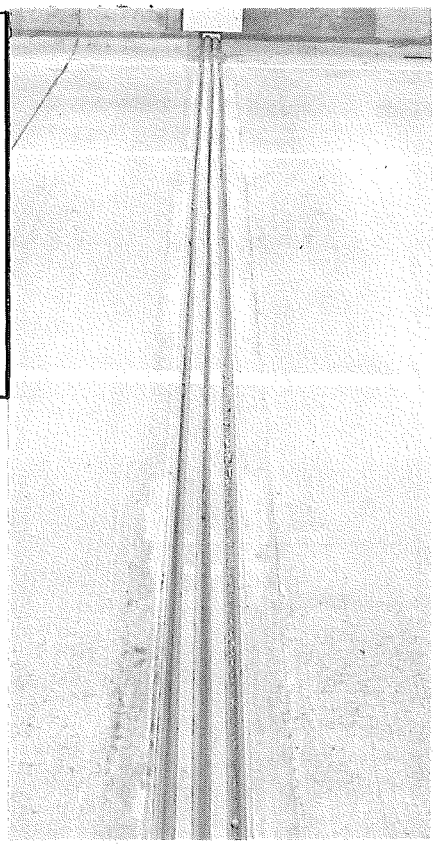


Figure 14. Cross-section of a double modular compression system (above) and an overall view of a triple modular system (right).

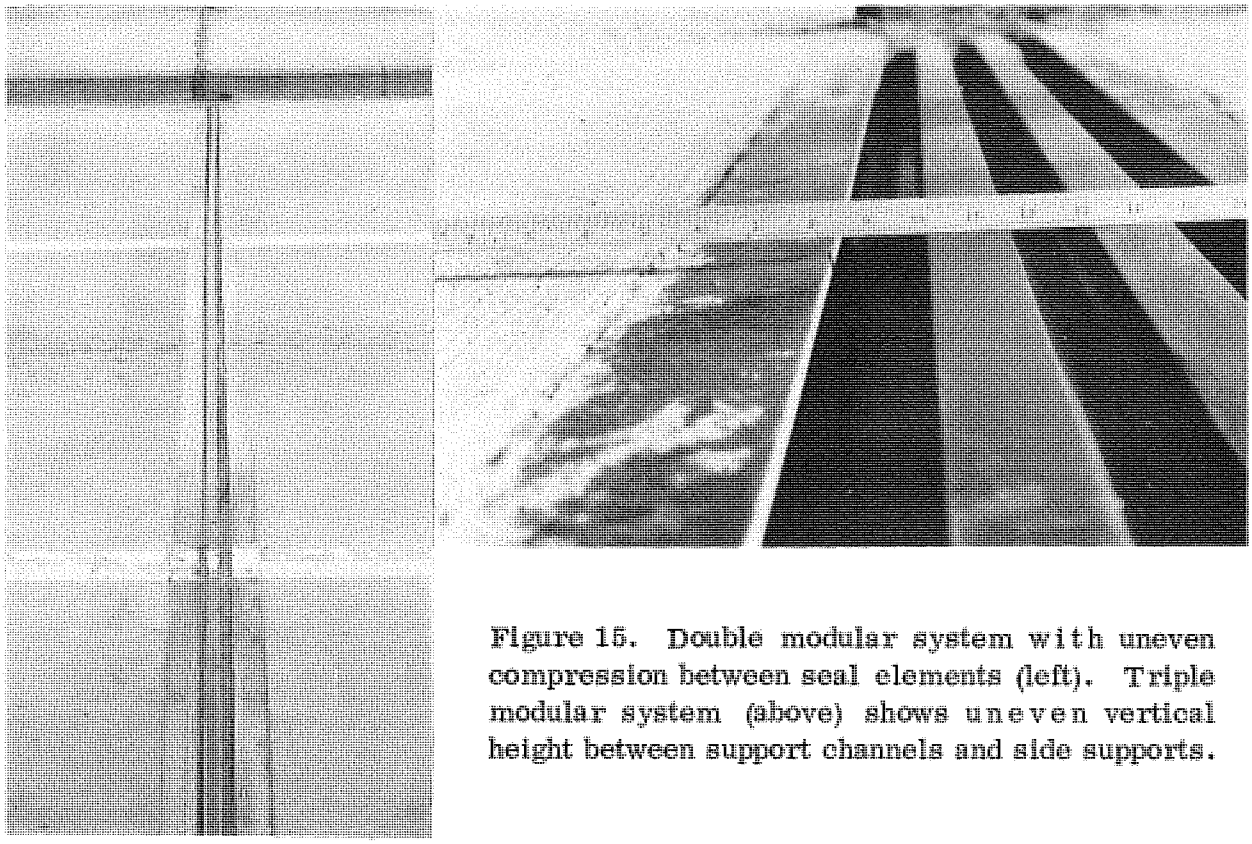
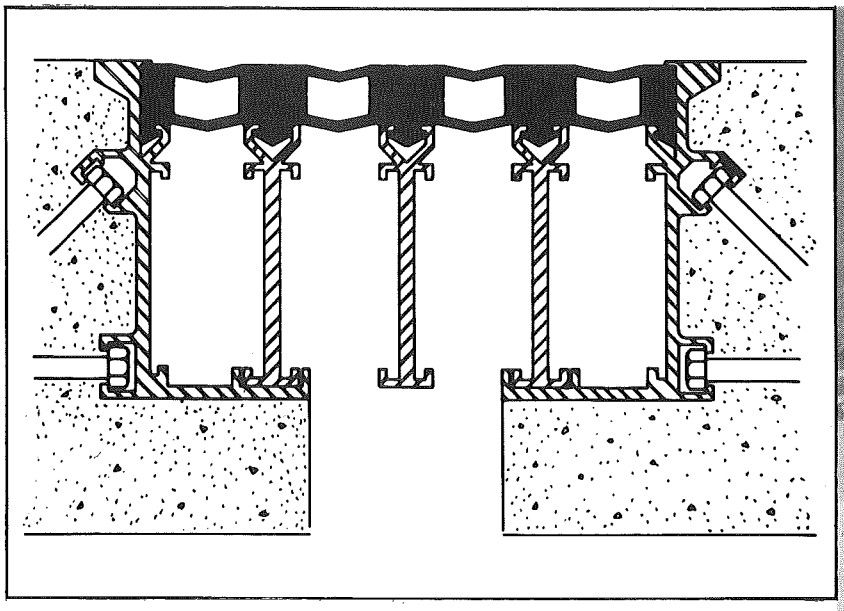


Figure 15. Double modular system with uneven compression between seal elements (left). Triple modular system (above) shows uneven vertical height between support channels and side supports.



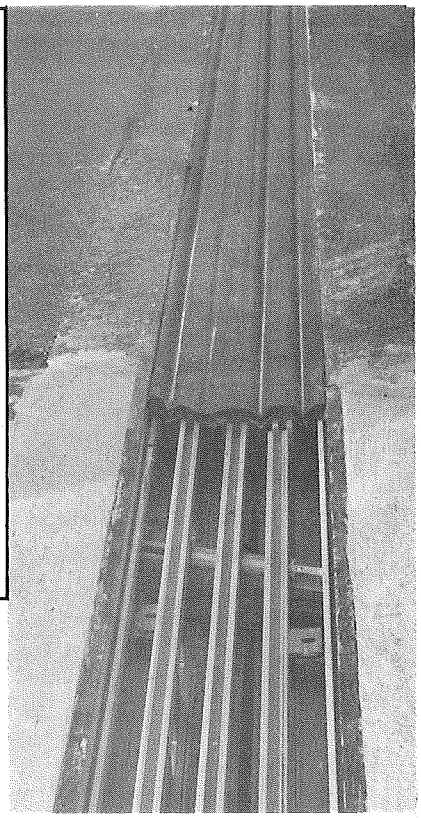
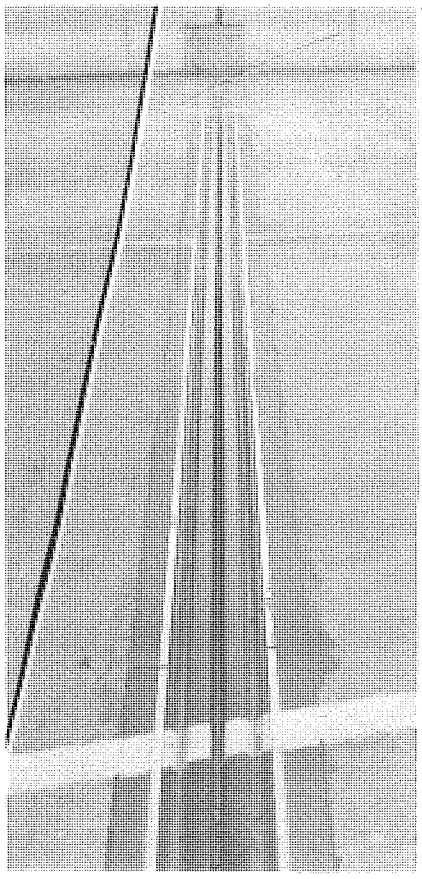


Figure 16. Delastiflex DL series during installation (right). The seal element was installed temporarily to maintain traffic. The drawing above shows a cross-section of the DL 300 (support system for center rail not shown).



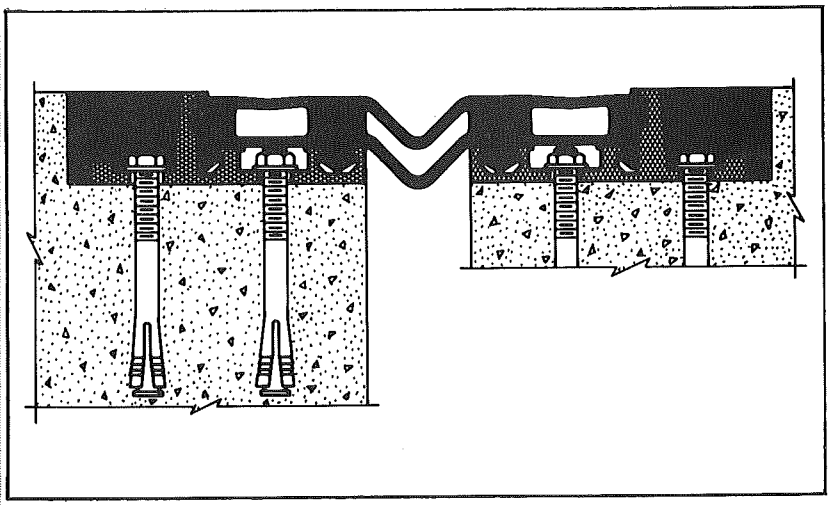


Figure 17. Cross-section of Delastiflex MT 300 (above) and an MT series installation (left).

The basic problem with the modular compression seal system is leakage between the compression seal and the steel supports. Some joints were found to be leaking over the full joint length, as well as containing dirt intrusion. The system is dependent on complete contact between the seal and steel under pressure to remain watertight. If the steel is well sandblasted and a high solids lubricant used, it may reduce the leakage problem.

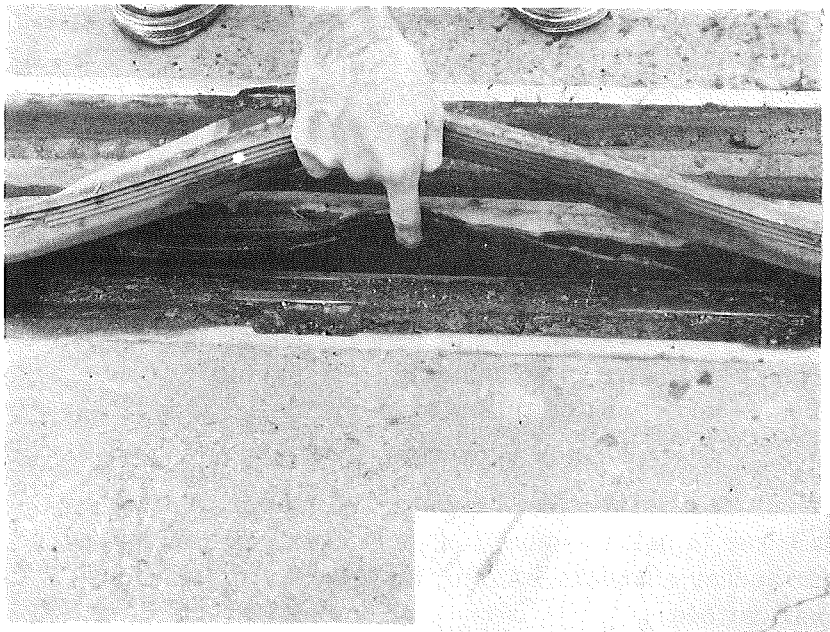
Uneven compression between channels has also occurred (Fig. 15). At least one manufacturer has incorporated the use of leaf springs on the multiple seal units in an attempt to ensure equal spacing. We have not evaluated any structures that have incorporated this design change.

A third problem area is unequal vertical height of the support channels (Fig. 15). One manufacturer is using a modified design which provides a vertical hold down for the center channels. Again, we have no installations incorporating these modifications.

Summary of 'Delastiflex' Expansion Joint System Installations

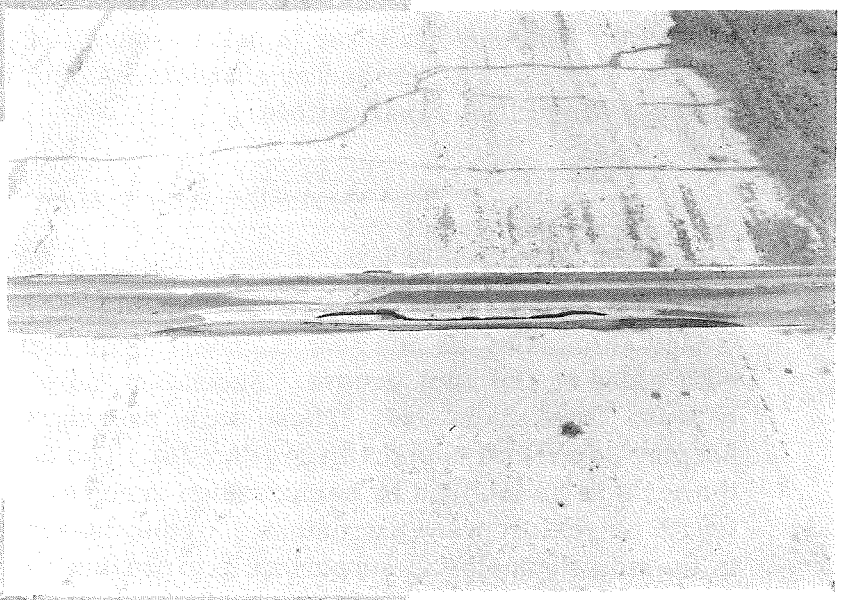
There are presently two different Delastiflex systems in use in Michigan. The first system is the DL series (Fig. 16) which consists of an extruded aluminum side and seat member. This member is cast-in-place on both sides of the joint groove. Secondary support rails are later placed between these members. These rails are supported vertically by telescoping horizontal support bars (Fig. 16). The horizontal spacing between the rails is maintained by compression springs. Two or more continuous length polychloroprene extrusions are compressed into the locking grooves in the side channels and support rails to produce the riding and sealing surface.

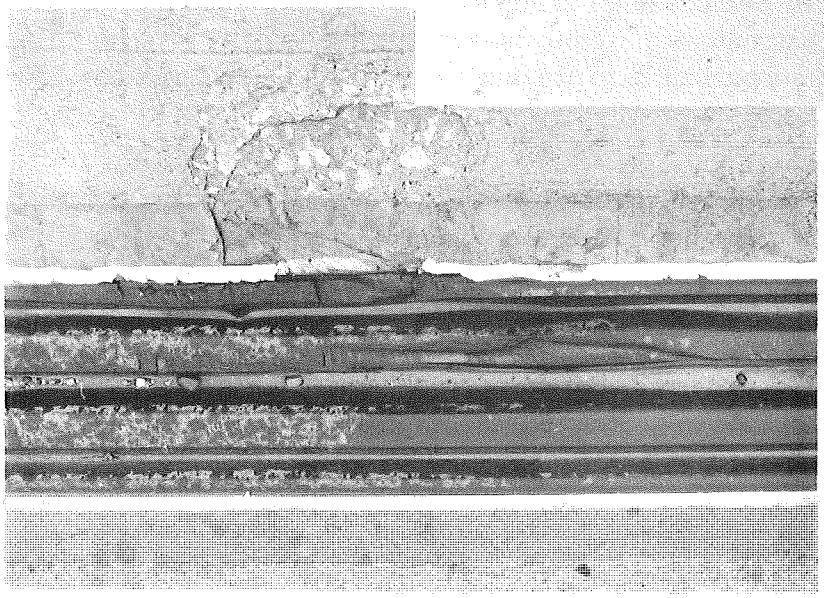
The second system is the MT Series (Fig. 17). With this system the joint seat is formed when the deck is poured and the extruded aluminum channels are bolted into place after the forms are removed. The channels are held into place by precast studs or expansion anchor type bolts. The void above the studs between the aluminum and deck is then filled with an epoxy mortar. A single continuous polychloroprene extrusion is then compressed into the locking grooves of the aluminum extrusion to provide the riding and sealing surface. This series has also been used as a cast-in-place system by bolting the anchors to the aluminum extrusion and casting the system into the deck at the time of the pour. Currently, we are inspecting 31 structures representing 44 joints sealed with the Delastiflex systems. Five of the joints have the DL series, 27 have the MT series, and 12 have



Snow removal damage to aluminum and polychloroprene.

Snow removal equipment has torn the polychloroprene seal and removed it from the side channel.





Close-up view of the installation shown above.

Figure 18. Snow removal equipment damage to Delastiflex systems.

the MT/CP series (Table 5, Appendix). The following is a brief summary relating to the ratings in the table.

DL Series:

General Appearance:	5 poor
Joints in System:	1 fair, 4 poor
Intruded Debris:	5 yes
Leaks:	3 yes, 2 undetermined
Damage:	5 yes, (5 severe)
Ride	
Quality:	5 good
Noise:	4 quiet, 1 moderate

MT Series:

General Appearance:	24 good, 1 fair, 2 poor
Joints in System:	none
Intruded Debris:	22 none, 5 yes
Leaks:	8 none, 19 undetermined
Damage:	8 none, 19 yes (4 severe)
Ride	
Quality:	27 good
Noise:	26 quiet, 1 moderate

MT/CP Series:

General Appearance:	10 good, 2 fair
Joints in System:	none
Intruded Debris:	11 none, 1 yes
Leaks:	1 none, 11 undetermined
Damage:	8 none, 4 yes (2 severe)
Ride	
Quality:	11 good, 1 moderate
Noise:	12 quiet

The major problem encountered with both Delastiflex series has been their susceptibility to snow removal equipment damage (Fig. 18). The total surface of the polychloroprene extrusion is exposed to traffic and since the extrusion is composed of thin wall cells, it is very easily torn by the snow removal equipment blades. Several polychloroprene extrusions have been damaged so severely that they should be or have been replaced.

Dirt and water intrusion between the polychloroprene and side channels as well as in the damaged areas is a problem (Fig. 19). The problem is

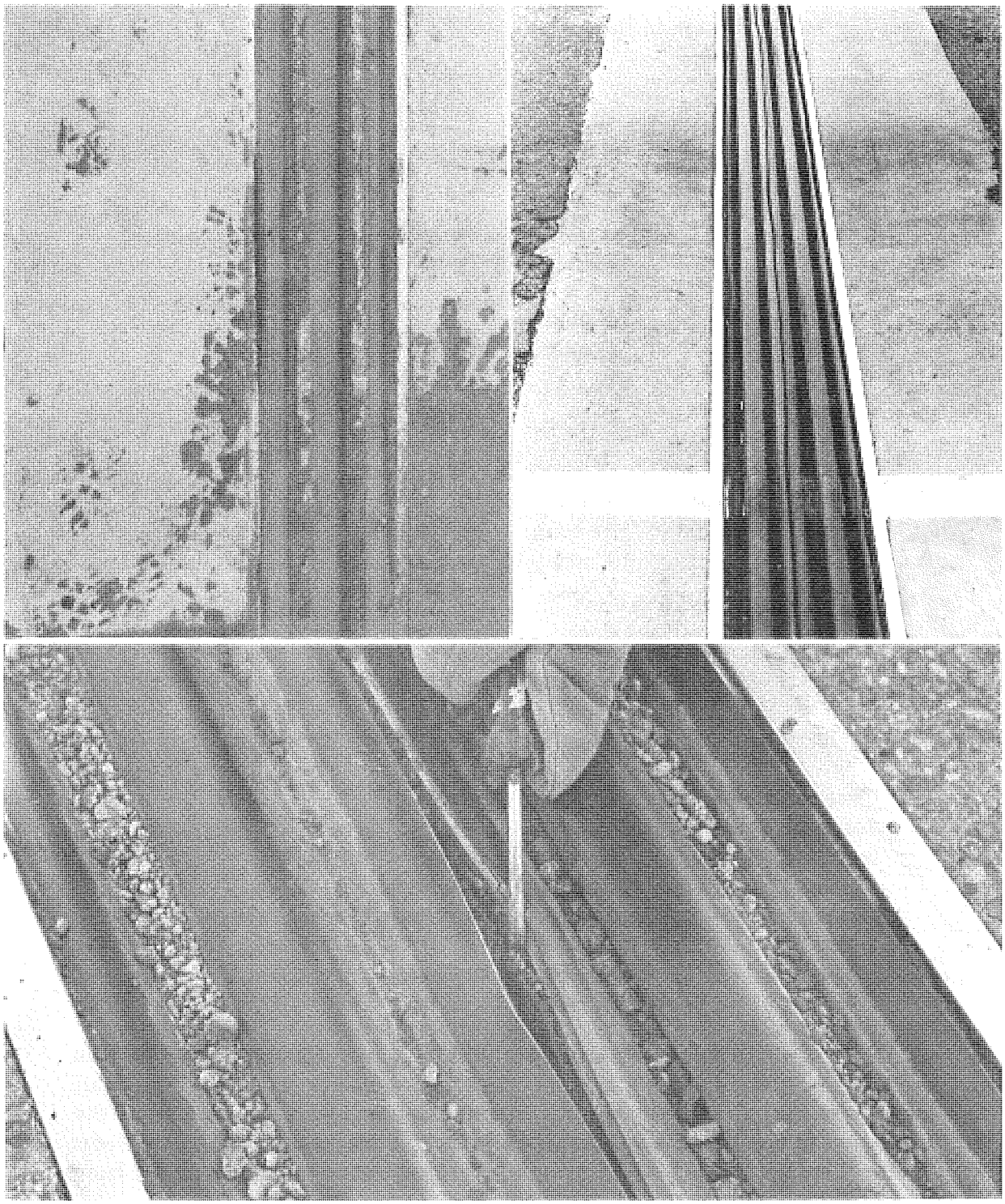


Figure 19. Seal element pulling out of the side channel (above left) and severe dirt intrusion between the polychloroprene and aluminum (above right). Lower photo shows dirt intrusion between the two polychloroprene seal elements in the Delastiflex systems.

especially severe for the DL series, with the additional problem of dirt intrusion into the longitudinal joint-in-system (Fig. 19). Three DL series polychloroprene extrusions have been replaced and the new extrusions are developing the same problems as before; consequently, there have been no installations of the DL series since. Sections of some of the CP and MT series joints have also developed dirt intrusion between the side channel and polychloroprene, and in three instances sections have started to pull out of the side channel (Fig. 19).

Summary of 'Type 190' (Michigan Modified Wabo-Maurer) Installations

The system consists of a continuous extruded polychloroprene seal locked into steel side channels and it is usually assembled and then cast-in-place (Fig. 20). The system is capable of 2.4 in. of movement.

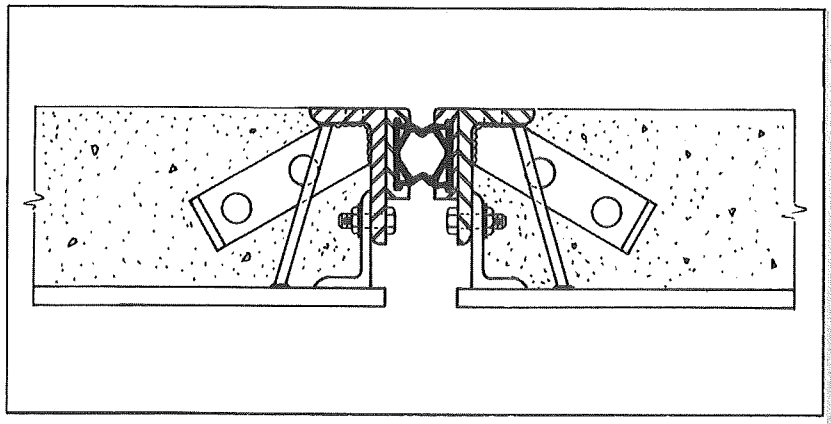
We have surveyed 43 bridges representing 56 joints which have a Type 190 system. Appendix Table 6 lists our detailed findings from these surveys. A brief summary of the table and the problems encountered with this system follows:

General Appearance:	49 good
Joints in System:	none
Intruded Debris:	53 none, 3 yes
Leaks:	32 none, 1 significant, 23 undetermined
Damage:	55 none, 1 yes (1 severe)
Ride	
Quality:	55 good, 1 moderate
Noise:	56 quiet

The only serious problem encountered with this system at this time is that one polychloroprene extrusion has a tear in the top surface (Fig. 21), which will allow the extrusion to fill with water and debris. One seal has started to pull out of the steel channel but this is due to a problem with the bridge itself and not a fault of the system.

Summary of 'Wabo-Maurer Strip Seal' Installations

This system consists of a polychloroprene strip seal element which is inserted into the locking groove incorporated into the extruded steel faces (Fig. 22). The polychloroprene element can be inserted before or after the installation of the steel edge extrusions to the deck. The steel side channels can be bolted (Fig. 22) or cast-in-place. The joint movement range is from 2 to 4 in.



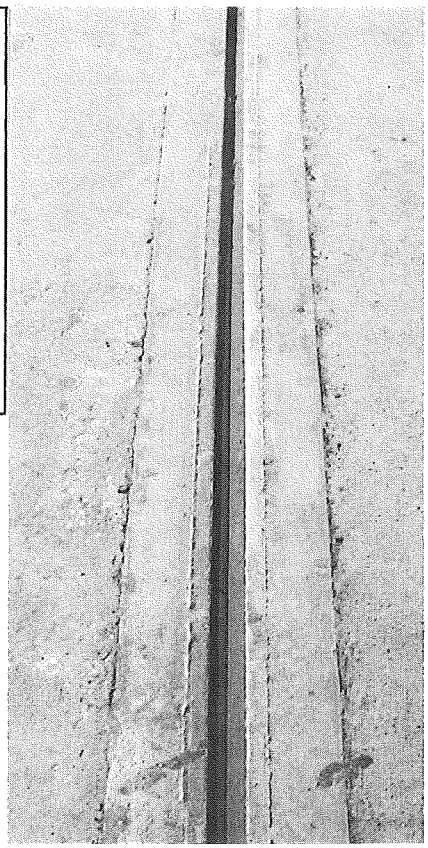


Figure 20. Cross-section (above) and typical installation (right) of the Type 190 Michigan Modified Wabo-Maurer seal.

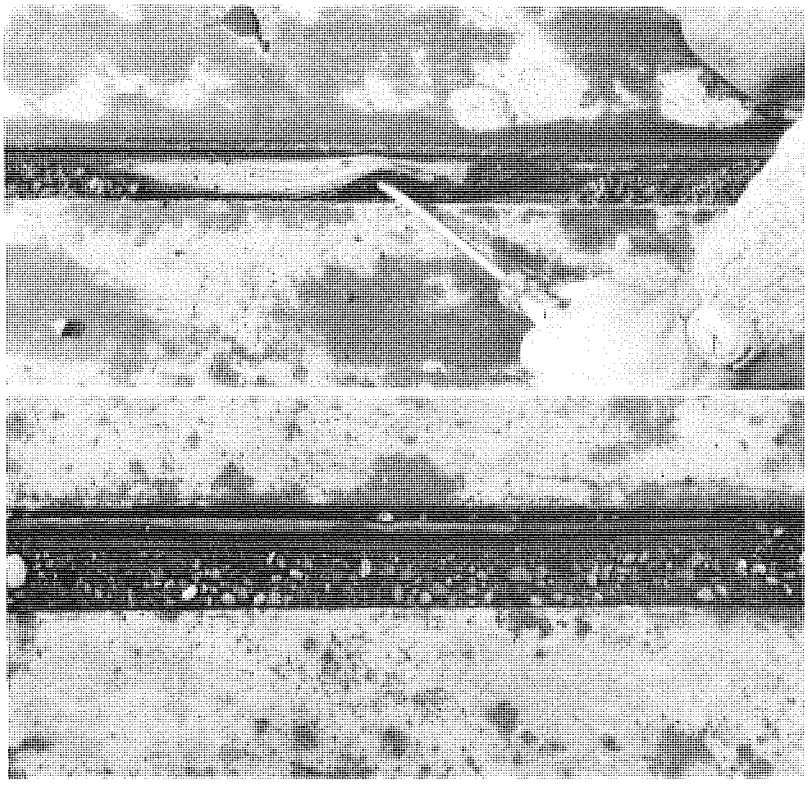


Figure 21. A 6-in. tear (above) in the top of the seal element allows water and debris to enter the seal cavity. The polychloroprene extrusion (below) has started to pull out of the channel because the joint has opened too wide.

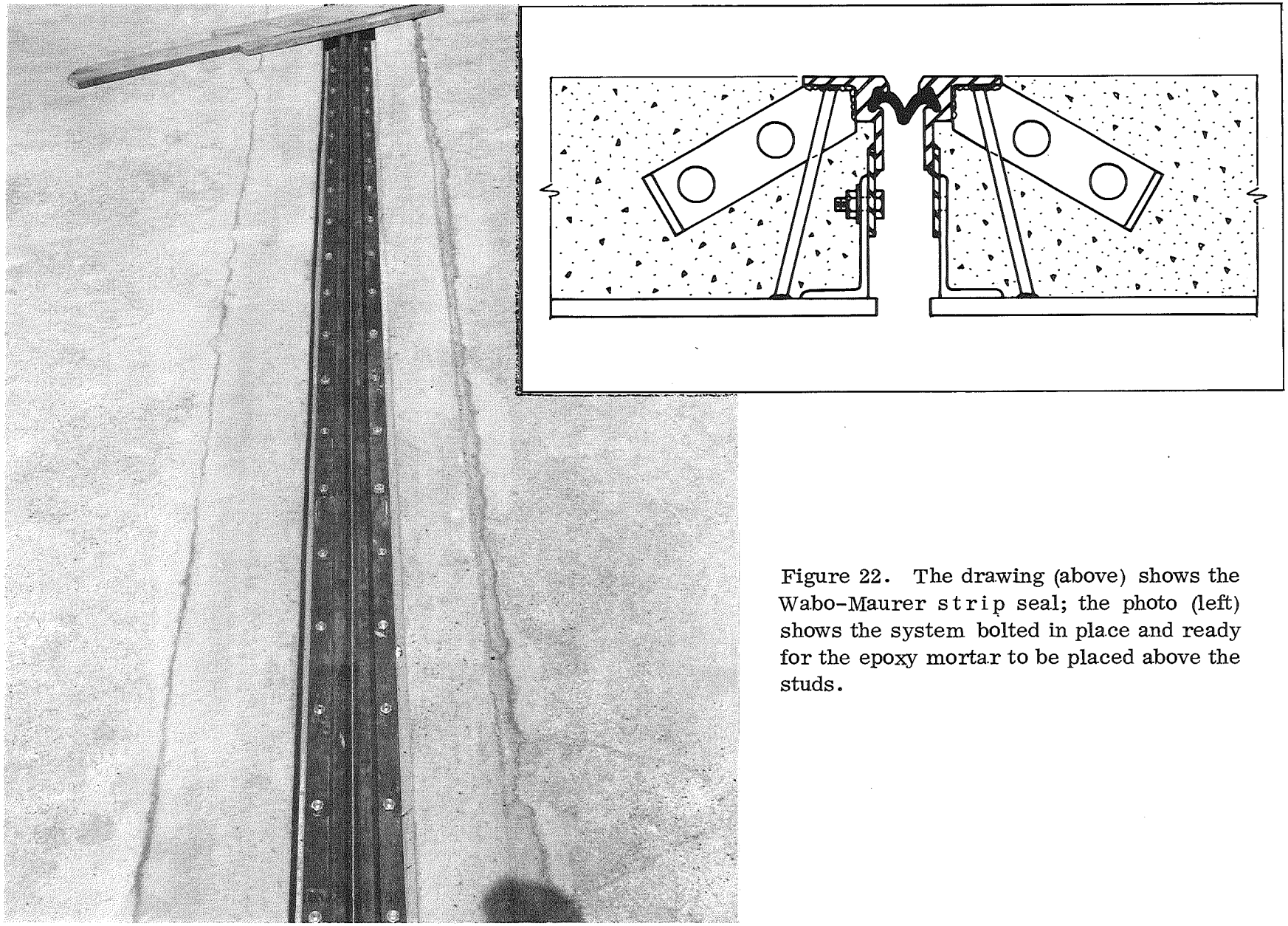


Figure 22. The drawing (above) shows the Wabo-Maurer strip seal; the photo (left) shows the system bolted in place and ready for the epoxy mortar to be placed above the studs.

Eleven joints on six bridges are under inspection. Table 7 in the Appendix includes the detailed information obtained from these inspections. The following is a summary of the ratings.

General Appearance:	10 good, 1 fair
Joints in System:	none
Intruded Debris:	10 none, 1 yes
Leaks:	10 none, 1 yes
Damage:	11 none
Ride	
Quality:	11 good
Noise:	11 quiet

Performance of this system has been very good with only a few problems encountered on three joints. One joint had 1 ft of the polychloroprene seal element pulled out of the steel edge extrusion. Two other joints had to have portions of the epoxy mortar adjacent to the steel channel replaced. One of the above mentioned joints also had a poor factory splice in the polychloroprene strip seal which had partially failed when installed. The splice was impossible to observe on subsequent inspections since it is hidden in a sidewalk area.

Summary of 'Onflex' Installations

The Onflex system consists of a continuous length of corrugated fabric reinforced ethylene propylene diene rubber (EPDM) membrane held in place by aluminum or steel anchoring members (Fig. 23). The cavity above the studs is filled with an epoxy mortar or if the system is used in conjunction with an overlay, the overlay material may be poured adjacent to the anchor system.

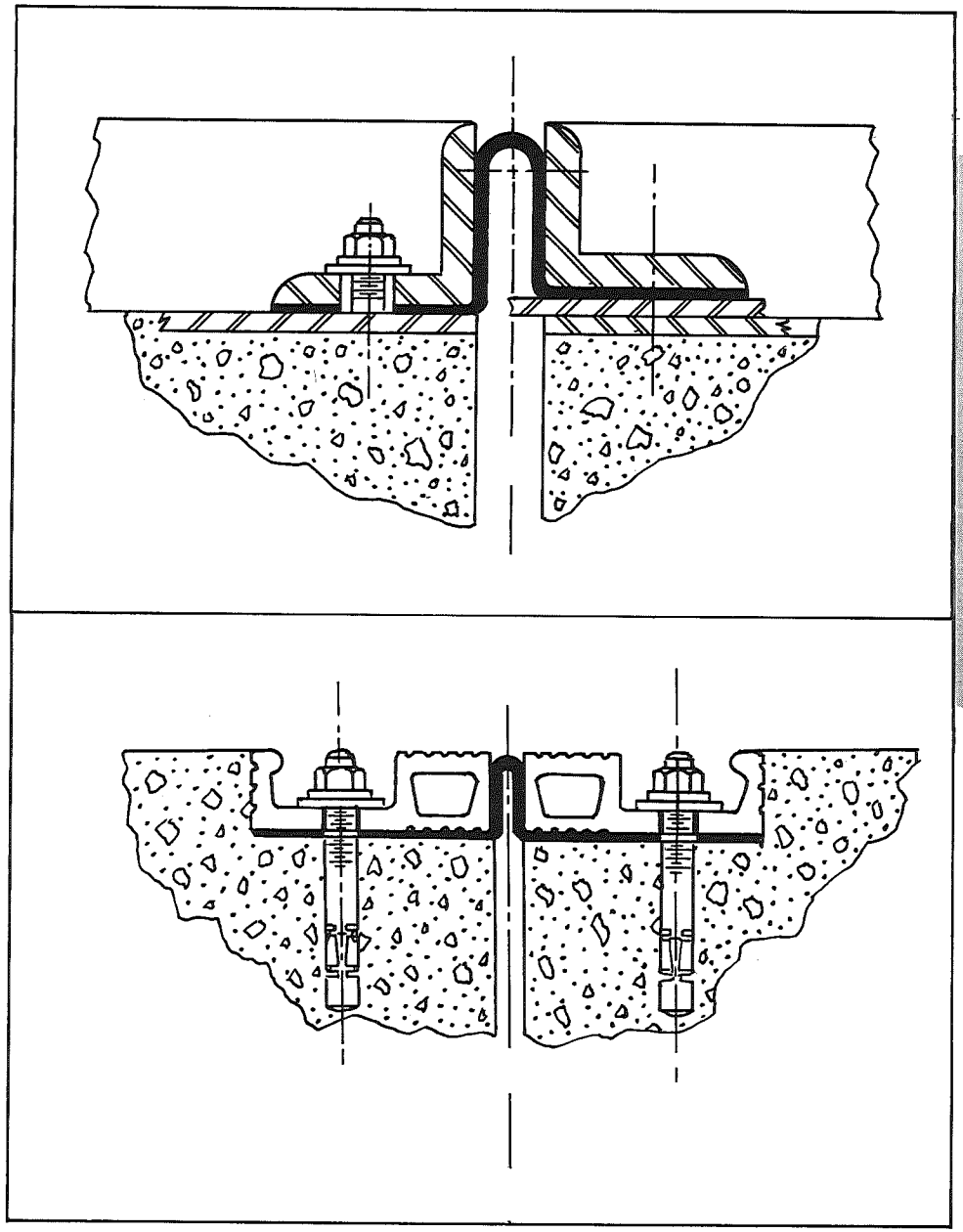
We presently have three Onflex joints installed on two structures, representing both the maintenance type and low profile type series. All aspects of the system appear to be functioning well though they have not been inspected for leakage. Appendix Table 8 includes the limited information we now have.

SUMMARY

Most of the experimental systems provide a more watertight seal than the conventional steel sliding plate system we used in the past; however, several serious problems exist and are discussed below.

Metal-Reinforced Polychloroprene Pad Systems

The following problems have been evident with the metal-reinforced polychloroprene pad type systems (Transflex, Waboflex, Fel Span):



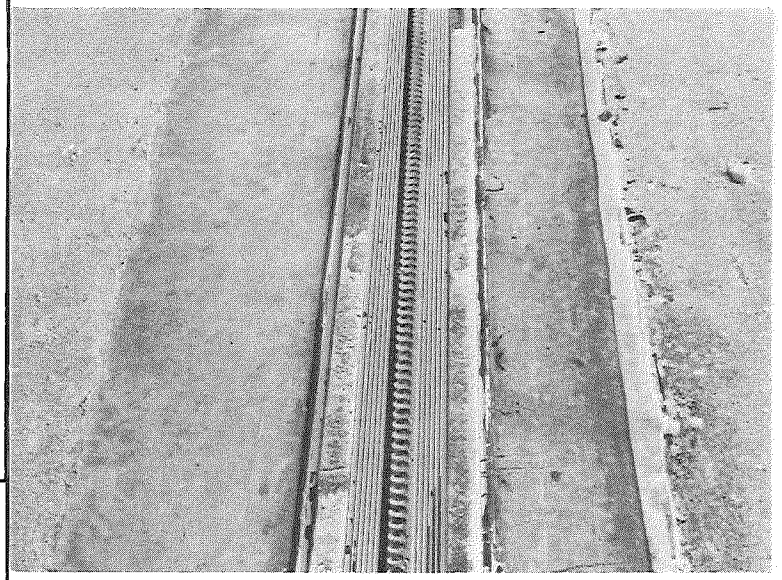


Figure 23. The drawing at the upper left shows the Onflex Maintenance Series installation; the lower drawing shows the Onflex Low Profile system. The photo above shows the Onflex Model 25 installed and in good condition at the time of inspection.

1) Short length metal reinforced elastomer pad type joint systems which rely on a mechanical interconnect butt joint with mastic sealant are very prone to leakage through the joints between sections. This leakage is due both to the fact that these systems are field labor sensitive as well as to inherent material and design characteristics. The new Fel Span interconnect system using 'Vel Cro' has not been in service a sufficient length of time to properly evaluate, but is still subject to the problem of proper workmanship.

2) Field butt joints without any mechanical interconnect in the roadway or at areas such as the curb and gutter are ineffective. Shop-fabricated curb sections are a major improvement but are still subject to the problems listed above.

3) In many instances, the block-outs formed in the concrete to receive pad type devices have been inaccurately constructed, making alignment and joining of these systems very difficult.

4) Damage by snow removal equipment has occurred on all pad type systems, even when the pad has been installed lower than the adjacent roadway surface. The high placement of the reinforcing steel plate in Transflex makes it particularly susceptible to severe damage—even to the point of delamination of the embedded steel. Skewed joints are particularly vulnerable when the angle coincides with the angle of scraper blades used to remove snow and ice.

5) All of the metal-reinforced polychloroprene pad systems are held in place by studs anchored into the deck. These studs have frequently been exposed to corrosion and possible loosening of the pads through snow plow damage, loss of stud hole plugs, cracked sealant, or studs being set too high or too close to the ends of the oblong slots in the pads.

6) The relatively high horizontal shear forces generated in the Transflex and Waboflex systems have caused several problems with the system and deck.

7) A high level of quality workmanship has been difficult to maintain and has added to the problems already existing with the systems.

8) Edge breakdown of the roadway surface material adjacent to the expansion joint pads is a frequent occurrence. The extent of the spalling varies considerably both in amount and degree.

Metal-Supported and Anchored Polychloroprene Compression Seals

The following problems are related to the modular compression seal system:

1) All joints inspected were leaking and nearly all were leaking very extensively. The contact pressure of the neoprene against the steel side walls is either inadequate to resist moisture intrusion or debris had intruded allowing moisture to enter.

2) Uneven compression between the compression seals and vertical misalignment of the steel channels have been constant problems.

Metal-Supported and Anchored Polychloroprene Continuous Element Extrusions

Problems occurring with the Delastiflex systems can be summarized as follows:

1) Damage by snow removal equipment is a serious problem, frequently tearing the polychloroprene extrusion severely or removing it from the metal side channels. The amount of damage is progressive with length of service and is attributable to design features inherent in the system. Several polychloroprene extrusions are presently in need of replacement.

2) Dirt intrusion and/or the polychloroprene extrusion pulling out of the side support channels has occurred on some of the MT/CP and MT series joints. While this problem is in some instances directly attributable to damage by snow removal equipment, in other instances it appears to have been the result of normal traffic usage.

3) The DL series joints all have developed severe dirt and water intrusion between the polychloroprene extrusion and side support channel and in the longitudinal joint in the system. The polychloroprene pulling out of the channel is a common occurrence. All DL series joints have had to be either repaired or have had polychloroprene extrusions replaced. Also, installation of the joint is time-consuming and difficult.

Other Systems

Following are observations regarding the remaining systems classified as metal-supported and anchored polychloroprene or EPDM continuous element extrusions (Type 190, Wabo-Maurer Strip Seal, Onflex).

1) All of the remaining three continuous seal element systems mentioned above are effectively sealing the joint against both water and dirt

intrusion. With the exception of one joint, leakage and debris intrusion have been minimal and uncommon.

2) These systems are not susceptible to damage by snow removal equipment, provide a good and quiet riding surface, and have experienced no serious problems at this time.

RECOMMENDATIONS

Based on our field investigations, the following recommendations for the systems are proposed.

Metal-Reinforced Polychloroprene Pad Systems

1) One of the intended major advantages of the pad type systems was the ease and availability of replacing one or more pads should they become damaged. This advantage actually never existed as pad removal was not possible without damage to the block-out area as well as to the adjacent pads. Moreover, compliance with our current specifications and recommendations in this report would completely eliminate the reality of this intended advantage.

2) If it is decided to continue to use the pad systems, then the following recommendations would improve their performance.

a. The surface of the recess to which the pad type systems are bolted should be carefully surfaced with epoxy mortar, if the as-cast surface is not reasonably smooth. Sandblasting of the recess should precede patching and/or placement of the pads.

b. All pads should be cleaned with solvent and bedded in an epoxy bedding compound. Joining surfaces between pad units should be cleaned with solvent before the specified adhesive or sealant is applied.

c. Pads that are jointed with a tongue-and-groove system should be jacked in place so that the joint is under compression as recommended by the manufacturer.

d. The use of rubber plugs to fill stud holes in the pad type systems should be discontinued and flexible epoxy used instead. The holes should be solvent cleaned before filling.

e. Flexible epoxy should be used to fill the groove between the block-out wall and the pad device. This would give more protection to

the concrete edge and would absorb compressive forces when the device goes into compression.

f. The pad type systems would be greatly improved if pads were shop-vulcanized together to form at least a continuous 12-ft seal or furnished originally in 12-ft lengths. This would reduce the number of joints that must be sealed in the field. Development of a reliable field vulcanizing process to seal the remaining joints would be a vast improvement.

g. Curb and gutter sections should be prefabricated in the factory and vulcanized to the adjacent roadway pad.

h. Proper use of materials and method of installation is critical. State approved instructions should be provided by the manufacturer complete with material specifications, finished product specifications, and installation procedures. Field inspection must enforce compliance with these instructions.

Metal-Supported and Anchored Polychloroprene Compression Seals

This system depends upon compression of the seal against the sidewall of the metal support to prevent leakage, rather than upon a system of locking the seal into the support. Our experience indicates that the system is incapable of providing a watertight joint; therefore, we recommend that its usage be discontinued.

Metal-Supported and Anchored Polychloroprene or EPDM Continuous Element Extrusions

1) Systems which incorporate an elastomeric strip or 'convolution' as a continuous sealing element across both the expansion opening and the full bridge width effectively prevent leakage.

2) Compliance with manufacturers' instructions during installation is a requirement if the sealing system is to perform well.

3) Fabric reinforced strip seals are more tear resistant than those without reinforcement.

4) A method of positive mechanical anchoring of the seal element into the metal side channel better ensures that no intrusion occurs. Positive anchoring refers to a system which in some way maintains a compressive force upon the seal element other than that generated by simply inserting the seal element into a cavity in the side channel.

General Recommendations for All Systems

1) The system must extend the full width of the deck including any medians, sidewalks, and bridge rail areas. If a sliding plate is used in the walk area the system should be placed under the plate. The ends of the system should be turned up to prevent the water from dripping off the end. FHWA Notice N 5140.11 dated October 27, 1977, essentially recommended that the expansion dam sealing elements should be full width of the deck and continuous, thus eliminating the problems associated with field joints between expansion dam segments. We are currently following the installation and performance of these newer continuous element dams under Research Project 78 F-154.

2) The installation procedure should be carefully inspected to ensure that all materials and workmanship comply with the specifications.

APPENDIX

TABLE 1
TRANSFLEX JOINT SYSTEM SURVEY

Bridge				Joint							Ratings							
No.	Spans No.	Spans Total Length, ft	Location	No.	Skew Angle, deg	Contributing Length, ft	Theoretical Movement, in.	Model	Date Sealed	Depth, in.	General Appearance	Joints in System	Intruded Debris	Leaks	Damage	Ride Quality	Ride Noise	Comments
S08-03035	1	121	Rural	1	39	94	1.18	200A	5-73	0.12	Good	Good	None	---	None	Good	Quiet	Numerous minor snow removal damage areas.
S12-03035	1	121	Rural	1	42	90	1.13	200A	5-73	0.11	Good	Good	None	Sign	Yes	Good	Quiet	Numerous leaks; numerous minor snow removal damage areas.
S02-19043	5	472	Rural	2	30	150	1.87	200A	9-72	0.34	Good	Good	None	---	None	Good	Quiet	
				5	30	249	3.11	400A	9-72	0.34	Good	Fair	None	Sign	Yes	Good	Quiet	Snow removal equipment has caused slight damage; three leaks at joints in system.
S05-19043	2	253	Rural	2	0	253	3.16	400A	8-72	0.25	Fair	Fair	None	Sign	Yes	Good	Quiet	Extensive leaks; numerous minor snow removal damage areas; migration of center portion of pad toward edge of pad.
S01-19081	2	170	Rural	1	0	270	3.38	400A	1974	0.48	Fair	Good	None	Yes	Yes	Mod.	Quiet	Considerable spalls; numerous minor snow removal damage areas; some studs exposed.
X01-19081	3	150	Rural	1	30	141	1.77	200A	1974	0.23	Good	Good	None	None	None	Mod.	Quiet	
X02-19081	3	151	Rural	1	21	141	1.77	200A	1974	0.43	Good	Good	None	None	None	Mod.	Quiet	Joint performing well; all stud hole plugs still in place.
S08-25032	2	228	Urban	1	3	228	2.85	250	1974	0.13	Good	Good	None	---	None	Good	Quiet	
S02-41029	3	203	Urban	3	24	181	2.26	200A	10-72	0.15	Good	Good	None	---	Yes	Rough	Mod.	Rough ride due to high concrete.
S22-41029	2	240	Rural	2	2	240	3.00	400A	11-72	0.56	Fair	Fair	None	---	None	Rough	Noisy	Some separation and misaligned sections; poorly sealed areas; minor nicks in steel armor.
S01-41133	1	134	Rural	1	0	134	1.67	200A	1971	+	Fair	Good	None	---	Yes	Good	Quiet	Numerous minor snow removal damage areas; some very deep.
S02-41133	1	134	Rural	1	0	134	1.67	200A	1971	+	Poor	Good	None	---	Yes	Good	Mod.	Extensive damage by snow removal equipment; over 50 percent of joint length.
S03-41133	2	252	Rural	1	0	252	3.15	400A	1972	0.56	Fair	Fair	None	---	Yes	Rough	Mod.	Height difference between adjacent pads; damage by snow removal equipment exposing steel reinforcement.
S04-41133	3	177	Rural	1	53	106	1.32	200A	1971	0.34	Fair	Good	None	---	Yes	Mod.	Quiet	Deep gouging from snow removal equipment; damage to steel armor.
S05-41133	3	187	Rural	1	55	106	1.32	200A	1971	0.32	Fair	Good	None	---	Yes	Mod.	Quiet	Damage by snow removal equipment; tear almost to steel within transflex.
S01-50061	2	172	Urban	1	0	172	2.15	250	11-72	0.26	Fair	Fair	None	Sign	Yes	Good	Quiet	Separation at joints in system in short sections, torn edge on east side.
S03-50061	2	178	Urban	1	0	178	2.22	250	1973	0.26	Fair	Fair	None	Yes	Yes	Good	Quiet	Curb section coming apart; sections tilted and rolled and raised at edge by jacking too tightly.
S04-50061	2	187	Urban	1	18	178	2.22	250	1973	0.10	Fair	Good	None	None	None	Good	Quiet	Sections tilted and rolled; jacked too tightly causing abutted edges to rise up.
S44-50061	2	178	Urban	1	0	178	2.22	250	1973	0.30	Fair	Poor	None	Yes	Yes	Good	Quiet	Moderate damage by snow removal equipment; open gap through some joints in system.
S05-63103	5	670	Urban	2	3	392	4.90	650	6-72	0.40	Good	Good	None	None	None	--	--	Bridge not open to traffic.
				5	3	255	3.19	400A	7-72	0.27	Good	Good	None	None	None	--	--	
S10-63103	2	200	Urban	2	2	200	2.50	250	6-72	0.32	Fair	Poor	None	Sign	Yes	Good	Quiet	Excessive spalling; separation at joints in system; extensive leaks.
S11-63103	2	196	Urban	2	0	197	2.46	250	5-72	0.62	Good	Fair	None	Sign	Yes	Rough	Mod.	Separation at joint causing leak; rough ride due to excessive depth.
S12-63103	2	172	Urban	2	39	172	2.15	250	11-71	+	Fair	Poor	None	Sign	Yes	Good	Quiet	Excessive spalling; separation at joints; only minor damage by snow removal equipment; extensive leakage.
S13-63103	2	241	Urban	2	39	179	2.24	400A	8-72	0.10	Good	Fair	None	Yes	Yes	Good	Quiet	Snow removal equipment damage; separation at joints; poorly sealed between seal and concrete; short section placed with no tongue and groove.
S14-63103	2	172	Urban	1	0	172	2.15	250	10-72	0.28	Fair	Good	None	Yes	Yes	Good	Quiet	One section is tilted and the south edge has 'rounded'; leakage at curb.
S01-63191	2	287	Urban	2	10	228	2.85	400A	7-72	0.25	Fair	Good	None	Sign	Yes	Good	Quiet	Extensive leakage; considerable damage by snow removal equipment.
S02-63191	3	232	Rural	1	39	156	1.95	250	5-73	0.08	Fair	Good	None	Yes	Yes	Good	Quiet	Considerable damage by snow removal equipment; some deep gouging.
S04-63191	4	281	Rural	2	25	126	1.56	200A	7-72	0.20	Fair	Good	None	---	Yes	Good	Quiet	Three-inch gouge to steel and numerous other areas.
				4	25	128	1.61	200A	7-72	0.18	Fair	Good	None	---	Yes	Good	Quiet	Extensive damage by snow removal equipment; numerous spalls.
S05-63191	4	287	Urban	2	28	129	1.61	200A	10-72	0.16	Fair	Good	None	Yes	Yes	Good	Quiet	Damage by snow removal equipment on all joints.
				4	23	131	1.64	200A	10-72	0.28	Good	Good	None	Yes	Yes	Good	Quiet	
				6	23	131	1.64	200A	10-72	0.22	Good	Good	None	Yes	Yes	Good	Quiet	Not open to traffic.
				7	28	129	1.61	200A	10-72	0.28	Good	Good	None	Yes	Yes	Good	Quiet	Not open to traffic.
S07-63191	4	262	Urban	2	12	131	1.63	200A	9-72	0.20	Good	Good	None	Yes	Yes	Good	Quiet	Gouging and spalling by snow removal equipment on both joint Nos. 2 and 4; 8-in. tear to steel reinforcing.
				4	11	127	1.59	200A	9-72	0.20	Fair	Good	None	Sign	Yes	Good	Quiet	Bad leak at centerline between concrete and steel.
S08-63191	3	130	Urban	2	1	143	1.79	250	4-73	0.45	Good	Good	None	Yes	None	--	--	Bridge not open to traffic.
				3	1	130	1.63	250	4-73	0.29	Good	Good	None	Sign	None	--	--	Considerable spalling.
S09-63191	5	421	Rural	2	18	160	2.00	250	10-73	0.10	Good	Good	None	Sign	Yes	Good	Quiet	Numerous leaks.
				3	18	240	3.00	250	10-73	0.14	Fair	Good	None	Yes	Yes	Good	Quiet	Few sections badly tilted and torn horizontally down to reinforcing steel; other damage by snow removal equipment also.
S10-63191	5	399	Rural	2	2	157	1.96	250	10-72	0.14	Good	Fair	None	Sign	Yes	Rough	Quiet	Numerous leaks; major damage by snow removal equipment; two-ft of pad separation between neoprene and reinforcing steel.
				4	2	242	3.03	250	10-72	0.40	Good	Fair	None	Sign	Yes	Rough	Quiet	Numerous leaks; minor damage by snow removal equipment.

TABLE 1 (Cont.)
TRANSFLEX JOINT SYSTEM SURVEY

Bridge				Joint							Ratings							
No.	Spans No.	Spans Total Length, ft	Location	No.	Skew Angle, deg	Contributing Length, ft	Theoretical Movement, in.	Model	Date Sealed	Depth, in.	General Appearance	Joints in System	Intruded Debris	Leaks	Damage	Ride Quality	Ride Noise	Comments
S19-63191	4	270	Urban	2	8	124	1.55	200A	10-72	0.20	Good	Good	None	None	None	--	--	Bridge not open to traffic.
				4	8	142	1.78	200A	10-72	0.16	Good	Good	None	None	None	--	--	Block out poor; required epoxy patching and repairs.
B01-70024	3	192	Rural	1	30	166	2.08	200A	11-73	0.32	Good	Good	None	U	Yes	Mod.	Quiet	Minor damage by snow removal equipment.
B02-70024	3	192	Rural	1	30	166	2.08	250	10-73	0.25	Fair	Good	None	U	Yes	Mod.	Quiet	Numerous minor snow removal damage areas.
B03-70024	3	180	Rural	1	27	144	1.80	200A	5-74	0.30	Good	Good	None	U	Yes	Good	Quiet	Minor damage by snow removal equipment.
B04-70024	3	180	Rural	1	27	144	1.80	200A	7-74	0.42	Good	Good	None	U	Yes	Mod.	Quiet	Moderate gouging by snow removal equipment.
S01-70024	2	250	Rural	1	18	238	2.98	400A	10-72	0.05	Good	Good	None	---	Yes	Good	Quiet	Numerous minor snow removal damage areas; some major damage exposing steel reinforcement.
S03-70024	2	258	Rural	2	18	245	3.07	400A	6-73	0.16	Good	Good	None	---	Yes	Good	Quiet	Minor damage only.
S04-70024	2	178	Rural	1	34	149	1.86	200A	6-74	0.33	Fair	Good	None	---	Yes	Good	Quiet	Numerous minor snow removal damage areas; 8-in. tear down to steel.
S11-70024	3	125	Rural	1	28	111	1.38	200A	1973	0.21	Good	Good	None	---	Yes	Mod.	Quiet	Minor gouges and steel damage from snow removal equipment.
S12-70024	3	130	Rural	2	42	90	1.13	200A	5-73	0.32	Good	Good	None	---	Yes	Mod.	Quiet	Minor damage by snow removal equipment over full length of traffic lane.
S13-70024	4	279	Rural	1	24	128	1.60	200A	4-73	0.15	Good	Good	None	---	Yes	Good	Quiet	Minor scrapes and gouges in seal and steel.
				3	24	128	1.60	200A	4-73	0.12	Good	Good	None	---	Yes	Good	Quiet	Steel reinforcing and neoprene separated over 2 ft length.
S15-70024	2	171	Rural	1	30	149	1.86	200A	7-74	0.39	Good	Good	None	---	Yes	Mod.	Quiet	Minor damage by snow removal equipment.
S02-81063	4	354	Urban	2	48	177	2.21	200A	9-72	0.45	Good	Good	None	Sign	Yes	Rough	Mod.	Extensive leakage; minor scrapes.
				4	48	177	2.21	200A	10-72	0.28	Good	Good	None	Sign	Yes	Rough	Mod.	Extensive leakage; minor scrapes.
S36-82022	4	184	Urban	1	15	89	1.11	200A	1974	0.08	Good	Fair	None	Yes	Yes	Good	Quiet	Two joints in system with considerable separation; longitudinal seal cuts through transverse seal; moderate damage by snow removal equipment.
S06-82081	2	234	Urban	2	6	233	2.91	250	1972	0.05	Fair	Poor	None	Yes	Yes	Good	Quiet	Excessive separation of joints in material; badly spalled; damage by snow removal equipment.
				5	6	233	2.91	250	1972	0.60	Fair	Fair	None	Sign	Yes	Rough	Noisy	Partial separation at joints; numerous leaks; snow removal equipment damagn.
S01-82122	3	377	Urban	2	45	107	1.34	250	5-72	0.24	Good	Good	None	Sign	Yes	Mod.	Mod.	Gouge to depth of steel reinforcement by snow removal equipment; extensive leakage.
				3	45	159	1.99	250	5-72	0.36	Good	Good	None	Sign	Yes	Mod.	Mod.	Leakage over 90 percent of joint length, probably due in part to joints in system though they appear good.
S11-82122	2	167	Urban	2	0	167	2.09	200A	7-73	0.15	Poor	Fair	None	Sign	Yes	Mod.	Quiet	Snow removal equipment has torn neoprene exposing steel, steel delaminating under tear; sections loose, tilted and closed toward one side; extensive leakage; pads need replacing.
S12-82122	2	158	Urban	2	0	158	1.97	200A	8-73	0.30	Good	Fair	None	Sign	Yes	Good	Quiet	Curb section torn and leaking, other areas leaking also.
S13-82122	2	177	Urban	2	0	177	2.22	250	10-73	+	Fair	Poor	None	Sign	Yes	Good	Quiet	1/8-in. open gap through joint in system; very extensive leakage, one 15-ft section leaking; minor gouging by snow removal equipment.
S14-82122	2	157	Urban	2	0	157	1.97	200A	9-73	0.20	Fair	Fair	None	Sign	Yes	Good	Quiet	Section tilted and closed toward one side, delaminated between neoprene and steel reinforcing; very extensive leakage including two 6-ft long sections.
S19-82122	2	166	Urban	10	0	165	2.06	200A	1972	0.22	Good	Good	None	Sign	Yes	Good	Quiet	Extensive leakage; joints in system may be contributing factor.
				13	0	165	2.06	200A	1972	0.12	Good	Good	None	Sign	Yes	Good	Quiet	Extensive leakage.
S20-82122	2	139	Urban	2	6	239	2.99	250	7-72	0.21	Fair	Good	None	Yes	Yes	Good	Quiet	Extensive damage by snow removal equipment; leakage at curbs and two joints in systems.
S21-82122	2	130	Urban	2	2	231	2.88	400A	5-72	0.22	Fair	Good	None	Yes	Yes	Good	Quiet	Snow removal equipment damage has exposed steel.
				5	2	231	2.88	400A	6-72	0.30	Good	Good	None	Yes	Yes	Good	Quiet	Minor damage by snow removal equipment.
				7	2	231	2.88	400A	5-72	0.25	Good	Good	None	No	Yes	Good	Quiet	Minor damage by snow removal equipment.
				8	2	231	2.88	400A	6-72	0.30	Fair	Good	None	No	Yes	Good	Quiet	Top of curb section has been almost removed by snow removal equipment.
S30-82122	2	167	Urban	2	0	167	2.08	200A	7-73	0.23	Poor	Poor	None	Sign	Yes	Mod.	Quiet	Sections jacked too tightly; high and tilted and warping; torn badly and steel reinforcing loose; two sections (including tilted pads) equalling 8 ft are leaking; two pads need replacing.
S31-82122	2	167	Urban	2	0	167	2.08	200A	7-73	0.18	Poor	Poor	None	Yes	Yes	Good	Quiet	Short sections tilted and closed to one side; tight jacking has raised abutting edge of adjacent pads and this edge has been torn by snow removal equipment; several leaks.
S32-82122	2	157	Urban	2	0	157	1.97	200A	7-73	0.16	Fair	Fair	None	Sign	Yes	Good	Quiet	Section is tilted, closed toward one side, and delaminated at steel reinforcing; continuous leaking over 12-ft length; numerous scrapes in seal.
S33-82122	2	157	Urban	2	0	157	1.97	200A	10-73	0.16	Fair	Fair	None	Sign	Yes	Good	Quiet	Snow removal equipment has gouged and exposed studs; continuous leakage over 8-ft length; section has tilted and is delaminated between neoprene and steel reinforcement.
S24-82123	2	228	Urban	2	21	226	2.82	250	7-72	0.37	Fair	Poor	None	Sign	Yes	Good	Quiet	Sections in the material are not tightly butted and have increased separation; extensive leakage; very minor damage to seal.
S07-82191	4	193	Rural	2	7	131	1.64	200A	8-72	0.10	Good	Fair	None	---	Yes	Good	Quiet	Minor damage by snow removal equipment.

TABLE 2
WABOFLEX JOINT SYSTEM SURVEY

Bridge				Joint							Ratings							
No.	Spans No.	Spans Total Length, ft	Location	No.	Skew Angle, deg	Contributing Length, ft	Theoretical Movement, in.	Model	Date Sealed	Depth, in.	General Appearance	Joints in System	Intruded Debris	Leaks	Damage	Ride Quality	Ride Noise	Comments
S02-03035	5	330	Rural	1	11	170	2.12	SR 2.5	1974	F	Good	Good	None	---	Yes	Good	Quiet	Extensive minor damage by snow removal equipment.
				2	11	84	1.05	SR 2	1974	+	Good	Good	None	---	Yes	Good	Quiet	Extensive though minor scraping where seal is high.
S04-03035	2	250	Rural	1	0	125	1.56	SR 2.5	9-74	0.15	Fair	Poor	None	---	None	Good	Quiet	Joints in system are not jacked together tightly.
				2	0	125	1.56	SR 2.5	9-74	0.15	Fair	Poor	None	---	Yes	Good	Quiet	Slight damage by snow removal equipment; joints in system not tightly jacked.
S05-03035	2	253	Rural	1	0	127	1.58	SR 2.5	10-74	0.25	Fair	Good	None	---	None	Good	Quiet	Considerable spalling.
				2	0	127	1.58	SR 2.5	10-74	0.23	Fair	Good	None	---	None	Good	Quiet	Considerable spalling.
S06-03035	2	244	Rural	2	4	241	3.02	SR 4	11-72	0.24	Fair	Good	None	---	Yes	Good	Mod.	Extensive damage by snow removal equipment; sealant failing in adhesion between pad and side wall concrete.
S07-03035	5	397	Rural	2	47	121	1.51	SR 2	9-73	0.30	Fair	Good	None	---	Yes	Good	Quiet	Sealant between pad and concrete sides failed in adhesion; moderate damage by snow removal equipment.
				3	47	198	2.48	SR 4	9-73	0.14	Fair	Good	None	---	Yes	Good	Quiet	Snow removal equipment ripped out one pad, replaced with a different style of SR.
S04-58171	4	330	Urban	1	30	138	1.72	SR 2	8-74	0.24	Fair	Poor	None	Sign	None	Good	Quiet	Extensive leakage.
				3	30	148	1.85	SR 2	8-74	0.32	Fair	Poor	None	Sign	None	Good	Quiet	Extensive leakage; open gaps through joints in system.
S05-58171	3	224	Rural	2	23	188	2.35	SR 2.5	7-74	F	Poor	Poor	None	Sign	Yes	Good	Quiet	Height difference between pads; tongue-and-groove interconnects are loose; two studs lost and one pad loose; sealant adhesion lost; slight damage to aluminum by snowremoval equipment.
S11-58171	3	224	Rural	2	23	188	2.35	SR 2.5	7-74	F	Fair	Poor	None	Sign	None	Good	Quiet	Extensive leakage; very little compression between joints in system.
S08-64015	3	331	Rural	1	13	192	2.40	SR 2.5	1976	0.25	Good	Good	None	---	None	Good	Quiet	Epoxy in stud wells is great improvement over plugs.
				2	13	129	1.62	SR 2	1976	0.20	Good	Good	None	---	None	Good	Quiet	Epoxy (3/4 in. width) between concrete and seal.
X01-64015	4	269	Rural	1	35	117	1.47	SR 2	1976	0.10	Fair	Fair	None	---	None	Good	Quiet	Considerable tilting of pads.
				2	35	104	1.30	SR 2	1976	0.10	Fair	Fair	None	---	None	Good	Quiet	Some misalignment of pads.
X03-64015	4	269	Rural	1	35	117	1.47	SR 2	1976	0.25	Good	Good	None	---	None	Good	Quiet	Epoxy in stud hole wells instead of caps.
				2	35	104	1.30	SR 2	1976	0.25	Good	Good	None	---	None	Good	Quiet	
S09-81075	3	141	Urban	1	7	42	0.53	SR 2	9-75	0.18	Fair	Fair	None	U	None	Good	Quiet	5/8-in. height differential between two pads caused interconnect to separate; concrete pavement header breaking up allowing leakage.
				2	7	42	0.53	SR 2	9-75	0.20	Fair	Fair	None	U	None	Good	Noisy	Separation at joints in system on all four joints.
				3	7	104	1.30	SR 2	9-75	0.22	Fair	Fair	None	U	None	Good	Quiet	
				4	7	104	1.30	SR 2	9-75	0.10	Fair	Fair	None	U	None	Good	Quiet	
S37-82022	4	430	Rural	1	15	208	2.59	SR 2.5	7-74	0.22	Poor	Poor	None	Sign	None	Good	Quiet	Pads tilted and rotated vertically; all joints in system leak.
				2	15	208	2.59	SR 2.5	7-74	0.19	Fair	Poor	None	Sign	None	Good	Quiet	All joints in system leak.
S17-82122	2	200	Urban	1	0	200	2.50	SR 2.5	1976	0.25	Good	Fair	None	Sign	None	Good	Quiet	Over one-third of joint length is leaking.
S18-82122	2	207	Urban	1	0	206	2.58	SR 2.5	1976	0.22	Good	Good	None	Sign	None	Good	Quiet	Epoxy in stud hole wells and between pads and concrete side walls; significant leakage.
CS82-240	3	156	Urban	1	30	94	1.18	SR 2.5	7-73	0.33	Poor	Poor	None	U	Yes	Good	Quiet	Aluminum shows some traffic wear, sections are misaligned horizontally and vertically and are not abutted tightly; sealant between pad and side wall cracked, spalled, and lost adhesion.
S11-82291	4	360	Urban	1	0	158	1.97	SR 2	1974	0.12	Good	Good	None	Sign	None	Good	Quiet	Extensive leakage; numerous spalls in adjacent concrete; adhesion failure of sealant
				2	0	202	2.53	SR 2.5	1974	0.25	Fair	Good	None	Sign	None	Good	Quiet	between pads and concrete side walls.
S14-82291	4	360	Urban	1	0	158	1.97	SR 2	1974	0.32	Good	Poor	None	Sign	Yes	Good	Noisy	Extensive leakage at joints in system; adhesion loss in sealant.
				2	0	203	2.53	SR 2.5	1974	0.48	Good	Poor	None	Sign	Yes	Rough	Noisy	Extensive leakage at joints in system; adhesion loss in sealant.
				3	0	158	1.97	SR 2	1974	0.19	Good	Good	None	Sign	None	-----	---	Joint Nos. 3 and 4 not open to traffic.
				4	0	203	2.53	SR 2.5	1974	0.30	Good	Good	None	Sign	None	-----	---	
S01-82292	2	290	Urban	1	13	290	3.62	SR 4	1975	0.25	Fair	Good	None	---	Yes	Good	Quiet	Minor scrapes by snow removal equipment.
S02-82292	2	292	Urban	1	0	292	3.65	SR 4	1975	0.26	Good	Good	None	---	None	Good	Quiet	Side walls sealed with two-component material, looks much better than old material or when left unsealed; plugs gone.
S05-82292	2	268	Urban	1	5	268	3.35	SR 4	1975	0.22	Good	Good	None	---	None	Good	Quiet	Plugs gone.
S08-82292	4	296	Urban	1	1	180	2.25	SR 2.5	1974	0.25	Fair	Fair	None	Sign	None	Good	Quiet	Not open to traffic; leakage over 70 percent of joint length; horizontal misalignment developing.
S11-82292	2	269	Urban	1	0	269	3.36	SR 4	1975	0.20	Good	Good	None	---	None	Good	Quiet	All plugs gone.
S15-82292	2	180	Urban	1	1	180	2.25	SR 2.5	1974	0.56	Fair	Good	Yes	Sign	None	Good	Quiet	Edge of pad rolling allowing dirt infiltration; 100 percent of joint length leaking; numerous spalled areas.
S01-82293	4	326	Urban	1	19	153	1.91	SR 2	1974	0.20	Poor	Fair	Yes	Sign	Yes	Good	Mod.	Extensive leaks; adhesion failure of sealant; damage by snow removal equipment allow-
				2	19	156	1.94	SR 2	1974	0.30	Poor	Fair	Yes	Sign	Yes	Good	Mod.	ing dirt infiltration; 100 percent of joint length leaking on 2nd joint; pads are migrating.
S02-82293	4	326	Urban	1	19	157	1.96	SR 2	1974	0.30	Fair	Poor	None	Sign	None	Good	Quiet	Adhesion failure of sealant; leaking full length; open gap through joint in system; mis-
				2	19	151	1.88	SR 2	1974	0.30	Fair	Fair	None	Sign	None	Good	Quiet	alignment of sections; pad moving leaving gaps along sides where sealant lost.

TABLE 2 (Cont.)
WABOFLEX JOINT SYSTEM SURVEY

Bridge				Joint							Ratings							Comments
No.	Spans No.	Spans Total Length, ft	Location	No.	Skew Angle, deg	Contributing Length, ft	Theoretical Movement, in.	Model	Date Sealed	Depth, in.	General Appearance	Joints in System	Intruded Debris	Leaks	Damage	Ride Quality	Ride Noise	
S03-82293	2	262	Urban	1	0	262	3.28	SR 4	1974	F	Fair	Fair	None	Sign	None	Good	Mod.	Leaking full length; sealant failed in adhesion; some sections are misaligned.
S04-82293	4	345	Urban	1	34	151	1.88	SR 2	1974	0.10	Fair	Poor	None	Sign	None	Good	Quiet	100 percent of both joints is leaking; sealant between concrete side wall and pad has
				2	34	151	1.88	SR 2	1974	0.10	Fair	Poor	None	Sign	None	Good	Quiet	failed in adhesion and been removed by traffic.
X01-82293	3	280	Urban	2	41	155	1.94	SR 2	1974	0.30	Poor	Fair	Yes	Sign	Yes	Good	Quiet	Extensive adhesion failure of bonlastic allowing dirt and water infiltration; some sections badly misaligned and migrating, leaking full length of joint; snow plow damage.
X03-82293	3	280	Urban	2	41	155	1.94	SR 2	1974	0.10	Fair	Fair	None	Sign	Yes	Good	Quiet	Extensive adhesion failure of bonlastic sealant; deep gouge from snow removal equipment; minor misalignment of sections; leaking full length.
B02-82293	2	170	Urban	1	20	170	2.12	SR 2	1973	0.30	Good	Good	None	U	None	Good	Quiet	
B03-82293	2	170	Urban	1	20	170	2.12	SR 2	1973	0.25	Fair	Good	None	U	None	Good	Quiet	

TABLE 3
FELSPAN JOINT SYSTEM SURVEY

Bridge				Joint							Ratings							Comments
No.	Spans No	Spans Total Length, ft	Location	No.	Skew Angle, deg	Contributing Length, ft	Theoretical Movement, in.	Model	Date Sealed	Depth, in.	General Appearance	Joints in System	Intruded Debris	Leaks	Damage	Ride Quality	Ride Noise	
S03-13081	4	256	Rural	1	0	126	1.58	T 20	4-74	0.17	Good	Poor	None	U	None	Good	Quiet	One-half of joints in system have failed in adhesion; some cracking and shrinking of sealant between pad and concrete side walls, does not appear to be standard sealant.
S04-13081	4	256	Rural	1	6	129	1.61	T 20	4-74	0.25	Good	Good	None	U	None	Good	Quiet	
				2	6	126	1.58	T 20	4-74	0.15	Good	Fair	None	U	None	Good	Quiet	Three joints in system have lost adhesion in the convolution.
B01-13082	4	275	Rural	7	30	138	1.71	T 30	9-72	0.27	Good	Good	None	U	None	Good	Quiet	New header and joint installed in 1977.
S06-13082	4	258	Rural	1	4	128	1.60	T 30	8-72	0.36	Good	Fair	None	U	Yes	Mod.	Mod.	Slight damage by snow removal equipment; one interconnect not sealing; some cracking and adhesion failure in edge and plug hole sealant.
S08-13082	4	238	Rural	5	1	129	1.61	T 30	8-72	0.50	Good	Good	None	U	None	Rough	Quiet	Poor approach is causing rough ride.
S01-18024	3	197	Rural	1	30	171	2.14	T 30	9-74	0.14	Fair	Poor	None	Yes	Yes	Good	Quiet	Joints in system have failed in cohesion; snow removal equipment has rounded off a portion of the inside edge and caused a moderate gouge.
S02-18024	3	200	Rural	1	28	176	2.20	T 30	9-74	0.12	Poor	Poor	Yes	Sign	Yes	Good	Quiet	Extensive damage by snow removal equipment exposing studs and also to curb and barrier; open puncture through convolution caused during installation by construction equipment; dirt and water infiltration through interconnects.
S05-18024	6	468	Rural	1	3	234	2.93	T 30	6-74	0.23	Good	Fair	None	Sign	Yes	Good	Quiet	Gouging by snow removal equipment and leakage through joints in system.
				2	3	234	2.93	T 30	6-74	0.20	Fair	Poor	None	Sign	Yes	Good	Quiet	Studs exposed by snow removal equipment damage; extensive leakage through joints in system.
X01-18024	3	138	Rural	1	0	138	1.72	T 30	9-74	0.28	Fair	Poor	None	Sign	Yes	Good	Quiet	Damage by snow removal equipment has exposed studs; leakage through several interconnects and at curb.
X02-18024	3	138	Rural	1	0	138	1.72	T 30	9-74	+	Fair	Poor	None	Yes	Yes	Good	Quiet	Interconnects leaking; stud well sealant cracking; minor damage by snow removal equipment.
B01-23152	3	269	Rural	1	0	268	3.36	T 30	4-73	0.42	Fair	Fair	None	U	None	Mod.	Mod.	Joints in system are not tightly abutted; some high studs.
S02-25032	4	181	Urban	2	0	123	1.54	T 20	10-75	0.36	Good	Good	None	---	None	Good	Quiet	Some height difference between pads.
S05-25042	4	226	Rural	1	3	113	1.41	T 30	1974	0.28	Good	Poor	None	---	Yes	Good	Quiet	Some joints in system have failed in adhesion; minor to moderate damage.
				2	3	113	1.41	T 30	1974	0.30	Good	Fair	None	---	Yes	Good	Quiet	Moderate height differential at centerline between joints in system, sealed well though.
B1-33-6-24	2	234	Urban	1	0	234	2.93	T 40	12-75	0.15	Good	Good	None	U	None	Good	Quiet	Problem contouring convolution in curb area to fit adjacent pad, had to fill with sealant.
B01-34032	5	375	Urban	1	0	150	1.88	T 20	1976	0.23	Good	Good	None	U	None	Good	Quiet	New interconnects with Vel Cro on this bridge.
				2	0	113	1.41	T 20	1976	0.53	Good	Good	None	U	None	Good	Quiet	
				3	0	113	1.41	T 20	1976	0.60	Good	Good	None	U	None	Good	Quiet	
S11-39022	4	238	Urban	2	51	205	2.56	T 30	2-73	F	Fair	Poor	None	---	Yes	Good	Quiet	Most joints in system have failed in cohesion; numerous minor damage by snow removal equipment.
B01-50021	2	90	Rural	2	20	80	1.00	T 30	1973	0.24	Good	Good	None	---	None	Good	Quiet	Studs protruding through top of stud well sealant due to shrinkage.
S03-50062	2	190	Urban	1	25	172	2.15	T 30	2-74	0.22	Good	Poor	None	Sign	Yes	Good	Quiet	Very extensive leakage (northbound lanes only); minor damage by snow removal equipment; interconnects have been repaired but are still leaking.
X01-56021	10	672	Urban	3	30	204	2.55	T 30	9-74	0.25	Good	Fair	None	U	None	Good	Quiet	Few joints in system have failed in cohesion at the convolution.
CS56-12-26	-	---	Rural	1	--	---	--	T 30	1976	--	Good	Poor	None	U	None	Good	Quiet	Numerous narrow spalls.
				2	--	---	--	T 30	1976	--	Good	Poor	None	U	None	Good	Quiet	Studs high.

TABLE 3 (Cont.)
FELSPAN JOINT SYSTEM SURVEY

Bridge				Joint							Ratings							Comments
No.	Spans No.	Spans Total Length, ft	Location	No.	Skew Angle, deg	Contributing Length, ft	Theoretical Movement, in.	Model	Date Sealed	Depth, in.	General Appearance	Joints in System	Intruded Debris	Leaks	Damage	Ride Quality	Ride Noise	
S08-58152	4	189	Rural	2	13	189	2.36	T 30	7-76	0.26	Good	Good	None	---	None	Good	Quiet	
S07-58171	2	288	Rural	1	0	288	3.60	T 40	6-75	0.25	Good	Good	None	---	None	Good	Quiet	
S08-58171	2	288	Rural	1	0	288	3.60	T 40	7-76	0.20	Good	Poor	None	---	None	Good	Quiet	Some of the joints in system have failed in adhesion.
S01-61074	4	180	Rural	1	3	90	1.11	T 30	4-74	0.19	Good	Good	None	None	None	Good	Quiet	Two studs exposed due to shrinkage in stud well sealant.
				2	3	90	1.11	T 30	4-74	0.14	Fair	Good	None	None	Yes	Good	Quiet	North curb torn and raised up; bad gouge from snow removal equipment.
S02-64014	3	363	Rural	1	15	108	1.35	T 30	1976	0.29	Good	Fair	None	None	None	Mod.	Mod.	Two interconnects bad.
				2	15	255	3.19	T 30	1976	0.30	Good	Good	None	None	None	Mod.	Mod.	
S07-64014	3	347	Rural	1	0	105	1.31	T 30	3-74	0.25	Good	Good	None	Yes	None	Good	Quiet	Slight leakage; minor damage to steel armor.
				2	0	242	3.03	T 30	3-74	0.43	Good	Fair	None	Yes	None	Good	Quiet	Dripping through one joint in system; minor damage to steel armor.
S04-64015	2	268	Rural	1	0	268	3.35	T 40	1976	F	Good	Good	None	---	Yes	Good	Quiet	Minor scrapes; plugs badly cracked.
B1-6-5-15	3	84	Rural	1	60	84	1.05	T 20	8-77	0.25	Good	Good	None	U	None	Good	Quiet	Special installation of factory vulcanized pads, excellent job.
X01-73075	3	183	Rural	1	41	138	1.73	T 30	1974	0.18	Fair	Good	None	---	Yes	Good	Quiet	Loss of epoxy to top of stud and cracked epoxy over studs; very minor scrape in seal.
				2	41	138	1.73	T 30	1974	0.27	Good	Good	None	---	None	Good	Quiet	
S02-73171	4	300	Rural	1	53	120	1.50	T 20	1976	0.41	Good	Good	None	---	None	Good	Quiet	
				2	53	120	1.50	T 20	1976	0.35	Good	Good	None	---	None	Good	Quiet	Some studs high and exposed.
B1-73-26-20	-	---	Urban	1	--	---	---	T 20	1976	--	Good	Good	None	U	None	Good	Quiet	
B1-78-12-1	-	---	Rural	1	--	---	--	T 20	1976	0.43	Good	Good	None	---	None	Good	Quiet	New interconnects with Vel Cro.
				2	---	---	--	T 20	1976	0.43	Good	Good	None	---	None	Good	Quiet	
S02-80023	4	227	Rural	1	2	113	1.42	T 30	1976	0.26	Good	Good	None	U	None	Good	Quiet	New interconnects with Vel Cro.
				2	2	113	1.42	T 20	1976	0.22	Good	Good	None	U	None	Good	Quiet	
S07-80023	4	243	Rural	1	21	113	1.42	T 30	1973	0.28	Good	Good	None	U	Yes	Good	Quiet	Minor damage by snow removal equipment; stud well sealant crackod.
S03-81041	4	303	Urban	1	12	147	1.84	T 30	2-74	0.30	Fair	Poor	None	Sign	None	Good	Quiet	Extensive leakage, interconnects up to 1/2 in. width opening at top and failed in adhesion.
				2	12	137	1.71	T 30	2-74	0.22	Fair	Poor	None	Sign	None	Good	Quiet	In addition to above the stud well sealant is cracked and lost some adhesion.
S04-81062	2	218	Urban	1	3	217	2.72	T 30	9-75	0.27	Fair	Good	None	None	Yes	Good	Quiet	Snow removal equipment has gnuged joint exposing a stud and spalling concrete.
S05-81062	4	227	Urban	1	0	227	2.84	T 30	10-73	0.38	Fair	Fair	None	Yes	None	Mod.	Quiet	Some gaps in joints in system; four field cut short sections with no overlap.
				2	0	227	2.84	T 30	9-73	0.30	Fair	Fair	None	None	Yes	Mod.	Quiet	Joint is closed too tightly causing vertical bowing and breaking of bonds at interconnects; 6 ft of moderate scrapes and spalling.
S12-81103	4	333	Rural	1	21	148	1.85	T 20	1976	0.05	Good	Good	None	Yes	None	Good	Quiet	Ramp B, northbound; considerable leakage both joints.
				2	21	138	1.73	T 20	1976	0.30	Good	Fair	None	Yes	None	Good	Quiet	One bad joint in system at centerline.
				1	21	148	1.85	T 20	1976	0.20	Good	Good	None	Yes	None	Good	Quiet	Ramp C, southbound.
				2	21	138	1.73	T 20	1976	0.20	Good	Good	None	Sign	None	Good	Quiet	Leaking in several locations including curb area.
S01-82021	2	260	Urban	1	0	260	3.25	T 40	10-75	0.38	Good	Fair	None	Yes	None	Good	Quiet	Moderate leakage; one-third of interconnects have failed.
S02-82021	2	264	Rural	1	0	264	3.30	T 40	1975	0.14	Fair	Fair	None	Sign	Yes	---	---	Not open to traffic; one split 6-in. long in seal, joints in system leak; some stud well sealant is cracked; stress cracking in some pads.
S17-82022	1	125	Urban	1	5	125	1.56	T 20	1976	0.26	Poor	Good	Yes	---	Yes	Good	Quiet	Headwall moved after joint was installod; joint is too tight (in overtravel) and is bowed upward where it was badly torn down to steel by snow removal equipment.
S03-82024	4	237	Urban	4	5	118	1.48	T 20	4-74	0.22	Fair	Fair	None	Yes	None	Good	Quiet	Height differential at centerline; bolts protruding through cracked stud well sealant; two joints in material were repsired but still failed in cohesion.
S02-82122	2	179	Urban	1	0	179	2.23	T 30	1976	0.18	Good	Good	None	Sign	None	Good	Quiet	Five areas leaking.
S03-82122	2	179	Urban	1	0	179	2.23	T 30	1976	0.27	Good	Good	None	Yes	None	Good	Quiet	Leakage at two locations; joint is closod tightly and bowing up at center.
S06-82122	2	179	Urban	1	0	179	2.23	T 30	1976	0.42	Fair	Good	None	Sign	None	Good	Quiet	Five areas are leaking.
S07-82122	2	176	Urban	1	0	176	2.20	T 30	1976	0.25	Fair	Poor	None	Sign	None	Good	Quiet	Pads tilted causing south side to be high; some interconnects have failed in adhesion; very extensive leakage; east curb section is torn at top portion.
S08-82122	2	177	Urban	1	0	176	2.20	T 30	1976	0.25	Fair	Fair	None	Sign	None	Good	Quiet	Few interconnects have failed in adhesion; extensive leakage; two of four curb sections are torn at top; field splices are very bad.
S09-82122	2	177	Urban	1	0	176	2.20	T 30	1976	0.37	Fair	Good	None	Sign	None	Good	Quiet	Extensive leakage, probably attributable to joints in system though appear to be good; joint is closed tight and bowed up; cracks in bolt hole material.
S10-82122	2	176	Urban	1	0	176	2.20	T 30	1976	0.28	Good	Fair	None	Sign	None	Good	Quiet	Extensive leakage; slight crack in curb section.
S15-82122	2	200	Urban	1	0	200	2.50	T 30	1976	0.05	Good	Fair	None	Yes	None	Good	Quiet	Several areas are leaking.
S16-82122	2	177	Urban	1	4	176	2.20	T 30	12-75	0.33	Good	Fair	None	Sign	None	Good	Quiet	Extensive leakage though joints in system were inspected and found to have maintained adhesion; subsequent inspections revealed a few bad interconnects.

TABLE 3 (Cont.)
FELSPAN JOINT SYSTEM SURVEY

Bridge No.	Spans No.	Spans Total Length, ft	Location	Joint No.	Skew Angle, deg	Contributing Length, ft	Theoretical Movement, in.	Model	Date Sealed	Depth, in.	Ratings: General Appearance	Joints in System	Intruded Debris	Leaks	Damage	Ride: Quality	Ride: Noise	Comments
S26-82122	2	220	Urban	1	6	230	2.88	T 30	5-76	0.23	Good	Fair	None	Yes	Yes	Good	Quiet	One interconnect has completely failed in adhesion; three areas leaking badly.
S27-82122	2	176	Urban	1	0	176	2.20	T 30	1976	F	Good	Poor	None	Sign	None	Good	Quiet	Interconnects have failed badly in adhesion; four areas leaking.
S28-82122	2	176	Urban	1	0	176	2.20	T 30	1976	0.28	Fair	Poor	None	Sign	None	Good	Quiet	Adjacent female pads are too far apart requiring a patch over the interconnect, patch has failed and can see through opening; extensive leakage.
S29-82122	2	172	Urban	1	0	172	2.15	T 30	1976	0.26	Good	Good	None	Yes	None	Good	Quiet	Several areas leaking including one curb area; one interconnect is bad; crack in curb section.
S34-82122	2	177	Urban	1	0	176	2.20	T 30	1976	0.18	Good	Fair	None	Yes	None	Good	Quiet	Two interconnects are leaking; one curb sections is cracked.
S35-82122	2	177	Urban	1	0	176	2.20	T 30	1976	0.25	Good	Fair	None	Yes	None	Good	Quiet	Moderate leakage.
S01-82291	2	286	Rural	1	0	286	3.58	T 40	6-75	0.22	Good	Fair	None	---	None	Good	Quiet	Three joints in system have partially failed in adhesion; stud well sealant did not harden properly.
S02-82291	2	286	Rural	1	0	286	3.58	T 40	8-75	0.10	Fair	Poor	None	Yes	Yes	Good	Quiet	Leakage at curb; minor damage by snow removal equipment; block out problems required extensive epoxy patching; some height differences and tilting between pads.
S03-82291	2	295	Rural	1	0	295	3.69	T 40	1975	0.06	Fair	Poor	None	Yes	None	Mod.	Quiet	Curb section is leaking; height differences between sides and rolling.
S05-82291	2	288	Rural	1	0	288	3.60	T 40	7-75	0.25	Good	Poor	None	Yes	None	Good	Quiet	Many joints in system have failed.
S06-82291	2	288	Rural	1	0	288	3.60	T 40	8-75	0.14	Good	Poor	None	---	None	Good	Quiet	Five joints in system have failed.
S07-82291	2	288	Rural	1	0	288	3.60	T 40	8-75	0.13	Good	Poor	None	Sign	None	Good	Quiet	Extensive leakage, cracks and air bubbles in stud well sealants.
S10-82291	4	402	Rural	2	27	143	1.79	T 30	7-75	0.30	Good	Poor	None	Sign	Yes	Good	Quiet	Joints in system have failed in adhesion and are no longer sealed; 2-ft moderate gouges.
				3	27	214	2.68	T 30	7-75	0.34	Fair	Poor	None	Sign	Yes	Mod.	Mod.	Moderate damage by snow removal equipment; moderate ride due to concrete height differences.
S18-82291	4	344	Rural	1	16	194	2.42	T 30	1976	0.18	Good	Good	None	---	Yes	Good	Quiet	Snow removal equipment gouged 2-ft section exposing studs.
				2	26	151	1.88	T 30	1976	0.20	Good	Good	None	---	None	Good	Quiet	Numerous spalls.
Camp 10 Rd	-	---	Rural	1	0	---	--	T 20	1976	F	Good	Poor	None	---	None	Good	Quiet	Joint has been covered with asphalt.
Morgan Rd	-	---	Rural	1	0	---	--	T 20	1976	0.25	Good	Good	None	---	None	Good	Quiet	New interconnects with Vel Cro, completely sealed.
S03-82292	2	288	Urban	1	0	288	3.60	T 40	1975	0.16	Good	Good	None	---	None	Good	Quiet	One interconnect is bad.
S06-82292	2	291	Rural	1	6	291	3.62	T 40	1976	0.20	Good	Poor	None	---	None	Good	Quiet	All interconnects have failed, can see through some to roadway below.
S07-82292	2	290	Rural	1	0	290	3.62	T 40	1976	0.15	Good	Poor	None	---	None	Good	Quiet	All interconnects have failed in adhesion.

TABLE 4
MODULAR COMPRESSION JOINT SYSTEM SURVEY

Bridge No.	Spans No.	Spans Total Length, ft	Location	Joint No.	Skew Angle, deg	Contributing Length, ft	Theoretical Movement, in.	Model	Date Sealed	Depth, in.	Ratings: General Appearance	Joints in System	Intruded Debris	Leaks	Damage	Ride: Quality	Ride: Noise	Comments
S22-82122	4	277	Urban	2	0	137	1.71	Double	1972	F	Good	None	None	Sign	None	Good	Quiet	Uneven compression between neoprene seals; entire joint length leaks.
				4	0	137	1.71	Double	1972	F	Good	None	None	Sign	None	Good	Quiet	Several drips over entire length of joint.
S23-82122	4	382	Urban	2	38	203	2.54	Double	1972	F	Good	None	None	Sign	None	Good	Quiet	Uneven compression of seals; leakage at sidewalk where modular system ends and other areas.
				4	38	178	2.23	Double	1972	+	Good	None	None	Sign	None	Good	Quiet	Center channel high and tilted; leakage over 60 percent of joint.
S12-82123	4	281	Urban	2	20	118	1.48	Double	1971	F	Good	None	None	Yes	None	Good	Quiet	Leaks at curb where modular system ends, three other leaks also.
				4	20	118	1.48	Double	1971	F	Good	None	None	Yes	None	Good	Quiet	Leaks at centerline and at curb.
S13-82123	4	331	Urban	2	37	89	1.11	Single	1971	F	Fair	None	None	Sign	Yes	Good	Quiet	Small tear through seal; leakage bad at curb where modular system ends; 100 percent leaking on double.
				3	37	153	1.91	Double	1971	F	Good	None	None	Sign	None	Good	Quiet	Uneven compression between neoprene seals; seal is pushed down to 1.45 in. below top of steel.
				4	37	89	1.11	Single	1971	F	Fair	None	None	Sign	Yes	Good	Quiet	Small tear through seal, factory splice at centerline is failing; numerous spalls.
S14-82123	4	286	Urban	2	15	143	1.79	Double	1971	F	Good	None	None	Sign	None	Good	Quiet	Leaking full length of joint.
				4	15	143	1.79	Double	1971	F	Good	None	None	Sign	None	Good	Quiet	Leaking full length of joint.
S15-82123	4	284	Urban	2	13	78	0.98	Single	1971	+	Good	None	Yes	Sign	Yes	Good	Quiet	Dirt and water infiltration along sides.
				3	13	130	1.63	Double	1971	F	Good	None	None	Sign	Yes	Good	Quiet	Joint leaking along full length.
				4	13	75	0.94	Single	1971	F	Good	None	Yes	Sign	Yes	Good	Quiet	Much dirt and water infiltration along sides, seal pulling away in spots, 100 percent leaking.
S16-82123	4	392	Urban	2	45	141	1.76	Double	1971	+	Good	None	None	Sign	None	Good	Quiet	Uneven compression, center rail high, extensive leakage over full length of joint.
				4	45	141	1.76	Double	1971	+	Good	None	None	Sign	None	Good	Quiet	Extensive leakage over full length of joint.

TABLE 4 (Cont.)
MODULAR COMPRESSION JOINT SYSTEM SURVEY

Bridge No.	Spans No.	Spans Total Length, ft	Location	Joint No.	Skew Angle, deg	Contributing Length, ft	Theoretical Movement, in.	Model	Date Sealed	Depth, in.	Ratings: General Appearance	Joints in System	Intruded Debris	Leaks	Damage	Ride: Quality	Ride: Noise	Comments
S17-82123	4	305	Urban	2	7	153	1.91	Double	1971	F	Good	None	None	Sign	None	Good	Quiet	Extensive leakage.
				4	7	150	1.88	Double	1971	F	Good	None	None	Sign	None	Good	Quiet	Extensive leakage.
S18-82123	4	303	Urban	2	2	150	1.87	Double	1971	F	Good	None	None	Sign	None	Good	Quiet	Uneven compression between seals; continuous leakage over 12 ft length.
				4	2	154	1.92	Double	1971	F	Good	None	None	Yes	None	Good	Quiet	Approximately 20 percent of joint length is leaking.
S12-82293	6	694	Rural	3	25	271	3.39	Triple	1971	+	Fair	None	None	Sign	None	Mod.	Mod.	Center steel rail was 0.3 in. higher than edge rails, but is leveling out somewhat; north edge is 1/2 in. higher in center track; numerous leaks.

TABLE 5
DELASTIFLEX JOINT SYSTEM SURVEY

Bridge No.	Spans No.	Spans Total Length, ft	Location	Joint No.	Skew Angle, deg	Contributing Length, ft	Theoretical Movement, in.	Model	Date Sealed	Depth, in.	Ratings: General Appearance	Joints in System	Intruded Debris	Leaks	Damage	Ride: Quality	Ride: Noise	Comments
S07-11017	3	157	Rural	1	4	107	1.34	MT/CP 200	1976	F	Good	None	None	U	None	Good	Quiet	
S01-13081	4	330	Rural	5	37	130	1.62	DL 300	1972	0.05	Poor	Fair	Yes	U	Yes	Good	Quiet	Snow removal equipment has torn through the seal and created other numerous damage areas; dirt has intruded in the longitudinal joint in system.
S02-13082	3	122	Urban	1	21	74	0.92	MT/CP 200	1976	0.23	Good	None	None	None	None	Good	Quiet	
S05-13082	4	311	Urban	1	39	130	1.62	MT 300	1974	F	Poor	None	Yes	U	Yes	Good	Quiet	Extensive areas of tears through the seal (one tear is over 6 ft long) and increasing yearly;
				5	39	113	1.41	MT 300	1974	F	Poor	None	Yes	U	Yes	Good	Mod.	extensive open spalls with anchoring bolts exposed.
S08-13082	4	258	Rural	5	4	129	1.61	MT 200	1976	0.18	Good	None	None	U	None	Good	Quiet	
S06-13083	4	227	Rural	1	0	114	1.42	MT/CP 300	1973	F	Fair	None	Yes	U	Yes	Good	Quiet	Numerous tears through seal, sections of seal coming out of channel, dirt intrusion.
				2	0	114	1.42	MT/CP 300	1973	F	Fair	None	None	U	Yes	Good	Quiet	Over 7 ft torn seal and aluminum, 5 ft of seal completely out by channel, dirt intrusion.
S11-13083	4	227	Urban	1	0	114	1.42	MT/CP 200	1976	0.25	Good	None	None	U	None	Good	Quiet	
S04-19022	4	248	Rural	1	17	118	1.48	DL 300	6-73	0.20	Poor	Poor	Yes	U	Yes	Good	Quiet	Snow removal equipment has torn through the seal for 5 in.; dirt has intruded entire depth of seal in areas and is also in the longitudinal joint in system.
B02-23151	3	303	Rural	1	0	206	2.58	MT/CP 300	1976	0.21	Good	None	None	---	None	Mod.	Quiet	
S01-25042	4	226	Rural	1	2	113	1.41	MT/CP 200	1976	0.20	Good	None	None	---	None	Good	Quiet	
				2	2	113	1.41	MT/CP 200	1976	0.20	Good	None	None	---	None	Good	Quiet	
S04-25042	4	226	Rural	1	0	113	1.41	MT/CP 200	1976	F	Good	None	None	---	None	Good	Quiet	
S03-38102	3	118	Rural	1	0	118	1.48	MT/CP 200	1976	0.30	Good	None	None	U	None	Good	Mod.	Some "slapping" noise.
S14-50061	6	164	Urban	1	2	171	2.14	MT 300	1977	F	Good	None	None	---	None	Good	Quiet	
				2	23	192	2.40	MT 300	1977	F	Good	None	None	---	Yes	Good	Quiet	Minor nick in aluminum; 5 in. of seal out of aluminum edge channel.
				3	31	252	3.15	MT 300	1977	F	Good	None	None	---	Yes	Good	Quiet	Gouge in aluminum-seal-epoxy.
S01-56023	3	167	Urban	1	32	84	1.05	MT/CP 200	1976	F	Good	None	None	U	Yes	Good	Quiet	Narrow scrape through seal.
				2	32	84	1.05	MT/CP 200	1976	F	Good	None	None	U	Yes	Good	Quiet	Ten ft of minor scrapes in seal.
S04-58152	4	332	Urban	1	32	132	1.65	MT 200	1976	F	Good	None	None	---	Yes	Good	Quiet	Minor scrapes in seal; epoxy mixed improperly—badly cracked and cheesy.
				2	32	145	1.81	MT 200	1976	F	Good	None	None	---	Yes	Good	Quiet	Moderate 8 in. scrape and gouge to aluminum and seal, additional tears and lengthening.
S01-64015	3	181	Rural	1	27	161	2.01	MT 200	1976	0.18	Good	None	None	---	None	Good	Quiet	Snow plow damage to aluminum only; epoxy backfill good.
S02-64015	3	179	Rural	1	25	162	2.03	MT 200	1976	0.15	Good	None	None	---	Yes	Good	Quiet	One very minor scrape.
S03-64015	3	115	Rural	1	15	111	1.39	MT 200	6-76	F	Good	None	None	---	Yes	Good	Quiet	Epoxy fill between pad and concrete; minor damage to aluminum lip and seal.
S06-64015	3	150	Rural	1	7	149	1.86	MT 200	7-76	F	Good	None	None	---	Yes	Good	Quiet	Few areas of aluminum damaged by snow removal equipment.
S07-64015	3	121	Rural	1	6	121	1.51	MT 200	7-76	F	Good	None	None	---	Yes	Good	Quiet	Epoxy fill between pad and concrete; minor damage to aluminum lip, numerous minor scrapes in seal caused by snow removal equipment; numerous damage to aluminum and epoxy.
S17-64015	3	115	Rural	1	15	111	1.39	MT 200	6-76	0.10	Good	None	None	---	Yes	Good	Quiet	Epoxy fill between pad and concrete is good; minor gouge in aluminum and seal.
S03-67015	5	404	Rural	1	15	138	1.73	MT 200	1976	F	Good	None	Yes	---	Yes	Good	Quiet	Minor scrapes in seal, one 8-in. tear through seal with dirt intrusion
				2	15	253	3.16	MT 300	1976	F	Good	None	None	---	None	Good	Quiet	
S04-67015	1	151	Rural	1	7	151	1.89	MT 200	1976	F	Good	None	Yes	---	Yes	Good	Quiet	Serious damage; bad gouge and 2 ft tear through seal allowing dirt intrusion.
S05-67015	1	148	Rural	1	13	148	1.85	MT 200	1976	F	Good	None	Yes	---	Yes	Good	Quiet	Serious damage; large gouge and 2-1/2 ft tear through seal with dirt intrusion.

TABLE 5 (Cont.)
DELASTIFLEX JOINT SYSTEM SURVEY

Bridge				Joint							Ratings							Comments
No.	Spans No.	Spans Total Length, ft	Location	No.	Skew Angle, deg	Contributing Length, ft	Theoretical Movement, in.	Model	Date Sealed	Depth, in.	General Appearance	Joints in System	Intruded Debris	Leaks	Damage	Ride Quality	Ride Noise	
S13-81103	4	326	Urban	1	29	144	1.80	MT 200	1976	0.11	Good	None	None	None	None	Good	Quiet	
				2	29	141	1.76	MT 200	1976	0.15	Good	None	None	None	Yes	Good	Quiet	Several minor gouges in aluminum.
S14-81103	4	324	Urban	1	28	147	1.83	MT 200	1976	0.16	Good	None	None	None	Yes	Good	Quiet	One minor gouge in aluminum.
				2	28	141	1.76	MT 200	1976	0.13	Good	None	None	None	Yes	Good	Quiet	Minor scrapes in aluminum.
S15-81103	4	301	Urban	1	19	144	1.80	MT 200	1976	0.15	Good	None	None	None	None	Good	Quiet	
				2	19	141	1.76	MT 200	1976	0.13	Good	None	None	None	Yes	Good	Quiet	Epoxy has hairline cracks - typical; few minor scrapes in aluminum.
S03-82024	4	237	Urban	2	5	118	1.48	DL 300	10-72	F	Poor	Poor	Yes	Yes	Yes	Good	Mod.	Extensive dirt intrusion between seal and aluminum and in longitudinal joint in system; extensive tearing through the seal by snow removal equipment; sections moving ununiformly, neoprene seal was replaced in 1977 and is beginning to show same problems.
S02-82102	4	304	Urban	1	19	147	1.84	MT 200	1976	0.11	Good	None	None	None	None	Good	Quiet	Epoxy lost some bond with aluminum.
				2	19	141	1.76	MT 200	1976	0.17	Good	None	None	None	None	Good	Quiet	
S09-82112	4	171	Urban	2	15	82	1.02	DL 300	10-72	F	Poor	Poor	Yes	Yes	Yes	Good	Quiet	Dirt intrusion between seal and aluminum; longitudinal joint is completely separated in areas by dirt; some tears through seal; uneven compression of seals--one nearly flat, DSB feels due to unequal properties of rubber; neoprene seal was replaced in 1977.
				4	15	82	1.02	DL 300	10-72	F	Poor	Poor	Yes	Yes	Yes	Good	Quiet	
X02-83031	3	157	Rural	1	--	157	1.96	MT 200	1976	F	Fair	None	None	---	Yes	Good	Quiet	Moderate damage to aluminum and seal, 6 in. tear through seal.

TABLE 6
TYPE 190 (MODIFIED WABO-MAURER) JOINT SYSTEM SURVEY

Bridge				Joint							Ratings							Comments
No.	Spans No.	Spans Total Length, ft	Location	No.	Skew Angle, deg	Contributing Length, ft	Theoretical Movement, in.	Model	Date Sealed	Depth, in.	General Appearance	Joints In System	Intruded Debris	Leaks	Damage	Ride Quality	Ride Noise	
S07-18024	7	489	Rural	1	15	120	1.50	Single	1974		Good	None	None	None	None	Good	Quiet	
				2	15	222	2.78	Single	1974		Good	None	None	None	None	Good	Quiet	
				3	15	130	1.63	Single	1974		Good	None	None	None	None	Good	Quiet	
S09-18024	7	490	Rural	1	15	130	1.62	Single	1974		Good	None	None	None	None	Good	Quiet	Some tilting causing north side to be 1/4-in. higher.
				2	15	222	2.53	Single	1974		Good	None	None	None	None	Good	Quiet	Some tilting causing south side to be 1/4-in. higher.
				3	15	121	1.51	Single	1974		Good	None	None	None	None	Good	Quiet	
B03-58034	3	250	Rural	1	24	228	2.85	Double	1976		Good	None	None	U	None	Good	Quiet	Center channel is slightly lower than side supports, compression is uniform.
S01-58171	4	275	Rural	2	0	195	2.44	Single	1974		Good	None	None	---	None	Good	Quiet	
S06-58171	4	371	Rural	1	29	158	1.97	Single	1974		Good	None	None	---	None	Good	Quiet	Some tilting.
				3	29	165	2.07	Single	1974		Good	None	None	---	None	Good	Quiet	Some tilting.
S09-58171	4	347	Rural	1	26	152	1.90	Single	1975		Good	None	None	---	None	Good	Quiet	
				2	26	160	1.99	Single	1975		Good	None	None	---	None	Good	Quiet	
X01-58171	3	187	Rural	1	13	187	2.34	Single	1975		*	None	None	None	None	Good	Quiet	*Additional armor has been welded above Nel Jo and filled with two-component sealant to match latex overlay.
X02-58171	3	145	Rural	1	19	90	1.12	Single	1975		Good	None	None	None	None	Good	Quiet	
X03-58171	3	187	Rural	1	0	187	2.34	Single	1975		*	None	None	None	None	Good	Quiet	*Additional armor has been welded above Nel Jo and filled with two-component sealant to match latex overlay.
X04-58171	3	145	Rural	1	19	90	1.12	Single	1975		Good	None	None	None	None	Good	Quiet	
S01-64014	1	110	Rural	1	26	99	1.24	Single	1975		Good	None	None	None	None	Good	Quiet	Joint width varies considerably.
S03-64014	4	319	Rural	1	27	142	1.78	Single	1976		Good	None	None	None	None	Good	Quiet	Some tilting.
				2	27	142	1.78	Single	1976		Good	None	None	Sign	None	Good	Quiet	Leakage over one-half of joint length; some tilting.
S05-64014	1	152	Rural	1	0	152	1.90	Single	1976		Good	None	None	None	None	Good	Quiet	
S06-64014	1	152	Rural	1	0	152	1.90	Single	1976		Good	None	None	None	None	Good	Quiet	
S08-64014	1	110	Rural	1	26	99	1.24	Single	1975		Good	None	None	None	None	Good	Quiet	
X01-64014	3	177	Rural	1	38	139	1.74	Single	1975		Good	None	None	None	None	Good	Quiet	
X02-64014	3	174	Rural	1	34	143	1.79	Single	1975		Good	None	None	None	None	Good	Quiet	
B02-70041	7	595	Rural	7	0	96	1.20	Single	1972		Good	None	None	---	None	Good	Quiet	

TABLE 6 (Cont.)
TYPE 190 (MODIFIED WABO-MAURER) JOINT SYSTEM SURVEY

Bridge				Joint							Ratings							Comments
No.	Spans No.	Spans Total Length, ft	Location	No.	Skew Angle, deg	Contributing Length, ft	Theoretical Movement, in.	Model	Date Sealed	Depth, in.	General Appearance	Joints in System	Intruded Debris	Leaks	Damage	Ride Quality	Ride Noise	
B05-73051	3	110	Rural	2	0	75	0.93	Single	1972		Good	None	None	U	None	Good	Quiet	
				3	0	35	0.44	Single	1972		Good	None	None	U	None	Good	Quiet	
S04-82122	2	176	Urban	1	0	176	2.20	Single	1976		Good	None	None	None	None	Good	Quiet	
S05-82122	2	179	Urban	1	11	179	2.24	Single	1976		Good	None	None	None	None	Good	Quiet	
S36-82122	2	176	Urban	1	0	176	2.20	Single	1976		Good	None	None	None	None	Good	Quiet	
S37-82122	2	176	Urban	1	0	176	2.20	Single	1976		Good	None	None	None	None	Good	Quiet	
S38-82122	2	176	Urban	1	0	176	2.20	Single	1976		Good	None	None	None	None	Good	Quiet	
S39-82122	2	176	Urban	1	0	176	2.20	Single	1976		Good	None	None	None	None	Good	Quiet	
S40-82122	2	176	Urban	1	0	176	2.20	Single	1976		Good	None	None	None	None	Good	Quiet	
S41-82122	2	176	Urban	1	0	176	2.20	Single	1976		Good	None	None	None	None	Good	Quiet	
S42-82122	2	176	Urban	1	0	176	2.20	Single	1976		Good	None	None	None	None	Good	Quiet	
B01-82291	4	296	Rural	1	15	136	1.70	Single	1975		Good	None	None	U	None	Good	Quiet	
				2	31	160	1.88	Single	1975		Good	None	None	U	None	Good	Quiet	
B02-82291	4	285	Rural	1	25	127	1.59	Single	1975		*	None	Yes	U	None	Good	Quiet	Joint widths vary considerably, joint in skew and rotation (due to headwall movement problems) causing seal to pull out of channel with much dirt intrusion; problem is not fault of seal but caused by headwall problem.
				2	18	135	1.68	Single	1975		*	None	Yes	U	None	Good	Quiet	
S04-82291	4	306	Rural	1	41	151	1.89	Single	1975		Good	None	Yes	None	Yes	Good	Quiet	6-in. tear through top of seal with dirt and water intrusion.
				2	41	156	1.94	Single	1975		Good	None	None	None	None	Good	Quiet	
S08-82291	3	210	Rural	1	48	141	1.76	Single	1975		Good	None	None	None	None	Mod.	Quiet	Height difference from one side to other.
S09-82291	1	137	Rural	1	23	126	1.58	Single	1975		*	None	None	---	None	Good	Quiet	*Additional armor has been welded above Nel Jo and filled with two-component sealant to match latex overlay.
S13-82291	3	201	Rural	1	46	141	1.76	Single	1975		*	None	None	None	None	Good	Quiet	*Additional armor has been welded above Nel Jo and filled with two-component sealant to match latex overlay.
S15-82291	1	126	Rural	1	23	126	1.58	Single	1975		Good	None	None	---	None	Good	Quiet	
X01-82291	3	180	Rural	1	31	105	1.31	Single	1975		Good	None	None	None	None	Good	Quiet	
X03-82291	3	190	Rural	1	31	104	1.31	Single	1975		*	None	None	None	None	Good	Quiet	*Additional armor has been welded above Nel Jo and filled with two-component sealant to match latex overlay.
B01-82292	4	228	Rural	1	41	126	1.58	Single	1975		Good	None	None	U	None	Good	Quiet	
				2	49	101	1.26	Single	1975		Good	None	None	U	None	Good	Quiet	
B04-82292	3	106	Rural	1	35	87	1.09	Single	1976		Good	None	None	U	None	Good	Quiet	
B05-82292	4	243	Rural	1	24	137	1.71	Single	1975		Good	None	None	U	None	Good	Quiet	
				2	24	105	1.31	Single	1975		Good	None	None	U	None	Good	Quiet	
B06-82292	3	106	Rural	1	35	87	1.09	Single	1976		Good	None	None	U	None	Good	Quiet	
S04-82292	1	120	Urban	1	0	120	1.50	Single	1975		Good	None	None	---	None	Good	Quiet	
S10-82292	1	120	Urban	1	0	120	1.50	Single	1975		Good	None	None	---	None	Good	Quiet	Joint is opened wide to 2.0 in.

TABLE 7
WABO-MAURER STRIP SEAL JOINT SYSTEM SURVEY

Bridge				Joint							Ratings							Comments
No.	Spans No.	Spans Total Length, ft	Location	No.	Skew Angle, deg	Contributing Length, ft	Theoretical Movement, in.	Model	Date Sealed	Depth, in.	General Appearance	Joints in System	Intruded Debris	Leaks	Damage	Ride Quality	Ride Noise	
B01-41542	-	---	Urban	1	0	---	--	SB 400	1976	F	Good	None	None	---	None	Good	Quiet	
			Urban	2	0	---	--	SB 400	1976	F	Fair	None	Yes	---	None	Good	Quiet	Seal has pulled out of channel for 1 ft on south side.
S03-70016	4	200	Rural	1	26	90	1.12	SB 200	4-73	F	Good	None	None	U	None	Good	Quiet	Three ft of epoxy has been replaced, presently in good condition.
				5	26	90	1.12	SB 200	4-73	F	Good	None	None	U	None	Good	Quiet	Nine ft of epoxy has been replaced, presently in good condition.
S03-38103	3	112	Rural	1	2	77	0.96	SA 300	1976	F	Good	None	None	None	None	Good	Quiet	

TABLE 7 (Cont.)
WABO-MAURER STRIP SEAL JOINT SYSTEM SURVEY

Bridge				Joint							Ratings							Comments
No.	Spans No.	Spans Total Length, ft	Location	No.	Skew Angle, deg	Contributing Length, ft	Theoretical Movement, in.	Model	Date Sealed	Depth, in.	General Appearance	Joints in System	Intruded Debris	Leaks	Damage	Ride Quality	Ride Noise	
X01-29011	3	167	Urban	1	31	94	1.19	SB 200	1976	F	Good	None	None	---	None	Good	Quiet	
				2	31	94	1.19	SB 200	1976	F	Good	None	None	---	None	Good	Quiet	
S01-29011	3	134	Urban	1	0	98	1.22	SB 200	1976	F	Good	None	None	---	None	Good	Quiet	
				2	0	98	1.22	SB 200	1976	F	Good	None	None	---	None	Good	Quiet	
S04-29011	3	144	Urban	1	30	143	1.79	SB 400	1976	F	Good	None	None	---	None	Good	Quiet	
				2	30	143	1.79	SB 400	1976	F	Good	None	None	---	None	Good	Quiet	

TABLE 8
ONFLEX JOINT SYSTEM SURVEY

Bridge				Joint							Ratings							Comments
No.	Spans No.	Spans Total Length, ft	Location	No.	Skew Angle, deg	Contributing Length, ft	Theoretical Movement, in.	Model	Date Sealed	Depth, in.	General Appearance	Joints in System	Intruded Debris	Leaks	Damage	Ride Quality	Ride Noise	
S10-58034	4	171	Rural	1	10	84	1.05	25	5-77	F	Good	None	None	---	None	Good	Quiet	Aluminum extrusion type.
B03-82191	--	---	Urban	1	--	--	-----	--	1976	F	Good	None	None	---	None	Good	Quiet	Maintenance type, top of convolution is 2 in. below deck.
				2					1976	F	Good	None	None	---	None	Good	Quiet	Maintenance type, top of convolution is 2 in. below deck.