

**RESEARCH PROJECT NO. RP 97-052 A & B  
EVALUATION OF MODULAR EXPANSION DAM  
FINAL REPORT**

**May 2008**

**FINAL REPORT**

**PREPARED BY:  
ROBIN SUKLEY, P.E.**



**Engineering Technology and Information Division  
BUREAU OF CONSTRUCTION & MATERIALS  
PENNSYLVANIA DEPARTMENT OF TRANSPORTATION**

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## Conversion Table

<i>TO CONVERT FROM</i>	<b>TO</b>	<b>MULTIPLY BY</b>
Length		
foot (ft)	meter (m)	0.3048
inch (in)	millimeter (mm)	25.4
yard (yd)	meter (m)	0.9144
mile (statute)	kilometer (km)	1.609
Area		
square foot (ft <sup>2</sup> )	square meter (m <sup>2</sup> )	0.0929
square inch (in <sup>2</sup> )	square centimeter (cm <sup>2</sup> )	6.451
square yard (yd <sup>2</sup> )	square meter (m <sup>2</sup> )	0.8361
Volume		
cubic foot (ft <sup>3</sup> )	cubic meter (m <sup>3</sup> )	0.02832
cubic yard (yd <sup>3</sup> )	cubic meter (m <sup>3</sup> )	0.7646
gallon (U.S. liquid)**	cubic meter (m <sup>3</sup> )	0.003785
gallon (Canadian liquid)**	cubic meter (m <sup>3</sup> )	0.004546
ounce (U.S. liquid)	cubic centimeter (cm <sup>3</sup> )	29.57
Mass		
ounce-mass (avdp)	gram (g)	28.35
pound-mass (avdp)	kilogram (kg)	0.4536
ton (metric)	kilogram (kg)	1000
ton (short, 2000 lbm)	kilogram (kg)	907.2
Density		
Pound-mass/cubic foot (lbm/ft <sup>3</sup> )	Kilogram/cubic meter (kg/m <sup>3</sup> )	16.02
pound-mass/cubic yard (lbm/yd <sup>3</sup> )	Kilogram/cubic meter (kg/m <sup>3</sup> )	0.5933
pound-mass/gallon (U.S.) (lbm/gal)**	Kilogram/cubic meter (kg/m <sup>3</sup> )	119.8
pound-mass/gallon (Canadian) (lbm/gal)**	Kilogram/cubic meter (kg/m <sup>3</sup> )	99.78
Temperature		
Celsius (°C)	Kelvin (°K)	$T_K = T_C + 273.15$
Fahrenheit (°F)	Kelvin (°K)	$T_K = \frac{5}{9}(T_F + 459.67)$
Fahrenheit (°F)	Celsius (°C)	$T_C = \frac{5}{9}(T_F - 32)$

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**EVALUATION OF  
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**May 2008**

**PREPARED BY:  
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**CONDUCTED BY:**

**Pennsylvania Department of Transportation**

**Bureau of Construction and Materials**

**Engineering Technology and Information Division**

**Engineering Support Section**

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## EXECUTIVE SUMMARY

The subject research project covers the field evaluation of the Modular Expansion Dam (MEJ) manufactured by Acme Watson Bowman. Three summarized sections of this report were used to provide the information to approve its use Design, Construction, and Performance Summaries.

The Design of this expansion dam included modification to the anchorage points from the modular dams tested under research project RP 87-037. It is the researchers opinion that additional modifications to the neoprene seal could possible trap less debris. Also modification to the underside dam structure is recommended to deter any bird nesting within the dam and bridge substructure itself.

Two sites were used for the evaluation of this dam system. The first was retrofitted into the bridge deck. The deck rebar was field modified to fit the size of the dam. The 1<sup>st</sup> site also held a trough underneath the dam to channel any water away. This trough prevented any detailed inspection of the dam from underneath. The 2<sup>nd</sup> site did not have the trough modification problems.

Field testing consisted of a Water Tightness Integrity Test after construction on the 2<sup>nd</sup> site and annual inspection looking at 6 criteria; General Appearance, Anchorage, Debris, Water tightness, Surface Damage, Noise. In particular the visual welds and spring area were closely inspected for distress which could merit remedial action.

PENNDOT would like to include the design life of the springs in the Bridge Management System (BMS) so that the owner can replace springs as a routine maintenance activity prior to failure. The manufacturer's representative was asked about the useful life of the spring assembly. The manufacturer advised that the springs are designed to have the same design life as the rest of the MEJ. Instead of scheduling replacement of the springs it is recommended that all elements of the joint be inspected periodically. This will require that the inspectors be knowledgeable in the functioning of the joint and the various parts of the MEJ. The joint is usually inspected from the topside only and there are telltales of joint performance that can make this sufficient.

Signs to look for:

- center beam should be equidistant from the extrusions within a 0.25 inch tolerance
- unusual sounds heard under traffic
- neoprene strip seal gland should be continuously held in the extrusion
- deck concrete should not spall or crack at the joint

All of these are indications that there may be problems and an underside inspection is warranted.

The modular expansion dam performance is satisfactory and it is recommended for further use.

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## INTRODUCTION

Modular expansion dams have been in use for three decades, past problems with these systems have been with welds, anchorage, and maintenance. RP No.87-037 found that the modular expansion dam had problems in maintaining the neoprene elements in their proper position and also with the support members. The MEJ has been reengineered since the RP87-37 study. The new design was demonstrated on two bridge structures in Pennsylvania. The design configuration, a miscommunication between District and central office, made site **A** (see figure 1) data very limited and this report is mainly concentrated on site **B** (see figure 2).

The first structure ( site **A**) was in District 12-0, SR 119 (B11), CMS No. 121145 in Fayette County. This structure sits over the Cheat River. This subject MEJ had a trough attached at the bottom in order to keep any water off the abutments. The MEJ was at the north end of the bridge Abutment 2 a Strip seal dam was placed at Abutment 1. The 2<sup>nd</sup> structure ( site **B**) was in District 6-0, at the Airport, in Philadelphia. The research project site was located on SR 0095 (AIR) construction of a new ramp to Philadelphia airport. The CMS 065336 contract was awarded to Driscoll-Belbold, LLC Joint venture. The let date was 7/06/2000, Notice To Proceed was 8/18/2000. This report will touch on the District 12-0 project and focus on the 2<sup>nd</sup> structure in district 6-0 whose data was much more extensive.

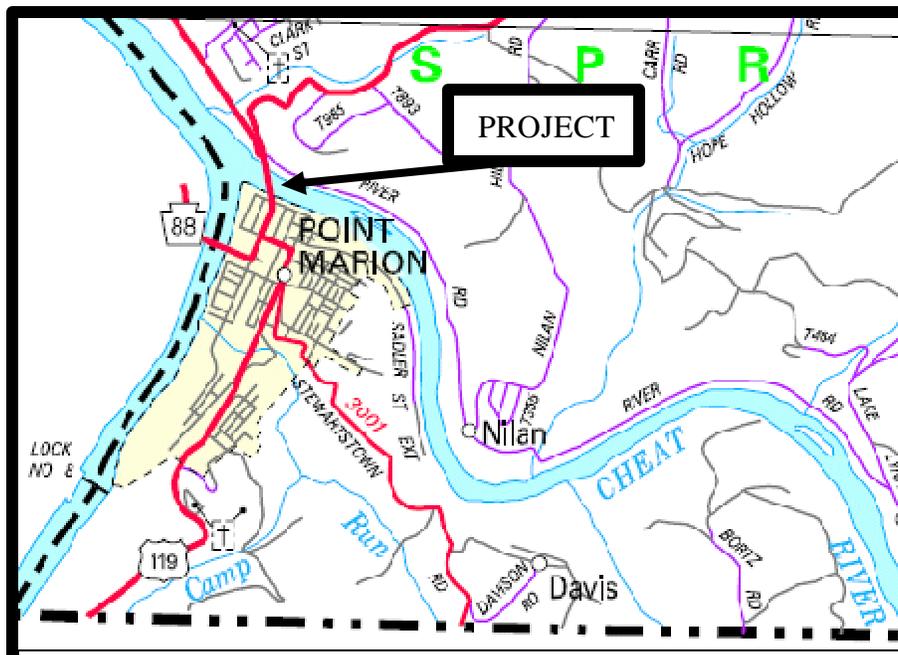
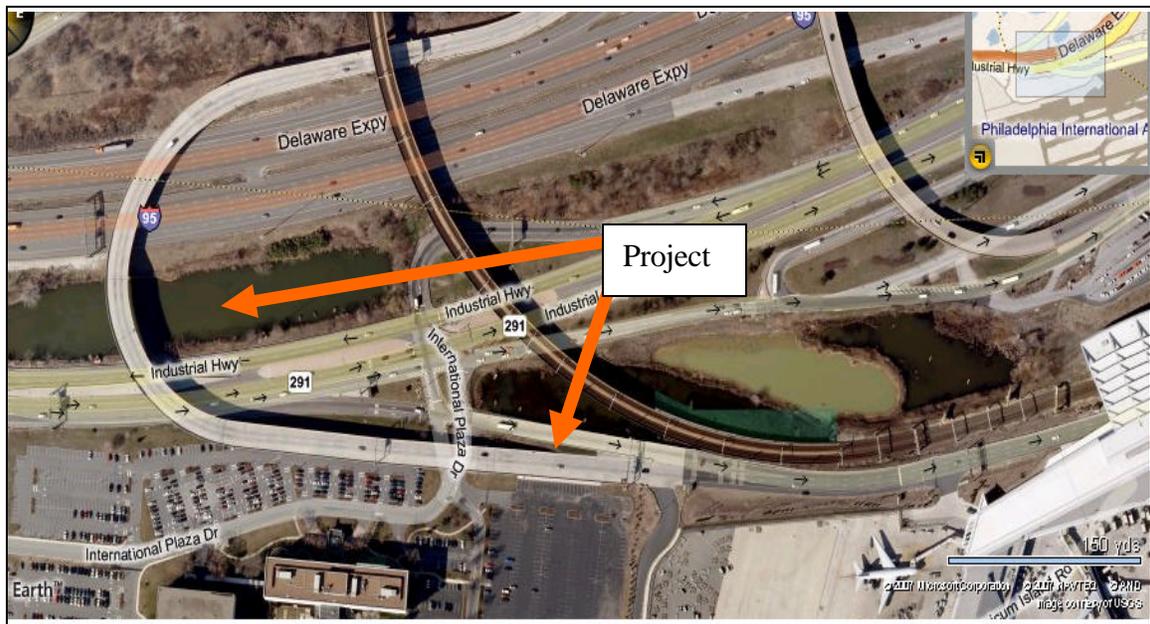


Figure 1 FAYETTE COUNTY SITE A LOCATION MAP SR 119,



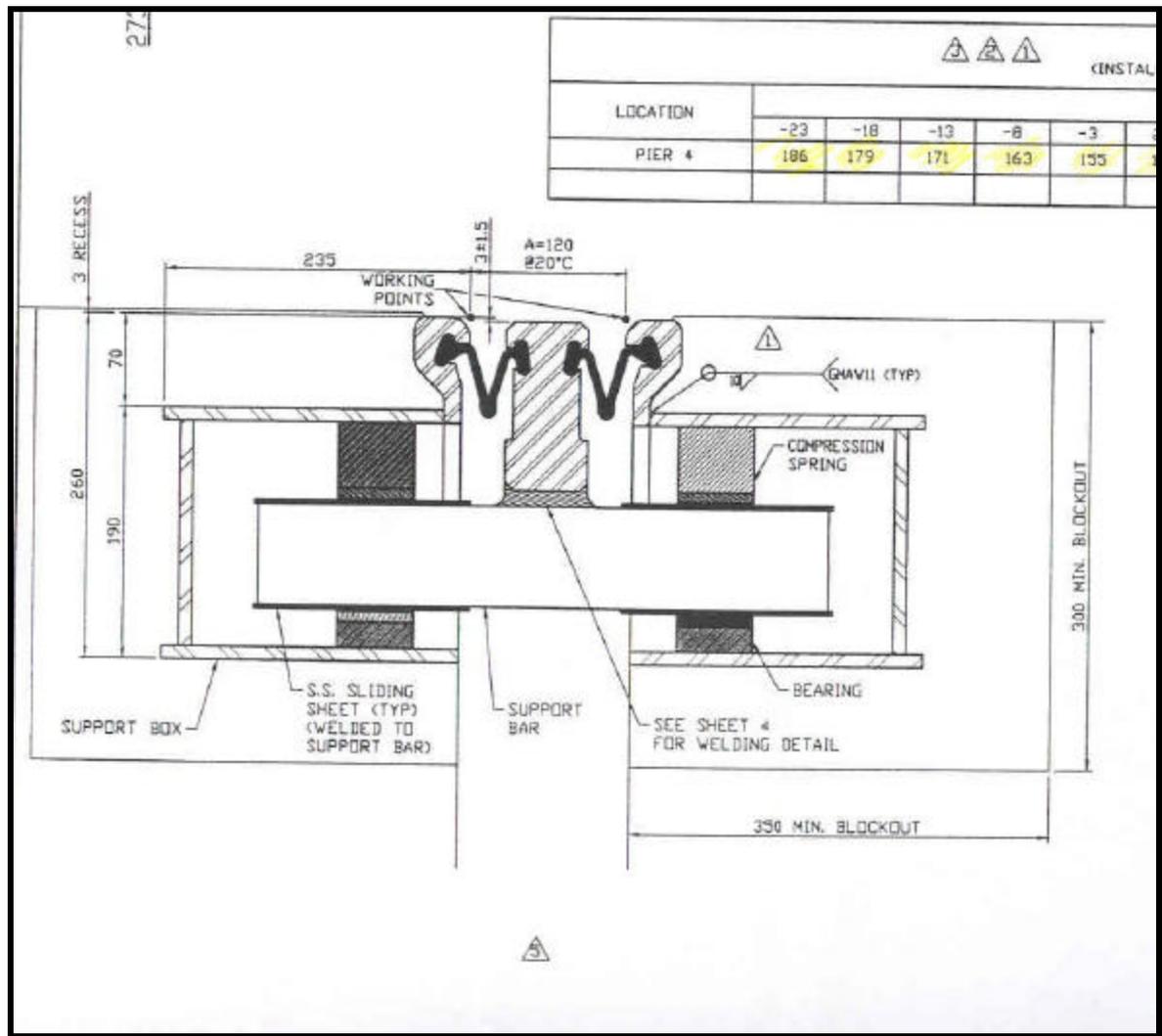
**FIGURE 2 SITE B COMPLETED PHILADELPHIA AIRPORT RAMP LL**



**FIGURE 3 LOCATION HYBRID MAP SR 95 AIRPORT RAMP LL, DELAWARE / PHILADELPHIA COUNTIES**

## DESIGN SUMMARY

The design calculations for both projects were reviewed, and verified, and accepted by Districts 12-0, and 6-0 respectively, and Central office Bridge Quality Assurance, Bureau of Design in accordance with NCHRP Report 12-40. A proposed AASHTO specification developed by NCHRP, which utilizes AASHTO loads and impact factors and fatigue design provisions was utilized (see Appendix B). A typical section showing the modular joint is shown in Figure 3.



**FIGURE 4 MODULAR JOINT SCHEMATIC**

PENNDOT would like to include the design life of the springs in the BMS system so that the owner can replace springs as a routine maintenance activity prior to failure. The manufacturer's representative was asked about the useful life of the spring assembly. The

manufacturer advised that the springs are designed to have the same design life as the rest of the MEJ. Instead of scheduling replacement of the springs it is recommended that all elements of the joint be inspected periodically. This will require that the inspectors be knowledgeable in the functioning of the joint and the various parts of the MEJ. The joint is usually inspected from the topside only and there are telltales of joint performance that can make this sufficient.

## **CONSTRUCTION SUMMARY**



These maps and directions are informational only. No representation is made or warranty given as to their content, road conditions, or any other information. All users of this website assume all responsibility for any loss or delay resulting from such use.

**FIGURE 5 SITE A SR 119 FAYETTE COUNTY HYBRID AERIAL VIEW**

Site A as shown in figure 5 above is a 3 –span bridge replacement project on SR 119 Section B-11 Fayette County District 12-0. This bridge crosses the Cheat river. The ETI Division was not present for construction. Site A project engineer voiced content over the field modification to rebar to accommodate the MEJ. Site B had no voiced concerns.



**FIGURE 6 SITE B I -95 AIRPORT CONSTRUCTION**

Site 'B' construction information was provided by district 6-0 consultant inspector Ed Russell and photos were provided by district 6-0 construction Paul Pappas. Below is a sequence of activities for the installation of the modular expansion dams at Bridge 215 (S-23215) on the above referenced project:

10-09-01 Stripped bulkhead



10-10-01 Placed and adjusted dam at pier 2 and began installing SIP metal closure pieces

10-11-01

SIP closure handwork under dam approximately 90%



10-12-01

All reinforcement steel completed (as modified by Harris), and completed SIP sheet metal closure



e

10-15-01

Poured deck closure at pier 2

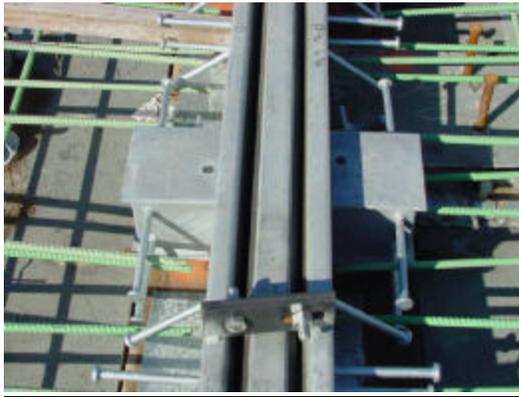


10-18-01 Placed and adjusted dam at pier 4



10-19-01 Started installing reinforcement steel and continued installing SIP sheet metal closure. Manufacturers representative on site

10-22-01 Continued installing reinforcement steel and SIP sheet metal closure



10-23-01 Continued installing reinforcement steel



**FIELD TESTING SUMMARY**

Site 'A' did not perform the water-tightness test and no good data on the water tightness of the joint is available. A water-tightness integrity test was performed by the contractor under the Department direction at site 'B' (see Figure 7,8, 9).

The water tightness test took several scenarios until an acceptable test was performed . Initially the Contractor piled snow on the dam, the dam evaluator did not believe this method duplicated the integrity of the test.

Sand bags were places on both sides of the expansion dam ( see figure 2) and a water truck placed water over dam until completely submerged by 1 inch of water for 1 hour . Minor leaking through the concrete was detected which was taken care of by a concrete sealer product. Only a high lift was available so the Pier 2 dam could be accessed for this test on this day. Inspection of the other Pier 2 dam would need a bridge inspection crane or appropriate alternate method. The sand bag ponded water method was again used for the 2<sup>nd</sup> joint and the results were accepted this time by the Department. Typically, the test is not performed in the rain but because it passed the test was determined successful.

Three Performance inspections were completed over a six year period (see Appendix A for completed inspection reports). The bridge inspection crane was utilized for these inspections. The last obtained semi-annual bridge inspection report completed after the six year period showed no mention of expansion joint problems. The inspections identified bulging springs missing nylon pins and evidence of birds nesting in the expansion dam underneath. There was no further signs of any leakage, no signs of weld problems, no signs of anchorage problems or dam malfunction.



**FIGURE 7 WATER - TIGHTNESS INTEGRITY TEST SITE**



**FIGURE 8 SAND BAGGED ONE HALF OF MEJ AT A TIME**



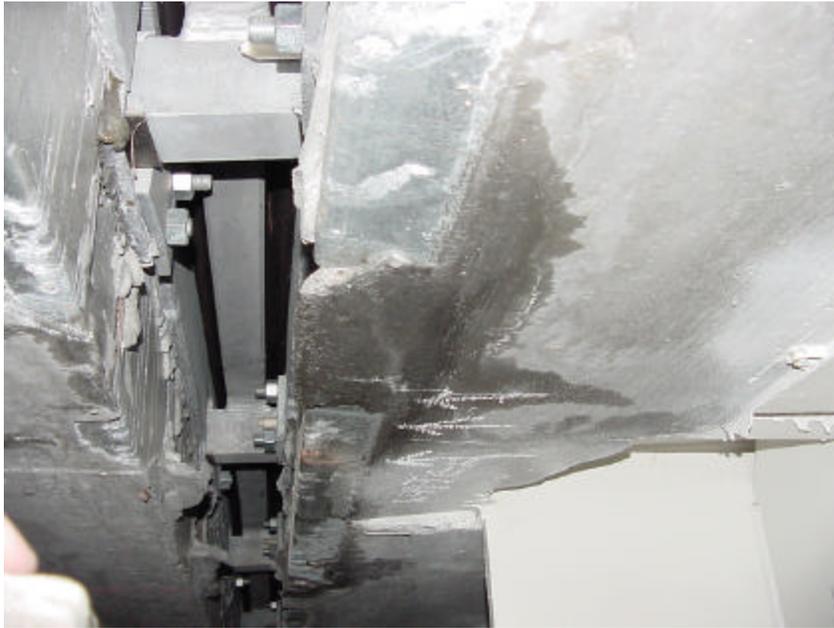
**FIGURE 9 AT LEAST 1 INCH OF WATER MAINTAINED FOR 1 HOUR**



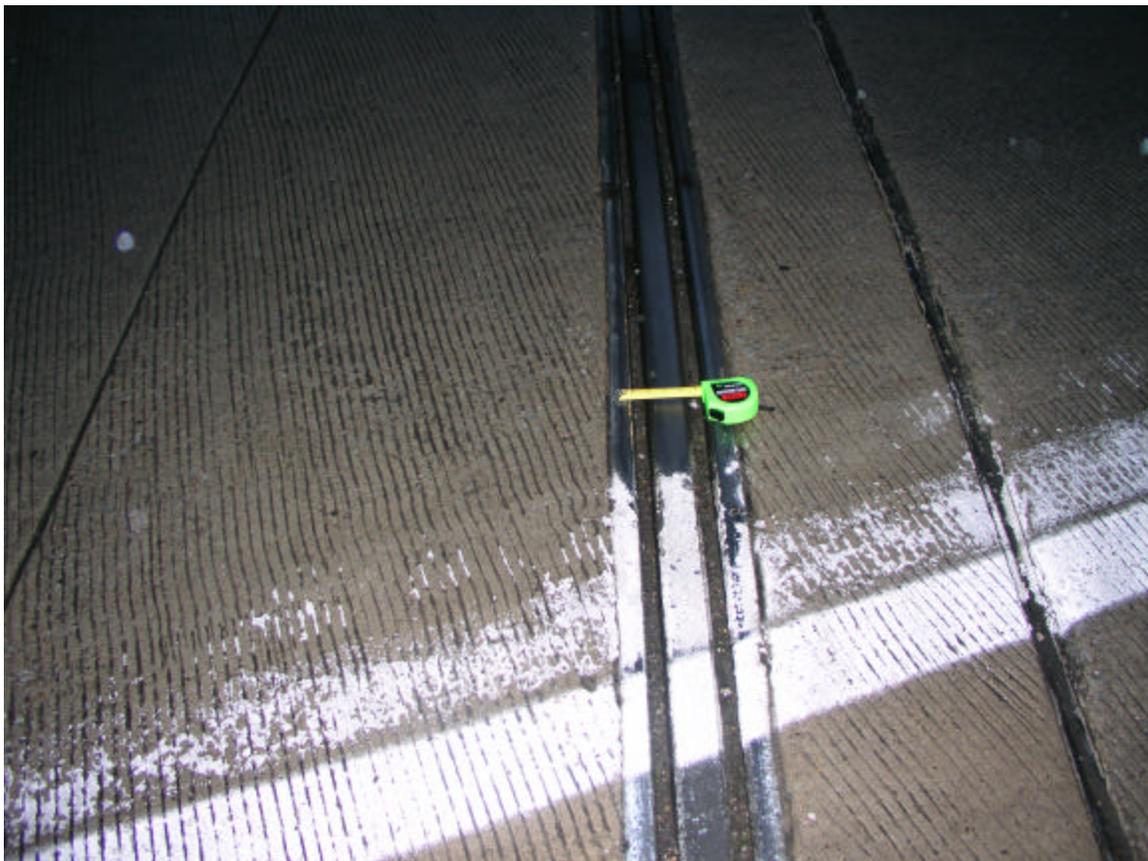
**FIGURE 10 CONCRETE AROUND MEJ SHOWED SOME WET SPOTS**



**FIGURE 11 MEJ UNDERVIEW DURING TEST**



**FIGURE 12 MEJ AGAIN CONCRETE SHOWED WET SPOTS**



**FIGURE 13 SITE A DECEMBER 2006 SEEMED GOOD PERFORMANCE IN THE RAIN**



**FIGURE 14 SITE B DECEMBER 2006 GOOD VISUAL PERFORMANCE OF JOINT IN THE RAIN**

## **CONCLUSIONS AND RECOMMENDATIONS**

Site **A** & **B** are performing as designed. Three substructure performance inspections Site **B** showed no detrimental area requiring immediate attention. Close watch should be kept on spring areas where nylon pin is not protruded through the metal on site **B**. Both dams should have regular surface maintenance to remove debris from the neoprene glands at least every 6 months. Springs should be monitored for replacement timing so that a life cycle maintenance cost could be developed for this joint system. Districts should continue surface inspections and concentrate on signs of unequal distances between the center bar and its sides and neoprene gland falling which may indicate a more detailed inspection is needed.

The dams are recommended for further use by the Department and a NCHRP specification utilized.

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## **ACKNOWLEDGEMENTS**

**District 6-0** Jim Mastrilli / George Dunheimer / Lorraine Ryan/  
Paul Pappas

**BMDJHarris Consultants** –Dave Handly and Dave Didier

**District 12-0** Steve Habizda

**Bureau of Design** –Brian Thompson

## **REFERENCES**

**RP87-037 Bridge Deck Expansion Joints ,Mellot & Dahir, Pennsylvania  
Department of Transportation ,December 1985**

**Fatigue Testing of Modular Bridge Expansion joint , Dexter &  
Kaczinski Lehigh University, ATLSS January 1994**

**Aerial Mapping Photography from yellowpages.com website**

## **Appendix A**

# **Report of Observations**

**Modular Expansion Joints**  
at Piers 2 and 4, Ramp LL  
Structure Plan Set S-23215

S.R.0095, Construction Section AIR  
Philadelphia and Delaware Counties, Pennsylvania

**Field Observations on April 16, 2004**

Joints Manufactured by Watson Bowman Acme  
Model No. WBA STM-600

Monitoring and Observation per PENNDOT Work Plan RP 97-052 A&B  
PENNDOT, Bureau of Construction and Testing  
and  
PENNDOT, Engineering District 6-0

Report submitted by:

DMJM+HARRIS, Inc.  
Philadelphia, Pennsylvania

**May 6, 2004**



The two Modular Expansion Joints on the Ramp LL viaduct were observed on Friday, April 16, 2004, as per PENNDOT Work Plan RP 97-052 A&B. The observations were made under closure of the right (looking stations and traffic ahead) shoulder and right lane. The left shoulder and lane were not accessible. A snooper was used for underside access. The weather was clear and atmospheric temperature was 50°F.

The structure was constructed in 2001 as part of the SR0095, Section AIR, construction project and was opened to traffic in 2002.

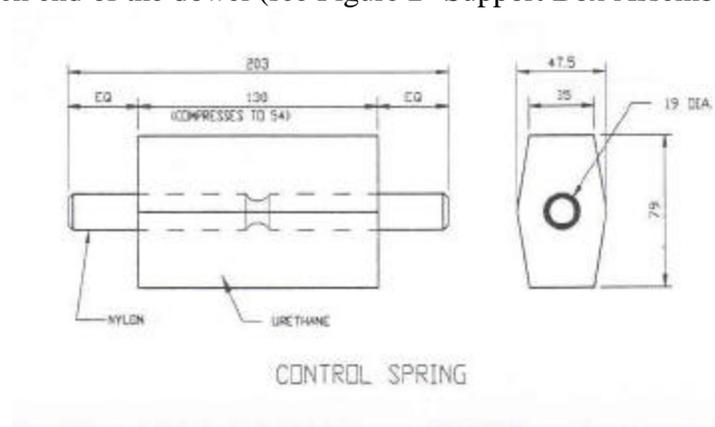
The primary objective of the field observations was to record the condition of the joints on the standard data sheet as per Work Plan RP 97-052 A&B. The data was entered in the form in the field and a copy of the form is attached. The names of the field view attendees are also recorded on the form. Additional measurements were taken between the center beam and the extrusion. Measurements were taken on both the station-back and -ahead sides of each joint at locations 1'-6" and 16'-0" from the right gutterline.

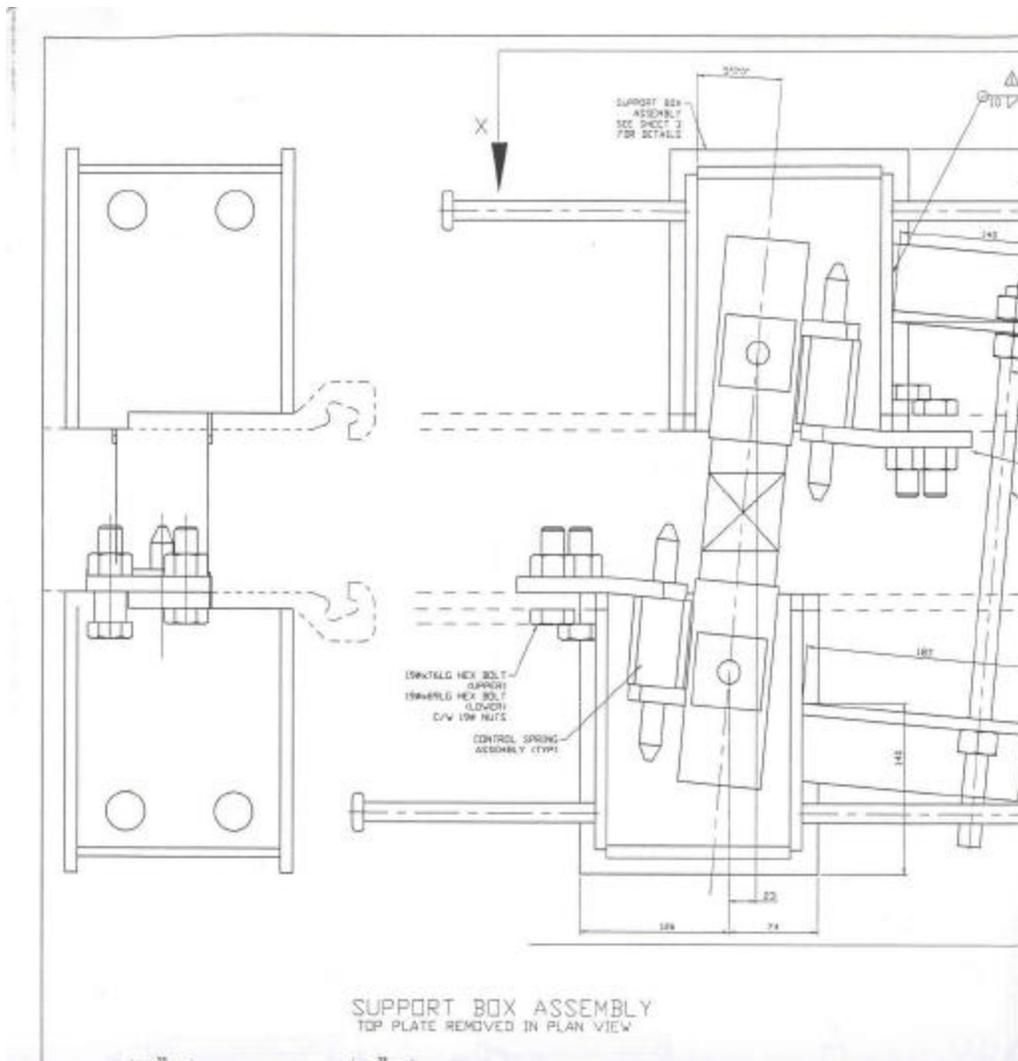
The joints were found to be in generally good condition. The only maintenance need is for flushing of both of the joints to remove debris that has collected in the neoprene glands with the largest concentration of debris in the shoulders.

During the underside observations, five conditions were observed that are worthy of comment. Two of these conditions concern the control spring assembly. The control spring assembly has two parts (see Figure 1 – Control Spring Assembly):

1. urethane block, called the control spring
2. nylon dowel, called the dowel

The control spring assembly is constructed by driving the nylon dowel through the cast hole in the urethane spring. The purpose of the control spring is to hold the center beam of the joint in horizontal position, equidistant from the extrusions. The control springs are intended to be in compression throughout the design temperature range. The dowels of the assembly are held in position within the support box assembly by two steel holding plates, one at each end of the dowel (see Figure 2- Support Box Assembly.)





**Figure 2 – Plan View, Support Box Assembly**

**Observation One**

At three locations [of 68 total locations on the two joints] the nylon dowel does not protrude through the hole in the steel plate (see Figure 3 – Photo Showing Empty Hole in Steel Holding Plate). The dowels were visible behind the plate and were still within the urethane spring. The cause of the condition is uncertain but the manufacturer reports that dowels have been known to work out of the hole in the steel plate by a prying action over time. As noted above, the purpose of the dowel is to hold the spring in position. However, because the urethane spring is compressed at almost all temperatures, it is unlikely that the spring would drop completely out of the box due to extreme joint movement. However, it appears that it could work its way out of position over time.

If the dowel is only slightly out of position and still near the hole it may be possible to work it back into the hole. However, the tight clearances on these small MEJ will make it difficult to get a tool into position. The alternative method of correcting the condition is to remove the bolted holding plate, drive a new dowel into the spring, reinstall the control

spring assembly, use a hydraulic ram to re-compress the spring and bolt the holding plate back in place with the dowel properly positioned.

This observation has been discussed with the manufacturer. Based on their review of the photos and the small number of occurrences observed, they advise that there is not an urgent need to re-position the dowels; monitoring the performance of the joint is recommended.



**Figure 3 – Photo Showing Empty Hole in Steel Holding Plate**

#### **Observation Two**

At five locations on the Pier 4 joint the urethane spring is deformed around the side of the bolted plate and is in contact with the side of the support bar (see Figure 4 – Photo Showing Bulging Urethane Spring; Figure 5 – Photo Detail, Bulging Urethane Spring.) This observation has been discussed with the manufacturer. Based on their review of the photos, they advise that the appearance of the spring does not indicate a deteriorated condition and the spring appears to be performing properly. They further advised, based on the small number of occurrences observed, that no remedial measures are required; monitoring the performance is recommended by the manufacturer.



**Figure 4 – Photo Showing Bulging Urethane Spring**



**Figure 5 – Photo, Close-up of Bulging Urethane Spring**

### **Observation Three**

Most of the steel boxes of the MEJ extend beyond the edge of the concrete (see Figure 3.) This is not the preferred construction. The concrete formwork should have been set flush with the front of the box and the concrete cast to the edge of the box. However, since no spalling was observed, the constructed condition appears to be adequate to date. Complete support and consolidation of the concrete under the box is critical as the concrete supports the box which in turn supports the joint. This observation should be considered in preparing contract drawings for future MEJ installations.

### **Observation Four**

Longitudinal cracking of the concrete deck, in excess of that immediately after construction, was observed on the topside adjacent to both joints.

### **Observation Five**

The right end (looking stations & traffic ahead) of the joint at Pier 4 is slightly misaligned. Measurements show that the center beam is closer to the ahead-station side of the joint (refer to the attached table of measurements.) Looking over the traffic barrier, the extreme end of the center beam was observed to be nearly in contact with the ahead-side extrusion.

### **Additional Information**

PENNDOT would like to include the design life of the springs in the BMS system so that the owner can replace springs as a routine maintenance activity prior to failure. The manufacturer's representative was asked about the useful life of the spring assembly. The manufacturer advised that the springs are designed to have the same design life as the rest of the MEJ. Instead of scheduling replacement of the springs it is recommended that all elements of the joint be inspected periodically. This will require that the inspectors be knowledgeable in the functioning of the joint and the various parts of the MEJ. The joint is usually inspected from the topside only and there are telltales of joint performance that can make this sufficient. Signs to look for:

- center beam should be equidistant from the extrusions within a 0.25 inch tolerance
- unusual sounds heard under traffic
- neoprene strip seal gland should be continuously held in the extrusion
- deck concrete should not spall or crack at the joint

All of these are indications that there may be problems and an underside inspection is warranted.

# **Report of Observations**

## **Modular Expansion Joints**

at Piers 2 and 4, Ramp LL  
Structure Plan Set S-23215

S.R.0095, Construction Section AIR  
Philadelphia and Delaware Counties, Pennsylvania

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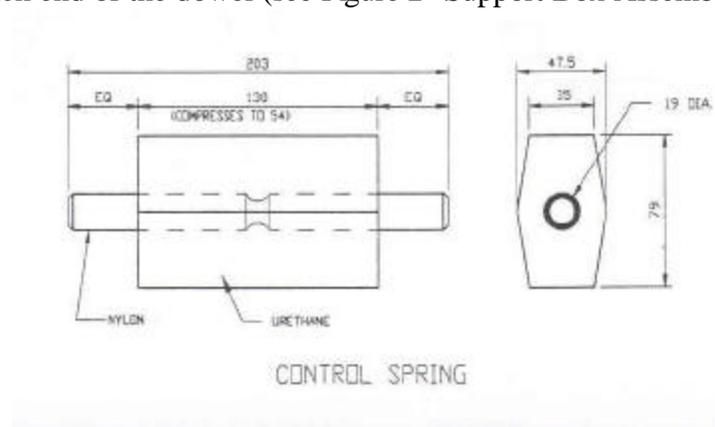
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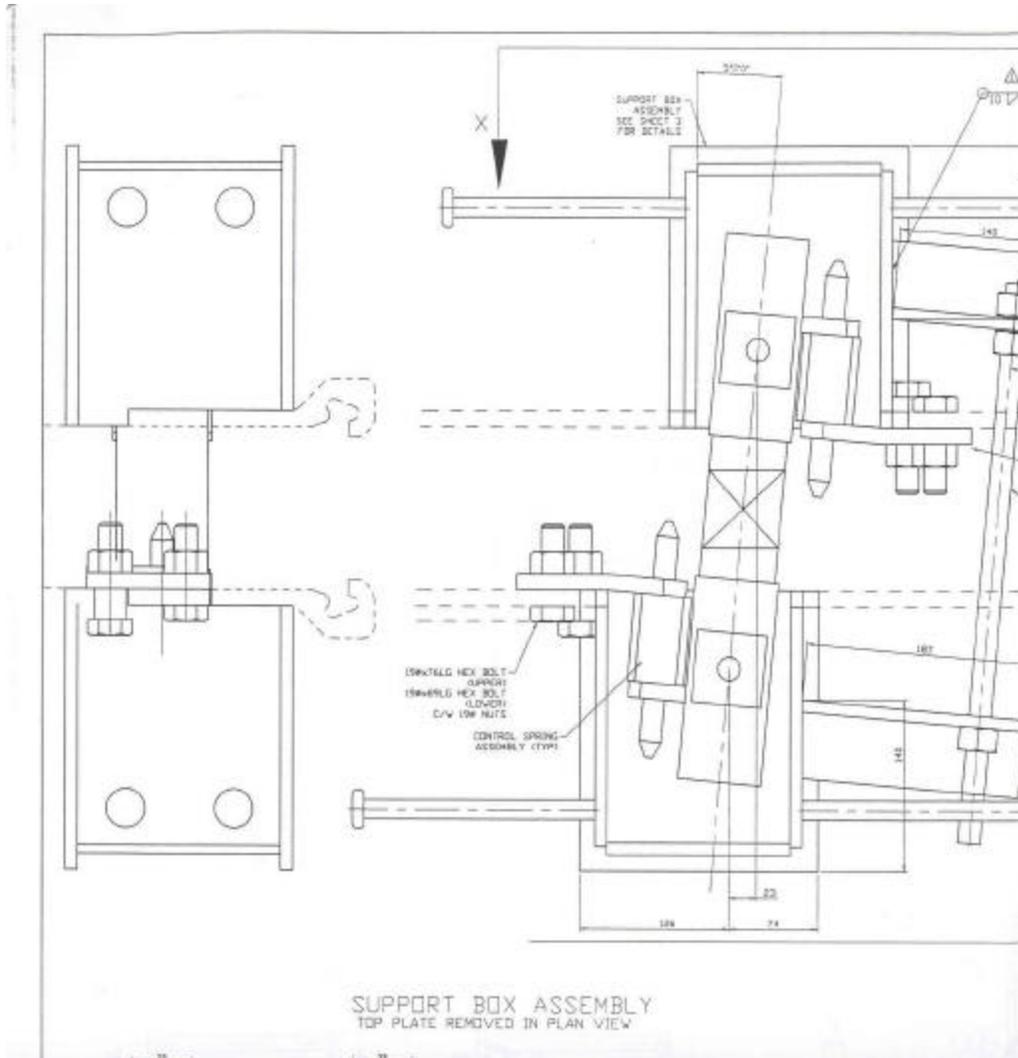
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3. urethane block, called the control spring
4. nylon dowel, called the dowel

The control spring assembly is constructed by driving the nylon dowel through the cast hole in the urethane spring. The purpose of the control spring is to hold the center beam of the joint in horizontal position, equidistant from the extrusions. The control springs are intended to be in compression throughout the design temperature range. The dowels of the assembly are held in position within the support box assembly by two steel holding plates, one at each end of the dowel (see Figure 2- Support Box Assembly.)



**Figure 1 – Control Spring Assembly**



**Figure 2 – Plan View, Support Box Assembly**

**Observation One**

At three locations [of 68 total locations on the two joints] the nylon dowel does not protrude through the hole in the steel plate (see Figure 3 – Photo Showing Empty Hole in Steel Holding Plate). The dowels were visible behind the plate and were still within the urethane spring. The cause of the condition is uncertain but the manufacturer reports that dowels have been known to work out of the hole in the steel plate by a prying action over time. As noted above, the purpose of the dowel is to hold the spring in position. However, because the urethane spring is compressed at almost all temperatures, it is unlikely that the spring would drop completely out of the box due to extreme joint movement. However, it appears that it could work its way out of position over time.

If the dowel is only slightly out of position and still near the hole it may be possible to work it back into the hole. However, the tight clearances on these small MEJ will make it difficult to get a tool into position. The alternative method of correcting the condition is to remove the bolted holding plate, drive a new dowel into the spring, reinstall the control

spring assembly, use a hydraulic ram to re-compress the spring and bolt the holding plate back in place with the dowel properly positioned.

This observation has been discussed with the manufacturer. Based on their review of the photos and the small number of occurrences observed, they advise that there is not an urgent need to re-position the dowels; monitoring the performance of the joint is recommended.



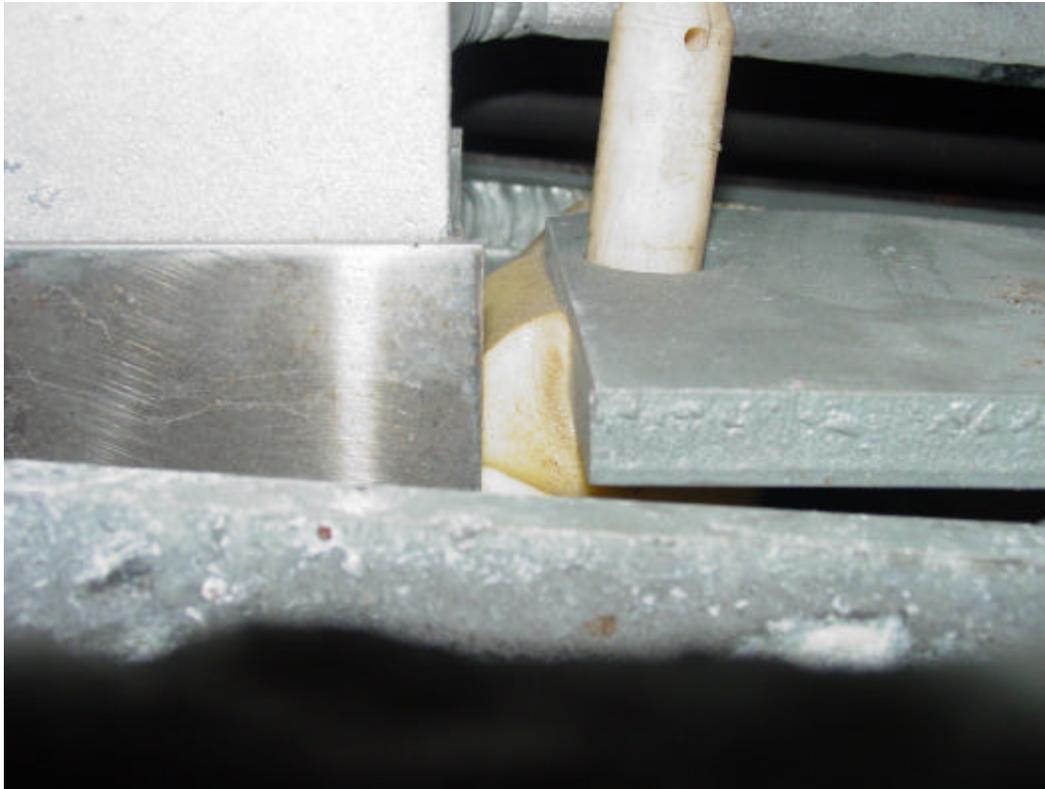
**Figure 3 – Photo Showing Empty Hole in Steel Holding Plate**

#### **Observation Two**

At five locations on the Pier 4 joint the urethane spring is deformed around the side of the bolted plate and is in contact with the side of the support bar (see Figure 4 – Photo Showing Bulging Urethane Spring; Figure 5 – Photo Detail, Bulging Urethane Spring.) This observation has been discussed with the manufacturer. Based on their review of the photos, they advise that the appearance of the spring does not indicate a deteriorated condition and the spring appears to be performing properly. They further advised, based on the small number of occurrences observed, that no remedial measures are required; monitoring the performance is recommended by the manufacturer.



**Figure 4 – Photo Showing Bulging Urethane Spring**



**Figure 5 – Photo, Close-up of Bulging Urethane Spring**

### **Observation Three**

Most of the steel boxes of the MEJ extend beyond the edge of the concrete (see Figure 3.) This is not the preferred construction. The concrete formwork should have been set flush with the front of the box and the concrete cast to the edge of the box. However, since no spalling was observed, the constructed condition appears to be adequate to date. Complete support and consolidation of the concrete under the box is critical as the concrete supports the box which in turn supports the joint. This observation should be considered in preparing contract drawings for future MEJ installations.

### **Observation Four**

Longitudinal cracking of the concrete deck, in excess of that immediately after construction, was observed on the topside adjacent to both joints.

### **Observation Five**

The right end (looking stations & traffic ahead) of the joint at Pier 4 is slightly misaligned. Measurements show that the center beam is closer to the ahead-station side of the joint (refer to the attached table of measurements.) Looking over the traffic barrier, the extreme end of the center beam was observed to be nearly in contact with the ahead-side extrusion.

### **Additional Information**

PENNDOT would like to include the design life of the springs in the BMS system so that the owner can replace springs as a routine maintenance activity prior to failure. The manufacturer's representative was asked about the useful life of the spring assembly. The manufacturer advised that the springs are designed to have the same design life as the rest of the MEJ. Instead of scheduling replacement of the springs it is recommended that all elements of the joint be inspected periodically. This will require that the inspectors be knowledgeable in the functioning of the joint and the various parts of the MEJ. The joint is usually inspected from the topside only and there are telltales of joint performance that can make this sufficient. Signs to look for:

- center beam should be equidistant from the extrusions within a 0.25 inch tolerance
- unusual sounds heard under traffic
- neoprene strip seal gland should be continuously held in the extrusion
- deck concrete should not spall or crack at the joint

All of these are indications that there may be problems and an underside inspection is warranted.

# **Report of Observations**

## **Modular Expansion Joints**

at Piers 2 and 4, Ramp LL

Structure Plan Set S-23215

S.R.0095, Construction Section AIR  
Philadelphia and Delaware Counties, Pennsylvania

## **Field Observations on February 22, 2006**

Joints Manufactured by Watson Bowman Acme

Model No.WBA STM-600

Monitoring and Observation per PENNDOT Work Plan RP 97-052 A&B

PENNDOT, Bureau of Construction and Materials

and

PENNDOT, Engineering District 6-0

Report submitted by:

Robin Sukley,P.E..

ETI Division BOCM

**Feb 26, 2006**

The two Modular Expansion Joints on the Ramp LL viaduct were observed on Friday, February 22, 6 as per PENNDOT Work Plan RP 97-052 A&B. The observations were made under closure of the right (looking stations and traffic ahead) shoulder and right lane. The left shoulder and lane were not accessible. A snooper was used for underside access. The weather was clear and atmospheric temperature was 34°F.

The structure was constructed in 2001 as part of the SR0095, Section AIR, construction project and was opened to traffic in 2002.

The primary objective of the field observations was to record the condition of the joints on the standard data sheet as per Work Plan RP 97-052 A&B. The data was entered in the form in the field and a copy of the form is attached. The names of the field view attendees are also recorded on the form. Additional measurements were taken between the center beam and the extrusion. Measurements were taken on both the station-back and -ahead sides of each joint at locations 1'.6" and 16'-0" from the right gutterline.

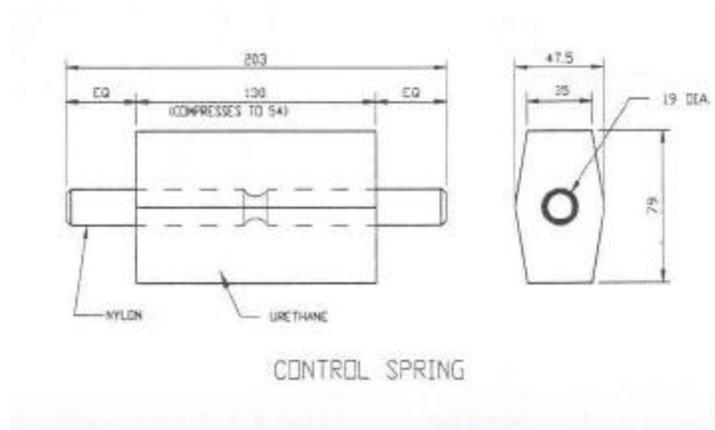
PIER	Location	A	B	C
2	1	1/4"	1 1/2"	1 1/2"
2	2	1/4"	1 1/2"	1 3/8"
4	1	1/4"	1 5/8"	1 3/4"
4	2	1/4"	1 5/8"	1 1/2"
4	End far right		2"	1"

The joints were found to be in generally good condition. The only maintenance need is for flushing of both of the joints to remove debris that has collected in the neoprene glands with the largest concentration of debris in the shoulders.

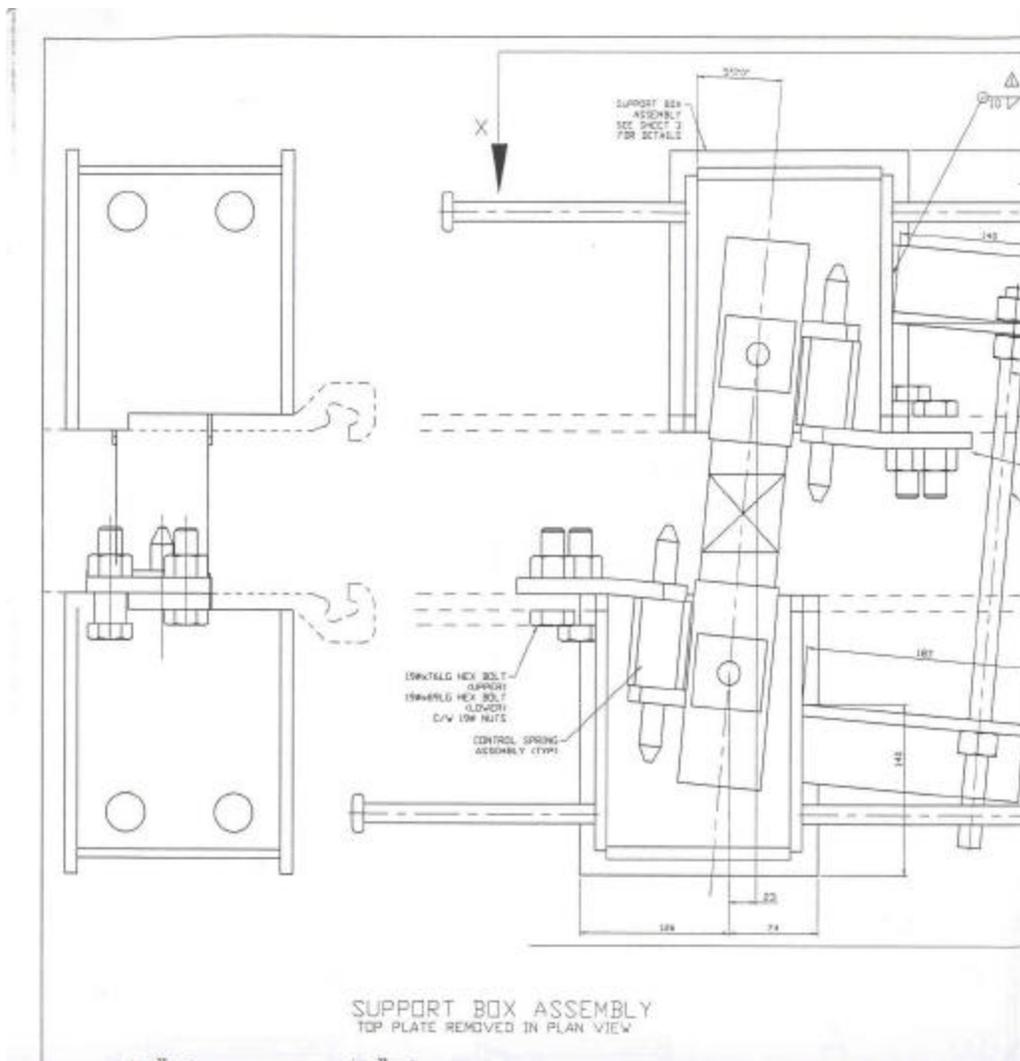
During the underside observations, two conditions were observed that are worthy of comment. Two of these conditions concern the control spring assembly. The control spring assembly has two parts (see Figure 1 – Control Spring Assembly):

5. urethane block, called the control spring
6. nylon dowel, called the dowel

The control spring assembly is constructed by driving the nylon dowel through the cast hole in the urethane spring. The purpose of the control spring is to hold the center beam of the joint in horizontal position, equidistant from the extrusions. The control springs are intended to be in compression throughout the design temperature range. The dowels of the assembly are held in position within the support box assembly by two steel holding plates, one at each end of the dowel (see Figure 2- Support Box Assembly.)



**Figure 1 – Control Spring Assembly**



**Figure 2 – Plan View, Support Box Assembly**

**Observation One**

At four locations [of 68 total locations on the two joints] the nylon dowel does not protrude through the hole in the steel plate (see photo 3 – Photo Showing Empty Hole in Steel Holding Plate). The dowels were visible behind the plate and were still within the urethane spring. The cause of the condition is uncertain but the manufacturer reports that dowels have been known to work out of the hole in the steel plate by a prying action over time. As noted above, the purpose of the dowel is to hold the spring in position. However, because the urethane spring is compressed at almost all temperatures, it is unlikely that the spring would drop completely out of the box due to extreme joint movement. However, it appears that it could work its way out of position over time.

### **Observation Two**



**Photo 1 Pier 4 Joint filled with debris**



**Photo 2 Pier 2 Debris removed for Joint Measurements**



**Photo 3 Pier 2 Box 1**



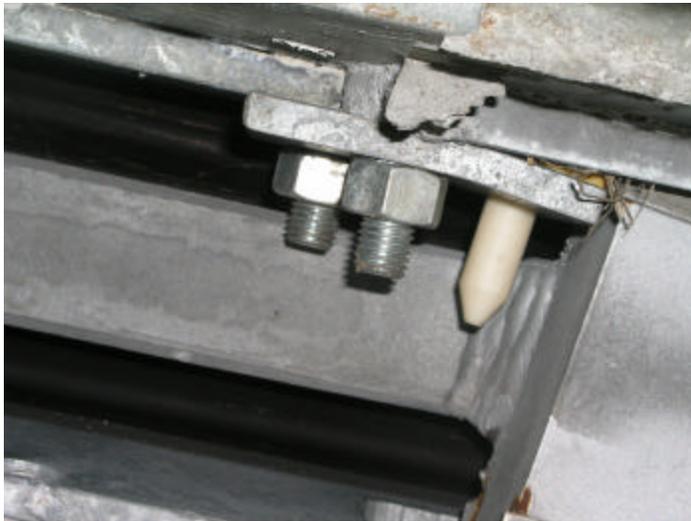
**Photo 4 Pier 2 Box 1**



**Photo 5 Pier 2 Box 2**



**Photo 6 15 Pier 2 Slight bulge in spring**



**Photo 7 Pier 2 Bird nesting signs**



**Photo 8 Pier 4 Box 2**



**Photo 9 Pier 4 Box 4 slightly budging spring**



**Photo 10 Pier 4 Missing Nylon Pin**



**Photo 11 Inspection 2/22/2006**

# APPENDIX B

## Modular Expansion Joint System, Special

DESCRIPTION- This work is the furnishing and installation of a Modular Expansion Joint System with fabric drain trough at abutment 2.

MATERIAL- Modular joint system and component parts, including stiffening plates and anchorages, as supplied by Harris Specialty Division, 95 Pineview Drive, Amherst, NY 14228-2166, Telephone (716) 691-7566, Fax (716) 691-9239. Certify all materials in accordance with Section 106.03(b)3. Furnish a manufacturer's certification that all materials proposed for use on the project have been pretested and meet the requirements as set forth in the manufacturer's current literature. Do not install in the field prior to the Engineer's acceptance.

- Section 1020 – The applicable parts pertaining to drain trough.
- Steel Elements – AASHTO M270 Grade 50W steel for all steel elements. Use machined or extruded steel shapes. Split channels or multiple-part welded shapes are not permitted. Provide a minimum 1/4" thickness for the configuration used to mechanically lock the polychloroprene sealing element. Measure thickness from the internal locking mechanism to the deck wearing surface, or surfaces to be embedded or in contact with steel members.
- Continuous Polychloroprene Seal – Provide and install the polychloroprene seal in one continuous length. Provide a seal of a box shaped design that promotes self-removal of foreign material during normal joint operation. Allow for a maximum three inch (3") opening per cell. Provide the polychloroprene seal with the properties as provided in Table 1 herein.

Table 1: Physical Requirements for Preformed Seals

Physical Properties	ASTM Test Method	Requirements
Tensile strength, min., psi	D-412	2000
Elongation @ break, min., %	D-412	250
Hardness, Type A durometer points	Modified	55+/-5
Oven aging, 70h @ 212 Fahrenheit	D-573	
Tensile Strength, max % loss		20
Elongation, max % loss		20
Hardness, Type A durometer, Points change		0 to +10
Oil Swell, ASTM Oil No. 3, 70h @ 212 Fahrenheit	D-471	
Weight change, max, %		
Ozone resistance	D-1149	
20% strain, 3000pphm in air 70h @ 104 Fahrenheit	Modified	No cracks

Low temperature stiffening 7 days @ 14 Fahrenheit	D-2240	
Hardness. Type A durometer, Points Change		0 to +15
Compression Set 70h @ 212 Fahrenheit max.	D-395 Modified B (Modified)	40%

- Lubricant Adhesive – Use a one part moisture curing polyurethane and hydrocarbon solvent mixture meeting the requirements of STM D-4070 to bond the polychloroprene seal to the steel shapes
- Head Studs – Section 709, Subsection 709.23.
- PTFE for Bearings – conform to the following:

PHYSICAL PROPERTY	ASTM TEST METHOD	REQUIREMENTS
Ultimate Tensile Strength, psi	D-638	2800
Ultimate Elongation, % min.	D-638	200
Specific Gravity, min.	D-792	2.13

- Stainless Steel – Conform to ASTM A-167, Type 304.

**CONSTRUCTION** – Submit shop drawings for review and acceptance within 30 days of receipt of Notice to Proceed. At the discretion of the Engineer, the manufacturer may be required to furnish facilities for the inspection of the completed device or a representative sample at his plant. Provide free access for the inspector to the necessary parts of the manufacturer’s plant. A manufacturer’s technical representative is to be present while the expansion device is being installed. Notify the manufacturer a minimum of two weeks prior to scheduled installation of the expansion device.

Indicate on the shop drawings the manufacturer’s instructions for the proper installation of the joint system. Shop drawings without installation instructions may be returned unaccepted.

Anchor the expansion joint device as indicated on the plans. Anchor the slider plates using cast-in-place inserts. Accurately set and secure the expansion joint device to the correct grade, elevation and correct joint opening as indicated on the plans and shop drawings.

Measure the structure temperature by recording the surface temperature of the concrete and/or steel using a surface thermometer as described as follows:

Record the temperature of the underside of the concrete slab at each end of the superstructure element adjacent to the expansion device. Take the average of the

readings to use with the temperature correction factors provided on the plans. In lieu of surface readings, internal slab temperatures may be taken by drilling a 1/4" diameter hole 3" deep into the concrete slab, filling the hole with water, waiting a minimum 15 minutes, and inserting a probe thermometer.

Provide all required details for curb units and other details as required on the shop drawings. All details are subject to the Engineer's review and acceptance.

Immediately prior to installation, the joint system will be inspected by the Engineer for proper alignment and complete mechanical anchorage between the polychloroprene seal and the steel, and proper anchor placement and effectiveness. No bends or kinks in the joint system will be allowed except as necessary to match the design roadway grades and cross slopes. Fully anchor the polychloroprene seal where not bonded to the steel, or correct to the satisfaction of the Engineer, at no additional expense to the Department. Visually inspect each anchor. Tap test each anchor as follows: strike each anchor a light blow using a 4 pound hammer and listen for a ringing sounds. Any anchor that does not have a complete weld or does not ring when tap tested is to be replaced at no expense to the Department.

Mechanical devices supplies to set the joint system to the correct opening remain property of the Contractor. Coordinate deck placement with the installation of the expansion joint system. Portions of the curb, parapet and deck cannot be placed until after installation of the expansion joint device. Submit to the Engineer for review and acceptance any required modifications to the deck placement sequence shown on the plans necessary for installation of the expansion joint device.

Blast clean all metal surfaces in contact with the neoprene sealer in accordance with the requirements of Steel Structures Painting Council Surface Preparation SP10-63T, "No. 10 Near White Blast Cleansing"

Hot dip galvanize the expansion joint device in accordance with ASTM A123.

Fabricate each modular expansion joint device as a single entity, unless stage construction of excessive length prohibits monolithic fabrication. Provide a modular expansion joint device that fits the full width of the structure as indicated on the plans.

The system is to be preset by the manufacturer to the joint opening as indicated on the contract plans prior to shipment.

Install the modular expansion joint system in strict accordance with the manufacturer's instructions, this specification, and the advice of the manufacturer's official representative. Match the finished roadway profile and grades. Perform a watertight test upon completion of the permanent installation of the expansion joint system and at such time as the Engineer has determined that all adjacent work has been completed to permit an accurate test of the joints watertightness.

Place and finish the surrounding deck concrete after the modular expansion joint device has been set to its final line and grade. Prime all existing concrete surfaces with an approved epoxy grout prior to placement of new concrete against existing concrete. Apply the epoxy grout no sooner than two (2) hours prior to placement of concrete. Finish the uppermost surfaces of the concrete as directed by the Engineer.

MEASUREMENT AND PAYMENT – Linear Foot. Measured as linear feet of expansion joint device installed, measure along the centerline of the joint system between the outer limits as indicated on the plans. The installation will be complete when the following operations have been completed to the satisfaction of the Engineer.

- Concrete placed and finished
- Nuts tightened, or retightened, as required
- Watertight integrity test performed