

**EVALUATION OF HIGH PERFORMANCE  
CONCRETE BRIDGE DECKS  
AND  
OTHER EXPERIMENTAL BRIDGE  
DECKS THROUGHOUT ILLINOIS**

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16. Abstract  The Illinois Department of Transportation (IDOT) received Innovative Bridge Research and Construction (IBRC) funds from the Federal Highway Administration (FHWA) for fiscal years 2000 and 2002. These funds were used to construct High Performance Concrete (HPC) bridge superstructures and substructures using various mix designs from 2000 through 2004. All the mix designs provided high strength and low permeability. These bridges have been examined over the years, and some bridges as late as 2011. The results of the bridge deck inspections indicate bridge decks constructed with HPC cracked as much or more than non-HPC bridge decks. The results yielded other information, but the most surprising fact was that in two cases it was suspected the coefficient of thermal expansion for a gravel coarse aggregate resulted in a significant amount of bridge deck thermal cracking.  The report also includes the results of four bridge decks built in the early 1990's using shrinkage-compensating concrete. These bridge decks were examined in 2008-2009 and showed less cracking than what is normally observed in the field. These results have prompted IDOT to perform more research in this area. The report also includes the results of one bridge deck constructed with synthetic fibers in 2009 that was examined in 2010.			
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Doug Dirks performed final editing of this report and was involved in the research from beginning to end. Any questions regarding the report should be directed to him. It also needs to be acknowledged that several people contributed to this research. Publication of the report is intended to provide the following:

- A record of IDOT efforts to build High Performance Concrete (HPC) bridge structures. This was encouraged by the Federal Highway Administration (FHWA).
- A reference document of the HPC bridge structure locations since the geographical area of the districts have been reorganized since construction. It is also hoped the structures will be evaluated at some point in the long term future to determine if any unexpected benefits were achieved.

## **DISCLAIMER**

The contents of this report reflect the views of the authors, who are responsible for the facts and accuracy of the data represented in this report. The contents do not necessarily reflect the official views or policies of IDOT. This report does not constitute a standard, specification, or regulation at IDOT

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## **EXECUTIVE SUMMARY**

The Illinois Department of Transportation (IDOT) received Innovative Bridge Research and Construction (IBRC) funds from the Federal Highway Administration (FHWA) for fiscal years 2000 and 2002. These funds were used to construct High Performance Concrete (HPC) bridge superstructures and substructures using various mix designs from 2000 through 2004. All the mix designs provided high strength and low permeability. These bridges have been examined over the years, and some bridges as late as 2011. The results of the bridge deck inspections indicate bridge decks constructed with HPC cracked as much or more than non-HPC bridge decks. The results yielded other information, but the most surprising fact was that in two cases it was suspected the coefficient of thermal expansion for a gravel coarse aggregate resulted in a significant amount of bridge deck thermal cracking.

The report also includes the results of four bridge decks built in the early 1990's using shrinkage-compensating concrete. These bridge decks were examined in 2008-2009 and showed less cracking than what is normally observed in the field. These results have prompted IDOT to perform more research in this area. The report also includes the results of one bridge deck constructed with synthetic fibers in 2009 that was examined in 2010.

## **1.0 Introduction and Background**

The Illinois Department of Transportation (IDOT) received funding from the Federal Highway Administration (FHWA) for fiscal year 2000 and 2002 for research and construction of High Performance Concrete (HPC) bridge superstructures and substructures. This was through federal highway bill TEA-21 Innovative Bridge Research and Construction (IBRC) funds. Various districts volunteered projects that incorporated HPC mix designs and specifications. The Special Provisions developed for 2000 and for 2002 included several new construction practices which are mentioned in 2.3 Construction Practices.

The Illinois Department of Transportation began implementation of HPC mixes for bridge structures on selected projects. Even though HPC may have a broad definition, the focus of HPC in Illinois during this period was to produce bridge decks with less cracking and chloride penetration (i.e. be less permeable), and be more durable than conventional mixes. It was hoped this type of HPC bridge deck would produce a longer service life. Unfortunately HPC bridge decks constructed in Illinois cracked also, and in some cases with more frequency and severity than conventional mixes used by IDOT. The formation of cracks defeats the purpose of increased durability and decreased permeability in the HPC bridge decks. It is believed shrinkage cracking was the primary cause of the cracking in the bridge decks.

IDOT surveyed the HPC bridge decks after completion. Other bridge decks besides the HPC bridge decks were surveyed during the inspections. The other structures surveyed included bridge decks poured in the 1990's utilizing shrinkage-compensating concrete; and a bridge deck poured in 2009 with synthetic fibers incorporated into the concrete mix. These structures are located in various districts throughout the state.

This report documents the observations and findings of IDOT with HPC, shrinkage-compensating concrete, and synthetic fiber concrete bridge decks.

## 2.0 History

### 2.1 High Performance Concrete (HPC) Bridge Decks in Illinois

In fiscal years 2000 and 2002, the Illinois Department of Transportation (IDOT) was provided funding from the Federal Highway Administration (FHWA) for constructing bridge superstructures and substructures with high performance concrete (HPC). The proposed intention of the HPC was to increase the long term durability of the structures by mitigating bridge deck cracking.

The following projects were chosen for HPC utilization in the superstructure. A few structures also used HPC in the substructure. The fiscal year for the IBRC funding is also indicated.

<u>County</u>	<u>Structure Number</u>	<u>Location</u>
Christian	011-0035	US 51 N.E. of Moweaqua, IL (NB) (2002)
Christian	011-0036	US 51 N.E. of Moweaqua, IL (SB) (2002)
Christian	011-0502	IL 104 over South Fork Sangamon River (2000)
Clark	012-0004	I-70 over Big Creek (WB) (2002)
Clark	012-0005	I-70 over Big Creek (EB) (2002)
Clark	012-0006	I-70 over E. Little Creek (WB) (2002)
Clark	012-0007	I-70 over E. Little Creek (EB) (2002)
Clark	012-0008	I-70 over Crooked Creek (WB) (2002)
Clark	012-0009	I-70 over Crooked Creek (EB) (2002)
Clark	012-0025	US 40 over I-70 (2002)
Clark	012-0052	I-70 over Mill Creek (EB) (2002)
Clark	012-0053	I-70 over Mill Creek (WB) (2002)
Clark	012-0054	I-70 over IL 1 (EB) (2002)
Clark	012-0055	I-70 over IL 1 (WB) (2002)
Clark	012-0069	I-70 over Hawks Creek (EB) (2002)
Clark	012-0070	I-70 over Hawks Creek (WB) (2002)
Fayette	026-0034	US 40 & 51 over Kaskaskia River in Vandalia, IL (2002)
Iroquois	038-0207*	IL 54 over a Branch of Spring Creek near Thawville, IL (2000)
Macon	058-0125*	US 51 over Dry Branch Creek (NB) (2000)
Macon	058-0126*	US 51 over Dry Branch Creek (SB) (2000)
Madison	060-0108	IL 4 over I-70 (2000)
Madison	060-0151	IL 143 over I-70 (2000)
Mason/ Menard	065-0501	IL 29 over Salt Creek (2002)
Sangamon	084-0065	IL 104 over Brush Creek (2000)

\*Substructure and superstructure were constructed of HPC.

The following projects utilized HPC in the superstructure, but were not part of IBRC funding. A few structures also used HPC in the substructure. The fiscal year for the project is also indicated.

<u>County</u>	<u>Structure Number</u>	<u>Location</u>
Cook	016-2720	25 <sup>th</sup> Ave over Addison Creek (2002)
Cook	016-2740	47 <sup>th</sup> St. over Des Plaines River (2002)
Cook	016-0982	I-290 over Higgins Road (SB) (2003)
Cook	016-0983	I-290 over Higgins Road (NB) (2003)
Cook	016-0979	I-290 over Woodfield Road (2003)
Henderson	036-0053	US 34 over Lone Tree (2002)
Iroquois	038-0118	IL 49 over Spring Creek (2001)
Iroquois	038-0210	US 45 over Spring Creek ((2002)
Madison	060-0004	FR 1836 over Railroad (2002)
McLean	057-6301	US 51 over Railroad (2004)
Sangamon	084-0499*	I-55 over Lake Springfield (2001)
Sangamon	084-0500*	I-55 over Lake Springfield (2001)
Will	099-4638	IL 59 over W. Norman Drain (2001)
Winnebago	101-0175	IL 251 over McDonald Creek (2002)

\*Substructure and superstructure were constructed of HPC.

The following projects used a conventional concrete bridge deck mix design for comparison to HPC. The fiscal year for the project is also indicated.

Champaign	010-0170	Duncan Road over I-72 (2000)
Winnebago	101-0176	IL 251 over McDonald Creek (2002)

The bridge decks were surveyed after completion. During the surveys, cracks were observed on top and bottom of the bridge deck. Survey forms for all of the structures and several detailed distress drawings for some of the structures are located in Appendix A. Some of the structures had a distress survey more than once to observe crack development. The survey form describes cracking on the top and bottom of the bridge deck. The detailed distress drawings illustrate cracks on the top of the bridge deck. Figure 2.1-1 is the survey form and Figure 2.1-2 is an example of a detailed distress drawing for an HPC bridge deck.



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 011-0036

Inspected By: DAD, DHT, JAB

Responsible District: 5

Date Inspected: 7/22/09

Number of Spans: 3

Span Lengths See below Total: 61.1m

Deck Width: 12.0m

Beam Type:  PPC-I  Steel  Other

Beam Spacing: 2.22m

Date of Beam Erection: 2002

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: 4000 (2007)

Stage Construction:  Y  N

Skew:  Y  N Angle: \_\_\_\_\_

Pour Dates: Stage 1, 2002 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: Transverse cracking was observed every 6' on average between beams. On top of the bridge deck, transverse cracking was observed every 4' – 5'.

Longitudinal Cracking: More longitudinal cracking observed on this deck than 011-0035.

Bridge Joint Cracking / Integral Abutment Cracking: "Integral Abutment" restraint cracking observed with more pronounced cracking near the approach slab.

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span Lengths: 1) 16.8m, 2) 25.3m, 3) 18.3m

**Mix Design Information: (from MISTIC)**

Mix Design Number: 85PCC6097

Coarse Aggregate Source: Material Service CA 11  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: Vulcan Materials FA 01 Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

Cement Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

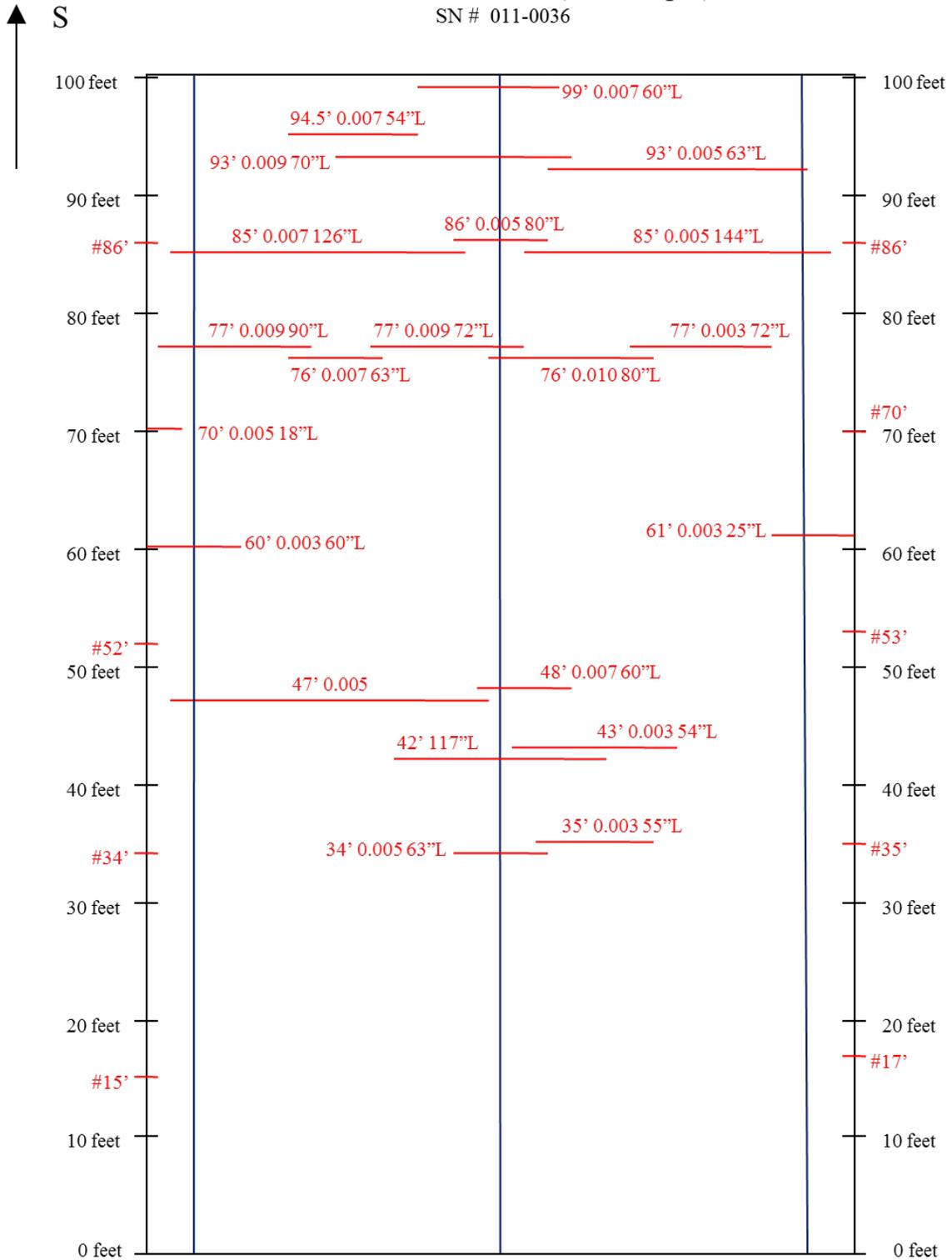
Fly Ash Source: ISG Resources, Inc.

Microsilica Source: W. R. Grace & Company

Figure 2.1-1

# US 51 - Flat Branch (Moweaqua)

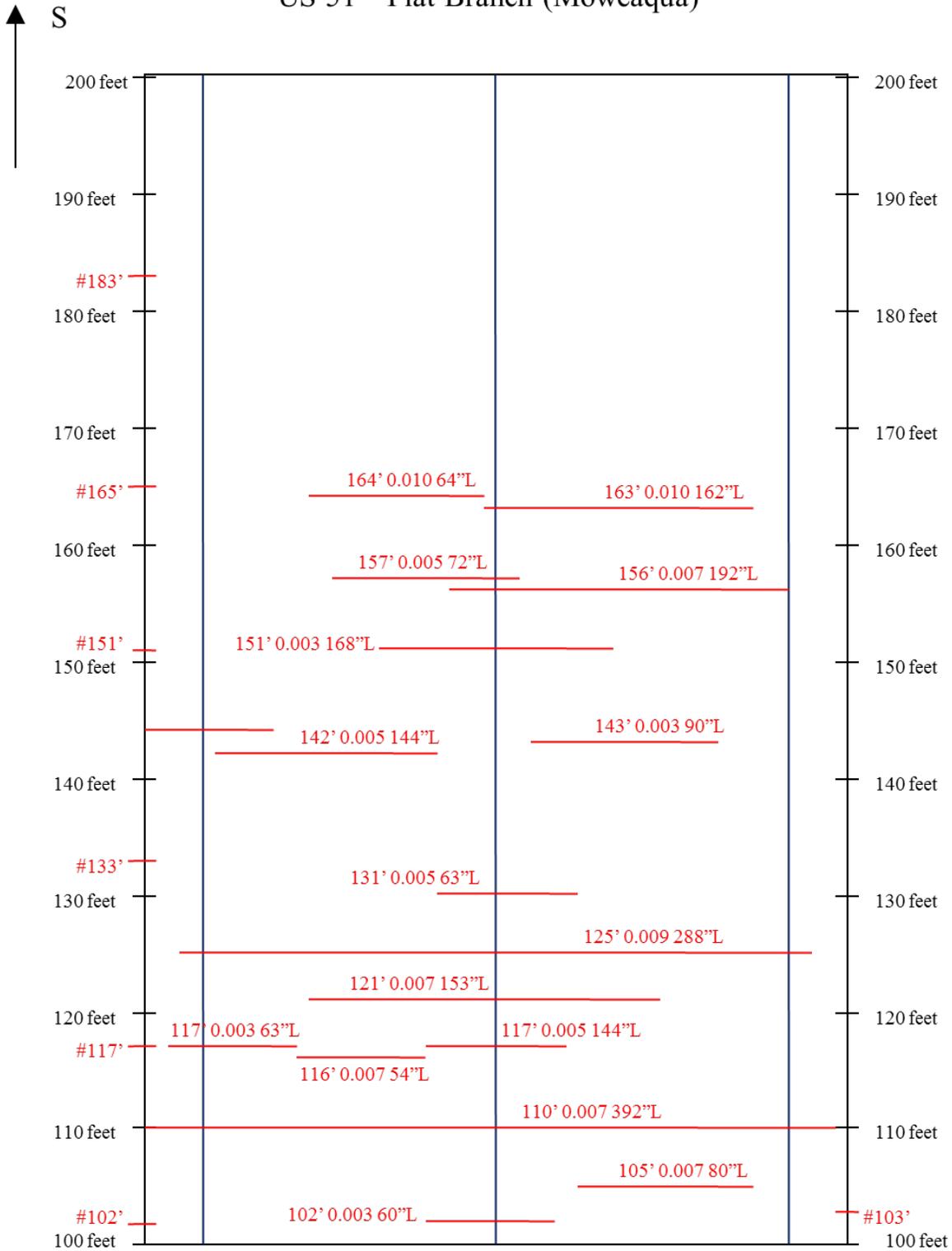
SN # 011-0036



Christian County – SN#011-0036 – Surveyed 9/16/2003

Figure 2.1-2

# US 51 – Flat Branch (Moweaqua)



Christian County – SN#011-0036 – surveyed 9/19/2003  
 The “#” symbol represents cracks in the parapet only.

Figure 2.1-2 (continued)

## 2.2 Mix Designs

For the years 2000 through 2004, several different HPC mix designs were utilized for the bridge decks. In 2001 and 2002, a conventional mix design was utilized for two bridge decks for comparison to HPC bridge decks. The structures numbered 010-0170 in Champaign County and 101-0176 in Winnebago County were poured with a conventional mix design.

The structure numbered 010-0170 in Champaign County was poured in 2001, the same year as the structure numbered 080-0499 in Sangamon County. The structure numbered 080-0499 used high performance concrete in its deck.

The 101-0176 structure in Winnebago County is located alongside a parallel structure numbered 101-0175 that utilized a HPC mix design for its bridge deck. Both structures were poured in 2002. The bridge decks on this dual structure utilized different concrete mix designs but experienced the same environmental conditions, structural restraints and loading. Therefore, the bridge decks should be an appropriate comparison of conventional and HPC mix designs.

The following Table 2.2-1 illustrates the proportions of the HPC mix designs and the conventional mix design used for bridge decks. Other superstructure components, such as the parapet, used the HPC mix design unless the bridge deck was the conventional mix design. For the HPC bridge superstructure mix designs, the mortar factor was 0.83 to 0.86. The water/cement ratio was 0.38 to 0.44. When fly ash, ground granulated blast-furnace slag, high-reactivity metakaolin, or microsilica are used in a concrete mix, the water/cement ratio was based on the total cement and finely divided minerals contained in the mixture.

Table 2.2-1 HPC Bridge Superstructure Mix Designs (Pounds of Material per Cubic Yard)

	1	2	3	4*	5	6	7	8
Cement	465	465	445	515	465	480	565	545
Fly Ash	120	120	90	135	-	135	-	-
GGBF**	-	-	-	-	120	-	-	-
Microsilica	25	-	25	-	-	33	25	25
HRM***	-	27	-	-	27	-	-	-

\*Conventional Mix Design

\*\*GGBF (Ground Granulated Blast-Furnace Slag)

\*\*\*HRM (High Reactivity Metakaolin)

The following projects contained IBRC funding. The mix design and bridge deck pour date information are indicated. The letters "AO" after the number indicates the aggregate gradation was optimized. In other words, the specifications required the Contractor to provide a uniformly graded aggregate in the bridge deck mix design.

<u>County</u>	<u>Structure Number</u>	<u>Mix Design Number</u>	<u>Bridge Deck Pour Date</u>
Christian	011-0035	1	8/27/2002
Christian	011-0036	1	8/27/2002
Christian	011-0502	1	10/12/2000
Clark	012-0004	7AO	8/27/2002
Clark	012-0005	7AO	4/19/2002 (DL) & 6/6/2002 (PL)
Clark	012-0006	7AO	9/12/2002
Clark	012-0007	7AO	5/18/2002
Clark	012-0008	7AO	9/18/2002
Clark	012-0009	7AO*	5/3/2002*
Clark	012-0025	7AO	3/29/2002 (EBL) & 7/11/2002 (WBL)
Clark	012-0052	8AO	4/26/2003
Clark	012-0053	8AO	8/5/2003 & 8/6/2003 (Night Pour)
Clark	012-0054	7AO	5/22/2002
Clark	012-0055	7AO	8/29/2002
Clark	012-0069	7AO	4/25/2002
Clark	012-0070	3AO	8/9/2002
Fayette	026-0034	3AO	10/17/2002 (EB) & 4/11/2003 (WB)
Iroquois	038-0207	1	11/3/2000
Macon	058-0125	1	10/12/2000
Macon	058-0126	2	10/3/2000
Madison	060-0108	1	7/27/2000 (SB) & 10/6/2000 (NB)
Madison	060-0151	2	7/31/2000 (NB) & 10/9/2000 (SB)
Mason/ Menard	065-0501	8AO*	8/26/2002 (Spans 7-10)**
Sangamon	084-0065	1 (WB) & 6 (EB)	8/3/2000 (WB) & 10/17/2000 (EB)

\* Information is believed to be accurate.

\*\* All bridge deck pour dates were not available.

The following projects did not contain IBRC funding. The mix design and pour date information are indicated. The letters "AO" after the number indicates the aggregate gradation was optimized. In other words, the specifications required the Contractor to provide a uniformly graded aggregate in the bridge deck mix design.

<u>County</u>	<u>Structure Number</u>	<u>Mix Design Number</u>	<u>Bridge Deck Pour Date</u>
Cook	016-2720	5	7/3/2002 (SB) & 10/1/2002 (NB)
Cook	016-2740	5	5/3/2002
Cook	016-0982	5	9/8/2003
Cook	016-0983	5	5/7/2003
Cook	016-0979	5	8/7/2003
Henderson	036-0053	3AO	9/6/2002
Iroquois	038-0118	7	8/8/2002
Iroquois	038-0210	3AO	8/26/2002 (NB) & 10/24/2002 (SB)
Madison	060-0004	1AO	6/27/2002
McLean	057-6301	3AO	5/21/2004
Sangamon	084-0499	1	9/13, 9/17, 9/21, and 9/25/2001
Sangamon	084-0500	1	3/28, 4/1, and 4/5/2002
Will	099-4638	5	4/30/2002
Winnebago	101-0175	3AO	8/28/2002

The following projects used a conventional concrete bridge deck mix design for comparison to HPC. The mix design and pour date information are indicated.

<u>County</u>	<u>Structure Number</u>	<u>Mix Design Number</u>	<u>Bridge Deck Pour Date</u>
Champaign	010-0170	4	9/20/2001
Winnebago	101-0176	4	6/12/2002

The following Table 2.2-2 below illustrates the proportions of the HPC mix designs used for substructures. For the HPC substructure mix designs, the mortar factor was 0.83 to 0.86. The water/cement ratio was 0.38 to 0.44. When fly ash, ground granulated blast-furnace slag, high-reactivity metakaolin, or microsilica are used in a concrete mix, the water/cement ratio was based on the total cement and finely divided minerals contained in the mixture.

Table 2.2-2 HPC Substructure Mix Designs (Pounds of Material per Cubic Yard)

	1	2
Cement	445	445
Fly Ash	90	90
GGBF*	-	
Microsilica	25	
HRM**		27

\*GGBF (Ground Granulated Blast -Furnace Slag)

\*\*HRM (High Reactivity Metakaolin)

The following projects used HPC in the substructure. Structures 038-0207, 058-0125, and 058-0126 contained IBRC funding. Structures 084-0499 and 084-0500 did not contain IBRC funding. The mix design information is indicated.

<u>County</u>	<u>Structure Number</u>	<u>Mix Design Number</u>
Iroquois	038-0207	1
Macon	058-0125*	1 for south abutment
Macon	058-0126	2
Sangamon	084-0499	1
Sangamon	084-0500	1

\* The north abutment used a bridge superstructure mix design number 1.

## 2.3 Construction Practices

Several new construction practices were evaluated through the HPC bridge deck projects. The new practices were eventually incorporated into all deck construction projects throughout the state. The new construction practices are listed as follows:

- Insertion of concrete vibrator between 3-5 seconds, or as determined by the Engineer. This practice was implemented to ensure good consolidation of the concrete.
- Fogging equipment to increase humidity above concrete and prevent plastic shrinkage cracks which occur when there is a high water evaporation rate. The high evaporation rate will cause a tensile crack to appear at the surface.

***Note: In 2013, IDOT specifications were changed to prevent fogging equipment from being installed on the finishing machine. Instead, hand held foggers were required. This change was done to prevent water from dripping on the bridge deck concrete surface because fogging nozzles would not shut off completely. In addition, excess water would accumulate on the bridge deck concrete surface. In both cases, this water would get finished into the surface which can result in less durable concrete.***

- Distance between the point of concrete placement and placement of curing limited to 35 feet. For bridge decks with a width greater than 50 feet, the distance was limited to 25 feet. This was done to prevent plastic shrinkage cracks.
- Use of cotton mats for curing in lieu of wet burlap. Two types of cotton mats were used, one with a fabric cover, the other with a burlap cover. The cottons mats were used because of their ability to hold more water, which made them less susceptible to drying out.

***Note: In 2013, Contractors were given permission to substitute cotton mats with one time use curing blankets. The lightweight material is easy to handle and less likely to mar the surface of freshly placed concrete.***

- Soaker hoses placed on top of cotton mats for continuous wet cure.
- Elimination of Type II membrane curing compound for initial curing.
- Use of rubber coated vibrators for epoxy coated reinforcement to prevent damage of the coating.

On four of the seven structures for the 2000 IBRC funds, the finishing machine rails were required to be outside the limits of the pour. For the other three structures, the contractors elected to place the rails outside the pour.

The placement of finishing machine rails outside of the pour allows the curing material to be placed quicker and prevent cracking. Unfortunately, this practice cannot be easily adopted statewide. In some cases, the exterior beam is not of sufficient depth, and the bridge designer must specify the location of the finishing machine rail on top of the beam.

The maximum concrete temperature for the 2000 IBRC projects was 85°F. Some contractors had to use ice or other means to maintain this temperature maximum. The 85°F maximum temperature was found to increase costs and the benefits appeared minimal. Thus, the maximum concrete temperature for the 2002 IBRC projects was raised to 90°F.

***Note: In 2013 the IDOT specifications were changed to require bridge deck concrete to be placed when the ambient air temperature is forecast to be lower than 85°F. In addition, a maximum concrete temperature of 85°F was specified. This was done in hopes of reducing cracks in bridge decks.***

### 3.0 HPC Performance Observations

The intent of the HPC study was to propose bridge decks with increased durability that would be less permeable to chlorides. The HPC structures cracked as much or more than the conventional concrete structures. The cracks will allow the ingress of deicing salts into the interior of the deck, corroding the reinforcement steel and spalling the concrete. Thus, the HPC structures are not expected to provide an increase in service life.

From the bridge surveys conducted by IDOT, transverse cracking appeared to be the dominant variable. Shrinkage and restraint along with other factors appeared to be the primary causes of bridge deck cracking. Restraint in the bridge deck comes from beams, shear stud connectors, reinforcement bars, and abutments. Thermal cracking in early-age concrete was also identified in the bridge surveys and is discussed more in 4.3 Thermal Cracking Study.

The following are additional HPC observations.

Total Bridge Length: The total length for influencing bridge deck cracking was undetermined, but the multi-span bridges cracked more than the single span bridges.

Span Lengths: The interior spans cracked more than the end spans. Longer spans typically have deeper girders. The deeper girders would provide more restraint against concrete drying shrinkage.

Prestressed vs. Steel Beams: The bridge decks supported by prestressed concrete beams cracked less than the ones supported by steel beams. The steel beams deflect more than the prestressed beams. The prestressed concrete beams matched the creep and shrinkage properties of the bridge deck more than the steel beams. Also, the temperature differential between the steel beams and the deck was greater than the prestressed concrete beams and the deck. Refer to Table 3.0-1.

Type of Abutment: The bridges built with integral and semi-integral abutments cracked more than the bridges with pile bent abutments. The integral abutments provided more restraint to the volume changes of the concrete and induced shrinkage cracking.

Staged Construction: A few stage constructed bridges cracked severely while some did not. Likewise, a few non-staged constructed bridges cracked severely while some did not.

Time of Year of The Deck Pour: The bridge decks poured in the spring and fall cracked more than the ones poured in the summer. The temperature differentials between day and night caused thermal stresses in the concrete.

Wind Conditions: High speed winds cause faster evaporation of surface water, which may produce plastic shrinkage cracks. High wind speeds are suspected of causing some increased cracking in the bridge decks.

Table 3.0-1 Prestressed vs. Steel Beams

Bridge Observed	Average Transverse Crack Spacing	
	Steel Beams (ft.)	Prestressed Concrete Beams (ft.)
1	3	6
2	3	10
3	3	4
4	3	4
5	6	4
6	2	4
7	2	8
8	2	6
9	2	6
10	7	6
11	5	6
12	4	8
13	3	
14	20	
15	20	
16	4	
17	4	
18	2	

Average for all HPC Decks with steel beams = 5.3 ft.  
 Average for all HPC Decks with prestressed beams = 6.0 ft.

## **4.0 Selected Studies**

### **4.1 University of Illinois at Urbana/Champaign Report**

The University of Illinois at Urbana/Champaign (UIUC), Department of Civil and Environmental Engineering conducted a study for IDOT on HPC that was completed in 2003. The report is IHR-R29 High Performance Concrete for Transportation Structures (2<sup>nd</sup> Revision October 18, 2003) and was prepared by David A. Lange, Jeffery R. Roesler, Matthew D. D'Ambrosia, Zachary Grasley, December Cowen, and Chang Joon Lee. The study was aimed at gaining an understanding of the behavior of IDOT mix designs in the laboratory and in the field on actual bridges. The reader is referred to the UIUC report since many of the structures listed herein were instrumented and evaluated in the field by the University. The report contains temperature measurements, strain measurements, and internal relative humidity measurements. In laboratory studies involving shrinkage tests by the University, the researchers formulated answers as to the mechanics about how and why IDOT HPC mixes shrink, crack, etc. and developed some tools for determining the propensity for a mix to crack. In field studies on bridges, the researcher determined that a reduction in shrinkage of 15 to 40% would produce a deck that was durable and of high quality.

The final conclusions of the researchers note that concrete material properties and structural restraint are the two biggest factors which contribute to concrete bridge deck cracking. If the concrete "were stronger, had lower shrinkage, or higher creep relaxation, the probability of cracking would be significantly reduced. Likewise, if the restraint provided by the structure were reduced cracking would also be reduced."

## 4.2 Chloride Penetration (Salt Ponding)

The methods used to perform the salt ponding and chloride ion content tests are Illinois Modified AASHTO T 259 and T 260. The T 259 test consists of collecting, preparing, and ponding the samples. Samples were collected at the project site for each pour and field cured for 24 hours by covering them with wet burlap and plastic sheeting. Specimens were sampled from the deck after placement. The test requires three samples to be collected: one for the reference and two for ponding. The samples are demolded and cured in a moist room for 6 days. After this period, they are removed from the moist room and allowed to air dry for an additional 21 days. When the samples are ready to be tested, wooden dikes are fastened to the perimeter and a 0.5 inch layer of 3% sodium chloride solution is ponded on the sample. The samples are ponded for a period of 6 months. Once ponding is complete, a powdered sample is collected from the center of the block and tested for chloride ion content.

Illinois Modified AASHTO T 260 consists of drilling and testing the samples. Four 3/4 inch diameter holes are drilled in the top of each test block. The first 1/2 inch of powder sample is discarded from each hole. A 5/8 inch diameter hole is then drilled for the next 1 inch. These samples are designated as the "top" samples. The 3/4 inch diameter drill bit is then used to enlarge the hole for the next drilling. The 5/8 inch diameter drill bit is then used to drill an additional 1 inch into the same holes. These samples are called the "bottom" samples. Once the samples are collected, they are analyzed for the parts per million (ppm) concentration of chloride in the sample. Theoretically, the HPC inhibits the chloride penetration into the block. Therefore, the bottom samples should show a lower concentration of chlorides than the top samples. The salt ponding results for HPC projects are shown in Table 4.2-1.

Table 4.2-1 Salt Ponding Test Results\*\*

Structure Location	Sample Location	Reference Block	Test Block 1	Test Block 2
Structure #	Top inch	105 ppm	651 ppm	574 ppm
058-0126 (Substructure*)	Bottom inch	95 ppm	153 ppm	133 ppm
Structure #	Top inch	109 ppm	460 ppm	812 ppm
058-0125 (Substructure*)	Bottom inch	134 ppm	161 ppm	247 ppm
Structure #	Top inch	102 ppm	671 ppm	424 ppm
058-0125 (Deck*)	Bottom inch	113 ppm	132 ppm	118 ppm
Structure #	Top inch	110 ppm	485 ppm	461 ppm
084-0065 (Stage I WB Deck*)	Bottom inch	109 ppm	111 ppm	108 ppm
Structure #	Top inch	36 ppm	982 ppm	929 ppm
060-0108 (Deck*)	Bottom inch	41 ppm	130 ppm	48 ppm
Structure #	Top inch	82 ppm	2741 ppm	2006 ppm
060-0151 (Deck*)	Bottom inch	127 ppm	225 ppm	84 ppm

\*See Section 2.2 for mix design information.

\*\*The values shown are average of 4 samples tested from each block at both depths.

The lower values for the bottom inch samples indicate that the chloride ions have not penetrated that far into the sample blocks. Most of the samples contain considerably higher chloride ion content in the top inch samples. Some of the samples almost appear to have “held” the chloride ions near the top inch level of the block.

### 4.3 Thermal Cracking Study

Thermal cracking in concrete occurs when warm days are followed by cool nights. Warm air temperatures during the day and cool air temperatures during the night occur frequently during the spring and fall seasons. The warm temperatures during the day combined with the heat of hydration of the concrete will affect the concrete as it cools from the cool temperatures at night. The large temperature difference between the surface and the interior of the concrete produces thermal stresses. If the difference of concrete temperature is extreme, thermal cracking may occur.

HPC was used on several bridge decks constructed in District 5 between 2002 and 2003. The bridge decks were mainly poured in the spring or fall of the year when warm days were followed by cool nights. Refer to Tables 4.3-1 and 4.3-2.

Numerous cracks were noticeable on the surface and underside of the decks on the bridges during bridge inspections. On the day of the bridge surveys, heavy rainfall occurred. Structure numbered 012-0004 showed mild transverse cracking at 10' - 12' spacing on bottom of the deck and the structure numbered 012-0005 showed more severe transverse cracking at 6' spacing. Both of the aforementioned structures exhibited cracking at the joint ends and water from the heavy rainfall was leaking through the joints. Structures numbered 012-0006 and 012-0007 exhibited severe transverse cracking at less than 3' spacing with a longitudinal crack underneath extending nearly the entire length of both bridge decks.

Severe transverse cracking was observed at 3' - 6' spacing on top of the decks and severe longitudinal cracking was observed underneath the decks on the structures numbered 012-0054 and 012-0055. The structures numbered 012-0052 and 012-0053 exhibited severe transverse cracks on the surface of the deck at 2' - 3' spacing and a longitudinal crack underneath the deck. Also, the structure numbered 012-0052 was patched. The survey forms for these and other structures are located in Appendix A.

In Tables 4.3-1 and 4.3-2, air temperatures from the day of the deck pour and the following 48 hours were gathered. By reviewing the tables, many of the structures experienced significant ambient temperature differences. Two bridge decks contained gravel in the concrete mix design. The other HPC bridge decks contained crushed stone (limestone or dolomite) in the concrete mix designs. Research has shown that gravel has a higher coefficient of thermal expansion than stone which leads to increases in tensile stresses. Also from research, the time of day that the concrete is placed affects its tensile stress. Concrete placed during the day has higher tensile stress than concrete placed at night. Pouring during the night gives the concrete time to set in cooler temperatures before the heat of the day begins and combines with the heat of hydration from the concrete mix to induce thermal cracking. These two research statements are based on ACI Materials Journal/September-October 2009, Title no. 106-M50, Effects of Construction Time and Coarse Aggregate on Bridge Deck Cracking by Kyle A. Riding, Jonathan L. Poole, Anton K. Schindler, Maria C. G. Juenger, and Kevin J. Folliard. However, even though the bridge deck for the structure numbered 012-0053 was poured on the night of August 5 - 6, 2003, the deck still cracked due to the higher coefficient of thermal expansion of the gravel in the HPC mix. The structure numbered 012-0052 also cracked because of the gravel mix, but also experienced an extreme temperature differential after the pour.

Table 4.3-1 Air Temperature (°F) and Wind Speed (mph) on Day of Deck Pour

County	NBI Structure Number	Structure Location	Date of Deck Pour	Temperature (°F)		Wind Speed (mph)		Temperature Difference
				Minimum	Maximum	Maximum Sustained	Maximum Gust	
Clark	012-0054 (EB)	Over Route 1	5/22/2002	34	67	11	17	33
	012-0055 (WB)	Over Route 1	8/29/2002	61	82	10	17	21
Clark	012-0005 (EB)	Over Big Creek	(DL) 4/19/2002	59	84	15	31	25
	012-0005 (EB)	Over Big Creek	(PL) 6/6/2002	57	78	10	17	21
	012-0004 (WB)	Over Big Creek	8/27/2002	61	86	11	No data	25
Clark	012-0007 (EB)	Over East Little Creek	5/18/2002	37	62	16	25	25
	012-0006 (WB)	Over East Little Creek	9/12/2002	47	79	9	No data	32
Clark	012-0009 (EB)	Over Crooked Creek	5/3/2002*	35	71	9	No data	36
	012-0008 (WB)	Over Crooked Creek	9/18/2002	53	85	12	17	32
Clark	012-0069 (EB)	Over Hawks Creek	4/25/2002	39	69	26	39	30
	012-0070 (WB)	Over Hawks Creek	8/9/2002	54	84	7	No data	30
Clark	012-0025 (EBL)	US Route 40 over I-70	3/29/2002	31	64	16	23	33
	012-0025 (WBL)	US Route 40 over I-70	7/11/2002	64	82	13	16	18
Clark	012-0052 (EB)	Over Mill Creek	4/26/2003	41	67	10	No data	26
	012-0053 (WB)	Over Mill Creek	8/5-6/2003 night pour	59	83	8	No data	24

\*Information is believed to be accurate.

Table 4.3-2 Air Temperatures (°F) Within 48 hours After Deck Pour

County	NBI Structure Number	Date of Deck Pour	Day 2 Temperature (°F)		Temp. Diff.	Day 3 Temperature (°F)		Temperature Difference
			Minimum	Maximum		Minimum	Maximum	
Clark	012-0054 (EB)	5/22/2002	50	79	29	49	78	29
	012-0055 (WB)	8/29/2002	60	85	25	61	85	24
Clark	012-0005 (EB)	(DL) 4/19/2002	56	84	28	46	59	13
	012-0005 (EB)	(PL) 6/6/2002	52	75	23	51	83	32
	012-0004 (WB)	8/27/2002	61	82	21	61	82	21
Clark	012-0007 (EB)	5/18/2002	33	62	29	33	62	29
	012-0006 (WB)	9/12/2002	47	85	38	64	84	20
Clark	012-0009 (EB)	5/3/2002*	35	70	35	45	77	32
	012-0008 (WB)	9/18/2002	68	86	18	64	86	22
Clark	012-0069 (EB)	4/25/2002	39	61	22	40	61	21
	012-0070 (WB)	8/9/2002	55	90	35	56	90	34
Clark	012-0025 (EBL)	3/29/2002	33	64	31	37	61	24
	012-0025 (WBL)	7/11/2002	58	82	24	58	85	27
Clark	012-0052 (EB)	4/26/2003	39	72	33	38	75	37
	012-0053 (WB)	8/5-6/2003 night pour	63	84	21	62	84	22

\*Information is believed to be accurate.

In Tables 4.3-3 and 4.3-4, air temperatures from the day of the deck pour and the following 48 hours for a selected number of structures were gathered for review. This was done to determine if a significant temperature change may have contributed to thermal cracking. Longitudinal cracking was also observed.

The structure numbered 058-0125 exhibited cracking on the bottom of the deck at 4' - 6' spacing. The structure numbered 058-0126 showed less cracking than the structure numbered 058-0125. From Tables 4.3-3 and 4.3-4, the structure numbered 058-0125 experienced a larger temperature fluctuation in the first 72 hours after the pour than the structure numbered 058-0126. These structures are a dual structure.

The structure numbered 026-0034 showed transverse and longitudinal cracking on the bottom of the bridge deck. Severe transverse cracking was visible at 2' - 3' spacing in the eastbound lanes with a low temperature differential and faint transverse cracking was visible at 7' - 8' spacing with a high temperature differential in the westbound lanes. Both the eastbound and westbound lanes exhibited longitudinal cracking at 4' or more spacing on the bottom of the deck. On top of the deck, cracking was observed at 3' - 5' spacing near the middle of the bridge.

The structure numbered 060-0004 exhibited transverse cracking on the top of the deck at 1' - 3' spacing, and on the bottom of the deck at 3' - 5' spacing in the middle and northern spans despite a mild temperature differential. The HPC structure numbered 060-0004 has a low ADT of 126.

After reviewing the temperature differences in the tables and comparing with the survey forms and detailed distress drawings located in Appendix A, a high temperature differential may produce more cracking. However, as seen from the previous discussion, bridges with a low temperature differential may still crack severely. Thus, indicating other factors may be involved in bridge deck cracking.

Table 4.3-3 Air Temperature (°F) and Wind Speed (mph) on Day of Deck Pour

County	NBI Structure Number	Structure Location	Date of Deck Pour	Temperature (°F)		Wind Speed (mph)		Temperature Difference
				Min.	Max.	Maximum Sustained	Maximum Gust	
Henderson	036-0053 (new)	Over Lone Tree	9/6/2002	56	87	8	No data	31
Macon	058-0126 (SB)	Over Dry Branch	10/3/2000	54	82	9	No data	28
	058-0125 (NB)	Over Dry Branch	10/12/2000	34	72	12	No data	38
Fayette	026-0034	Vandalia	10/17/2002 (EB)	41	54	12	23	13
			4/11/2003 (WB)	36	68	10	17	32
Mason/ Menard	065-0501 (new)	Over Salt Creek	8/26/2002 Spans 7-10	64	85	7	No data	21
Christian	011-0035 (NB)	NE of Moweaqua	8/27/2002	63	82	14	No data	19
	011-0036 (SB)	NE of Moweaqua	8/27/2002	63	82	14	No data	19
Sangamon	084-0499	Over Lake Springfield	9/13/2001 (SB)	53	86	20	26	33
			9/17/2001 (SB)	50	77	8	No data	27
			9/21/2001 (SB)	51	80	22	31	29
			9/25/2001 (SB)	36	61	12	18	25
Sangamon	084-0500	Over Lake Springfield	3/28/2002 (NB)	24	51	19	23	27
			4/1/2002 (NB)	26	61	24	33	35
			4/5/2002 (NB)	23	60	20	30	37
Sangamon	084-0065	Over Brush Creek	8/3/2000 (WB)	64	88	20	35	24
	084-0065	Over Brush Creek	10/17/2000 (EB)	46	60	11	No data	14
Christian	011-0502	Near Kincaid, IL	10/12/2000	31	75	12	No data	44
Madison	060-0004	Livingston Exit	6/27/2002	75	88	15	29	13
Madison	060-0108	IL 4 over I-70	7/27/2000 (SB)	68	88	14	No data	20
	060-0108	IL 4 over I-70	10/6/2000 (NB)	46	61	18	No data	15
Madison	060-0151	IL 143 over I-70	7/31/2000 (NB)	68	79	11	No data	11
	060-0151	IL 143 over I-70	10/9/2000 (SB)	32	57	13	No data	25

Table 4.3-4 Air Temperatures (°F) Within 48 hours After Deck Pour

County	NBI Structure Number	Date of Deck Pour	Day 2 Temperature (°F)		Temp. Diff.	Day 3 Temperature (°F)		Temperature Difference
			Minimum	Maximum		Minimum	Maximum	
Henderson	036-0053 (new)	9/6/2002	59	89	30	64	89	25
Macon	058-0126 (SB)	10/3/2000	55	73	18	54	57	3
	058-0125 (NB)	10/12/2000	48	75	27	48	79	31
Fayette	026-0034 (EB)	10/17/2002	34	66	32	46	61	15
	026-0034 (WB)	4/11/2003	41	70	29	39	70	31
Mason/ Menard	065-0501 (new)	8/26/2002 Spans 7-10	64	85	21	63	83	20
Christian	011-0035 (NB)	8/27/2002	61	84	23	59	81	22
	011-0036 (SB)	8/27/2002	61	84	23	59	81	22
Sangamon	084-0499	9/13/2001 (SB)	50	70	20	48	74	26
		9/17/2001 (SB)	50	76	26	59	72	13
		9/21/2001 (SB)	46	76	30	47	77	30
		9/25/2001 (SB)	36	71	35	36	74	38
Sangamon	084-0500	3/28/2002 (NB)	37	53	16	36	59	23
		4/1/2002 (NB)	26	61	35	30	56	26
		4/5/2002 (NB)	23	60	37	26	57	31
Sangamon	084-0065	8/3/2000 (WB)	60	80	20	60	80	20
	084-0065	10/17/2000 (EB)	37	69	32	39	76	37
Christian	011-0502	10/12/2000	40	80	40	61	80	19
Madison	060-0004	6/27/2002	70	88	18	72	91	19
Madison	060-0108	7/27/2000 (SB)	68	84	16	68	77	9
	060-0108	10/6/2000 (NB)	30	48	18	34	54	20
Madison	060-0151	7/31/2000 (NB)	64	86	22	70	90	20
	060-0151	10/9/2000 (SB)	32	64	32	34	70	36

#### 4.4 Air Temperature vs. Concrete Strength

The HPC bridge deck concrete mixes, except in one case, met the IDOT criteria for minimum compressive strength of 4000 psi and minimum flexural strength of 675 psi at 14 days. As shown in Table 4.4-1, the field strength test results exceed the strength requirements. The fluctuations in air temperature during the first 72 hours of the deck pour had very little to no effect on the compressive strength of the concrete.

Table 4.4-1 14-Day Compressive Strength Test Results of HPC Bridge Decks

County	Structure Number	Pour Date	Air Temperature Differences			Strength at 14 days (psi)	
			Day of Pour	48 hrs. after Pour	72 hrs. after Pour	Compressive	Flexural
Henderson	036-0053	9/6/2002	31	30	25		688
Macon	058-0126	10/3/2000	28	18	3	5668,6069	
	058-0125	10/12/2000	38	27	31	7003,6209	
Fayette	026-0034	10/17/2002	13	32	15		895
		4/11/2003	32	29	31		990,840
Mason/Menard	065-0501	8/26/2002	21	21	20		
Christian	011-0035	8/27/2002	19	23	22	4658,5200	
	011-0036	8/27/2002	19	23	22	4658,5200	
Clark	012-0054	5/22/2002	33	29	29	4000,4000,4329	
	012-0055	8/29/2002	21	25	24	4840	
	012-0005	(DL) 4/19/2002	25	28	13	4250	
	012-0005	(PL) 6/6/2002	21	23	32	4575,4575	
	012-0004	8/27/2002	25	21	21	4375	
	012-0007	5/18/2002	25	29	29	4685	
	012-0006	9/12/2002	32	38	20	4320	
	012-0009	5/3/2002*	36	35	32	5389	
	012-0008	9/18/2002	32	18	22	4625	
	012-0069	4/25/2002	30	22	21	4560,4835	
	012-0070	8/9/2002	30	35	34		
	012-0025	3/29/2002	33	31	24	5796,5561	
	012-0025	7/11/2002	18	24	27	5440,4894	
	012-0052	4/26/2003	26	33	37	5221,5281	
	012-0053	8/5-6/2003 night pour	24	21	22	5904, 6120	
Sangamon	084-0499	9/13/2001	33	20	26	5155	820
		9/17/2001	27	26	13	5680	730
		9/21/2001	29	30	30	6660, 6315	
		9/25/2001	25	35	38	5480	720
	084--0500	3/28/2002	27	16	23	4845, 4975	
		4/1/2002	35	35	26	4660, 6400, 4285, 4475, 5075	
		4/5/2002	37	37	31	4918, 5235, 4225, 5010	

\*Information is believed to be accurate.

Table 4.4-1 (continued) 14-Day Compressive Strength Test Results of HPC Bridge Decks

County	Structure Number	Pour Date	Air Temperature Differences			Strength at 14 days (psi)	
			Day of Pour	48 hrs. after pour	72 hrs. after pour	Compressive	Flexural
Sangamon	084-0065 (WB)	8/3/2000	24	20	20	5590, 5290	
	084-0065 (EB)	10/17/2000	14	32	37	6095, 4952	
Christian	011-0502	10/12/2000	44	40	19		616
Madison	060-0004	6/27/2002	13	18	19		799
Madison	060-0108 (SB)	7/27/2000	20	16	9	5366, 5758, 4496, 6001	
	060-0108 (NB)	10/6/2000	15	18	20	5831, 6693, 4997, 4793	
Madison	060-0151 (NB)	7/31/2000	11	22	20	5610	
	060-0151 (SB)	10/9/2000	25	32	36	5649, 6505, 5214, 5671	
Champaign	010-0170	9/20/2001					
McLean	057-6301	5/21/2004					
Will	099-4638	4/30/2002					1128
	101-0175 (SB)	8/28/2002					
Cook	016-2720	7/3/2002(SB)					1068, 1039
		10/1/2002(NB)					1046, 1008, 1029, 1000
	016-2740	5/3/2002					1084, 967
	016-0982	9/8/2003					
	016-0983	5/7/2003					
	016-0979	8/7/2003(NB)					
		6/16/2003(SB)					
Iroquois	038-0207	11/3/2000					
	038-0118	8/8/2002					
	038-0210	8/26/2002(NB)					
		10/24/2002(SB)					

#### 4.5 Freezing and Thawing

The Department monitors how well samples hold up to repetitive cycles of freezing and thawing through the use of ASTM C 215-97, Standard Test Method for Fundamental Transverse, Longitudinal, and Torsional Resonant Frequencies of Concrete Specimens. Beams 3 inch x 4 inch x 16 inches were subjected to 300 cycles of freezing and thawing. Samples were collected for three HPC pours, and Table 4.5-1 depicts the results from the freezing and thawing sonic testing.

Table 4.5-1 Freezing and Thawing Sonic Testing

<b>Location</b>	<b>Minimum Relative Durability</b>	<b>Approximate Air Content (%)</b>
Structure # 084-0065 (Deck*)	39.94%	6.0
Structure # 060-0108 (Deck*)	52.31%	6.0
Structure # SN# 060-0151 (Deck*)	76.50%	7.4

\*See Section 2.2 for mix design information.

The IDOT criteria for chemical admixtures, which shows how well a sample performs in the sonic test, is based upon an 80% minimum relative durability. If the sample retains at least 80% of the original frequency, it passes. As shown in the above table, all of the bridge deck mix design samples tested below the 80% minimum. The Department does not require superstructure aggregate to be freeze-thaw durable. Without knowing which ledge the aggregates were produced from at the appropriate quarries, one cannot determine if the aggregates are freeze-thaw durable. By looking at the sonic testing data, one could conclude that freeze-thaw durable aggregate was probably not used for the three deck mix design pours. The air content of the concrete which the samples were obtained from seems to have no relation to how well the samples perform in the sonic test.

#### 4.6 Salt Scaling

The salt scaling test is Illinois Modified ASTM C 672 and consists of making 7 inch x 12 inch samples with a height of 3 inches. A wooden dike is attached to the perimeter of the blocks, as is done for the salt ponding test previously mentioned. Three specimens are made for each test and moist cured for 14 days. Next the samples are removed from the moist room and stored in air for an additional 14 days.

The testing of the specimens begins with covering the samples with a 1/8 inch to 1/4 inch layer of water. The specimens are then placed in a freezing environment for approximately 16 hours, after which they are evenly covered with sodium chloride and placed back in the freezer for an additional 5 hours. Once this is complete, the specimens are rinsed with clear water and allowed to thaw for 3 to 3.5 hours. The test is complete once the specimens have been through 60 cycles.

Each specimen is evaluated and photographed at 0, 5, 20, 40, and 60 cycles. The following system is used to evaluate the samples.

##### Condition of Surface

- 0 Finished surface
- 1 Dusting off of surface
- 2 Light scale or sand pitting
- 3 Light scale with coarse aggregate showing
- 4 Medium scale with coarse aggregate protruding
- 5 Heavy scaling

Samples for salt scaling testing were collected for three HPC pours, and Table 4.6-1 outlines the results of these tests.

Table 4.6-1 Salt Scaling Testing

<b>Deck Location</b>	<b>Rating</b>	<b>Comments</b>
Structure # 084-0065 (Stage I WB Deck*)	2.8	Light with sand pitting to light with coarse aggregate showing
Structure # 060-0108 (Deck*)	2.5	Light with sand pitting to light with coarse aggregate showing
Structure # 060-0151 (Deck*)	1.7	Dusting of surface to light with fine aggregate pitting

\*See Section 2.2 for mix design information.

Most of the test results are in the mid-range of the rating system. The test results fall within a range that is typically seen through laboratory specimen testing.

## **5.0 Experimental Bridge Decks - Shrinkage-Compensating Concrete & Synthetic Fibers**

In the early 1990's, IDOT built four bridges using shrinkage-compensating concrete for the bridge deck. These bridge decks were surveyed and very few cracks were observed. The survey forms for these structures are located in Appendix B.

A shrinkage-compensating expansive cement called Type K was used for a shrinkage-compensating concrete bridge deck mix design in structures numbered 018-0007, 094-0045 and 094-0046. The mix design had 715 lbs. of expansive cement per cubic yard. The expansive cement caused the concrete to increase in volume after setting and during hardening. Restraint provided by reinforcing steel and bridge girders results in compressive forces in the concrete which offset the tensile forces due to shrinkage as the concrete dries, eliminating or greatly reducing cracking.

The structure numbered 018-0007 located on US 40 over Muddy Creek and the structures numbered 094-0045 and 094-0046 located on IL 67 over South Henderson Creek used Type K cement per ASTM C 845 by Southdown, Inc. in Fairborn Ohio. The structure numbered 018-0007 was crack free. Minor cracking was observed on the bridge decks for structures numbered 094-0045 and 094-0046 with longitudinal cracking present on the parapet.

A shrinkage-compensating powder (SCP) as an admixture that was added to the Portland cement which produced a shrinkage-compensating concrete mixture was used in the bridge decks for structures numbered 017-0006 and 102-0046. The shrinkage-compensating concrete caused an increase in volume after setting and during hardening. Restraint provided by reinforcing steel and bridge girders results in compressive forces in the concrete which offset the tensile forces due to shrinkage as the concrete dries, eliminating or greatly reducing cracking.

The structure numbered 017-0006 located on Palestine Road over Hutson Creek and the structure numbered 102-0046 on IL 24 located over a railroad used the shrinkage-compensating powder. For both structures, it is believed that approximately 85-90 lbs. of Chem Comp III dry cementitious powder by CTS Cement Manufacturing Company and 605 lbs. of Type I cement were in each cubic yard of concrete. Chem Comp III can be mixed with Type I cement to meet the requirements for Type K cement per ASTM C 845. Structure numbered 017-0006 consisted of three spans with cracks observed in the middle span and almost no cracks observed in the end spans. Structure numbered 102-0046 was nearly free of cracks.

In the fall of 2009, a structure numbered 062-0072 located on IL 17 over Senachwine Creek in Marshall County used synthetic fibers in the bridge deck. The purpose for the addition of the synthetic fibers was to reduce plastic shrinkage cracks. The survey form for this structure is located in Appendix C.

The bridge was constructed in two stages. During Stage I, the project used 4 lbs. fibers per cubic yard in the NW span and 6 lbs. fibers per cubic yard in the NE span. During Stage II, the project used 4 lbs. fibers per cubic yard in the first 45 cubic yards and 6 lbs. fibers per cubic yard in the second 45 cubic yards. For the bridge approach on the Stage II side, no more than 6 lbs. per cubic yard of fibers were also used.

This structure was surveyed in May of 2010. Five transverse cracks were visible in the Stage II eastbound lanes. No transverse cracks were observed in the Stage I westbound lanes except near the ends.

## 6.0 Summary of Findings

The use of High Performance Concrete, based on the mix design developed for the bridge decks, was expected to decrease chloride penetration and reduce cracking in the hopes of increasing service life. From the bridge surveys conducted by IDOT, the bridge decks placed with HPC concrete cracked as much or more than the non-HPC bridge decks. Transverse cracking across the width of the bridge deck was the predominant cracking.

Cracking in bridge decks causes durability problems and reduces service life. The HPC bridge decks may be less permeable to chloride, but with the bridge deck cracking, the deicing salts will penetrate into the cracks and corrode the reinforcing steel. The durability and service life of the HPC decks are not expected to exceed a conventional bridge deck.

The strength test results of the HPC bridge decks met or exceeded the compressive strength requirements of IDOT. However, the concrete mixes may have been too strong and thus brittle. This brittleness could have resulted in increased cracking.

Drying shrinkage appeared to be the major cause of early age shrinkage cracking. Drying shrinkage results from the loss of original concrete mix water after the concrete has cured. As free water in the concrete pore structure evaporates, the concrete shrinks and will cause transverse cracking.

If the drying shrinkage can be delayed until the concrete is stronger, the amount of cracks and the width associated with the cracks may be greatly reduced. The reduction of cracks by using shrinkage-compensating concrete mixes may be a solution. The history of bridge decks built by IDOT using shrinkage-compensating concrete mixes yielded positive results.

Thermal cracking was a factor in some bridge decks. Warm daytime temperatures and cool nighttime temperatures led to extreme temperature differentials, which resulted in cracking. If the concrete temperature is high during placement, the rate of the heat of hydration is increased. At lower temperatures, the hydration rates are slowed and the concrete mix could remain plastic for a longer period of time and inhibit early age cracking.

Encouraging night pours for bridge decks could be a possibility. Pouring bridge decks at night can reduce cracking because the concrete has time to set before tensile stresses begin, and before the heat of the day increases the rate of hydration.

The type of aggregate and the source of aggregates used in the concrete mix can be a factor in deck cracking. For example, the structures numbered 012-0052 and 012-0053 contained gravel in the concrete mix. Gravel has a higher coefficient of thermal expansion than stone (limestone or dolomite). Both of these bridge decks are severely cracked and structure 012-0052 was patched a year after casting because of extensive cracking. Extreme temperature changes combined with an aggregate having a high coefficient of thermal expansion could induce cracking. For another field example regarding this possibility, refer to Auburn University Highway Research Center, Research Report for ALDOT Project 930-645 (August 2010), Evaluation of Cracking of The US 331 Bridge Deck by Anton K. Schindler, Mary L. Hughes, Robert W. Barnes, and Benjamin E. Byard.

In conclusion, shrinkage in concrete cannot be prevented. However, the research indicates the amount of deck cracking could be reduced by investigating the use of materials which reduce the amount of shrinkage.

Appendix A  
Bridge Survey Forms and Distress Drawings  
HPC

Champaign County



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 010-0170

Responsible District: 5

Number of Spans: 4

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

ADT @ time bridge was built: 12,700 (2007)

Skew:  Y  N Angle: \_\_\_\_\_

Inspected By: DAD, SWL, JAB

Date Inspected: 10/12/11

Span Lengths See below Total 67.5m

Deck Width: 12.6m

Beam Spacing: 1.98m (interior), 1.74m (exterior)

Date of Beam Erection: 2001

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 2001 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: Top: Southbound-cracking observed at 12-14' spacing at end and ~6' spacing in middle; Northbound-Three transverse cracks observed the entire length of bridge.

Longitudinal Cracking: None

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span Lengths: 1) 16.8m, 2) 25.3m, 3) 18.3m

**Mix Design Information: (from MISTIC)**

Mix Design Number: 85PCC6097

Coarse Aggregate Source: Material Service CA 11  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: Vulcan Materials FA 01 Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

Cement Source: \_\_\_\_\_

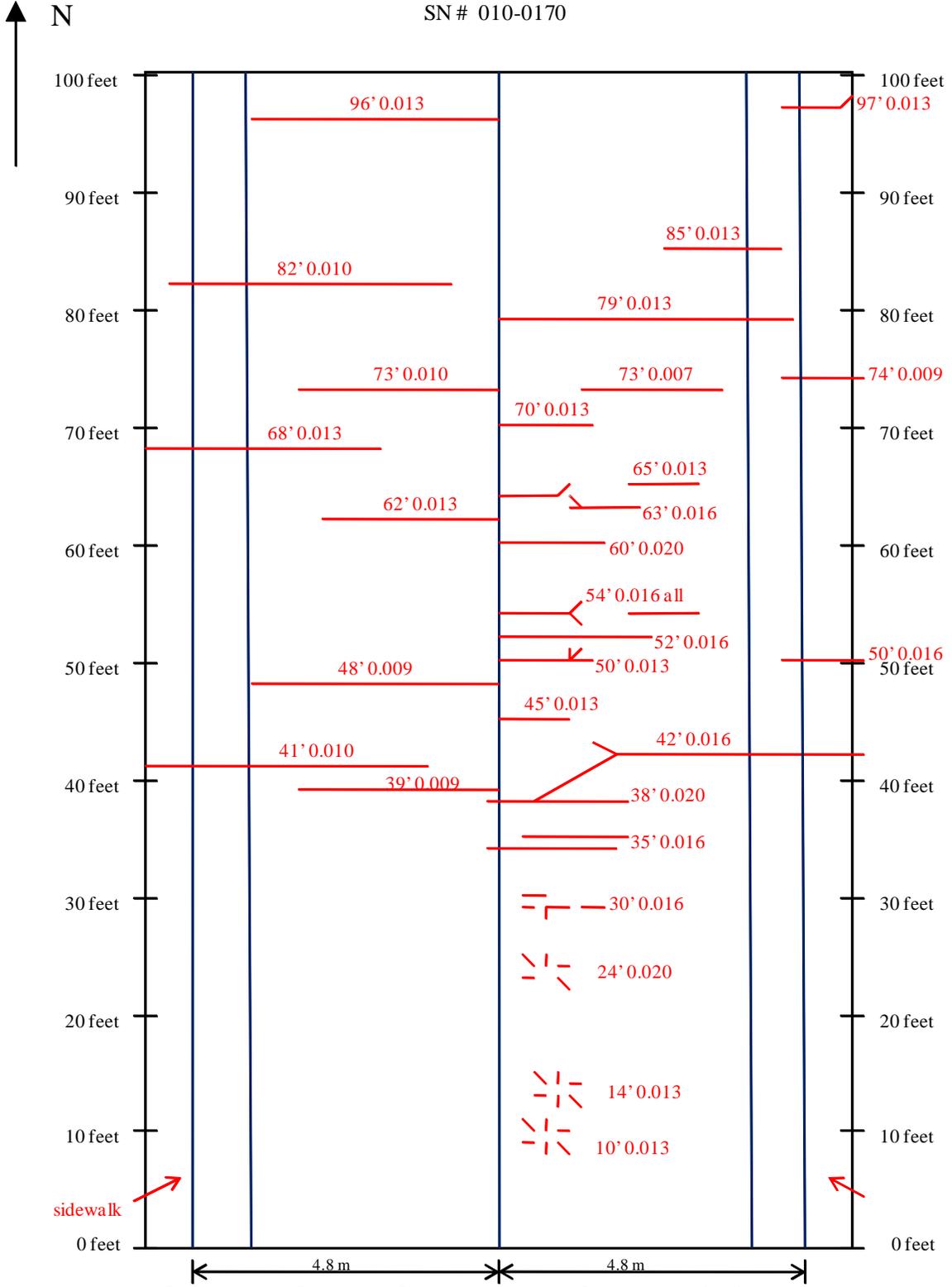
GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: ISG Resources, Inc.

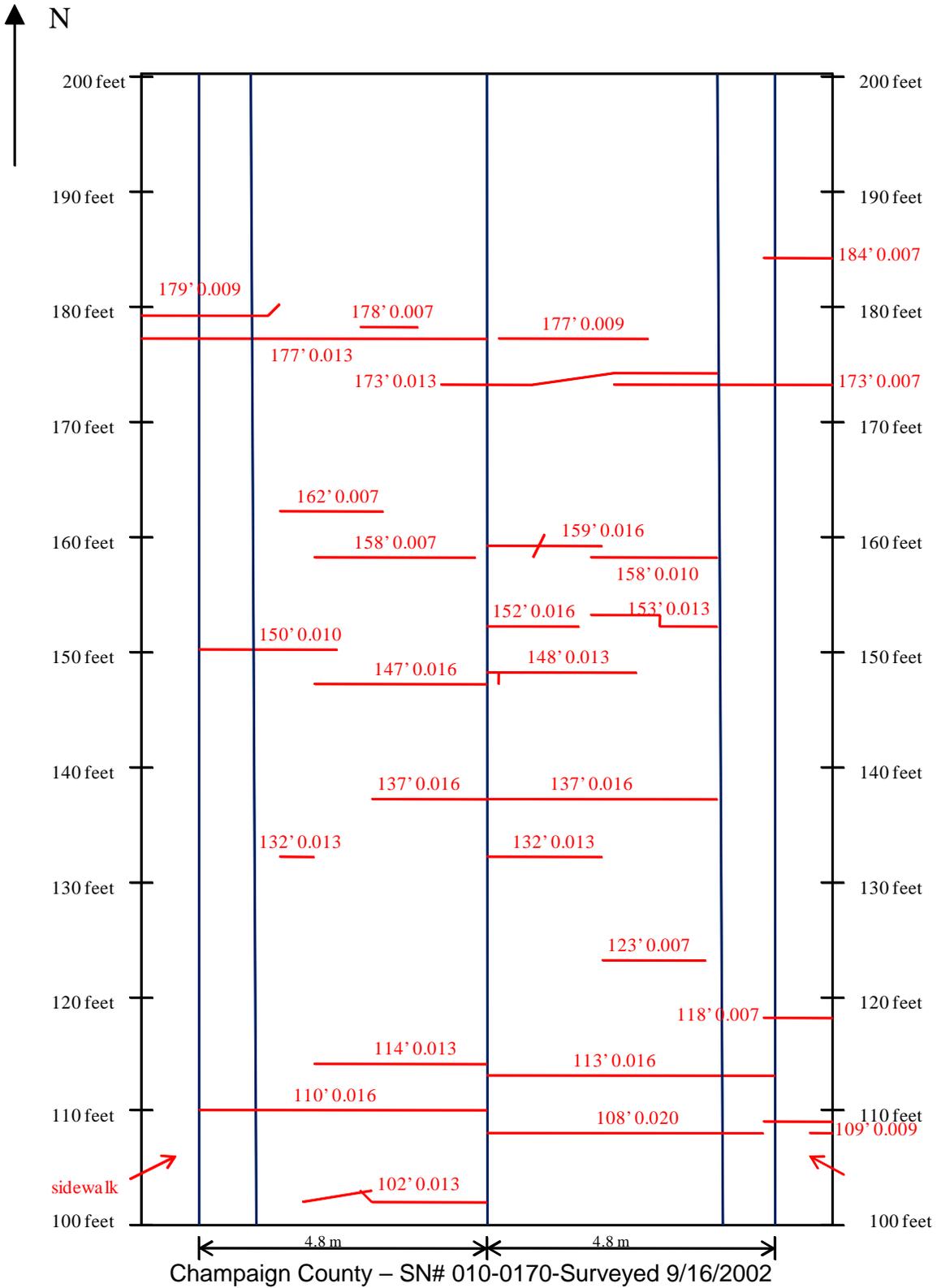
Microsilica Source: W. R. Grace & Company

# Duncan Road over I – 72

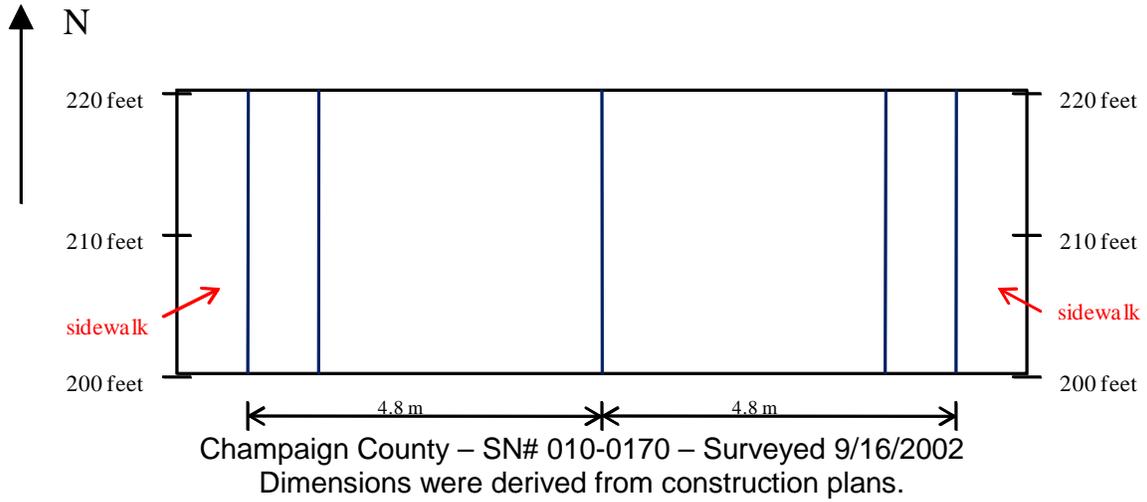
SN # 010-0170



# Duncan Road over I – 72

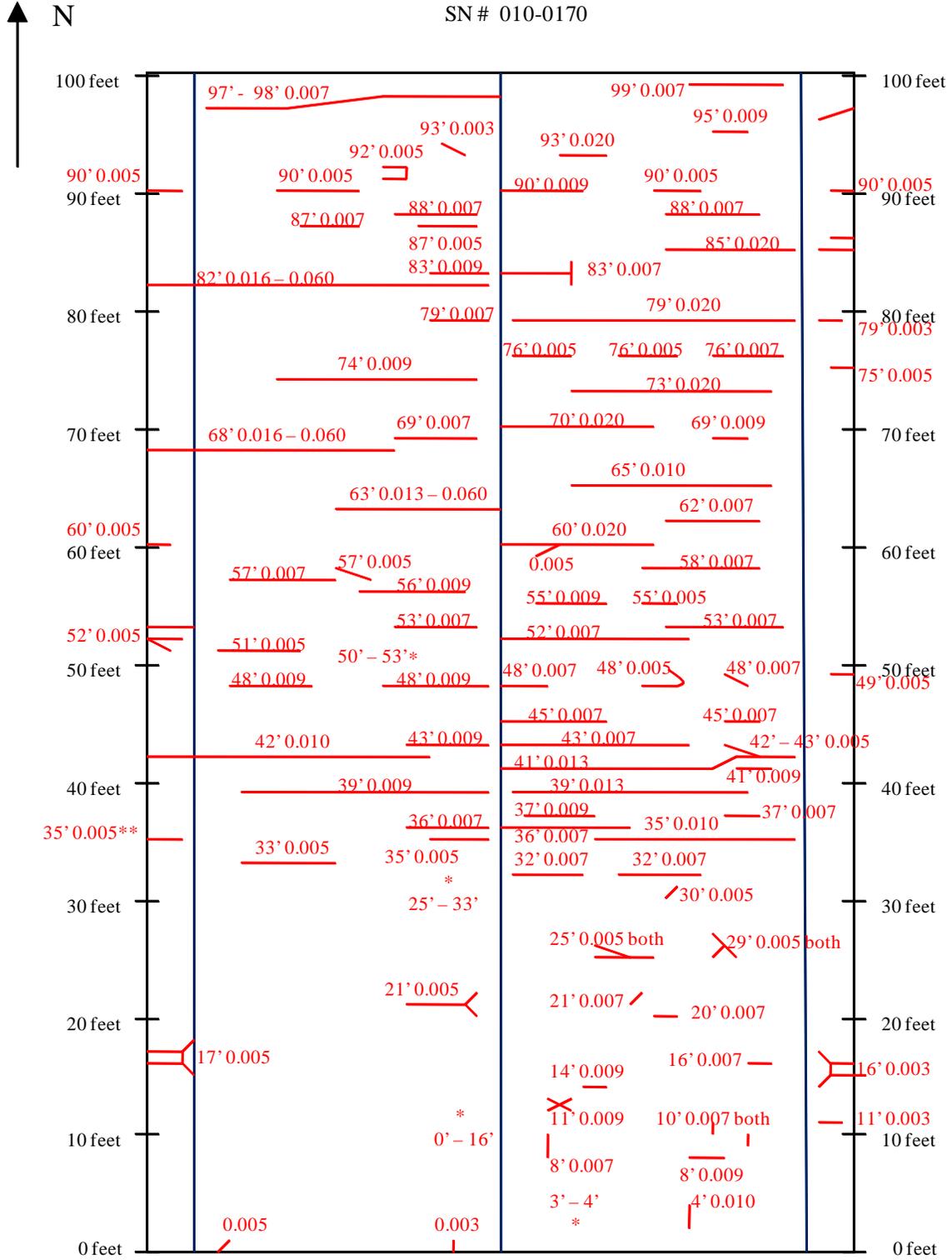


# Duncan Road over I – 72



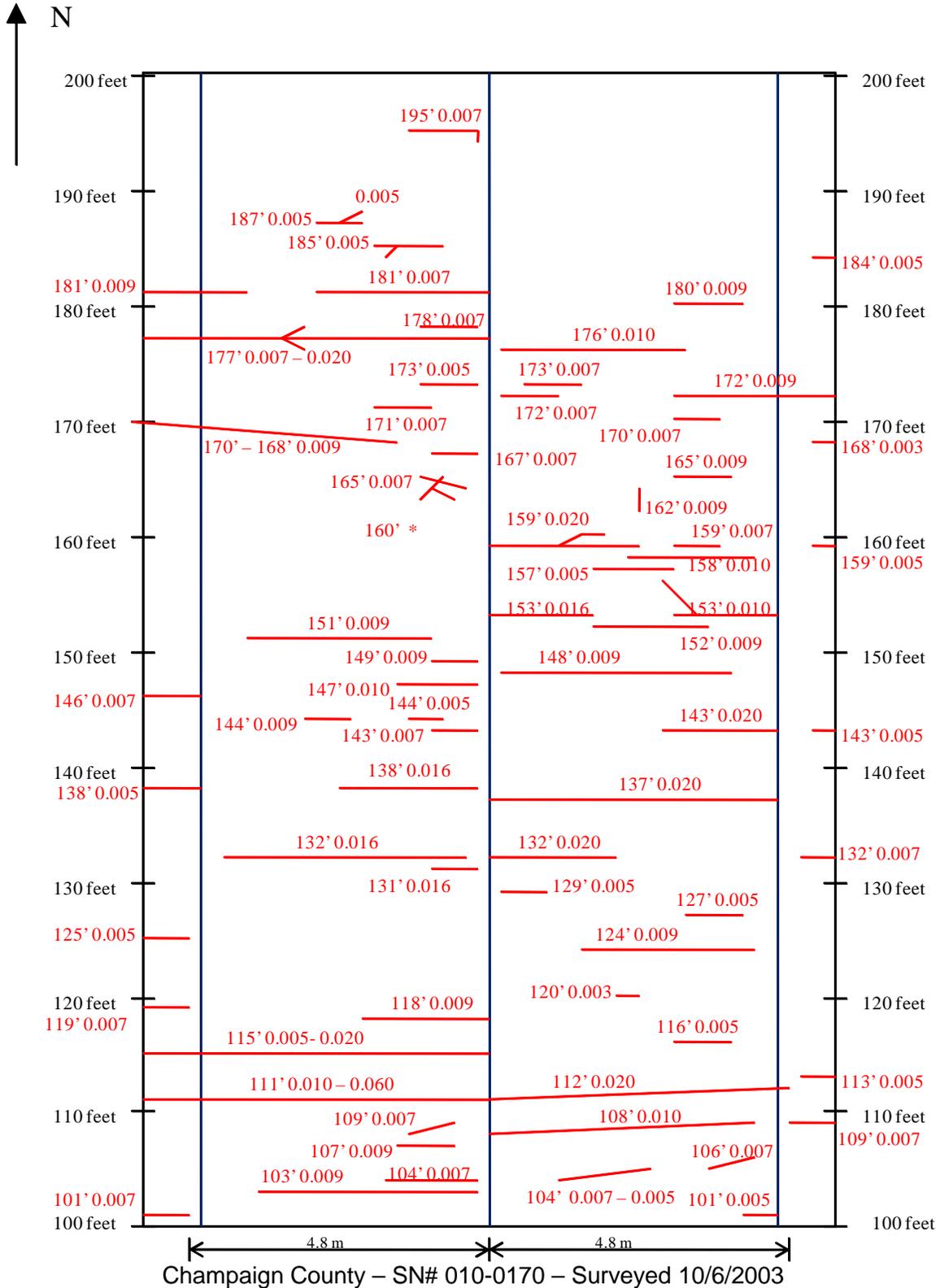
# Duncan Road over I-72

SN # 010-0170

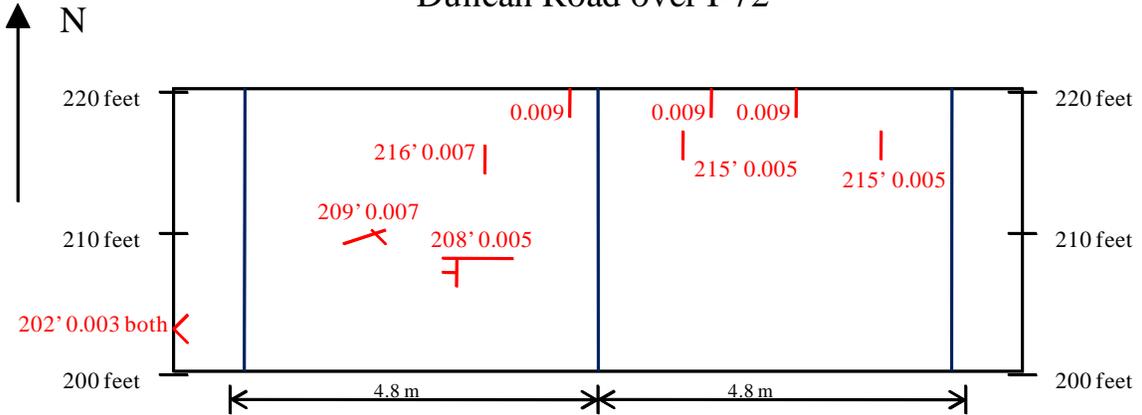


Champaign County – SN# 010-0170 – Surveyed 10/6/2003

# Duncan Road over I-72



# Duncan Road over I-72



Champaign County – SN# 010-0170 – Surveyed 10/6/2003

\* Denotes areas showing map cracking.

Also, several cracks extended into the sidewalk.

Christian County



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 011-0035

Responsible District: 5

Number of Spans: 3

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  Semi-Integral  Other

ADT @ time bridge was built: 4000 (2007)

Skew:  Y  N Angle: \_\_\_\_\_

Inspected By: DAD, DHT, JAB

Date Inspected: 7/22/09

Span Lengths See below Total: 61.1m

Deck Width: 12.0m

Beam Spacing: 2.22m

Date of Beam Erection: 2002

Bridge Joint:  Integral  Finger  Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 2002 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: Transverse cracking was observed every 8' – 9' between beams. Map and transverse cracking were seen every 3' – 6' on top.

Longitudinal Cracking: Longitudinal cracking was seen on top of bridge deck every 6' – 7'.

Bridge Joint Cracking / Integral Abutment Cracking: "Integral Abutment" restraint cracking observed with more pronounced cracking near the approach slab.

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span Lengths: 1) 16.8m, 2) 25.3m, 3) 18.3m

**Mix Design Information: (from MISTIC)**

Mix Design Number: 85PCC6097

Coarse Aggregate Source: Material Service CA 11  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: Vulcan Materials FA 01 Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

Cement Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: ISG Resources, Inc.

Microsilica Source: W. R. Grace & Company



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 011-0036

Inspected By: DAD, DHT, JAB

Responsible District: 5

Date Inspected: 7/22/09

Number of Spans: 3

Span Lengths See below Total: 61.1m

Deck Width: 12.0m

Beam Type:  PPC-I  Steel  Other

Beam Spacing: 2.22m

Date of Beam Erection: 2002

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: 4000 (2007)

Stage Construction:  Y  N

Skew:  Y  N Angle: \_\_\_\_\_

Pour Dates: Stage 1, 2002 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: Transverse cracking was observed every 6' on average between beams.

On top of the bridge deck, transverse cracking was observed every 4' – 5'.

Longitudinal Cracking: More longitudinal cracking observed on this deck than 011-0035.

Bridge Joint Cracking / Integral Abutment Cracking: "Integral Abutment" restraint cracking observed with more pronounced cracking near the approach slab.

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span Lengths: 1) 16.8m, 2) 25.3m, 3) 18.3m

**Mix Design Information: (from MISTIC)**

Mix Design Number: 85PCC6097

Coarse Aggregate Source: Material Service CA 11  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: Vulcan Materials FA 01 Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

Cement Source: \_\_\_\_\_

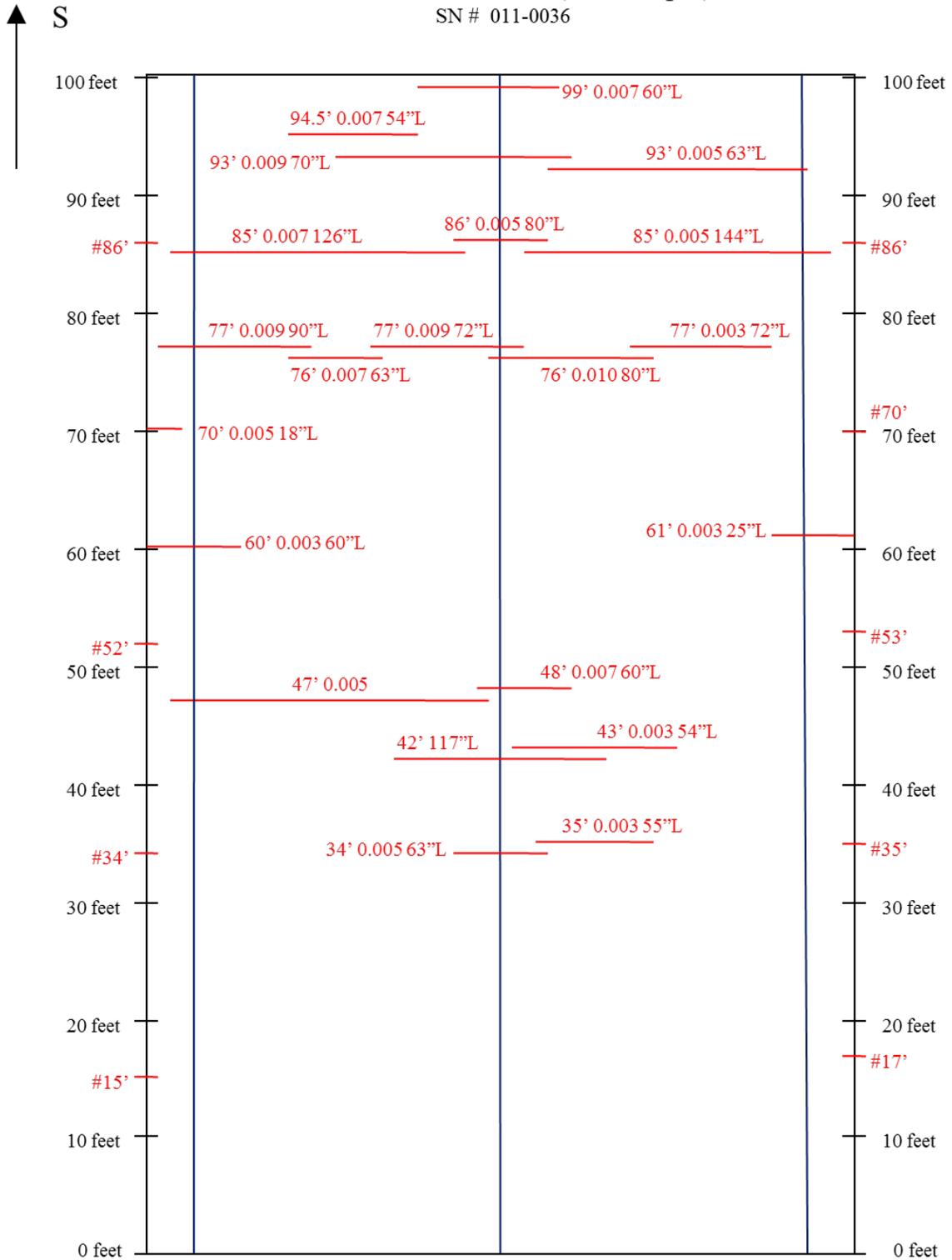
GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: ISG Resources, Inc.

Microsilica Source: W. R. Grace & Company

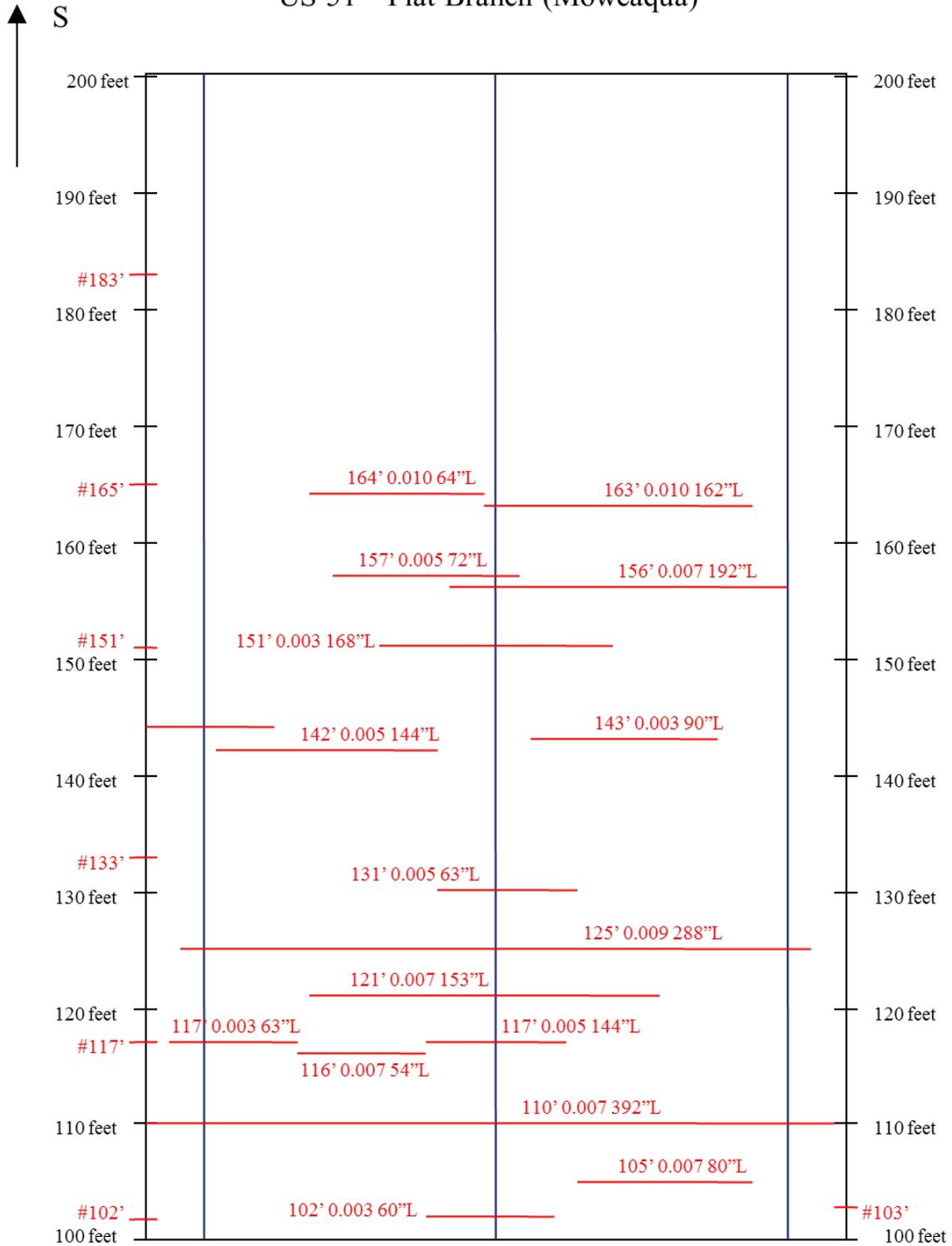
# US 51 - Flat Branch (Moweaqua)

SN # 011-0036



Christian County – SN#011-0036 – Surveyed 9/16/2003

# US 51 – Flat Branch (Moweaqua)



Christian County – SN#011-0036 – 9/19/2003  
 The “#” symbol represents cracks in the parapet only.



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 011-0502

Responsible District: 6

Number of Spans: 3

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

ADT @ time bridge was built: 3,850 (2007)

Skew:  Y  N Angle: \_\_\_\_\_

Inspected By: DAD, DHT, JAB

Date Inspected: 6/9/10

Span Lengths See below Total: 100.3m

Deck Width: 12.2m

Beam Spacing: 2.260m

Date of Beam Erection: 2000

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 2000 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: On top, sealed cracks at 2'-3' spacing. On bottom, cracks were present at 4'-5' spacing.

Longitudinal Cracking: Map cracking present on top.

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span lengths: 1&3) 30.8m, 2)37.0m

**Mix Design Information: (from MISTIC)**

Mix Design Number: 86PCC2078

Coarse Aggregate Source: Material Service  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: Buckhart S & G Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

Cement Source: \_\_\_\_\_

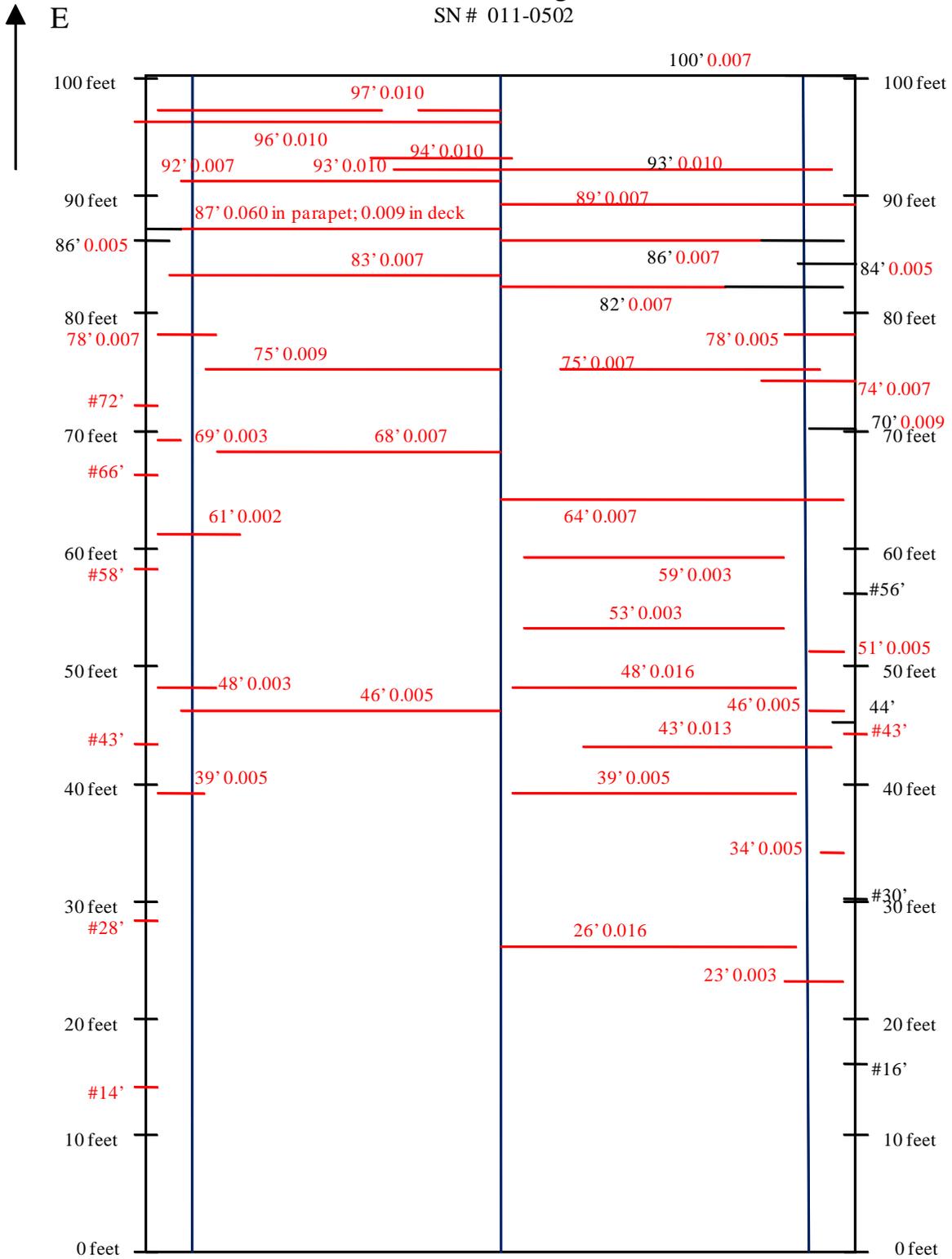
GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: Mineral Resource Tech

Microsilica Source: W. R. Grace & Co.

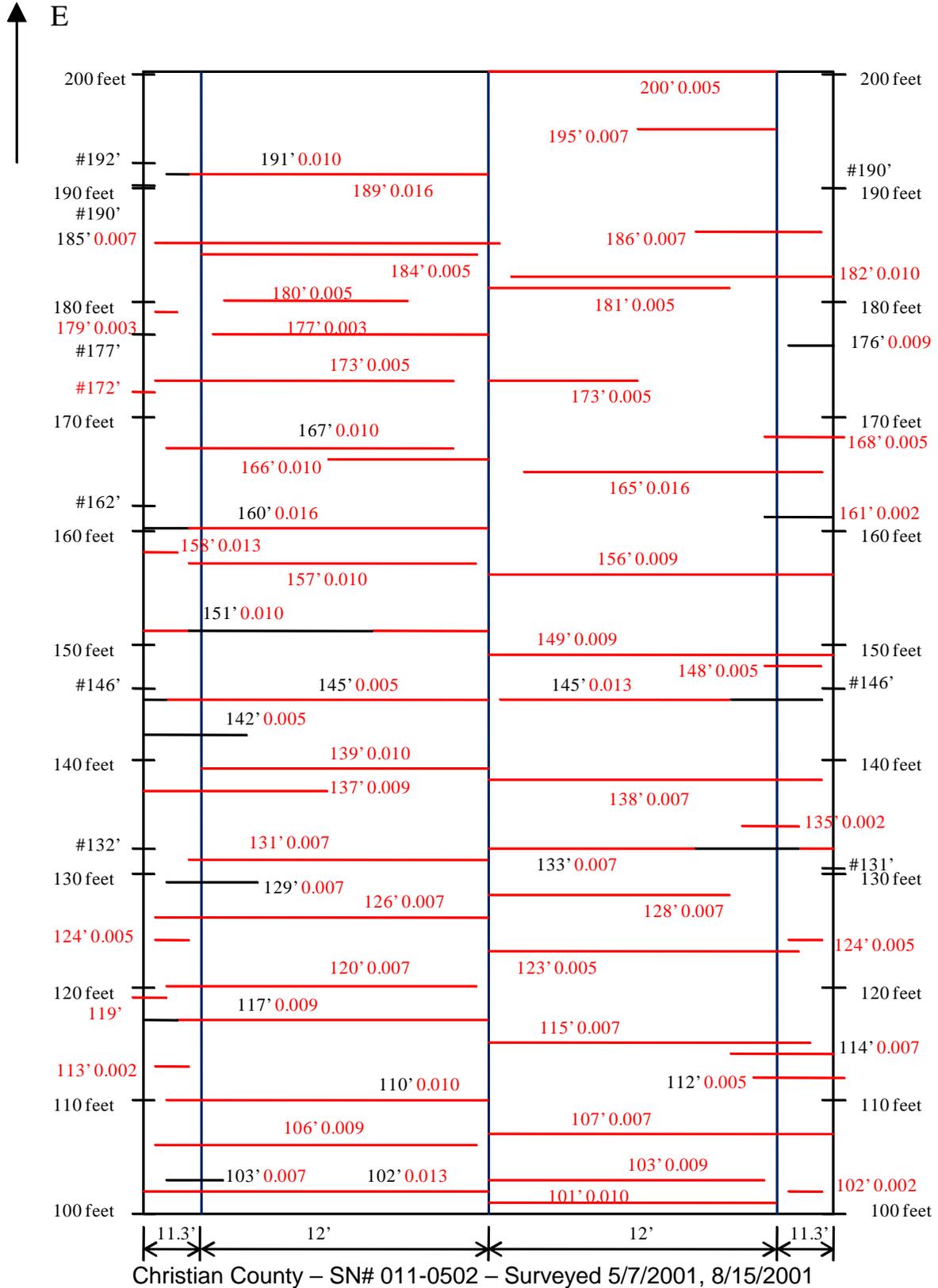
# 104 over S. Fork Sangamon River

SN # 011-0502

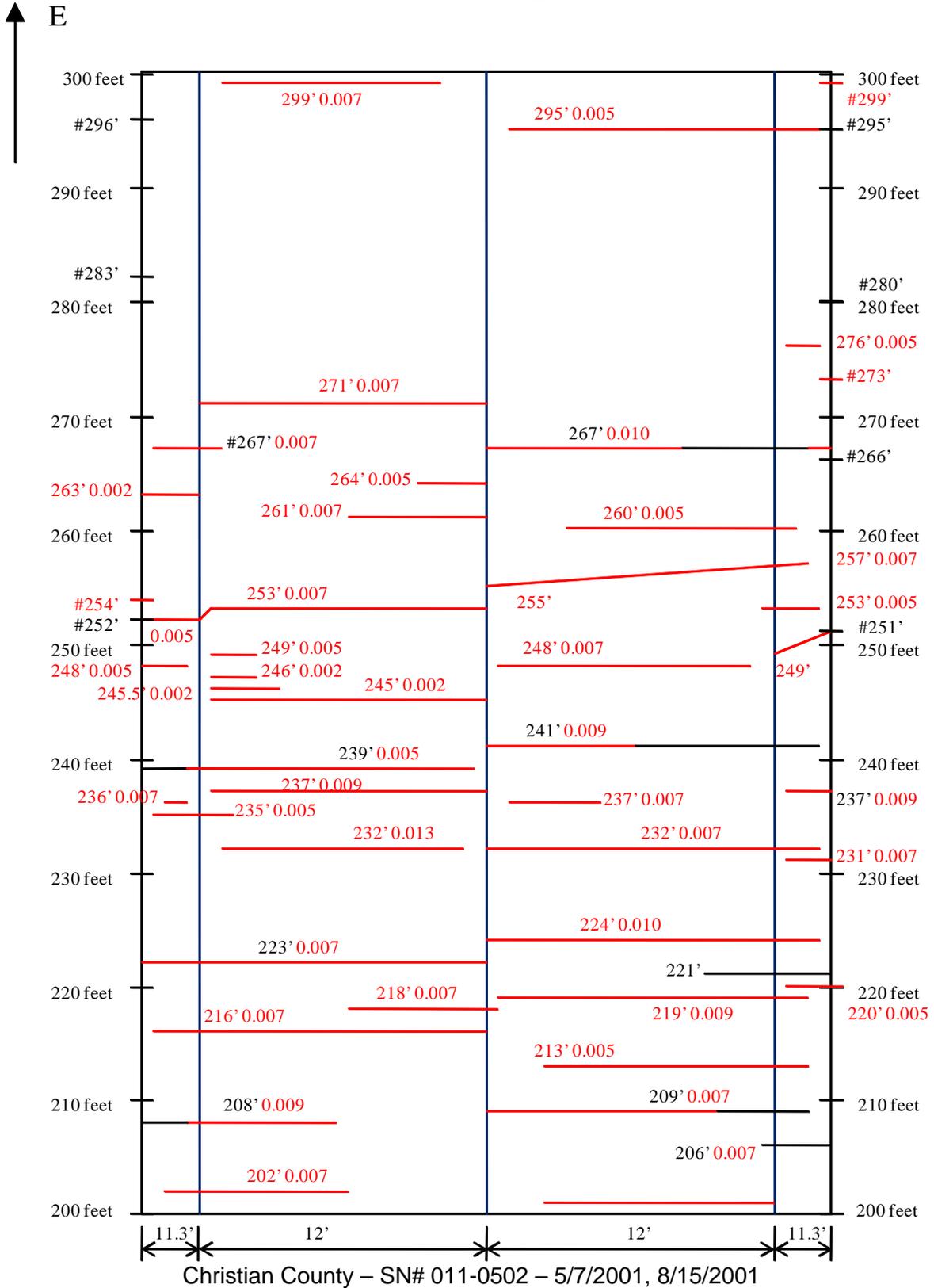


Christian County – SN# 011-0502 – Surveyed 5/7/2001, 8/15/2001

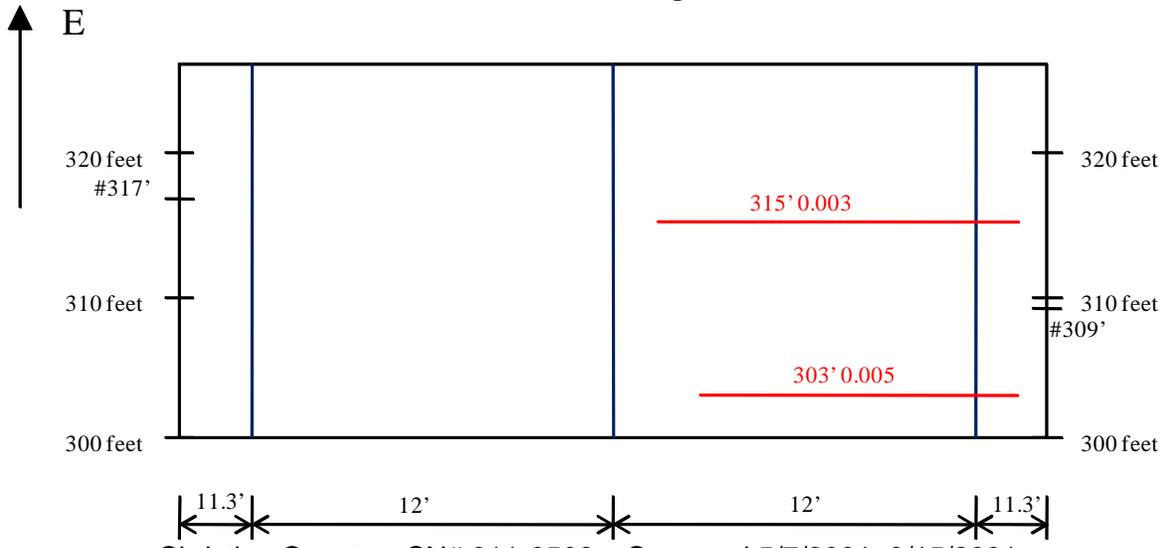
# 104 over S. Fork Sangamon River



# 104 over S. Fork Sangamon River



# 104 over S. Fork Sangamon River

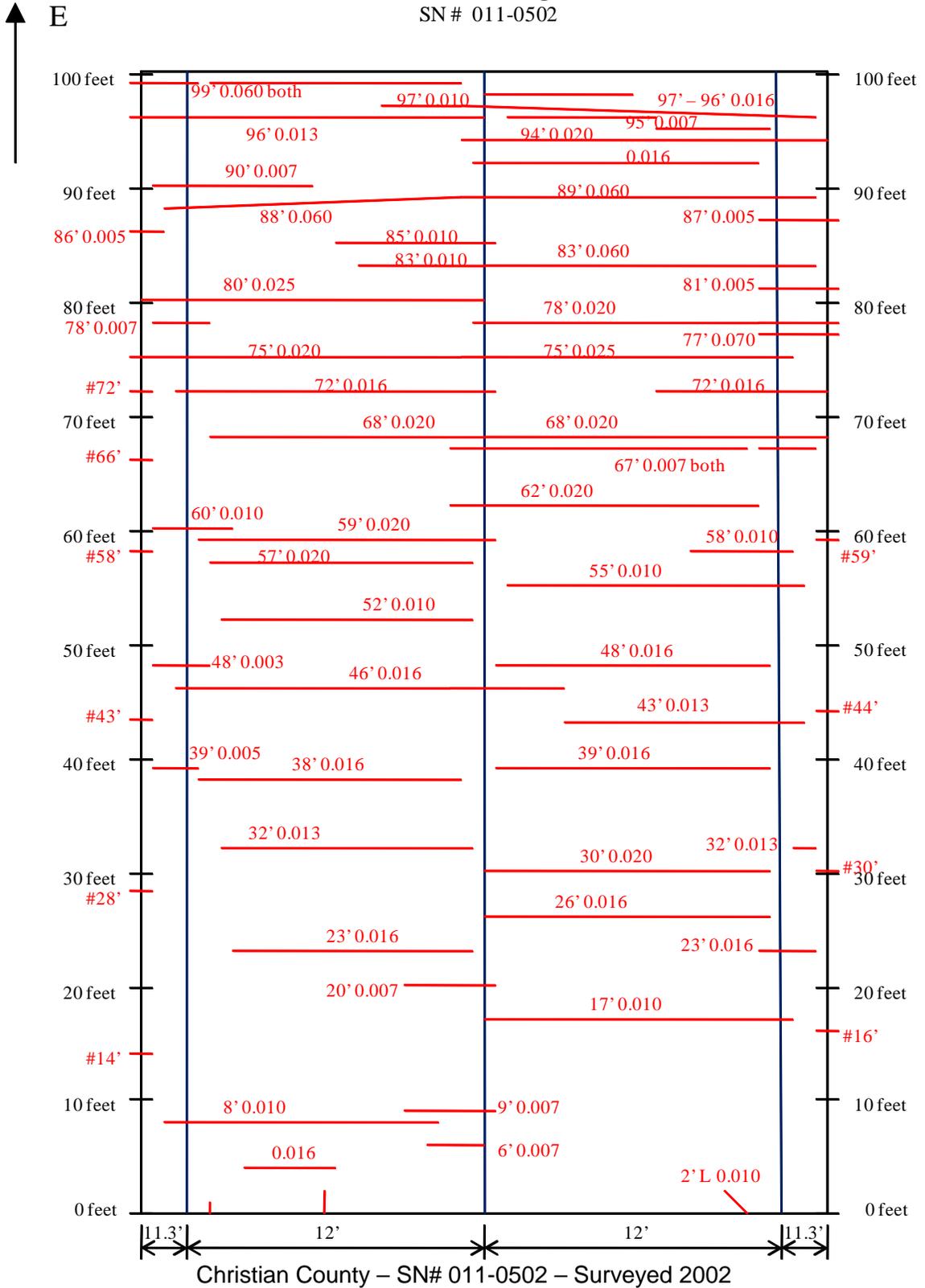


Christian County – SN# 011-0502 – Surveyed 5/7/2001, 8/15/2001

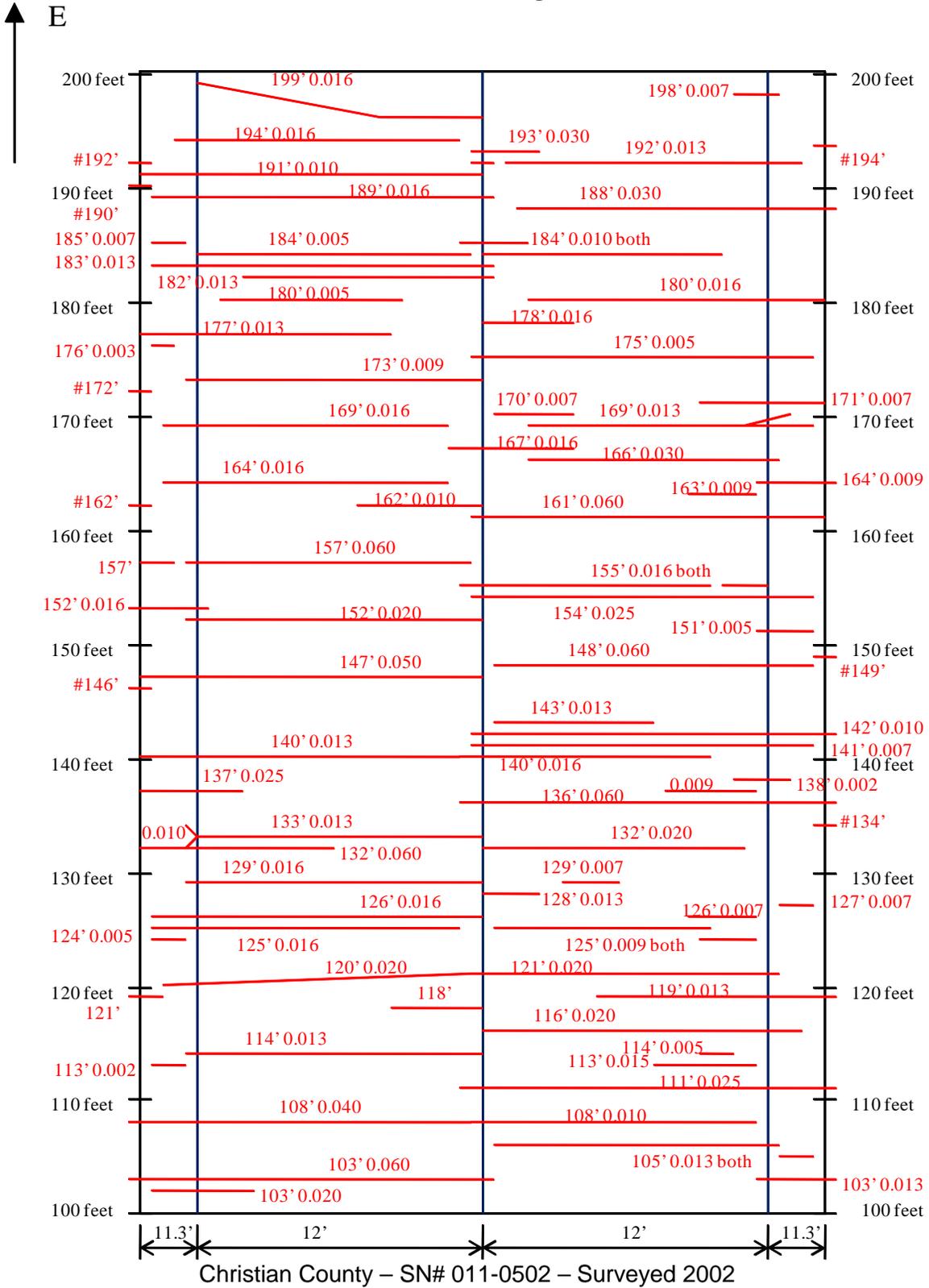
SN# 011-0502 was poured 10/12/2000 and the initial survey showed three hairline cracks.  
The “#” symbol represents cracks in the parapet only.

# 104 over S. Fork Sangamon River

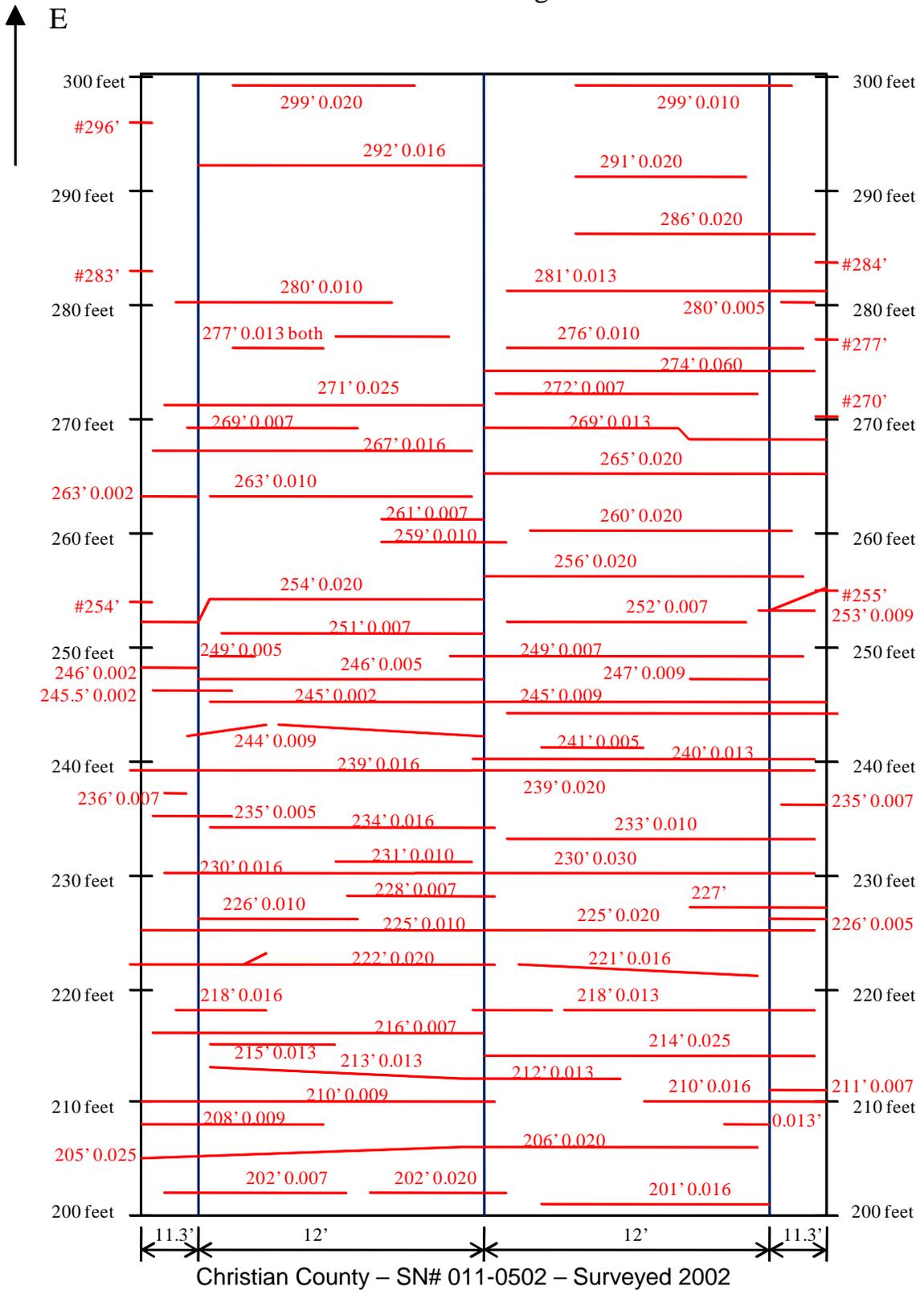
SN # 011-0502



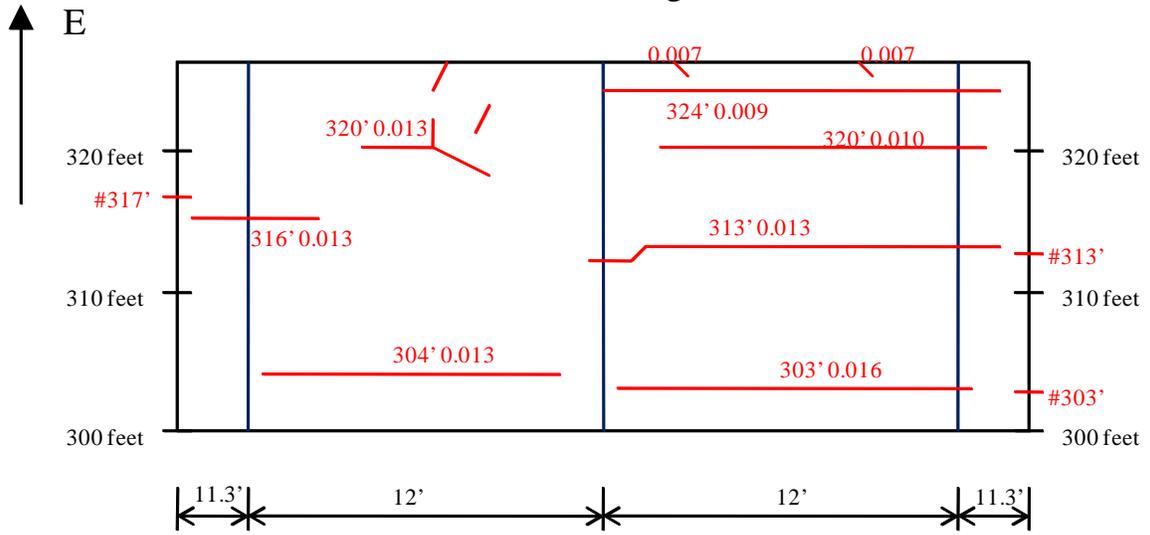
# 104 over S. Fork Sangamon River



# 104 over S. Fork Sangamon River



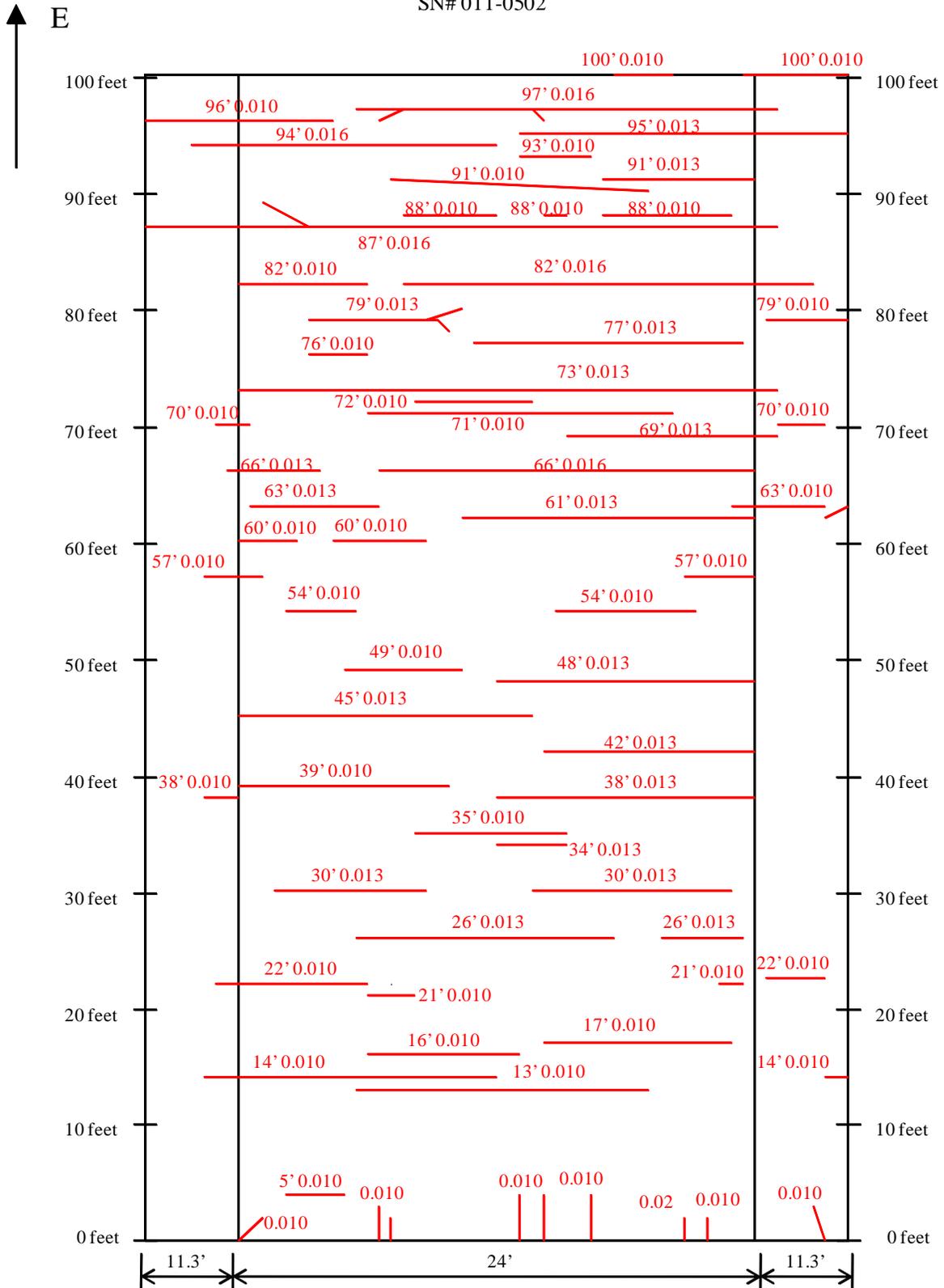
# 104 over S. Fork Sangamon River



Christian County – SN# 011-0502 – Surveyed 2002  
 The “#” symbol represents cracks in the parapet only.

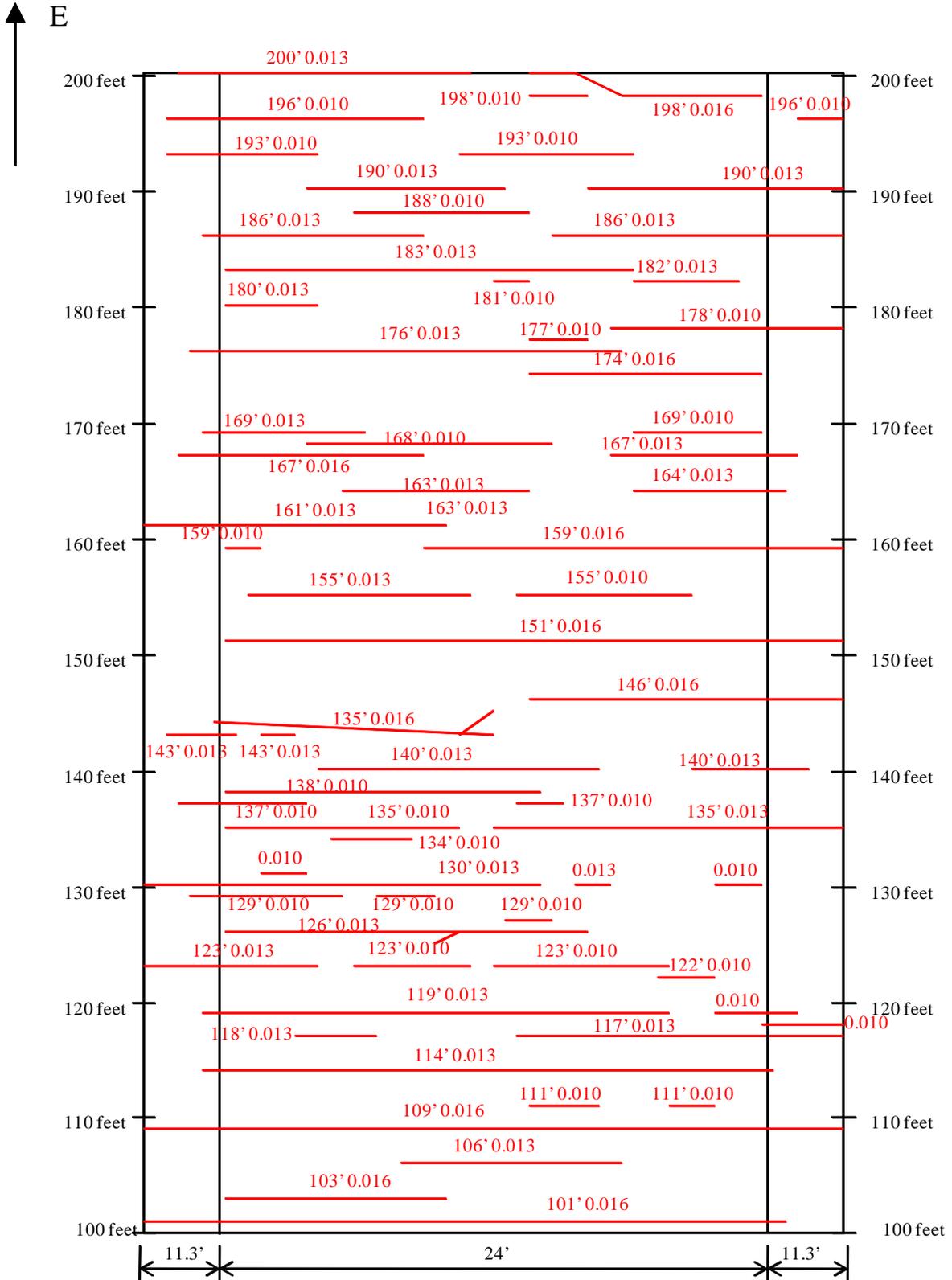
# IL 104 over South Fork Sangamon River

SN# 011-0502



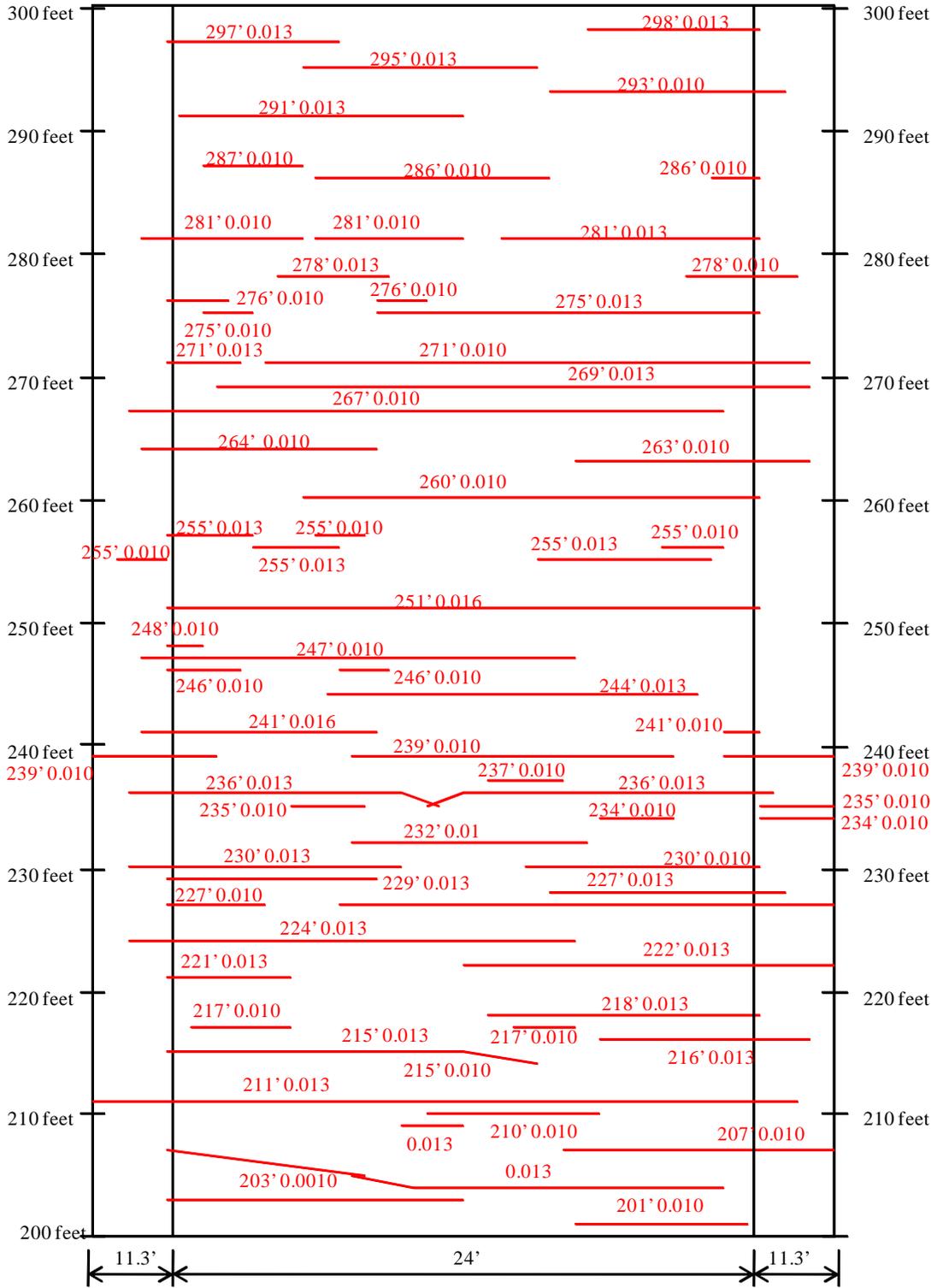
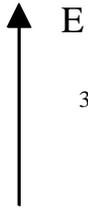
Christian County – SN# 011-0502 – Surveyed 12/30/2003

# IL 104 over South Fork Sangamon River

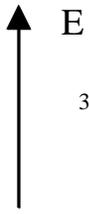


Christian County – SN# 011-0502 – Surveyed 12/30/2003

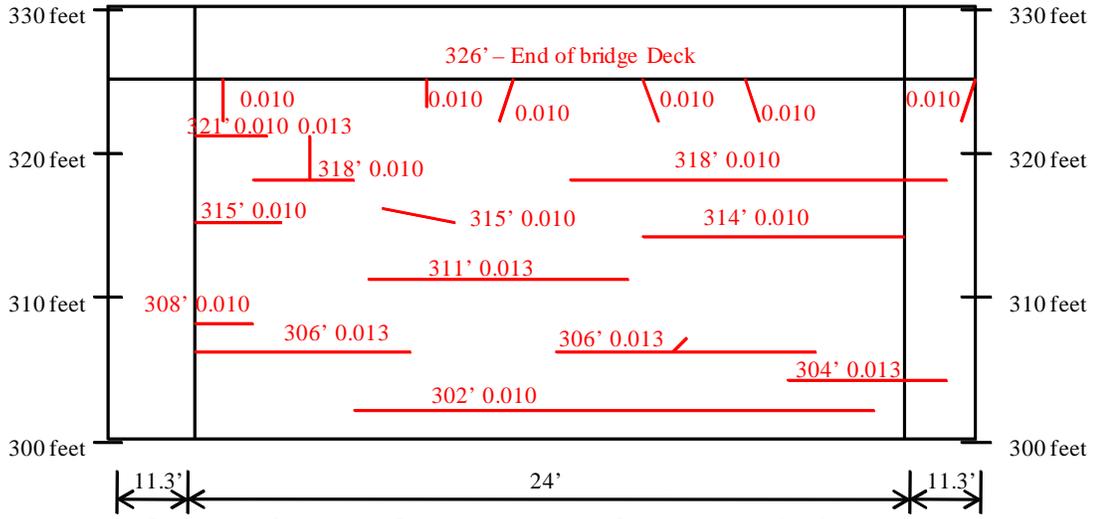
# IL 104 over South Fork Sangamon River



Christian County – SN# 011-0502 – Surveyed 12/30/2003



# IL 104 over South Fork Sangamon River



Christian County – SN# 011-0502 – Surveyed 12/30/2003

Clark County



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 012-0069

Inspected By: DAD, DHT, JAB

Responsible District: 5

Date Inspected: 9/12/08

Number of Spans: 3

Span Lengths See below Total: 238'5"

Deck Width: 38'

Beam Type:  PPC-I  Steel  Other

Beam Spacing: 6'10"

Date of Beam Erection: 2002

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: 21,400 (2007)

Stage Construction:  Y  N

Skew:  Y  N Angle: \_\_\_\_\_

Pour Dates: Stage 1, 2002 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: Underneath the deck, in the middle spans, transverse cracks were seen at more than 4' – 6' spacing and in the end spans, little to no transverse cracks were seen.

Longitudinal Cracking: Some longitudinal cracks were observed near the integral abutments.

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span Lengths: 1&3) 79'7", 2) 79'3"

**Mix Design Information: (from MISTIC)**

Mix Design Number: 85PCC2230

Coarse Aggregate Source: Lincoln Park Stone CM 11  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: S & G Excavating FA 01 Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

Cement Source: \_\_\_\_\_

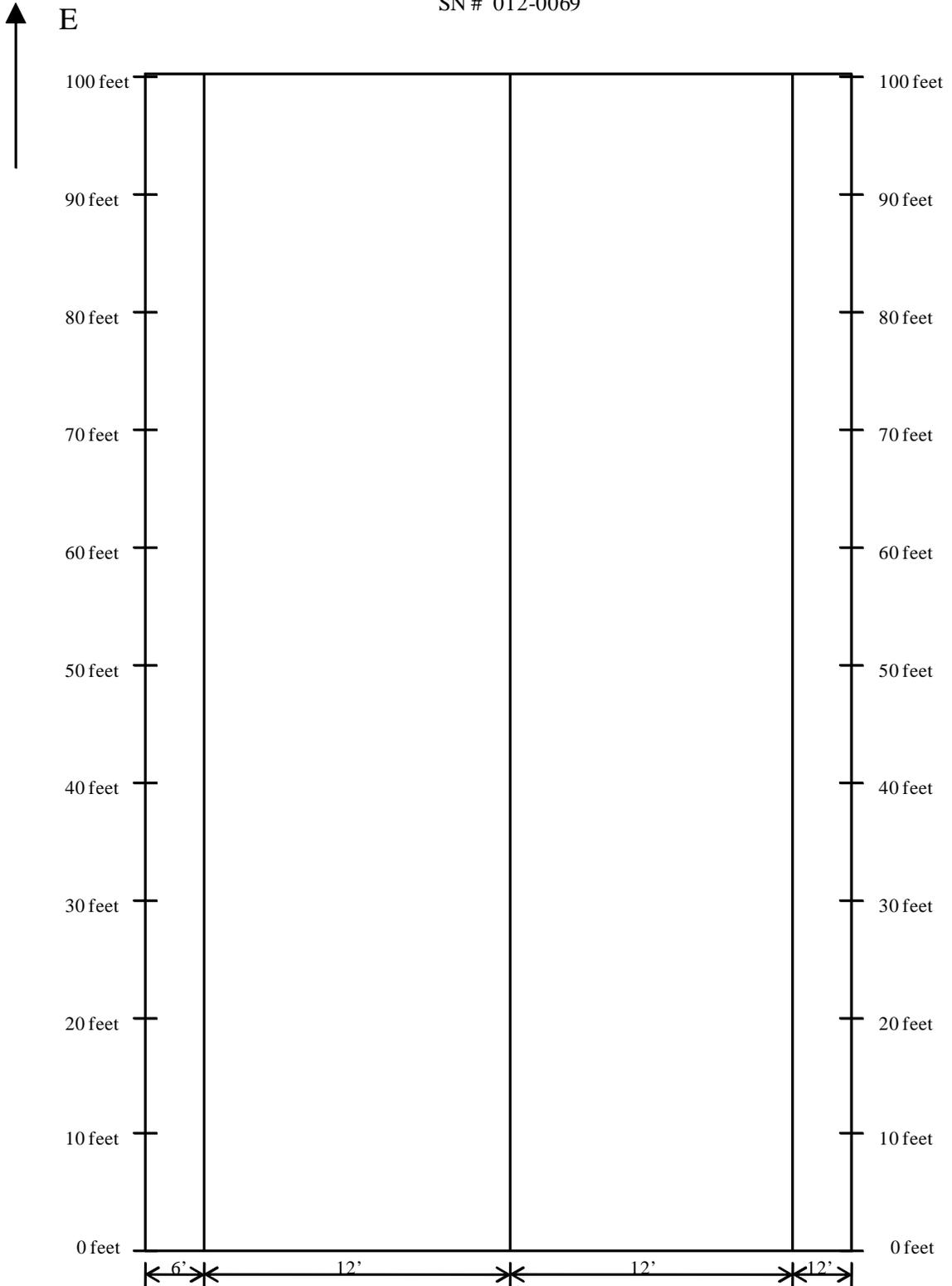
GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: \_\_\_\_\_

Microsilica Source: Elkem Materials, Inc.

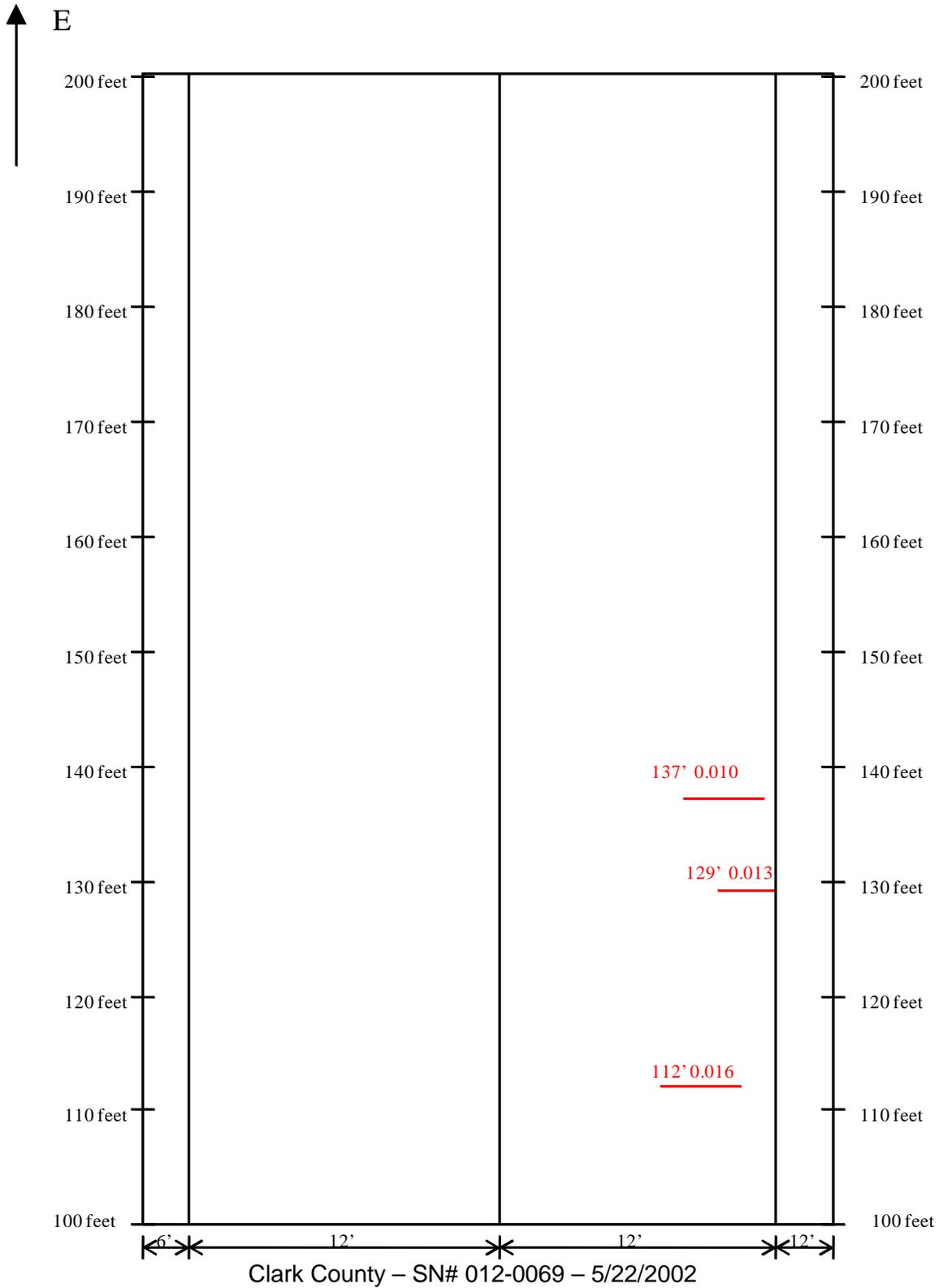
# I-70 Over Hawks Creek (EB)

SN # 012-0069

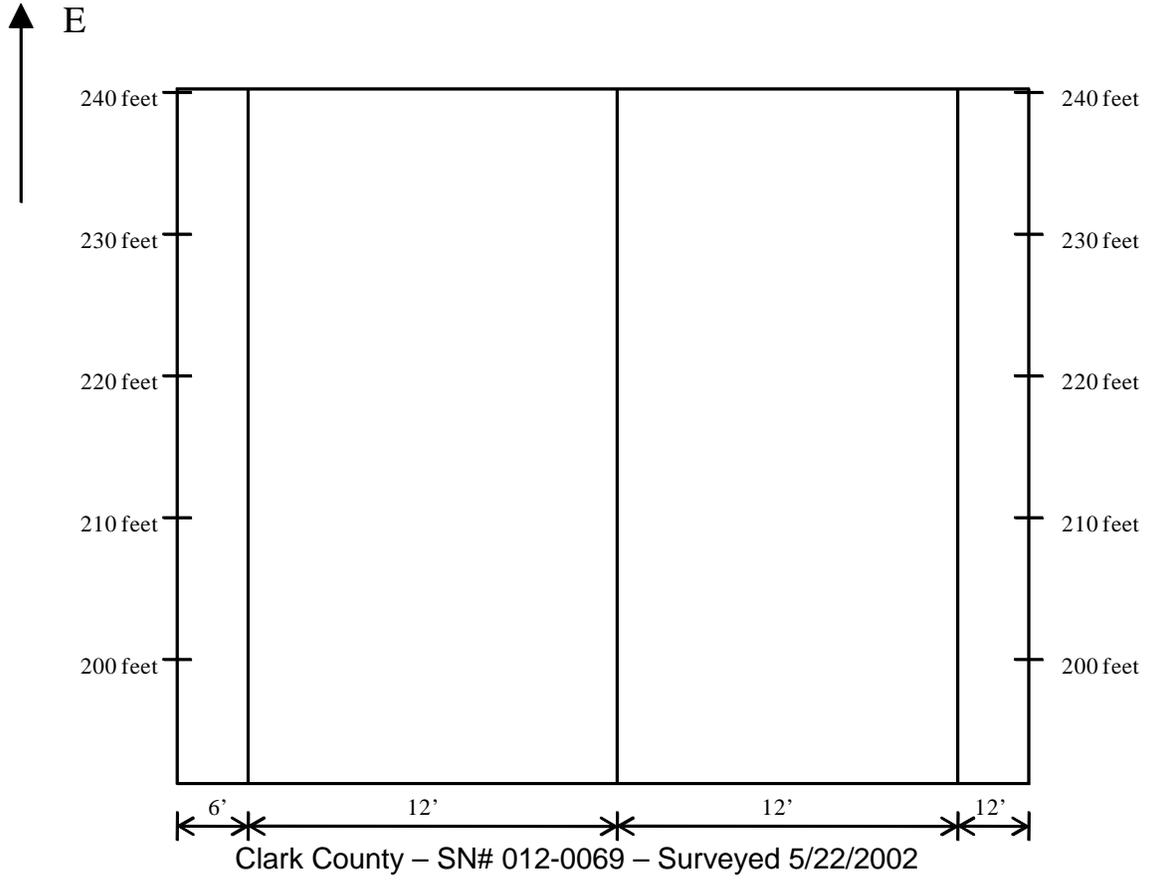


Clark County – SN# 012-0069 – Surveyed 5/22/2002

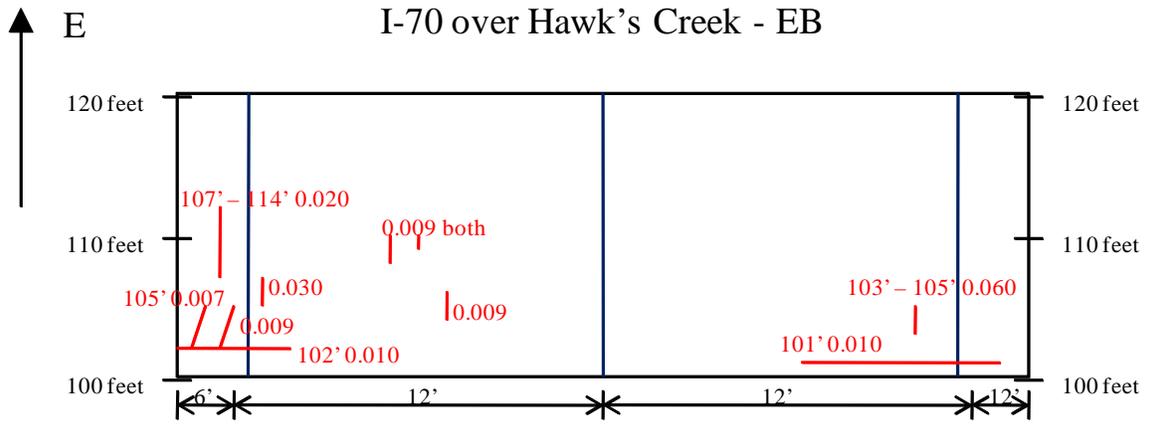
# I-70 Over Hawks Creek (EB)



# I-70 Over Hawks Creek (EB)







Clark County – SN# 012-0069 – Surveyed 10/1/2003

This is a partial deck survey due to time constraints and traffic safety concerns.

\*\*Huge foot print measuring 10" long, 1" deep

\* Yellow Crack sealer applied; therefore, the width of the cracks could not be measured.



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 012-0070

Inspected By: DAD, DHT, JAB

Responsible District: 5

Date Inspected: 9/12/08

Number of Spans: 3

Span Lengths See below Total: 238'5"

Deck Width: 38'

Beam Type:  PPC-I  Steel  Other

Beam Spacing: 6'10"

Date of Beam Erection: 2002

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: 21,400 (2007)

Stage Construction:  Y  N

Skew:  Y  N Angle: \_\_\_\_\_

Pour Dates: Stage 1, 2002 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: Underneath the deck, in the middle spans, transverse cracks were seen at more than 4' – 6' spacing and in the end spans, little to no transverse cracks were seen.

Longitudinal Cracking: Some longitudinal cracks were observed near the integral abutments.

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span Lengths: 1&3) 79'7", 2) 79'3

**Mix Design Information: (from MISTIC)**

Mix Design Number: 85PCC2232

Coarse Aggregate Source: Lincoln Park Stone CM 11  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: S & G Excavating Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

Cement Source: \_\_\_\_\_

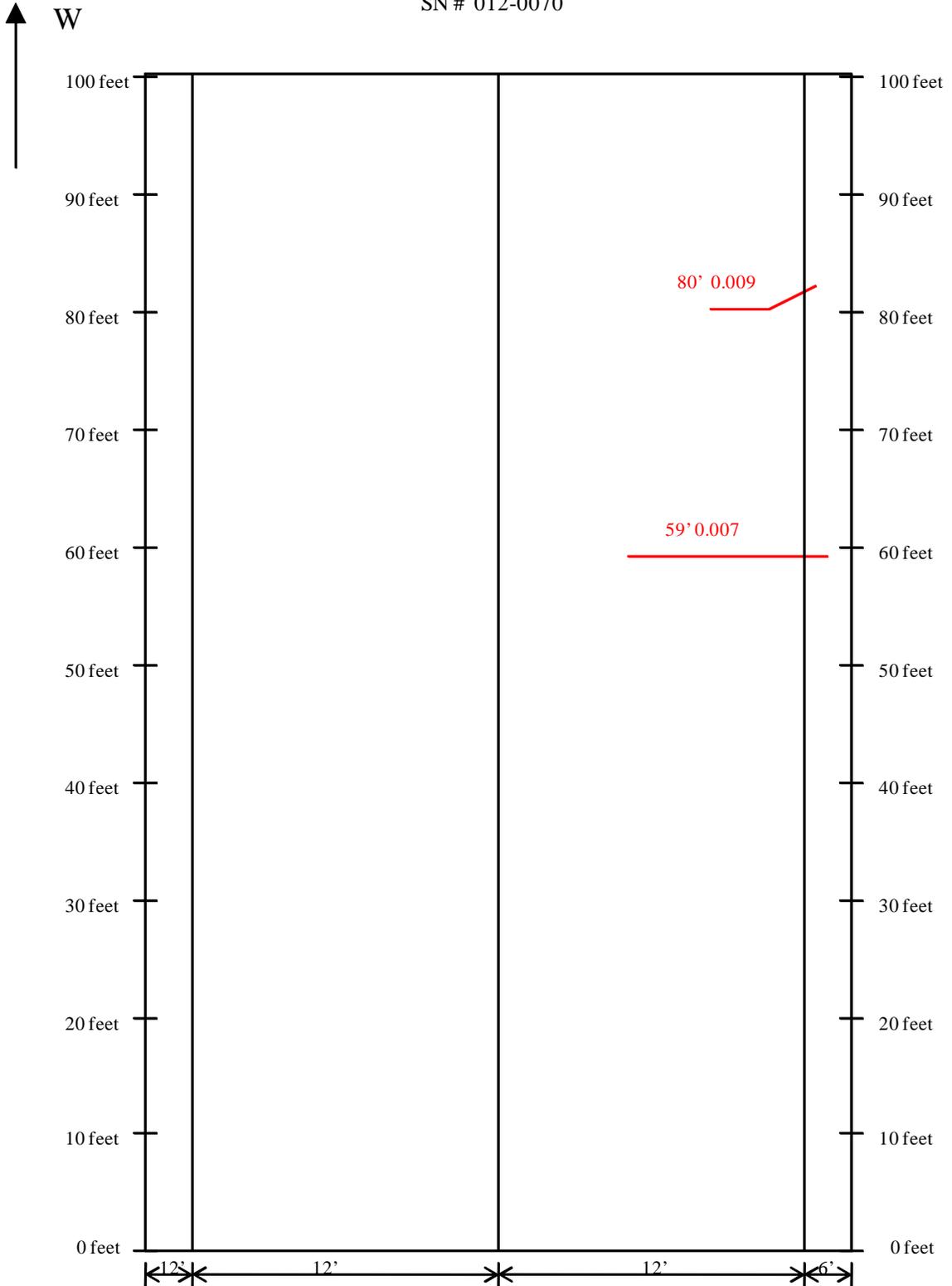
GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: Lafarge N. America

Microsilica Source: Elkem Materials, Inc.

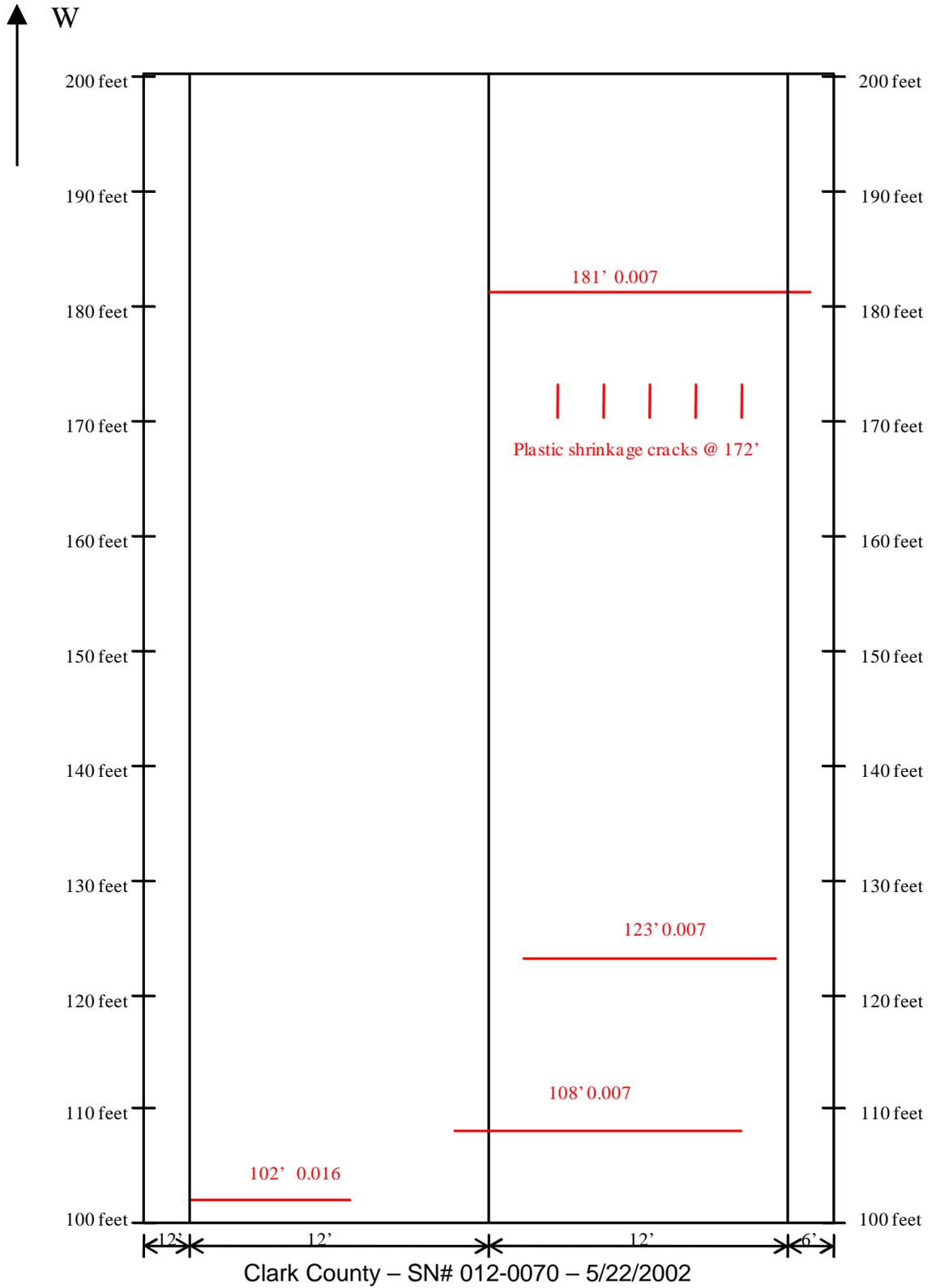
# I-70 Over Hawks Creek (WB)

SN # 012-0070

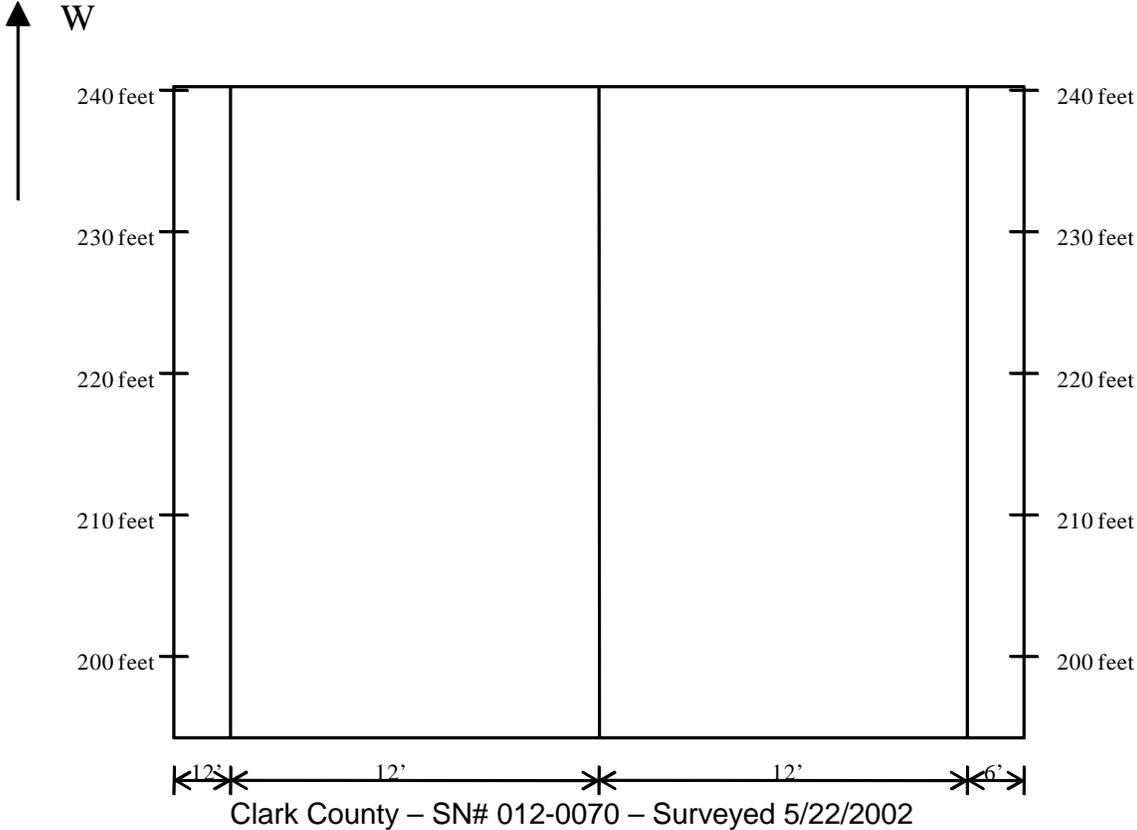


Clark County – SN# 012-0070 – Surveyed 5/55/2002

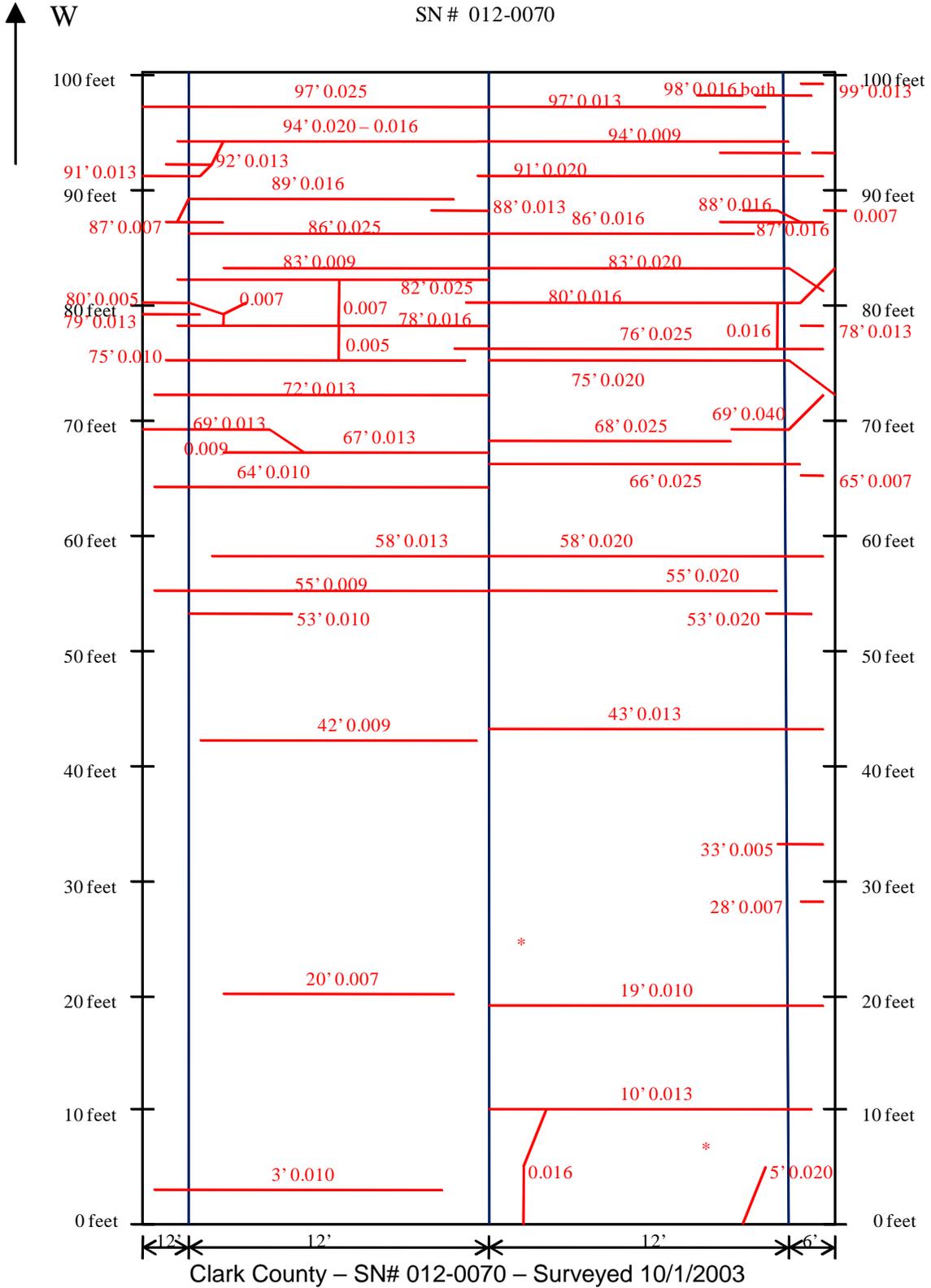
# I-70 Over Hawks Creek (WB)



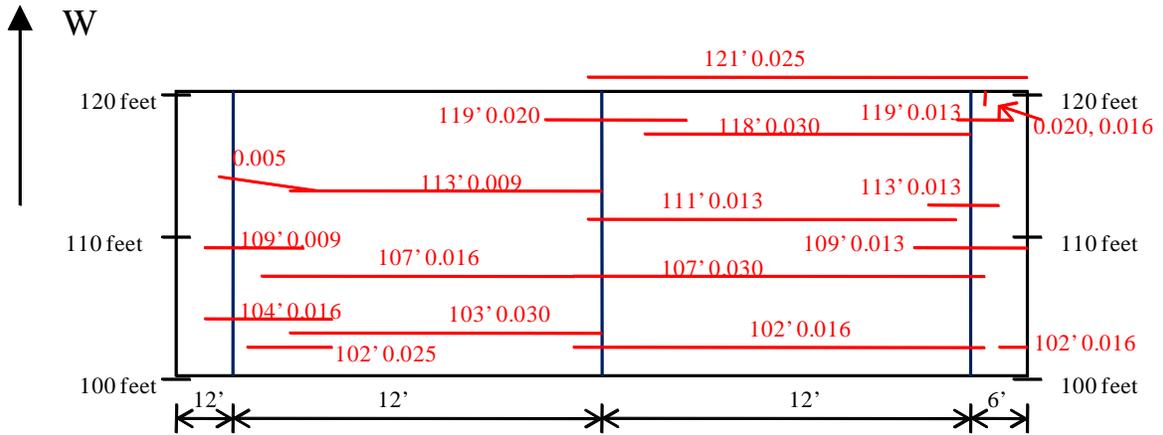
I-70 Over Hawks Creek (WB)



I-70 over Hawk's Creek – WB  
 SN # 012-0070



# I-70 over Hawk's Creek - WB



Clark County – SN# 012-0070 – 10/1/2003

This is a partial deck survey due to time constraints and traffic concerns.

\* Denotes holes on top of the bridge deck.



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 012-0004

Inspected By: DAD, DHT, JAB

Responsible District: 5

Date Inspected: 9/12/08

Number of Spans: 4

Span Lengths See below Total: 275'9"

Deck Width: 42'0"

Beam Type:  PPC-I  Steel  Other

Beam Spacing: 7'9"

Date of Beam Erection: 2002

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: 21,400 (2007)

Stage Construction:  Y  N

Skew:  Y  N Angle: 41°

Pour Dates: Stage 1, 2002 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: On bottom of the deck, the crack spacing is approximately ±10' - ±12'.

Longitudinal Cracking: Longitudinal cracks were seen underneath the deck at regular spacing.

Bridge Joint Cracking / Integral Abutment Cracking: Cracks were observed at the joints at ends of the bridge.

Cracking over Piers: Cracks were diagonal with piers, around 2'-3' in length.

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span Lengths: 1&4) 66ft7in., 2&3) 67ft5in.

Bridge deck and parapet instrumented

Good rating with cracking concentrated in center spans..

**Mix Design Information: (from MISTIC)**

Mix Design Number: 85PCC2230

Coarse Aggregate Source: Lincoln Park Stone CM 11  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: S & G Excavating FA 01 Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

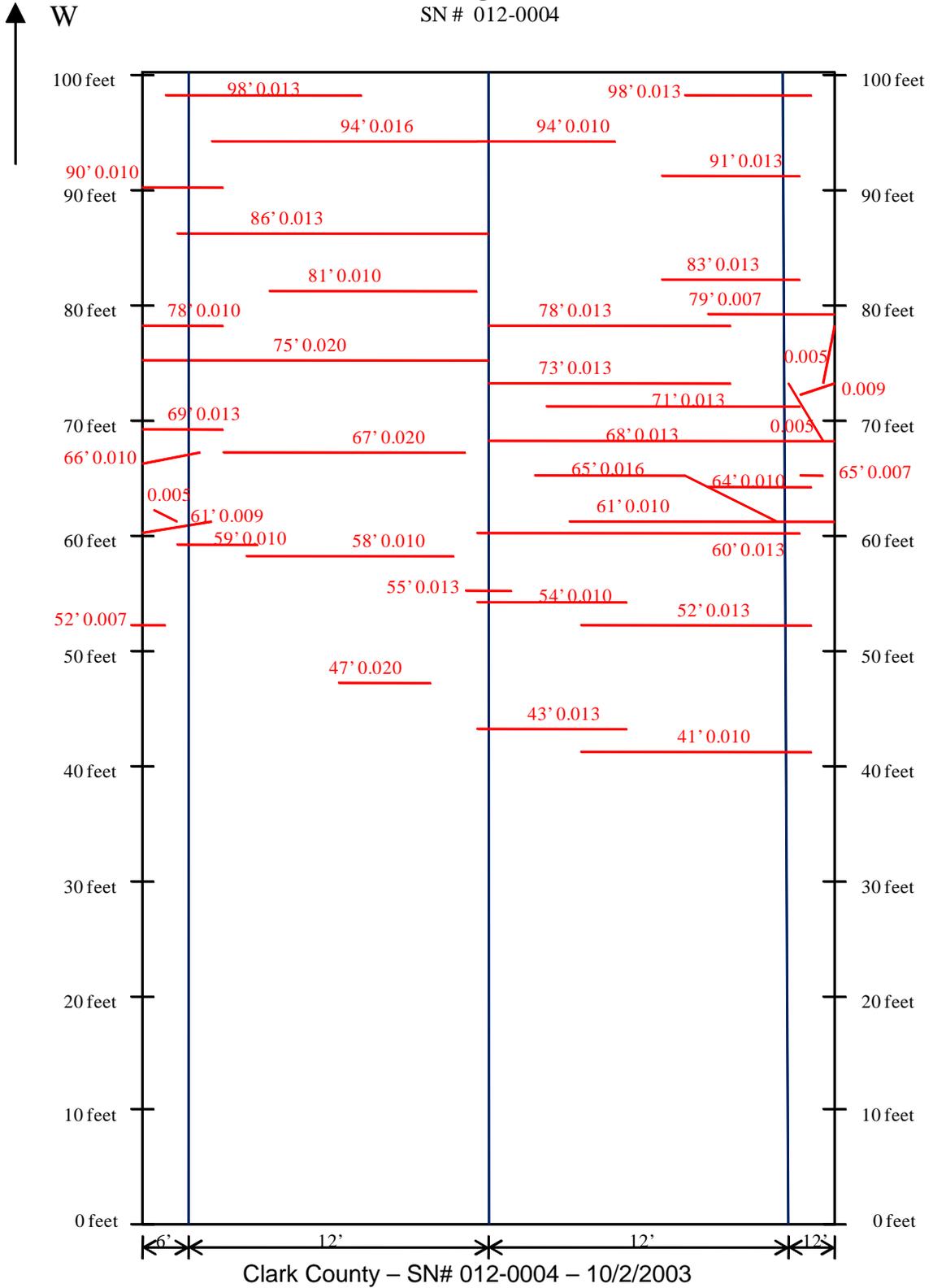
Cement Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

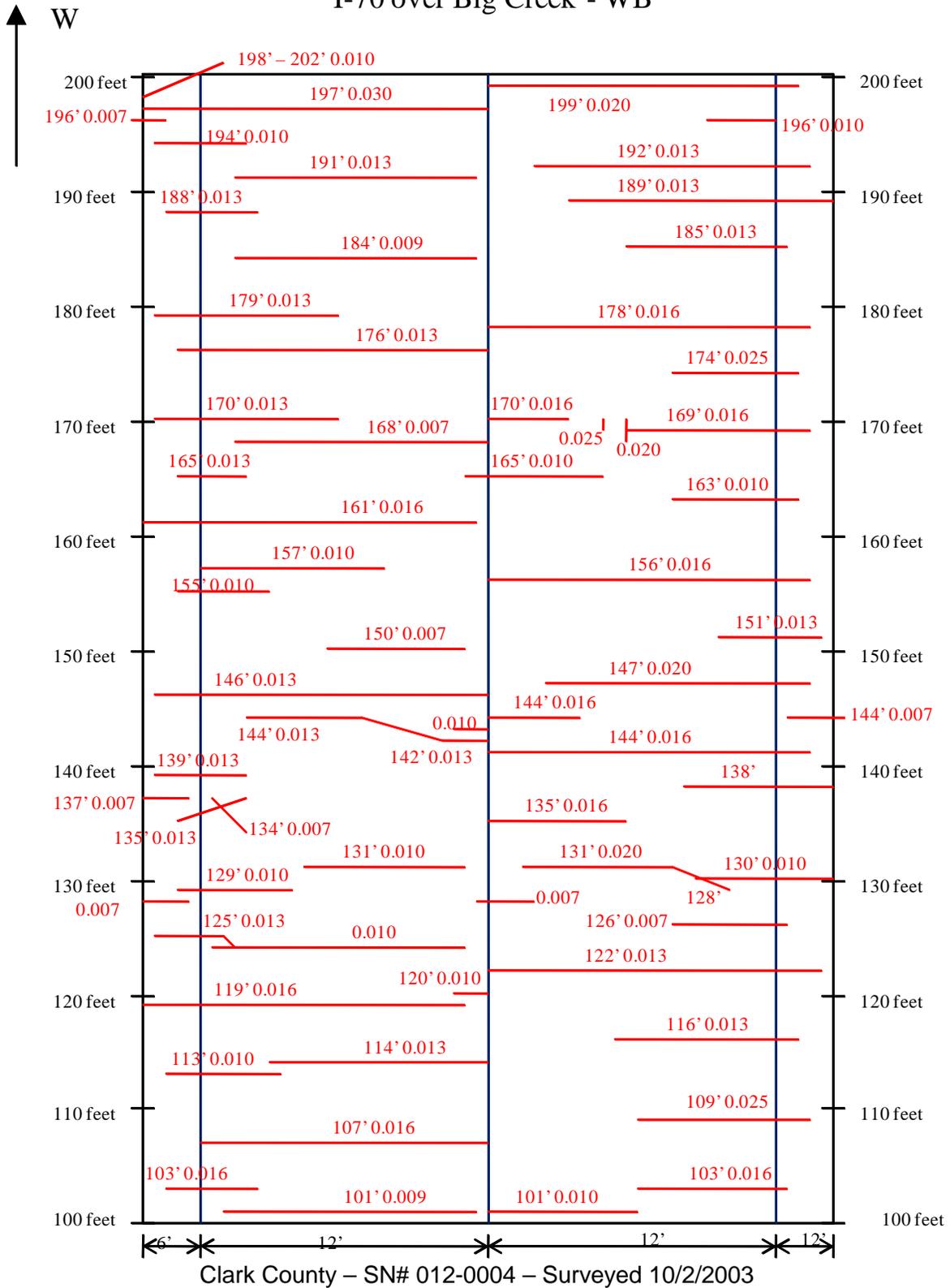
Fly Ash Source: \_\_\_\_\_

Microsilica Source: Elkem Materials, Inc.

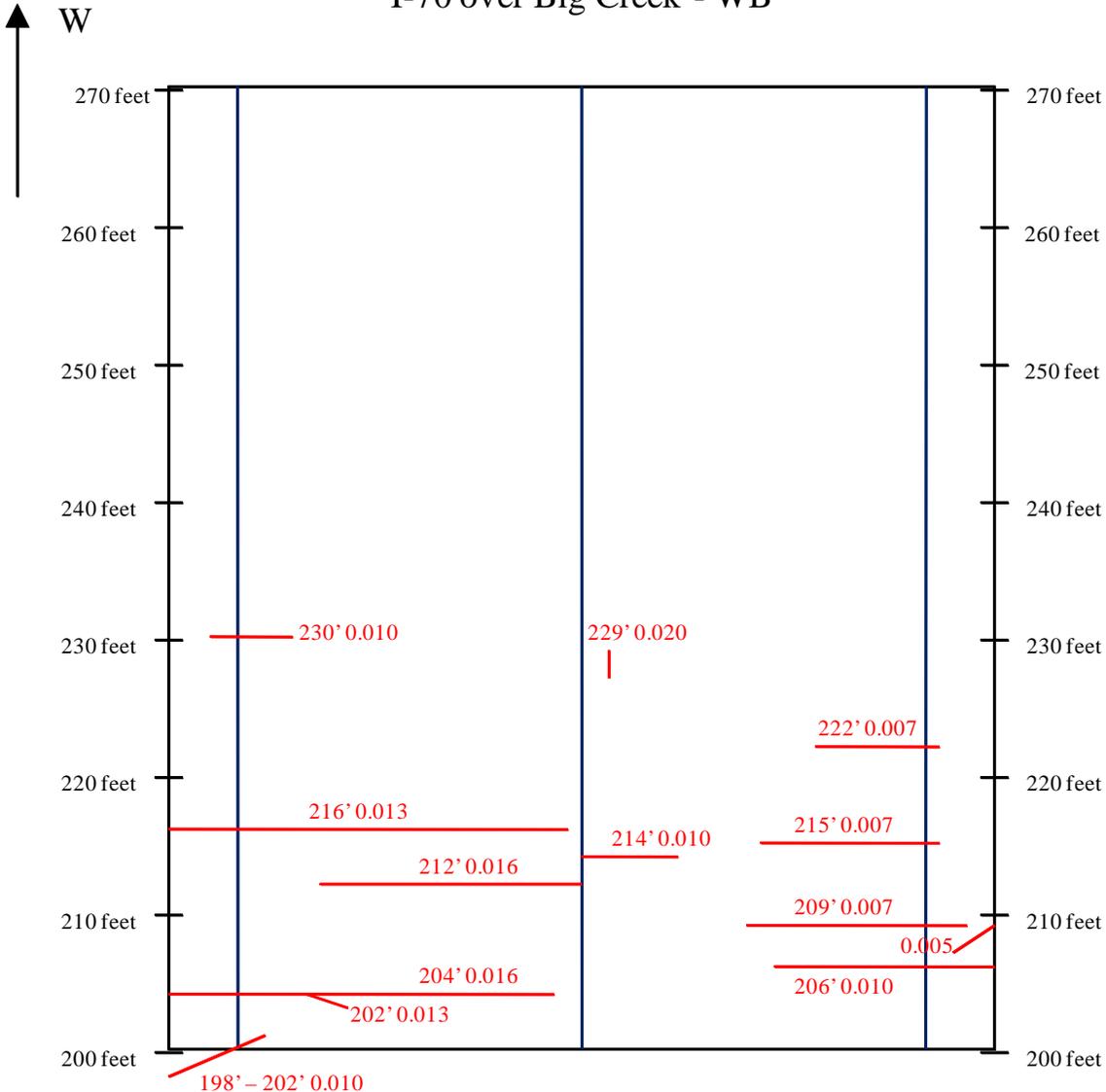
I-70 over Big Creek – WB  
 SN # 012-0004



# I-70 over Big Creek - WB



# I-70 over Big Creek - WB



Clark County – SN# 012-0004 – 10/2/2003



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 012-0005

Inspected By: DAD, DHT, JAB

Responsible District: 5

Date Inspected: 9/12/08

Number of Spans: 4

Span Lengths See below Total: 275'9"

Deck Width: 42'0"

Beam Type:  PPC-I  Steel  Other

Beam Spacing: 7'9"

Date of Beam Erection: 2002

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: 21,400 (2007)

Stage Construction:  Y  N

Skew:  Y  N Angle: 41°

Pour Dates: Stage 1, 2002 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: A few cracks nearly 6' apart were in the passing lane. Little to no cracks were in the driving lane.

Longitudinal Cracking: Longitudinal cracks were visible underneath the deck at regular spacing.

Bridge Joint Cracking / Integral Abutment Cracking: Cracks were observed at the joints at ends of the bridge.

Cracking over Piers: Cracks were diagonal with piers, around 2'-3' in length.

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span Lengths: 1&4) 66ft7in., 2&3) 67ft5in.

Cracking was concentrated in center spans.

**Mix Design Information: (from MISTIC)**

Mix Design Number: 85PCC2230

Coarse Aggregate Source: Lincoln Park Stone CM 11  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: S & G Excavating FA 01 Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

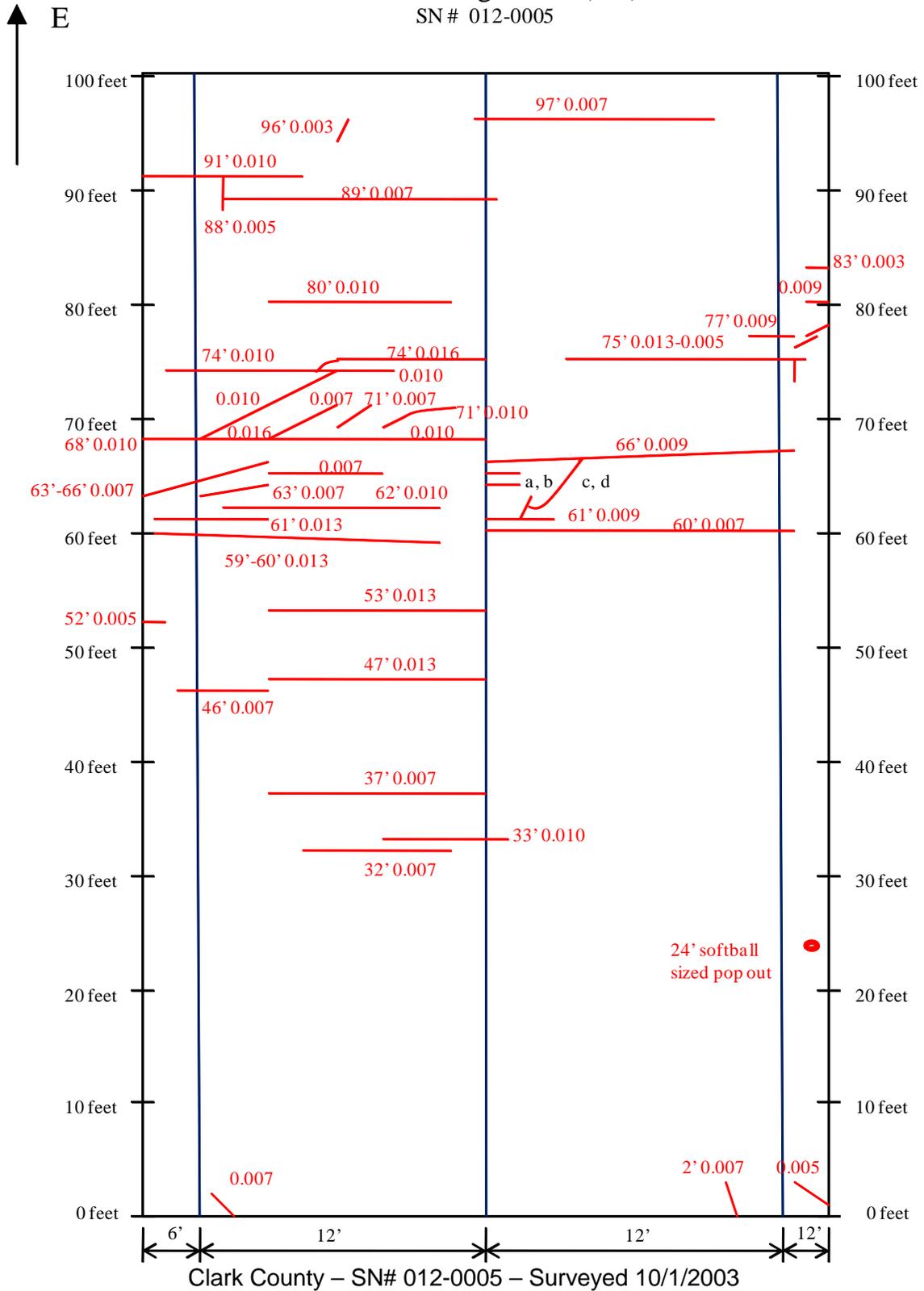
Cement Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: \_\_\_\_\_

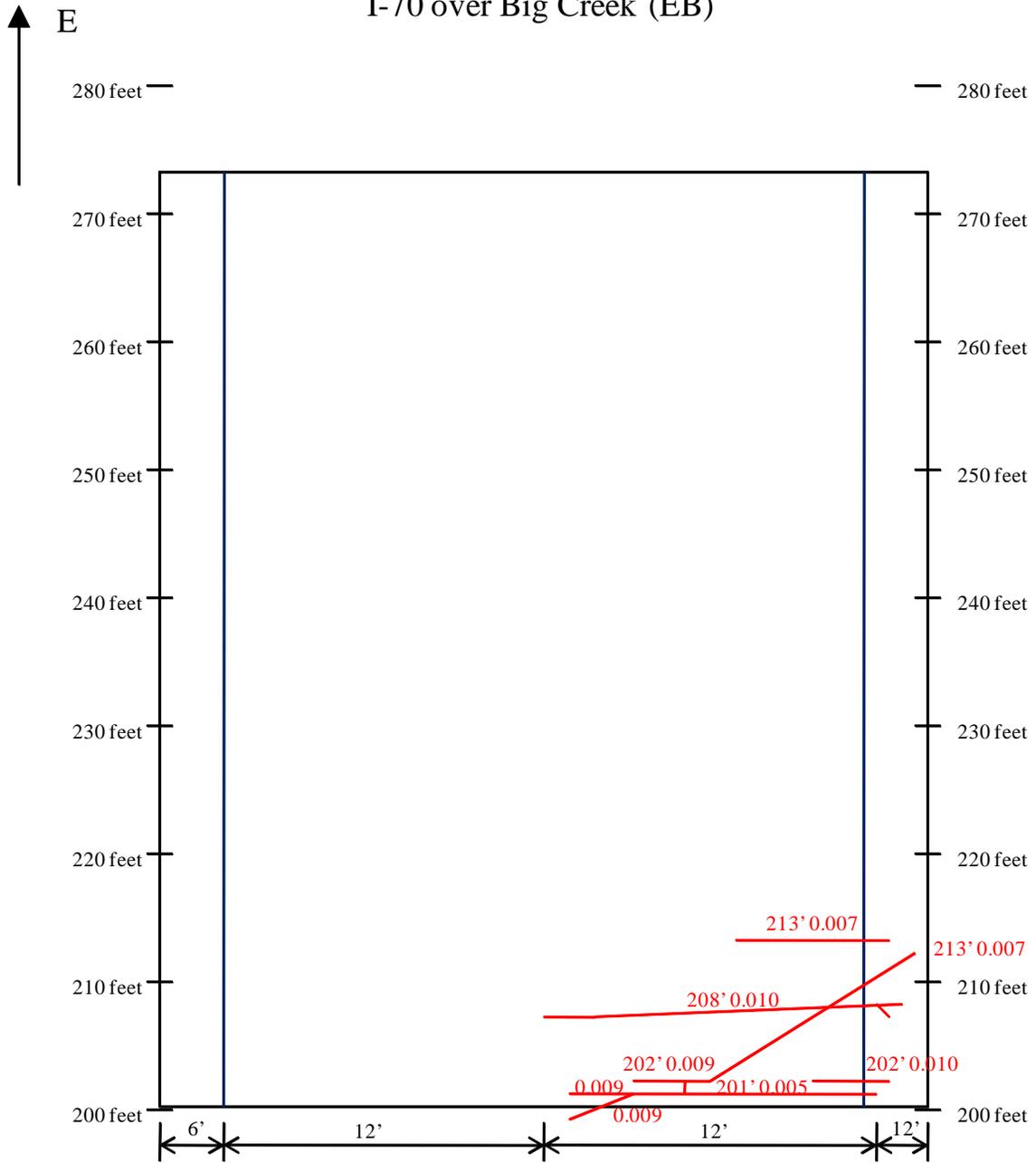
Microsilica Source: Elkem Materials, Inc.

I-70 over Big Creek (EB)  
SN # 012-0005





# I-70 over Big Creek (EB)



Clark County – SN# 012-0005 – Surveyed 10/1/2003  
 This survey was a partial survey due to time limitations and traffic safety.  
 a = 0.007 @ 64'; b = 0.009 @ 65'; c = 0.009; d = 0.009



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 012-0006

Responsible District: 5

Number of Spans: 3

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  Semi-Integral  Other

ADT @ time bridge was built: 21,400 (2007)

Skew:  Y  N Angle: 15°

Inspected By: DAD, DHT, JAB

Date Inspected: 9/12/08

Span Lengths See below Total: 236'3"

Deck Width: 40'0"

Beam Spacing: 7'2½"

Date of Beam Erection: 2002

Bridge Joint:  Integral  Finger  Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 2002 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: Transverse cracks were observed with spacing less than 3' apart.

Longitudinal Cracking: A longitudinal crack, nearly the entire length of the deck bottom, on both the passing and driving lanes. On the deck top, the approach slab had longitudinal cracks.

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span Lengths: 1&3) 70ft5in., 2) 90ft3in.

**Mix Design Information: (from MISTIC)**

Mix Design Number: 85PCC2230

Coarse Aggregate Source: Lincoln Park Stone CM 11  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: S & G Excavating FA 01 Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

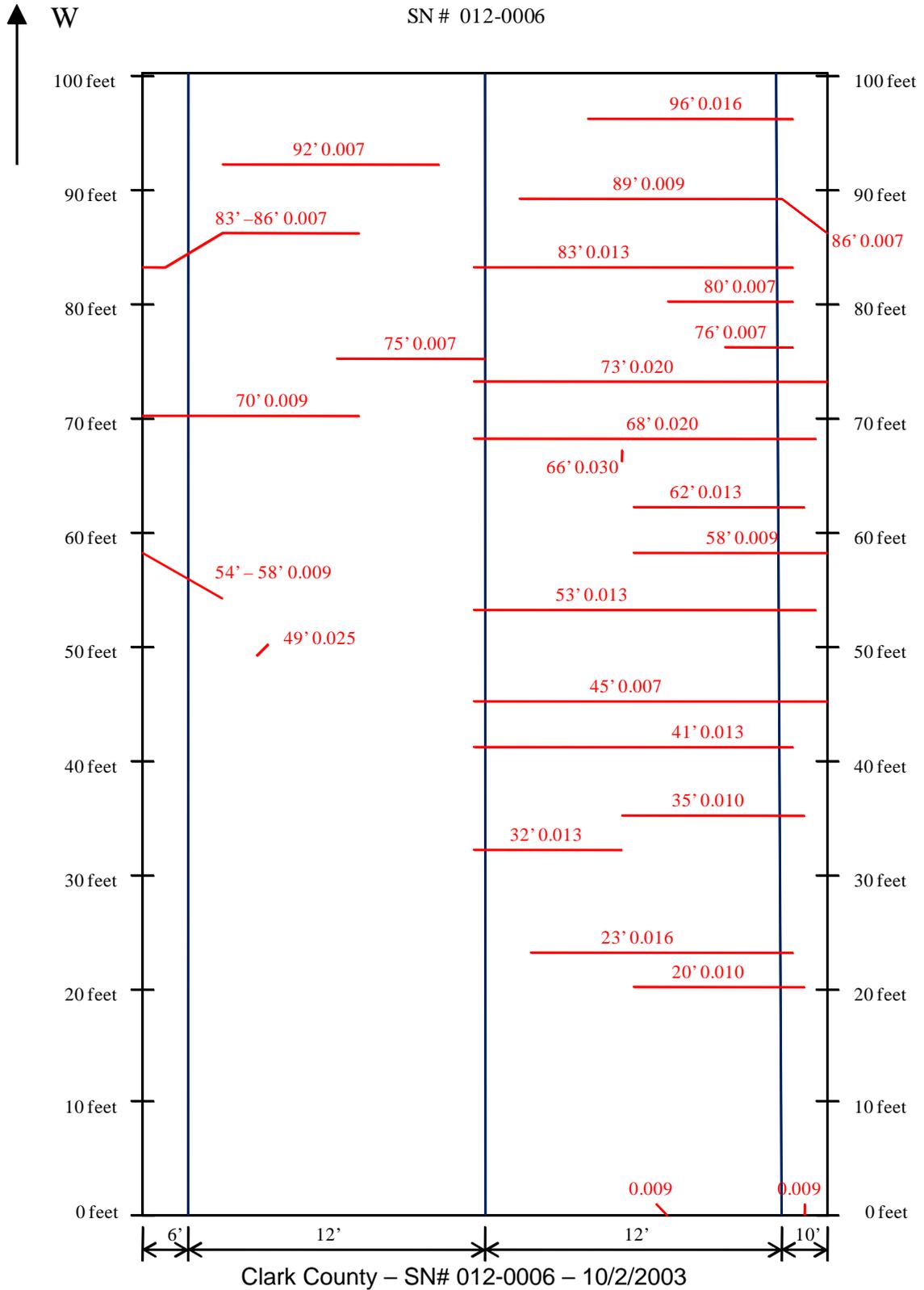
Cement Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

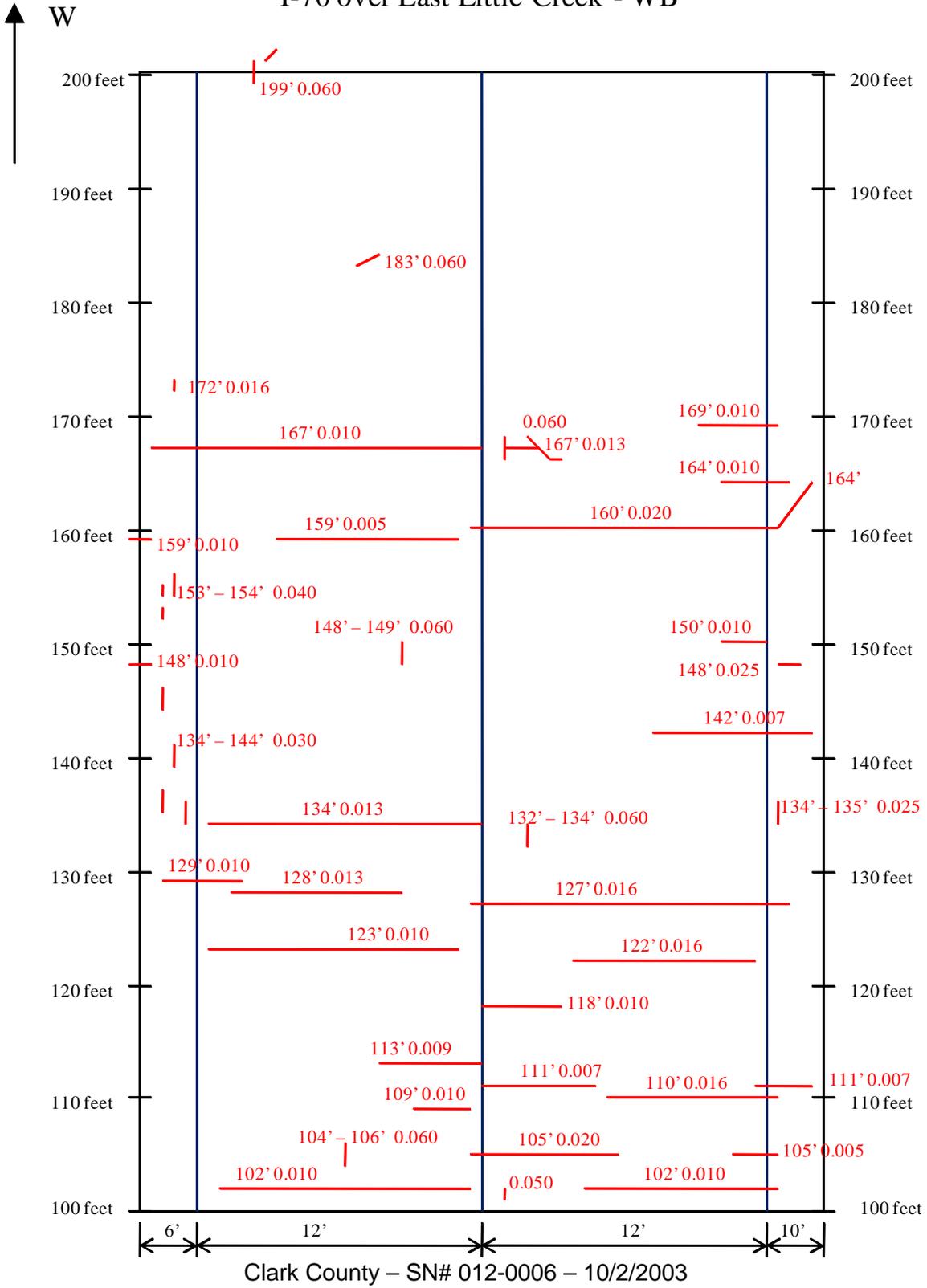
Fly Ash Source: \_\_\_\_\_

Microsilica Source: Elkem Materials, Inc.

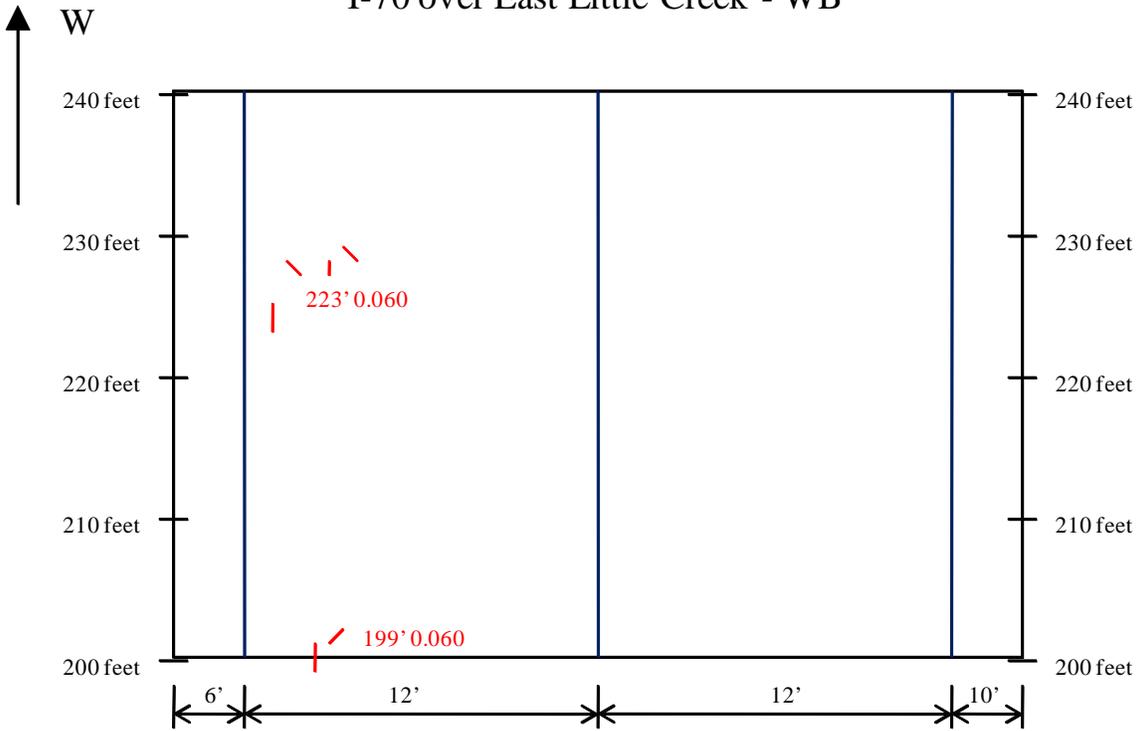
I-70 over East Little Creek – WB  
 SN # 012-0006



# I-70 over East Little Creek - WB



# I-70 over East Little Creek - WB



Clark County – SN# 012-0006 – Surveyed 10/2/2003

This is a partial deck survey due to time constraints and traffic safety concerns.



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 012-0007

Responsible District: 5

Number of Spans: 3

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  Semi-Integral  Other

ADT @ time bridge was built: 21,400 (2007)

Skew:  Y  N Angle: 15°

Inspected By: DAD, DHT, JAB

Date Inspected: 9/12/08

Span Lengths See below Total: 236'3"

Deck Width: 40'0"

Beam Spacing: 7'2½"

Date of Beam Erection: 2002

Bridge Joint:  Integral  Finger  Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 2002 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: Transverse cracks were observed with spacing less than 3' apart.

Longitudinal Cracking: A longitudinal crack, nearly the entire length of the deck bottom, on both the passing and driving lanes.

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span Lengths: 1&3) 70ft5in., 2) 90ft3in.

**Mix Design Information: (from MISTIC)**

Mix Design Number: 85PCC2230

Coarse Aggregate Source: Lincoln Park Stone CM 11  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: S & G Excavating FA 01 Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

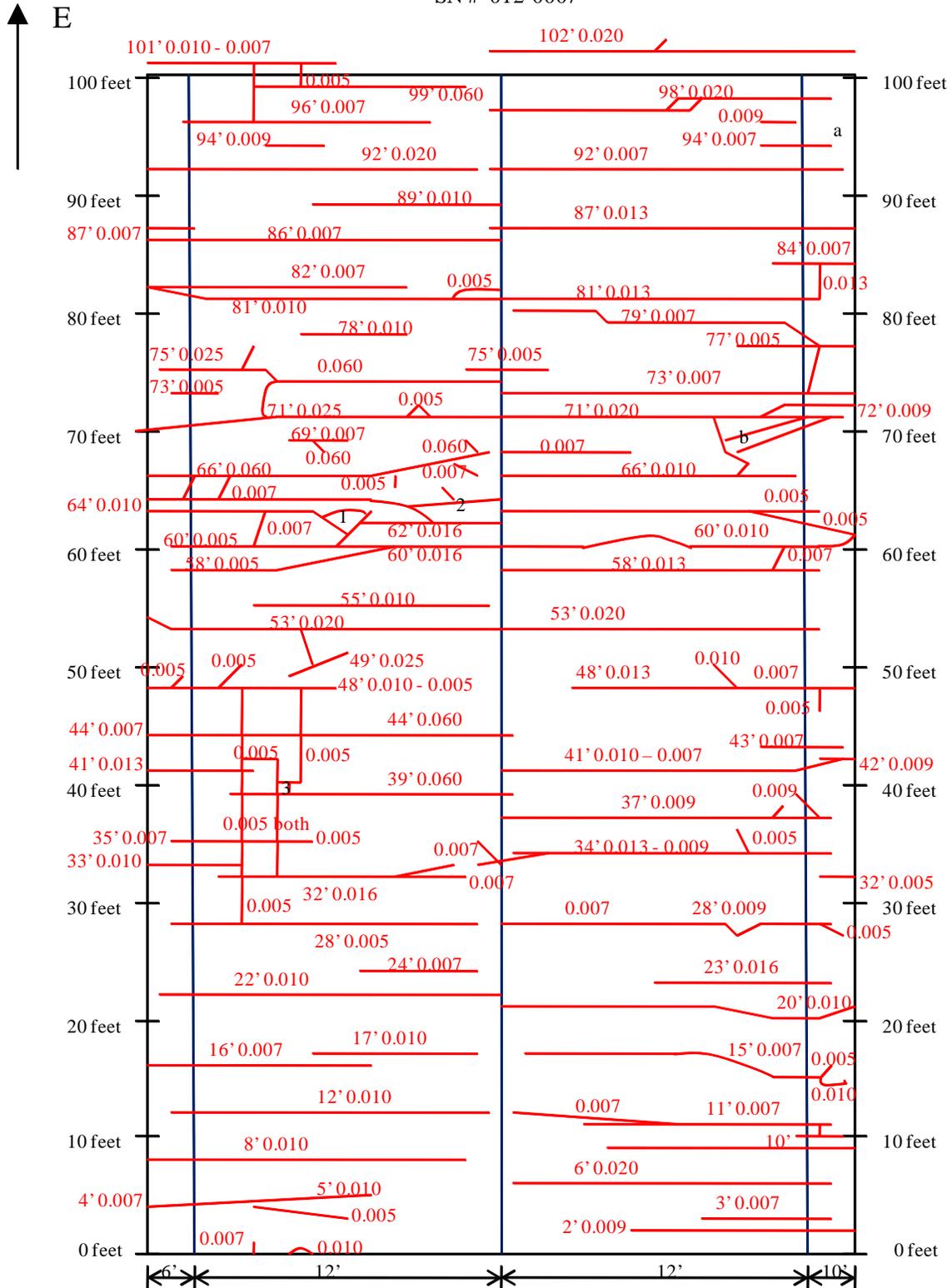
Cement Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: \_\_\_\_\_

Microsilica Source: Elkem Materials, Inc.

I-70 over E. Little Creek – EB  
SN # 012-0007



Clark County – SN# 012-0007 – Surveyed 10/1/2003

This is a partial deck survey due to time constraints.

1 = 0.007, 0.005; 2 = 0.060, 0.016, 0.016; 3 = 0.005, 0.003; a = map cracking, b = 0.010, 0.005, 0.007. a, b, and c were in the 66' to 71' range.



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 012-0008

Responsible District: 5

Number of Spans: 3

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

ADT @ time bridge was built: 21,400 (2007)

Skew:  Y  N Angle: 20°

Inspected By: DAD, DHT, JAB

Date Inspected: 9/12/08

Span Lengths See below Total: 161 ft

Deck Width: 40 ft

Beam Spacing: 7'5"

Date of Beam Erection: 2002

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 2002 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: Transverse cracks were observed on the bottom of the deck at a spacing of 4' – 6' or more.

Longitudinal Cracking: Longitudinal cracks were visible on the deck top and bottom.

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span Lengths: 1&3) 51ft4in., 2)52ft3in.

Average rating. \_\_\_\_\_

**Mix Design Information: (from MISTIC)**

Mix Design Number: 85PCC2230

Coarse Aggregate Source: Lincoln Park Stone CM 11  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: S & G Excavating FA 01 Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

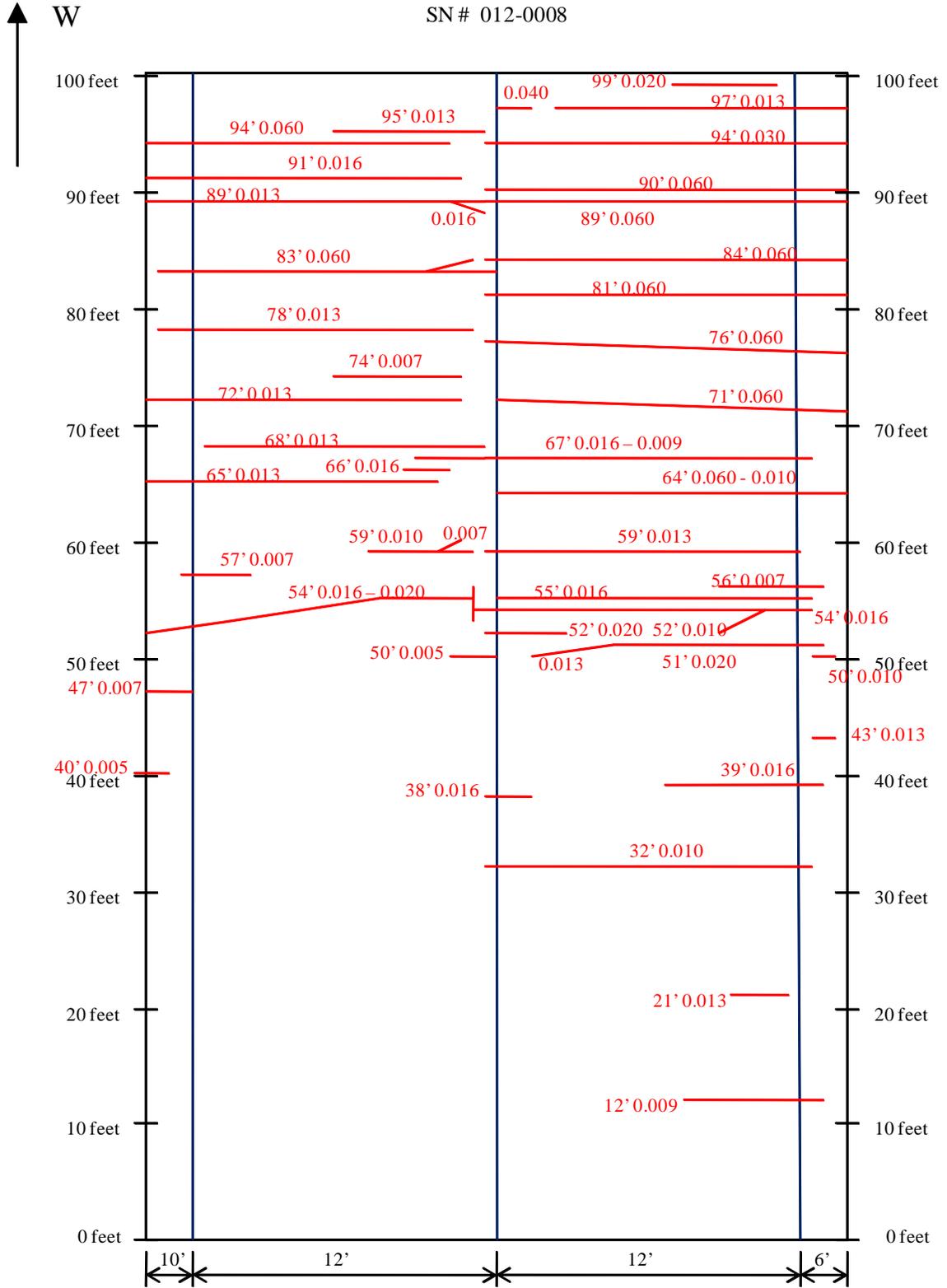
Cement Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: \_\_\_\_\_

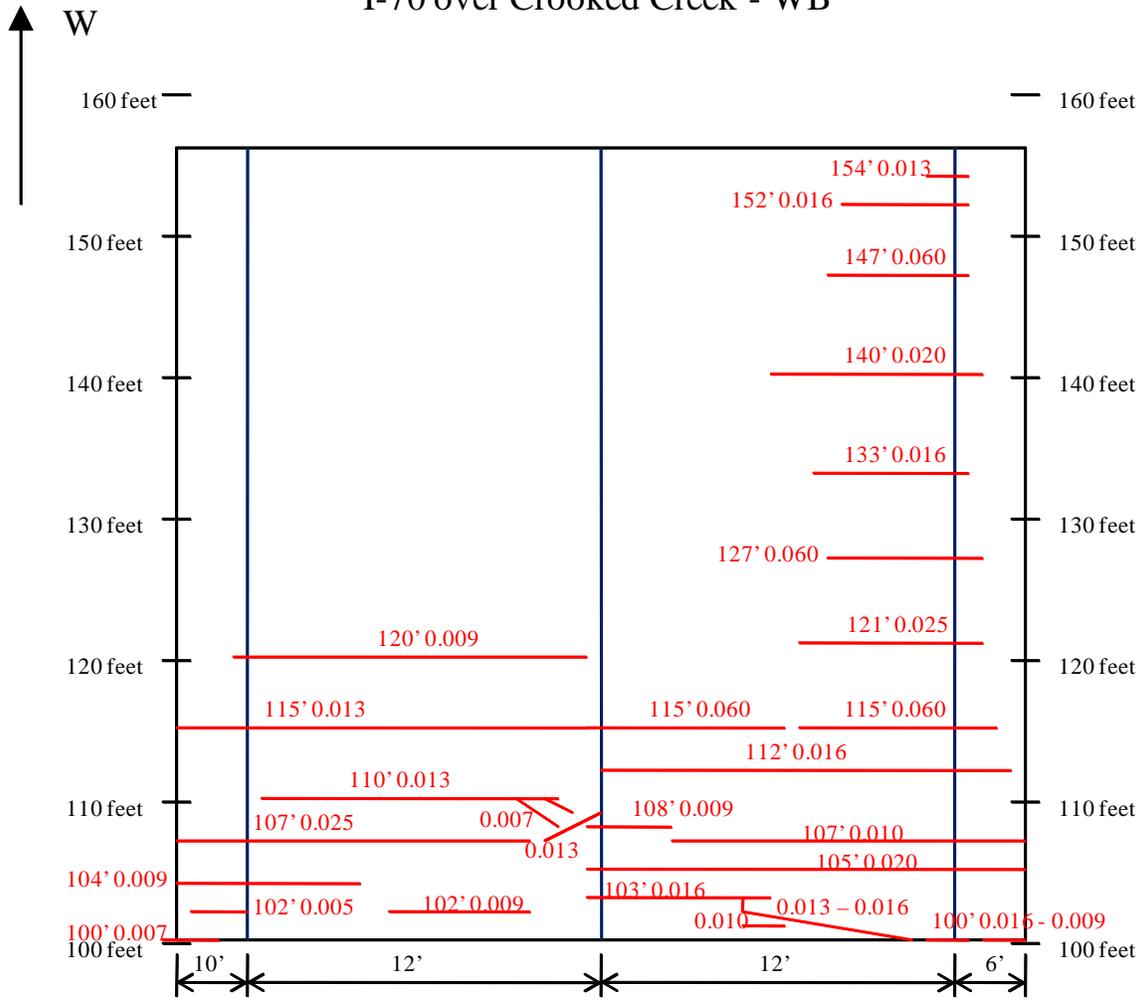
Microsilica Source: Elkem Materials, Inc.

I-70 over Crooked Creek – WB  
SN # 012-0008



Clark County – SN# 012-0008 – 10/1/2003

# I-70 over Crooked Creek - WB



Clark County – SN# 012-0008 – Surveyed 10/1/2003



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 012-0009

Responsible District: 5

Number of Spans: 3

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  Semi-Integral  Other

ADT @ time bridge was built: 21,400 (2007)

Skew:  Y  N Angle: 20°

Inspected By: DAD, DHT, JAB

Date Inspected: 9/12/08

Span Lengths See below Total: 161 ft

Deck Width: 40 ft

Beam Spacing: 7'5"

Date of Beam Erection: 2002

Bridge Joint:  Integral  Finger  Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 2002 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: Transverse cracks were observed on the bottom of the deck at a spacing of 4' – 6' or more.

Longitudinal Cracking: Longitudinal cracks were visible on the deck top and bottom.

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span Lengths: 1&3) 51ft4in., 2)52ft3in.

Above average rating.

**Mix Design Information: (from MISTIC)**

Mix Design Number: \_\_\_\_\_

Coarse Aggregate Source: \_\_\_\_\_  Crushed Stone  Gravel

Coarse Aggregate Source: \_\_\_\_\_  Crushed Stone  Gravel

Fine Aggregate Source: \_\_\_\_\_ Fine Aggregate Source: \_\_\_\_\_

HRM Source: \_\_\_\_\_

Cement Source: \_\_\_\_\_

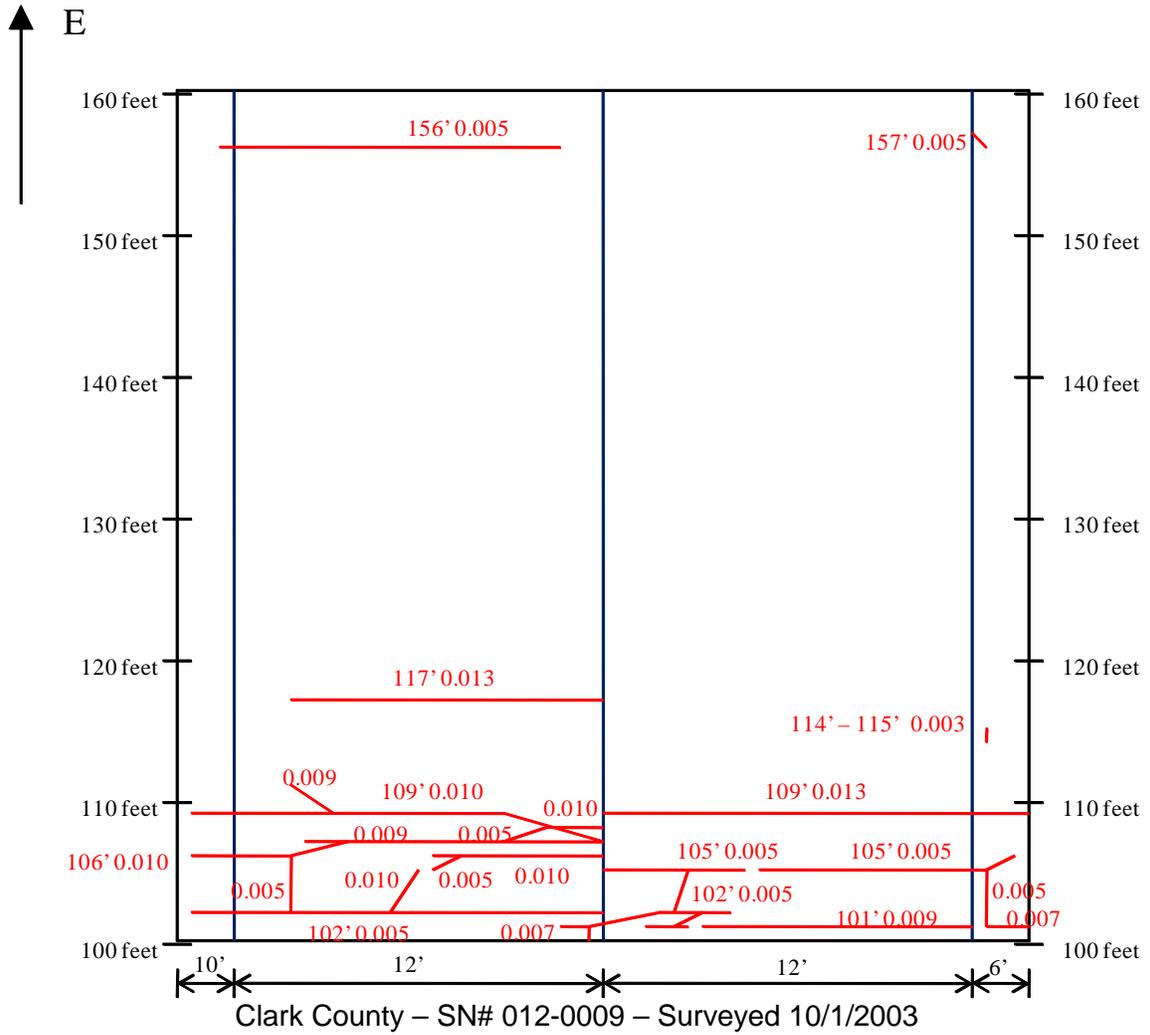
GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: \_\_\_\_\_

Microsilica Source: \_\_\_\_\_



# I-70 over Crooked Creek - EB





**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 012-0025

Inspected By: DAD, DHT, JAB

Responsible District: 5

Date Inspected: 9/12/08

Number of Spans: 4

Span Lengths See below Total: ~306'

Deck Width: 55' 6"

Beam Type:  PPC-I  Steel  Other

Beam Spacing: 6' 6<sup>3</sup>/<sub>4</sub>" (8 spaces)

Date of Beam Erection: 2002

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: 25,400 (2007)

Stage Construction:  Y  N

Skew:  Y  N Angle: 41° 27' 43"

Pour Dates: Stage 1, 2002 Stage 2, 2002

**Description of Cracking:**

Average Transverse Crack Distance: Transverse cracks were observed at a spacing of 6' – 8' under the deck.

Longitudinal Cracking: Mapping longitudinal cracks were observed on top of the deck and longitudinal cracks were observed under the deck.

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span Lengths: End Spans – 56' 1<sup>1</sup>/<sub>2</sub>" and 55' 6"; Interior Spans – 93' 8<sup>1</sup>/<sub>2</sub>"

From MISTIC: HPC Bridge Deck Mix with retarder and high range water reducer

**Mix Design Information: (from MISTIC)**

Mix Design Number: 85PCC2230

Coarse Aggregate Source: Lincoln Park Stone (CM 11)  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: S & G Excavating (FA 01) Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

Cement Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: \_\_\_\_\_

Microsilica Source: Elkem Materials, Inc.



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 012-0052

Inspected By: DAD, DHT, JAB

Responsible District: 5

Date Inspected: 9/12/08

Number of Spans: 3

Span Lengths See below Total: 240'6"

Deck Width: 40'

Beam Type:  PPC-I  Steel  Other

Beam Spacing: 7'2 1/2"

Date of Beam Erection: 2003

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: 25,400 (2007)

Stage Construction:  Y  N

Skew:  Y  N Angle: \_\_\_\_\_

Pour Dates: Stage 1, 2003 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: Cracks were 2' – 3' apart on top of the deck and were spalling. Mapping cracks were also observed on top and bottom.

Longitudinal Cracking: On top, the longitudinal cracks traveled the entire length at the approach slabs every 2' -3' of deck width.

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span lengths: 1&3) 71'11", 2) 92'0"

Bridge Deck Mix Design consisted partially of crushed gravel and included retarder and HRWR.

This was the dual structure that was "patched".

**Mix Design Information: (from MISTIC)**

Mix Design Number: 85PCC8461

Coarse Aggregate Source: Lawrence Gravel CA 11  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: Lawrence Gravel FA 01 Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

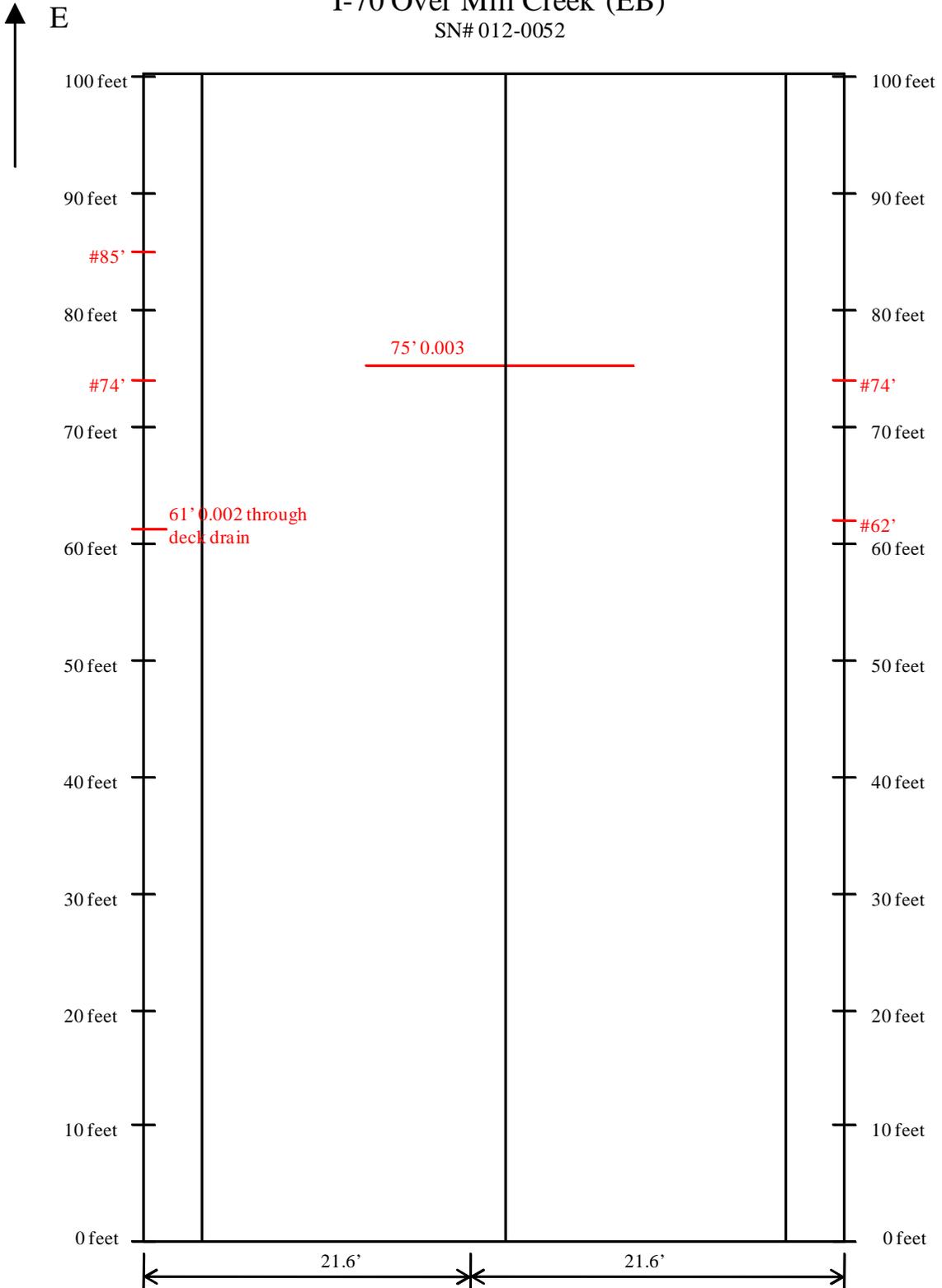
Cement Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: \_\_\_\_\_

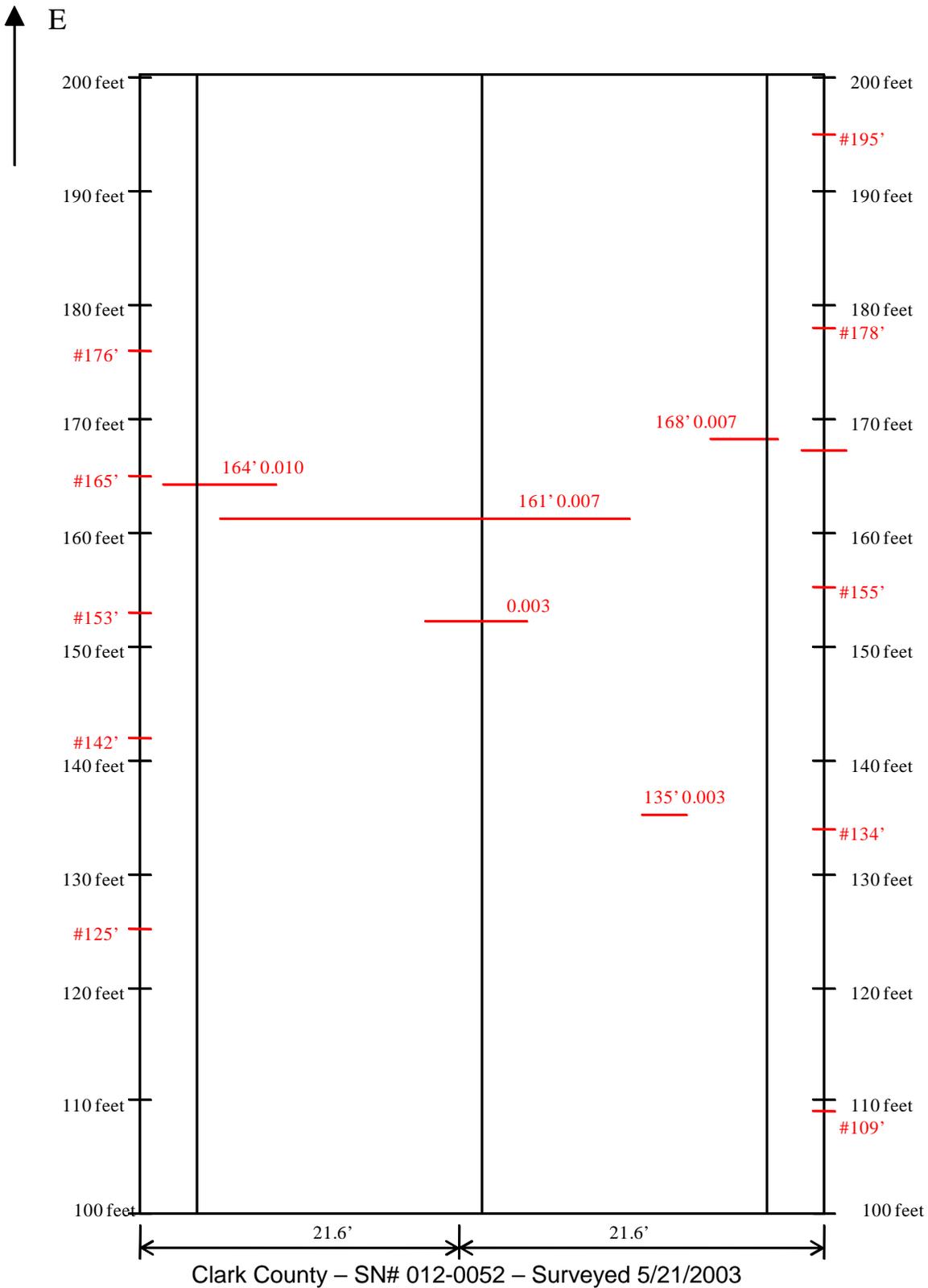
Microsilica Source: Elkem Materials, Inc.

I-70 Over Mill Creek (EB)  
SN# 012-0052



Clark County – SN# 012-0052 – Surveyed 5/21/2003

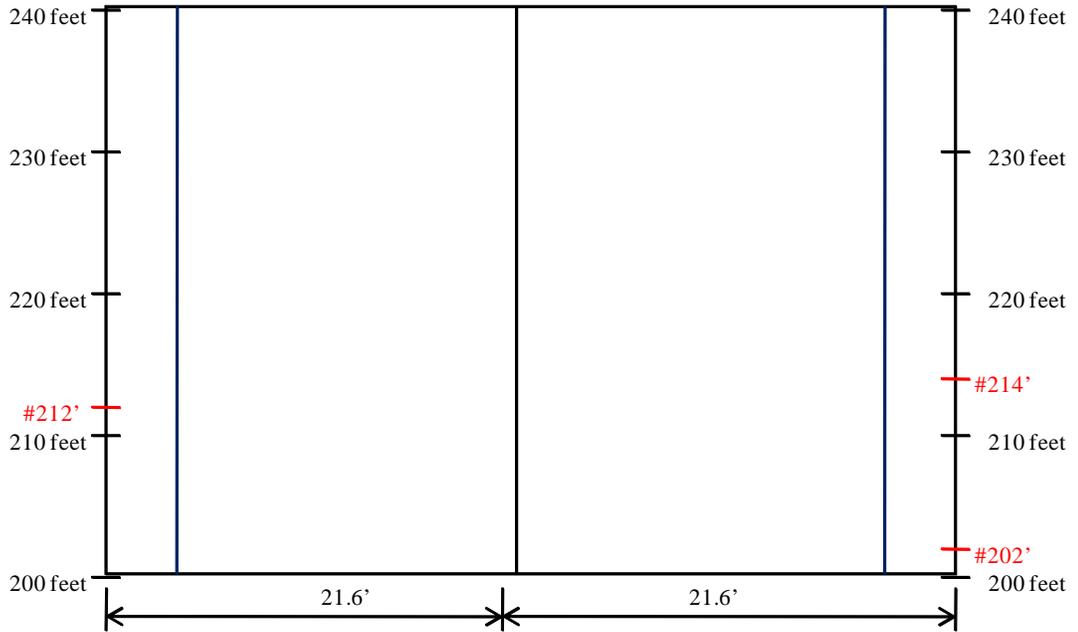
# I-70 Over Mill Creek (EB)





E

### I-70 Over Mill Creek (EB)



Clark County – SN# 012-0052 – Surveyed 5/21/2003  
The “#” symbol represents cracks in the parapet only.



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 012-0053

Inspected By: DAD, DHT, JAB

Responsible District: 5

Date Inspected: 9/12/08

Number of Spans: 3

Span Lengths See below Total: 240'6"

Deck Width: 40'

Beam Type:  PPC-I  Steel  Other

Beam Spacing: 7'2 1/2"

Date of Beam Erection: 2003

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: 25,400 (2007)

Stage Construction:  Y  N

Skew:  Y  N Angle: \_\_\_\_\_

Pour Dates: Stage 1, 2003 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: Cracks were 2' – 3' apart on top of the deck and were spalling. Mapping cracks were also observed on top and bottom.

Longitudinal Cracking: On top, the longitudinal cracks traveled the entire length at the approach slabs every 2' -3' of deck width.

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span lengths: 1&3) 71'11", 2) 92'0"

Bridge Deck Mix Design consisted partially of crushed gravel and included retarder and HRWR.

This was the dual structure that was "patched".

**Mix Design Information: (from MISTIC)**

Mix Design Number: 85PCC8461

Coarse Aggregate Source: Lawrence Gravel CA 11  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: Lawrence Gravel FA 01 Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

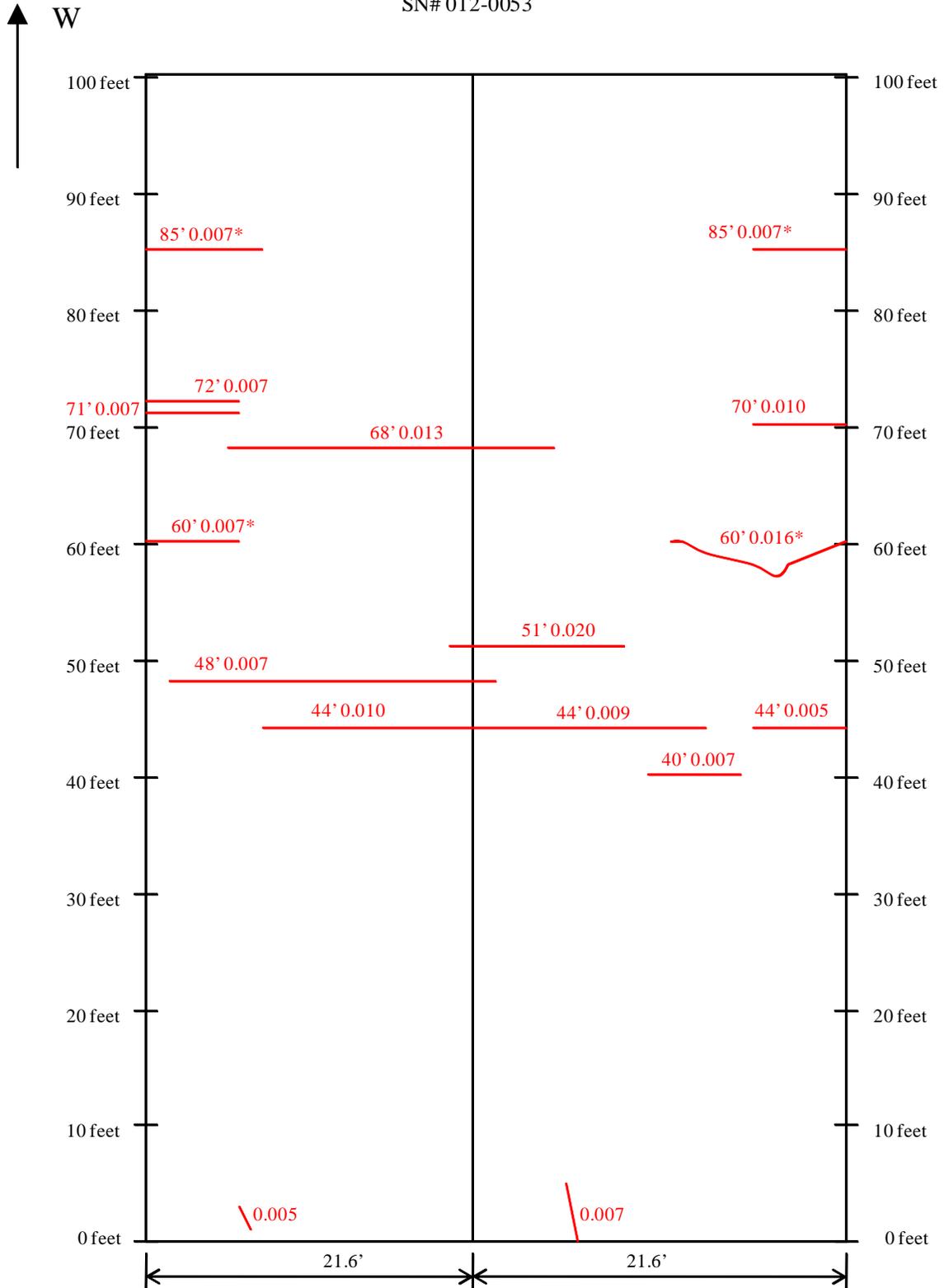
Cement Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: \_\_\_\_\_

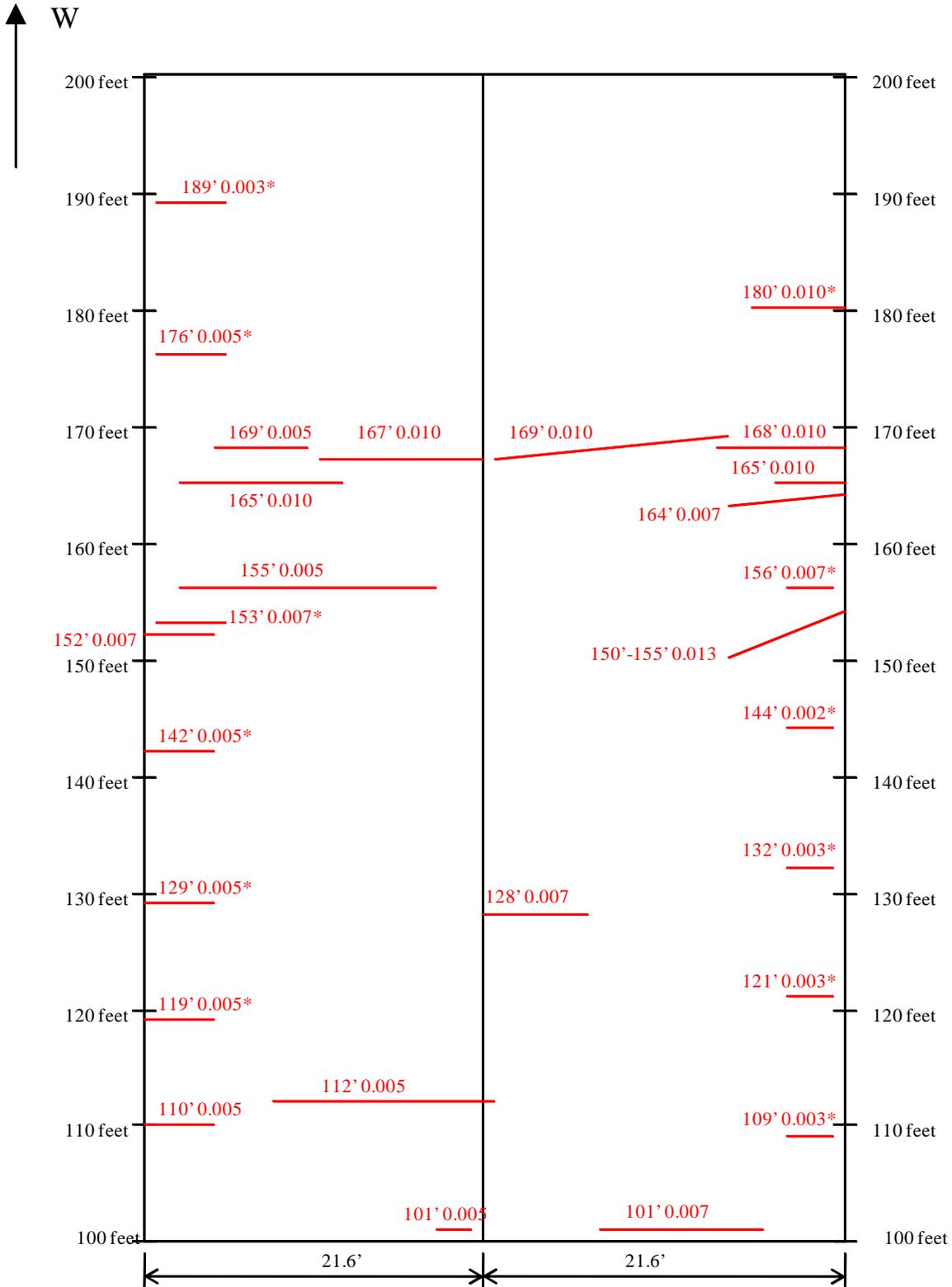
Microsilica Source: Elkem Materials, Inc.

I-70 Over Mill Creek (WB)  
SN# 012-0053



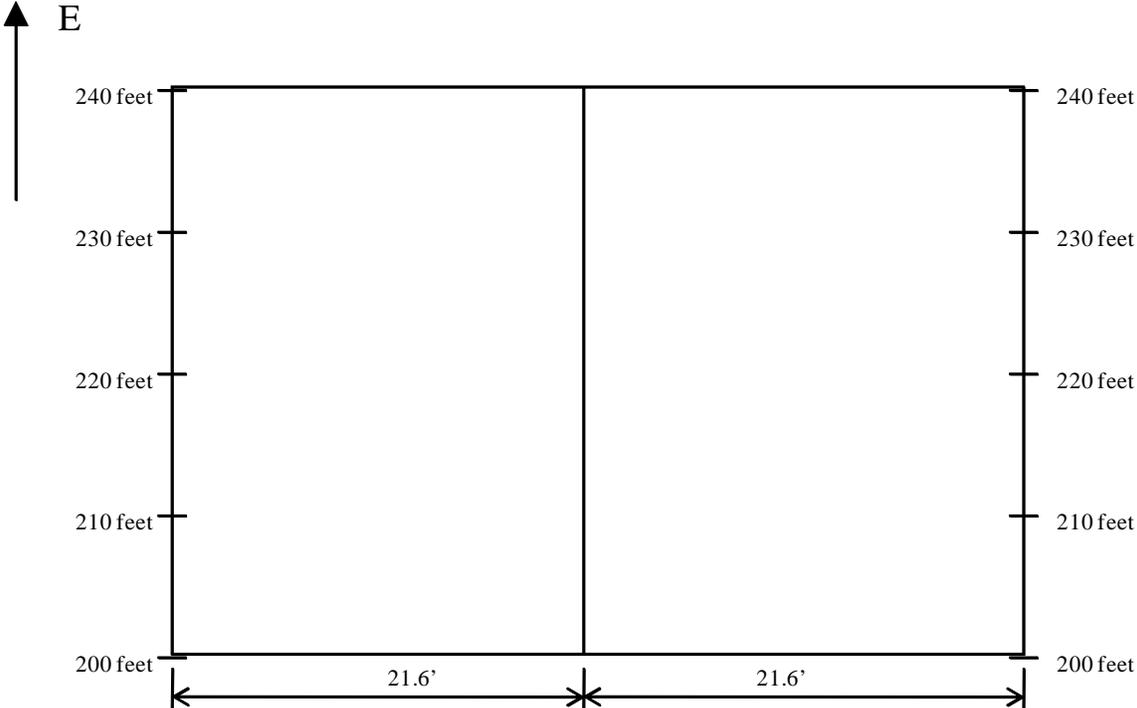
Clark County – SN# 012-0053 – Surveyed 10/1/2003

# I-70 Over Mill Creek (WB)



Clark County – SN# 012-0053 – Surveyed 10/1/2003

I-70 Over Mill Creek (WB)



Clark County – SN# 012-0053 – Surveyed 10/1/2003

\* Crack traversed through deck drain.



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 012-0054

Inspected By: DAD, DHT, JAB

Responsible District: 5

Date Inspected: 9/12/08

Number of Spans: 4

Span Lengths See below Total: 175'6"

Deck Width: 40'0"

Beam Type:  PPC-I  Steel  Other

Beam Spacing: 7'2½"

Date of Beam Erection: 2002

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: 10,600 (2007)

Stage Construction:  Y  N

Skew:  Y  N Angle: 13°06'49"

Pour Dates: Stage 1, 2002 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: On top, transverse cracks nearly every 3' – 6' along the bridge deck. Some cracks were more than 6' apart. On bottom, cracks were very visible and severe.

Longitudinal Cracking: Longitudinal cracks were observed on top but with longer spacing than transverse. A few severe longitudinal cracks were seen on the bottom of the deck.

Bridge Joint Cracking / Integral Abutment Cracking: Cracking is fairly severe near the ends of the structure.

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span Lengths: 1&4) 41ft3in., 2&3) 44ft0in.

Average rating. \_\_\_\_\_

**Mix Design Information: (from MISTIC)**

Mix Design Number: 85PCC2230

Coarse Aggregate Source: Lincoln Park Stone CM 11  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: S & G Excavating FA 01 Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

Cement Source: \_\_\_\_\_

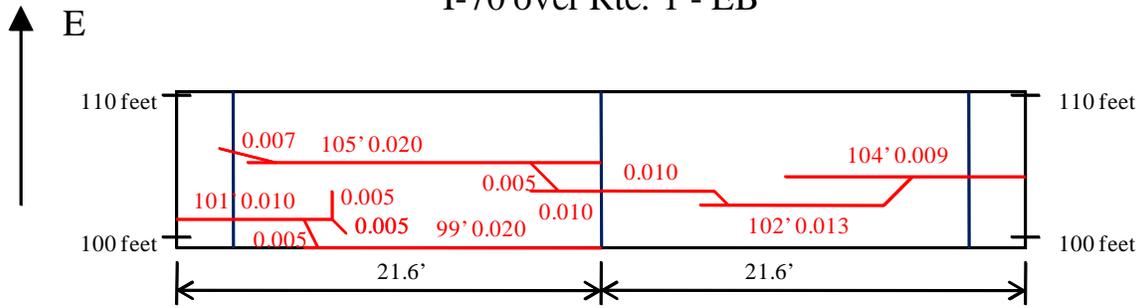
GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: \_\_\_\_\_

Microsilica Source: Elkem Materials, Inc.



# I-70 over Rte. 1 - EB



Clark County – SN# 012-0054 – Surveyed 10/1/2003

The southwest corner was chipped off.

This was a partial deck survey due to time constraints and traffic conditions.



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 012-0055

Inspected By: DAD, DHT, JAB

Responsible District: 5

Date Inspected: 9/12/08

Number of Spans: 4

Span Lengths See below Total 175'6"

Deck Width: 40'0"

Beam Type:  PPC-I  Steel  Other

Beam Spacing: 7'2½"

Date of Beam Erection: 2002

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: 10,600 (2007)

Stage Construction:  Y  N

Skew:  Y  N Angle: 13°06'49"

Pour Dates: Stage 1, 2002 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: On top, transverse cracks nearly every 3' – 6' along the bridge deck. Some cracks were more than 6' apart. On bottom, cracks were very visible and severe.

Longitudinal Cracking: Longitudinal cracks were observed on top but with longer spacing than transverse. A few severe longitudinal cracks were seen on the bottom of the deck.

Bridge Joint Cracking / Integral Abutment Cracking: Cracking is fairly severe near the ends of the structure.

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span Lengths: 1&4) 41ft3in., 2&3) 44ft0in.

Average rating. \_\_\_\_\_

**Mix Design Information: (from MISTIC)**

Mix Design Number: 85PCC2230

Coarse Aggregate Source: Lincoln Park Stone CM 11  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: S & G Excavating Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

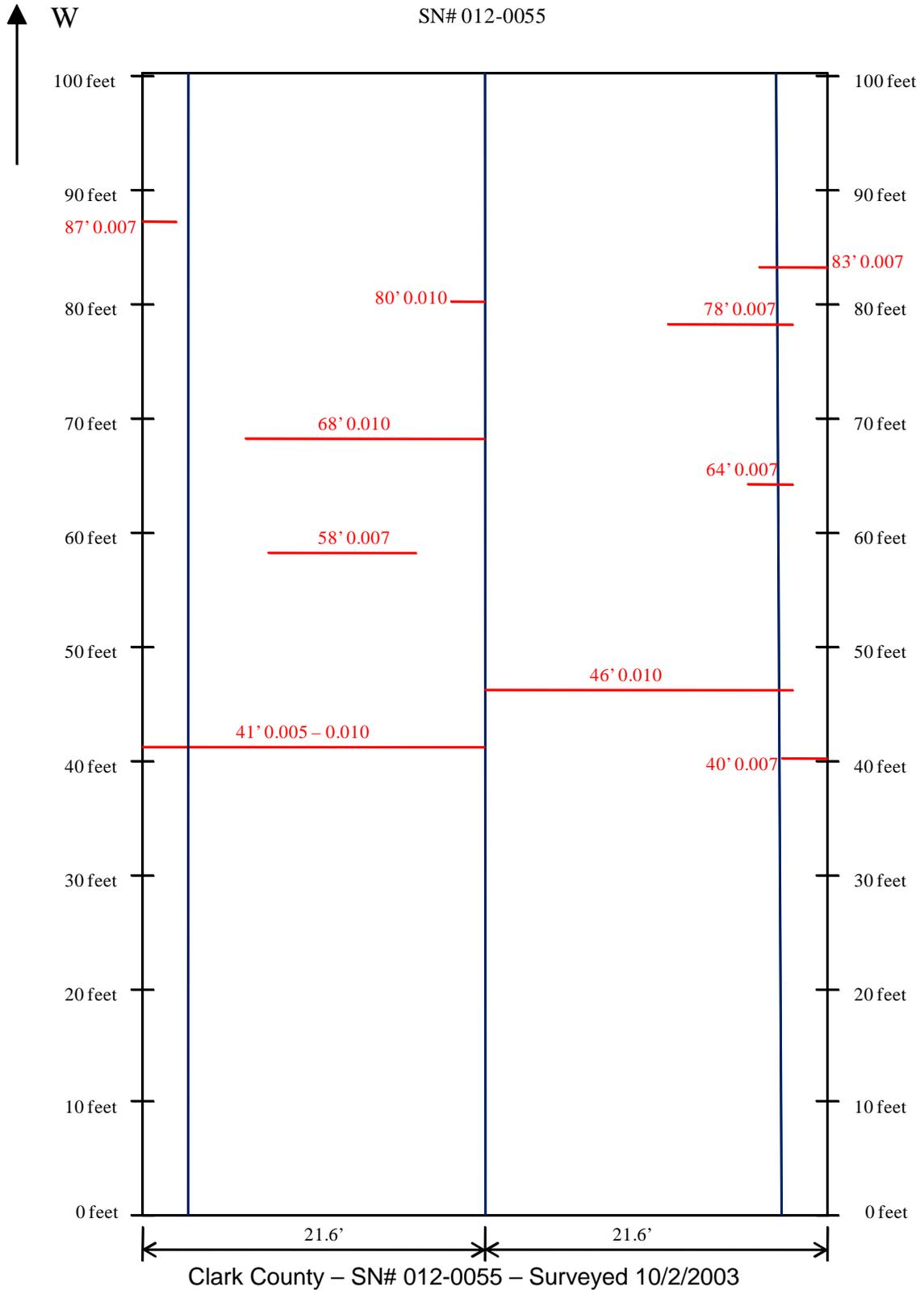
Cement Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

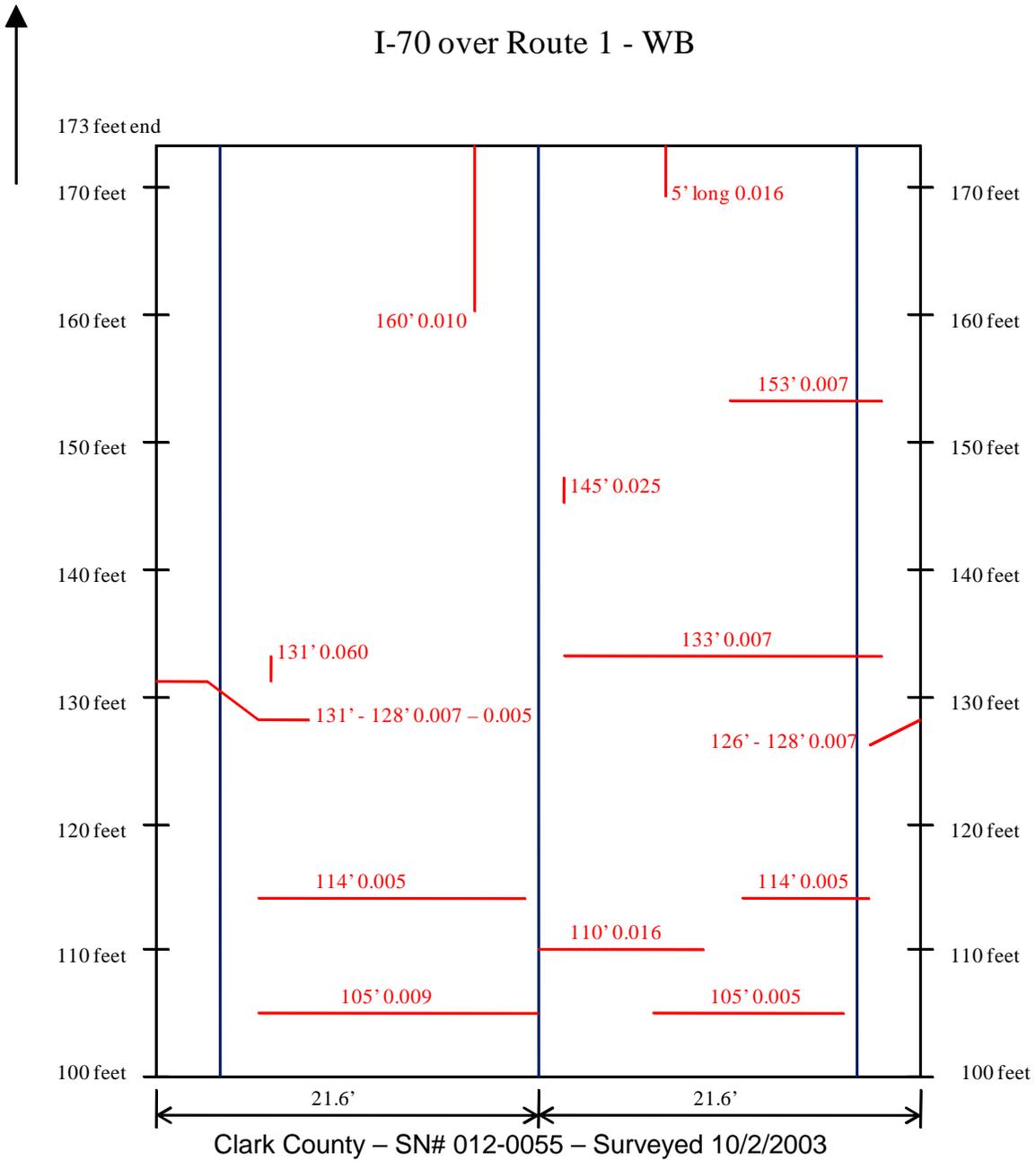
Fly Ash Source: \_\_\_\_\_

Microsilica Source: Elkem Materials, Inc.

I-70 over Route 1 – WB  
SN# 012-0055



# I-70 over Route 1 - WB



Cook County



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 016-2720

Responsible District: 1

Number of Spans: 3

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

ADT @ time bridge was built: 32,200 (2007)

Skew:  Y  N Angle: 45°

Inspected By: DAD, JAB

Date Inspected: 8/23/11

Span Lengths 1&3)21.4m,2)17.0m Total 62.7m

Deck Width: 15.2m

Beam Spacing: 2.022m

Date of Beam Erection: 2002

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 07/2002 Stage 2, 10/2002

**Description of Cracking:**

Average Transverse Crack Distance: NB: cracking observed at 3'-4' spacing in midspan and 5'-6' spacing at ends. SB: cracking observed at 3'-5' spacing in midspan and 4'-6' spacing at ends.

Longitudinal Cracking: Longitudinal cracking observed in SB lanes.

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: Yes

**Other Observations:**

The southbound (SB) lanes were poured in Stage I and the northbound (NB) lanes were poured in Stage II. Stage I exhibited more cracking than Stage II.

**Mix Design Information: (from MISTIC)**

Mix Design Number: 71PCCFR05

Coarse Aggregate Source: Material Service  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: Midwest Material Fine Aggregate Source: N/A

HRM Source: Engelhard Corporation

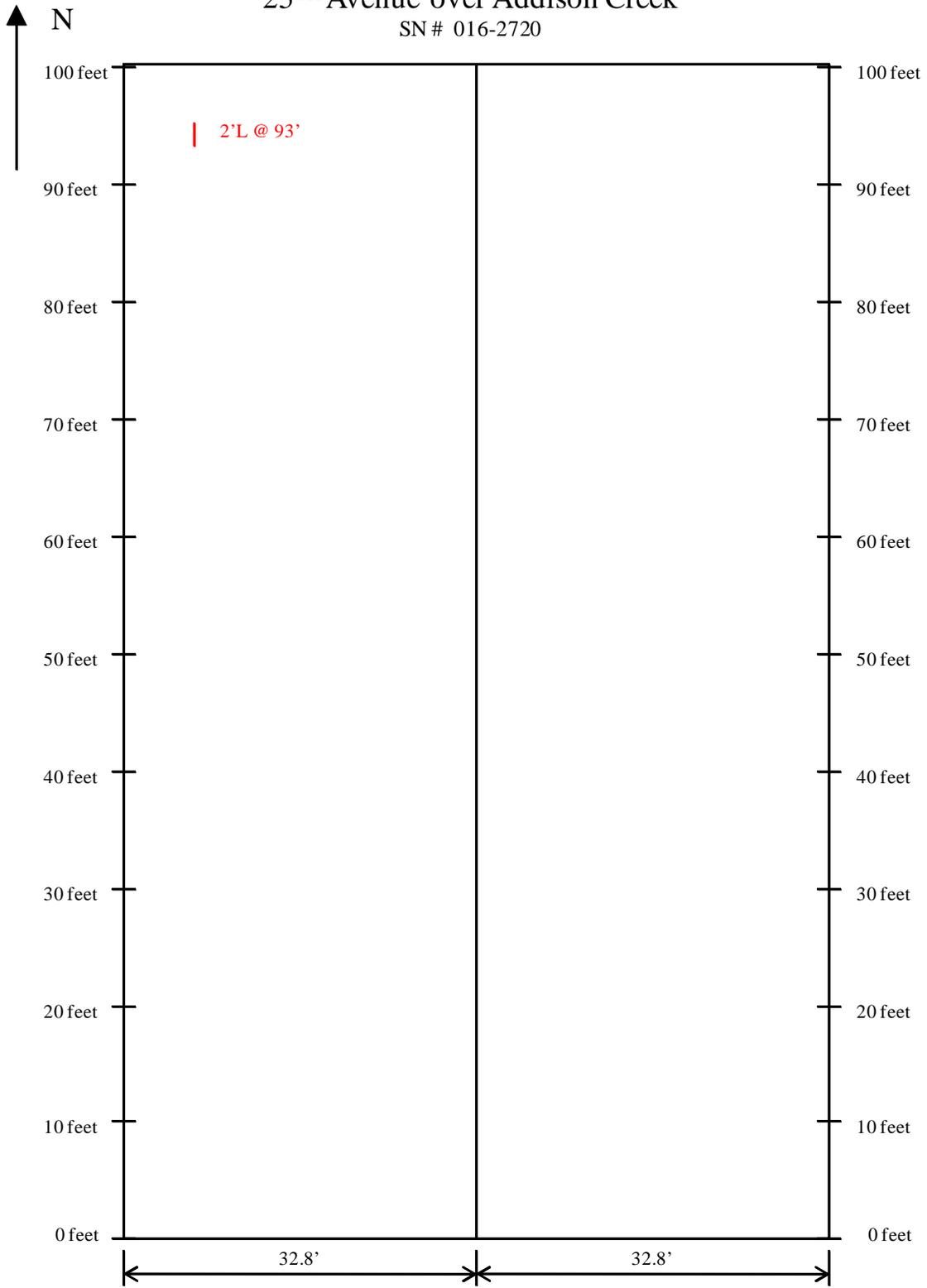
Cement Source: \_\_\_\_\_

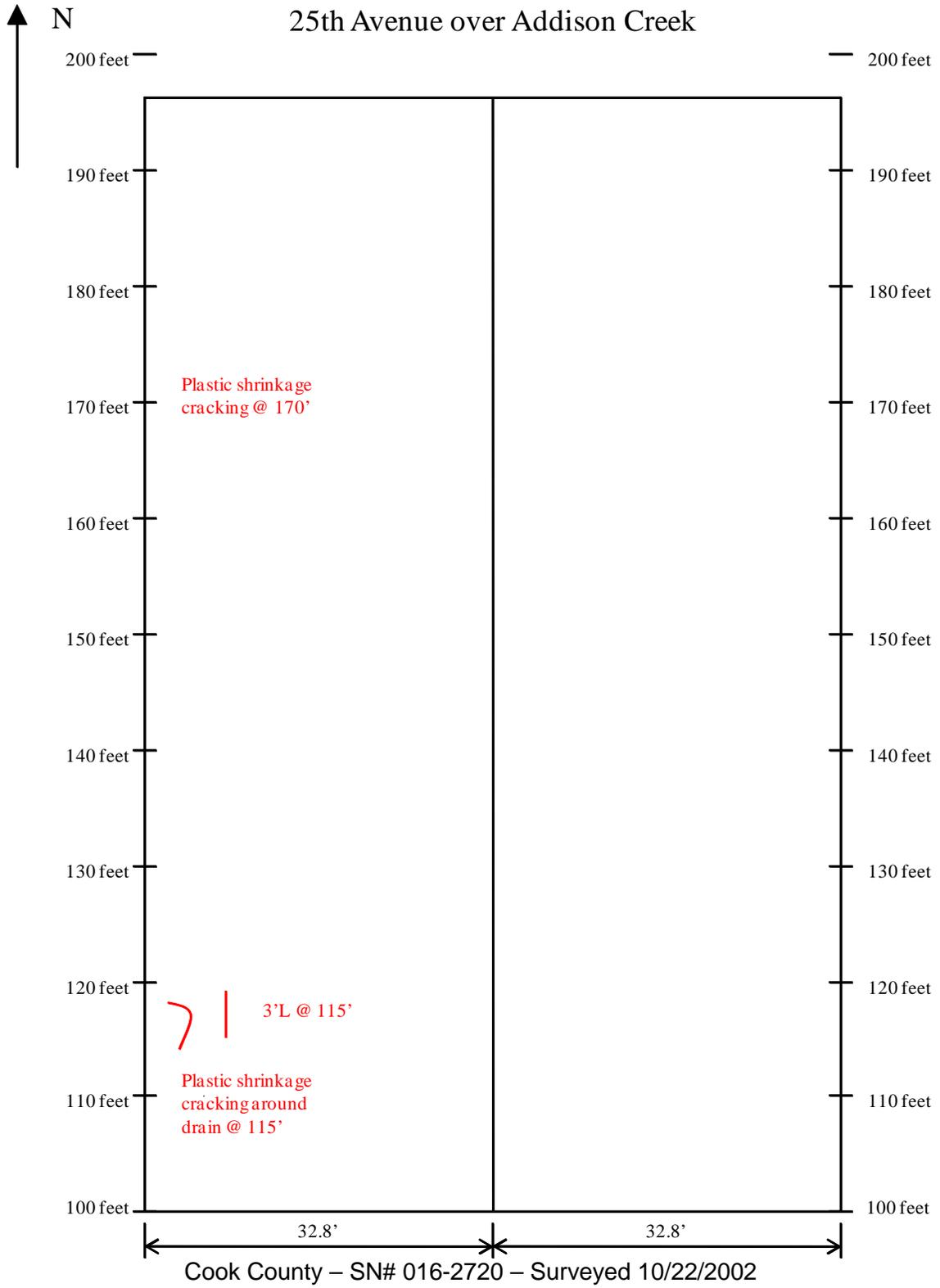
GGBF Slag Source: Holcim (US) Inc.

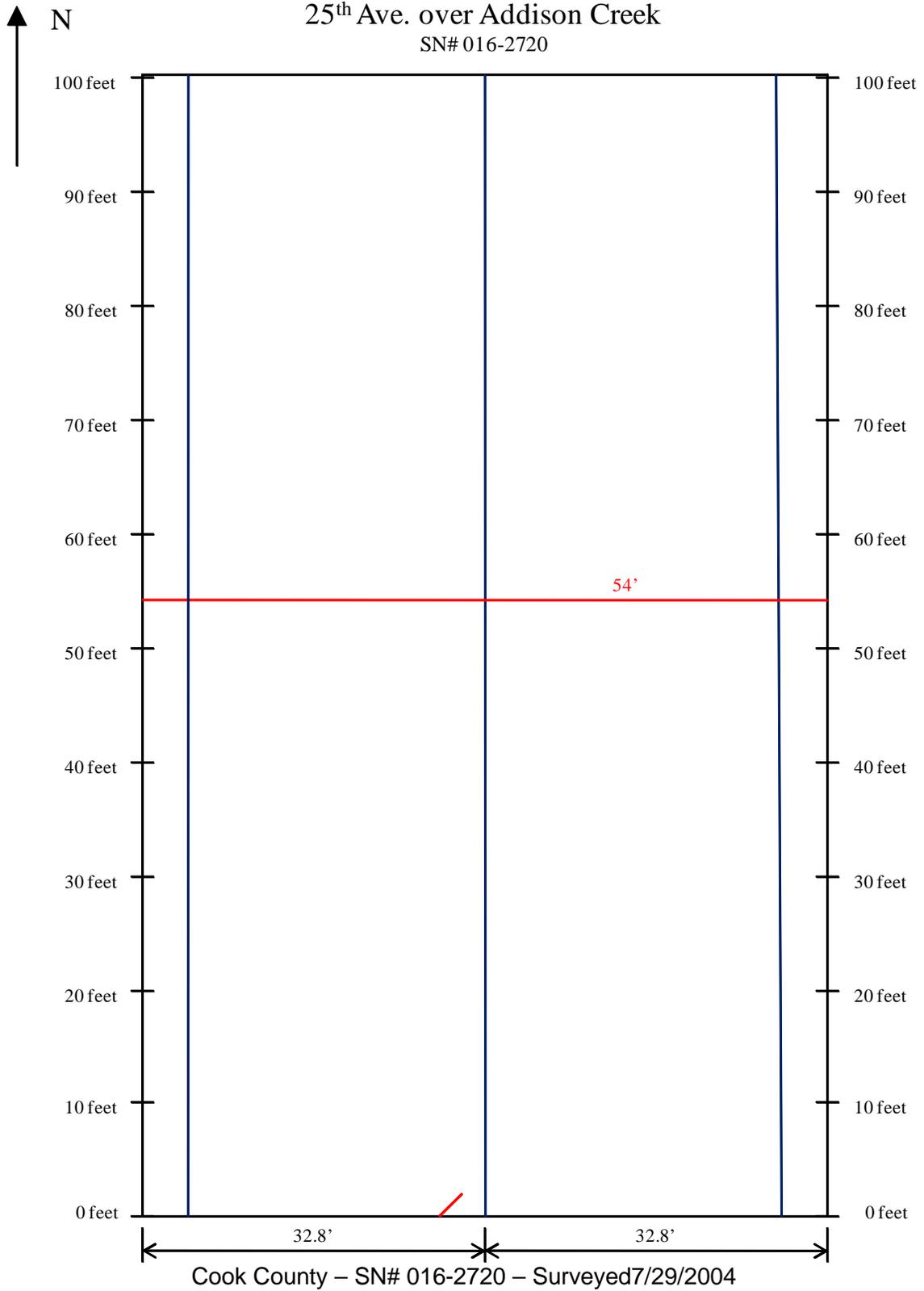
Fly Ash Source: \_\_\_\_\_

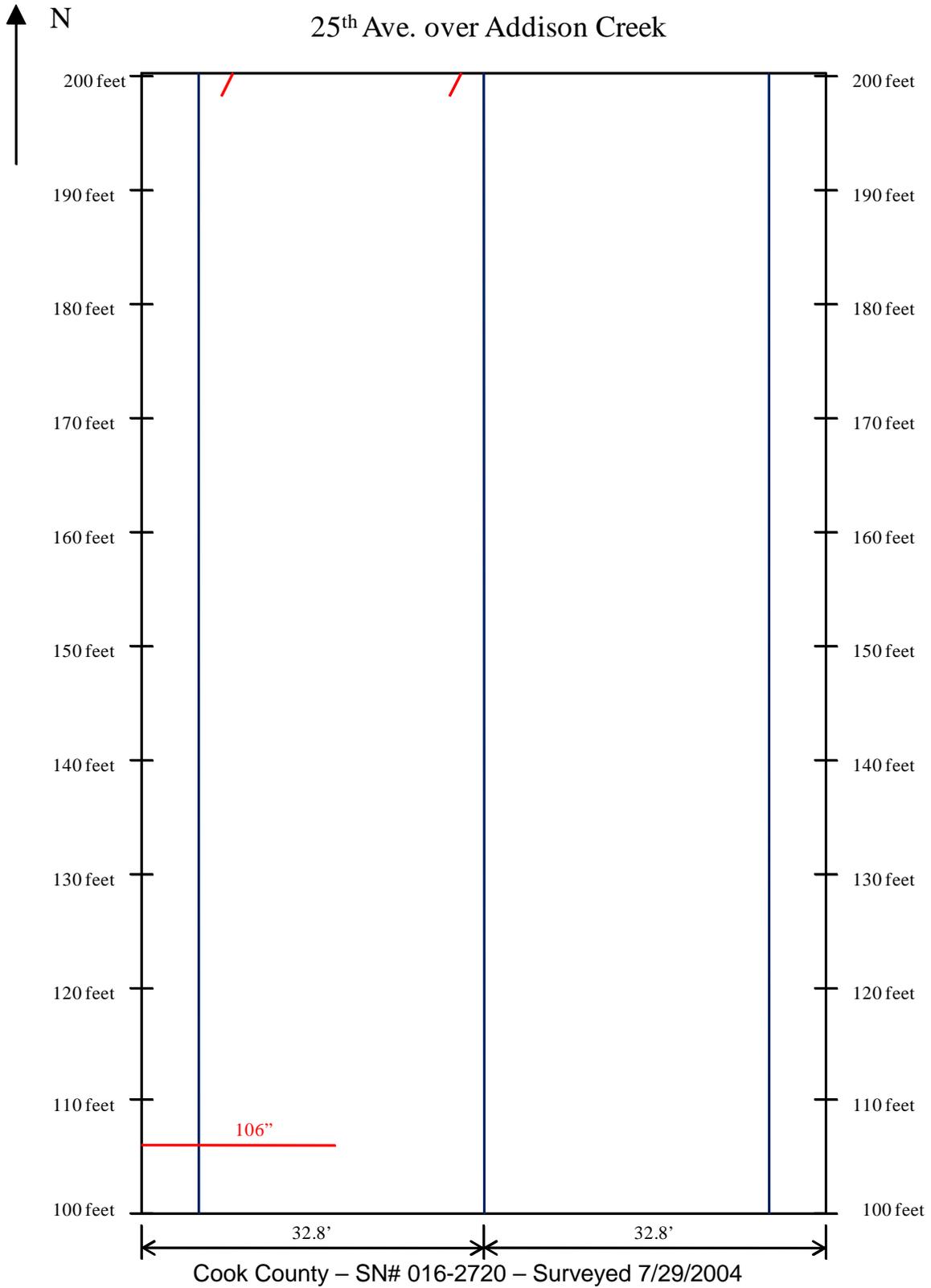
Microsilica Source: \_\_\_\_\_

25<sup>TH</sup> Avenue over Addison Creek  
SN # 016-2720











**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 016-2740

Responsible District: 1

Number of Spans: 4

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

ADT @ time bridge was built: 32,200 (2007)

Skew:  Y  N Angle: \_\_\_\_\_

Inspected By: DAD, JAB

Date Inspected: 8/23/11

Span Lengths See below Total: 151.99m

Deck Width: 15.2m

Beam Spacing: 1.88m (9 spaces), 2.12m (1 space)

Date of Beam Erection: 2002

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 05/2002 Stage 2, 2002

**Description of Cracking:**

Average Transverse Crack Distance: No transverse cracks observed under the deck. On top, WB, few transverse cracks were observed and EB, 2 or 3 transverse cracks were observed.

Longitudinal Cracking: none

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span lengths: 1&4)37.4m, 2&3)37.7m

Beam: PCC Bulb-T

WB is westbound and EB is eastbound.

**Mix Design Information: (from MISTIC)**

Mix Design Number: 71PCCFR05

Coarse Aggregate Source: Material Service  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: Midwest Material Fine Aggregate Source: N/A

HRM Source: Engelhard Corporation

Cement Source: \_\_\_\_\_

GGBF Slag Source: Holcim (US) Inc.

Fly Ash Source: \_\_\_\_\_

Microsilica Source: \_\_\_\_\_



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 016-0983

Responsible District: 1

Number of Spans: 3

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

ADT @ time bridge was built: 144,100 (2007)

Skew:  Y  N Angle: 16°

Inspected By: DAD, JAB

Date Inspected: 8/24/11

Span Lengths 14.9m, 41.3m Total: 72.6m

Deck Width: 21.6m

Beam Spacing: 2.08m

Date of Beam Erection: 2003

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 2003 Stage 2, 2003

**Description of Cracking:**

Average Transverse Crack Distance: On top, transverse cracks observed at 3'-4' spacings in midspan and about 5±' apart at ends. Few transverse cracks were observed near approach with many cracks in midspan under deck.

Longitudinal Cracking: none

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Mix Design Information: (from MISTIC)**

Mix Design Number: 71PCCFR08

Coarse Aggregate Source: Material Service  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: Bluff City Materials Fine Aggregate Source: N/A

HRM Source: Engelhard Corporation

Cement Source: \_\_\_\_\_

GGBF Slag Source: Holcim (US) Inc.

Fly Ash Source: \_\_\_\_\_

Microsilica Source: \_\_\_\_\_



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 016-0982

Responsible District: 1

Number of Spans: 3

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

ADT @ time bridge was built: 144,100 (2007)

Skew:  Y  N Angle: 16°

Inspected By: DAD, JAB

Date Inspected: 8/24/11

Span Lengths 14.9m, 41.3m Total: 72.6m

Deck Width: 21.6m

Beam Spacing: 2.08m

Date of Beam Erection: 2003

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 2003 Stage 2, 2003

**Description of Cracking:**

Average Transverse Crack Distance: On top, transverse cracks observed at 3'-4' spacings in midspan and about 5±' apart at ends. Few transverse cracks were observed near approach with many cracks in midspan under deck.

Longitudinal Cracking: No longitudinal cracking observed underneath. Longitudinal cracking observed on bridge approach on north end.

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Mix Design Information: (from MISTIC)**

Mix Design Number: 71PCCFR05

Coarse Aggregate Source: Material Service  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: Midwest Material Fine Aggregate Source: N/A

HRM Source: Engelhard Corporation

Cement Source: \_\_\_\_\_

GGBF Slag Source: Holcim (US) Inc.

Fly Ash Source: \_\_\_\_\_

Microsilica Source: \_\_\_\_\_



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 016-0979

Responsible District: 1

Number of Spans: 3

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

ADT @ time bridge was built: 164,000 (2007)

Skew:  Y  N Angle: 1°04'28"

Inspected By: DAD, JAB

Date Inspected: 8/24/11

Span Lengths 13.2m,23.9m,12.7m Total: 51.3m

Deck Width: 25.01m

Beam Spacing: 1.02m, 1.98m, 1.49m

Date of Beam Erection: 2003

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 2003 Stage 2, 2003

**Description of Cracking:**

Average Transverse Crack Distance: On top and bottom, numerous transverse were observed at 1'-3' spacings.

Longitudinal Cracking: none

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Mix Design Information: (from MISTIC)**

Mix Design Number: 71PCCFR05

Coarse Aggregate Source: Material Service  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: Midwest Material Fine Aggregate Source: N/A

HRM Source: Engelhard Corporation

Cement Source: \_\_\_\_\_

GGBF Slag Source: Holcim (US) Inc.

Fly Ash Source: \_\_\_\_\_

Microsilica Source: \_\_\_\_\_

Fayette County



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 026-0034

Inspected By: DAD, DHT, JAB

Responsible District: 7

Date Inspected: 7/22/09

Number of Spans: 4

Span Lengths See below Total: 429'

Deck Width: 64'

Beam Type:  PPC-I  Steel  Other

Beam Spacing: 7'6"

Date of Beam Erection: 2002&2003

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: 4,100 (2007)

Stage Construction:  Y  N

Skew:  Y  N Angle: \_\_\_\_\_

Pour Dates: Stage 1, 2002 Stage 2, 2003

**Description of Cracking:**

Average Transverse Crack Distance: Stage I is "badly" cracked every 2' to 3' on average. With Stage II, faint cracking 7' - 8' apart on average. Stage II is not cracked as much as Stage I.

Longitudinal Cracking: Longitudinal cracks were observed every 4' on Stage I. Stage II had cracks but not as much as Stage I. Map cracking was also observed.

Bridge Joint Cracking / Integral Abutment Cracking: Cracking around bridge joints on top of deck. Faint and sporadic cracking occurred near abutments.

Cracking over Piers: Faint cracking was seen over the piers.

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span lengths: 1&4) 84'0", 2&3) 108'0"

Eastbound Lanes Deck & Parapet instrumented. On top of the bridge deck, around the middle, cracks were evident every 3' - 5' then occurred sporadically throughout the deck.

**Mix Design Information: (from MISTIC)**

Mix Design Number: 87PCC5141

Coarse Aggregate Source: Pana Limestone (CA 11)  Crushed Stone  Gravel

Coarse Aggregate Source: Material Service (CA 16)  Crushed Stone  Gravel

Fine Aggregate Source: Central Ill. Material (FA 01) Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

Cement Source: \_\_\_\_\_

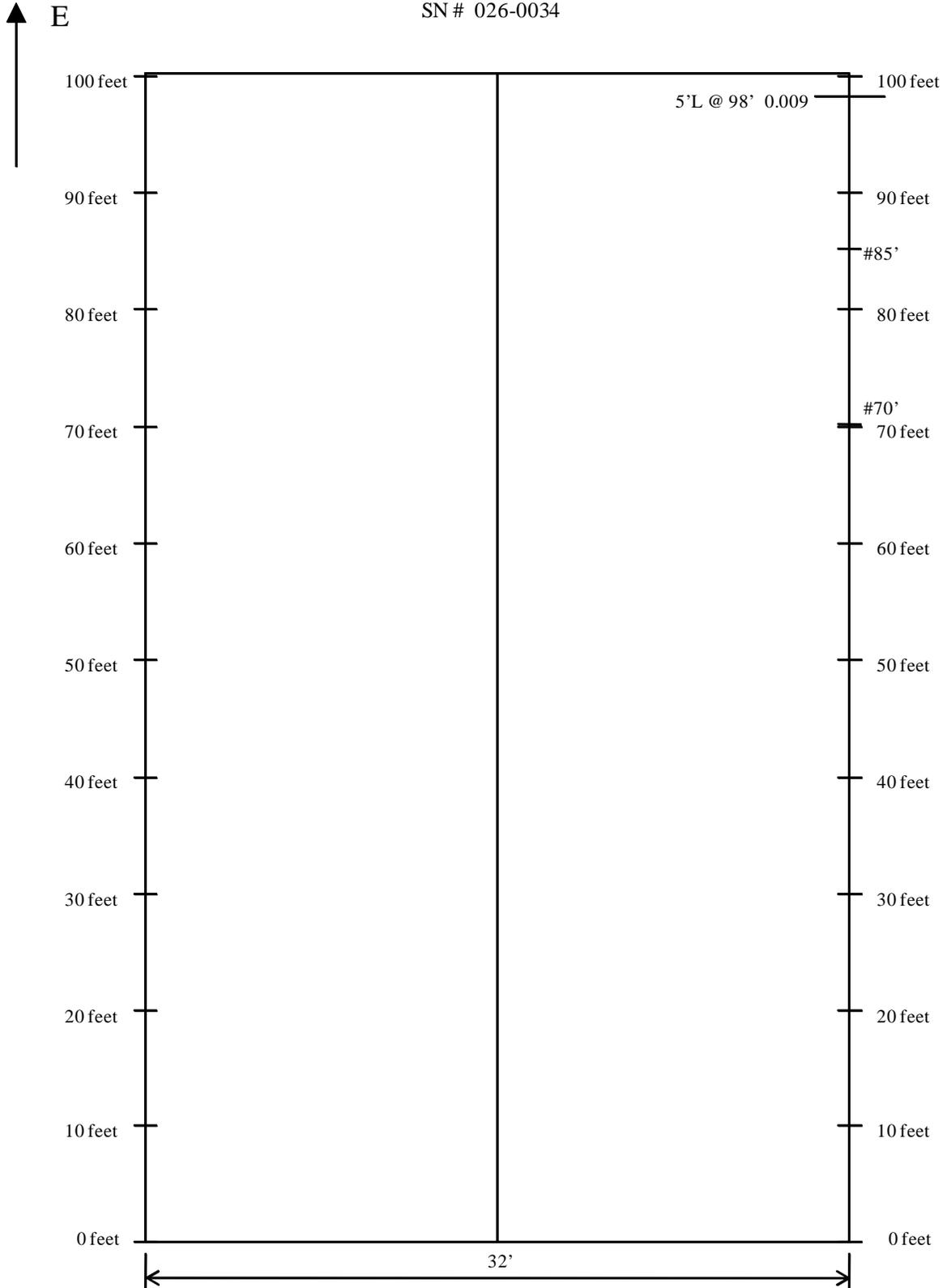
GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: Lafarge N. America

Microsilica Source: W. R. Grace & Company

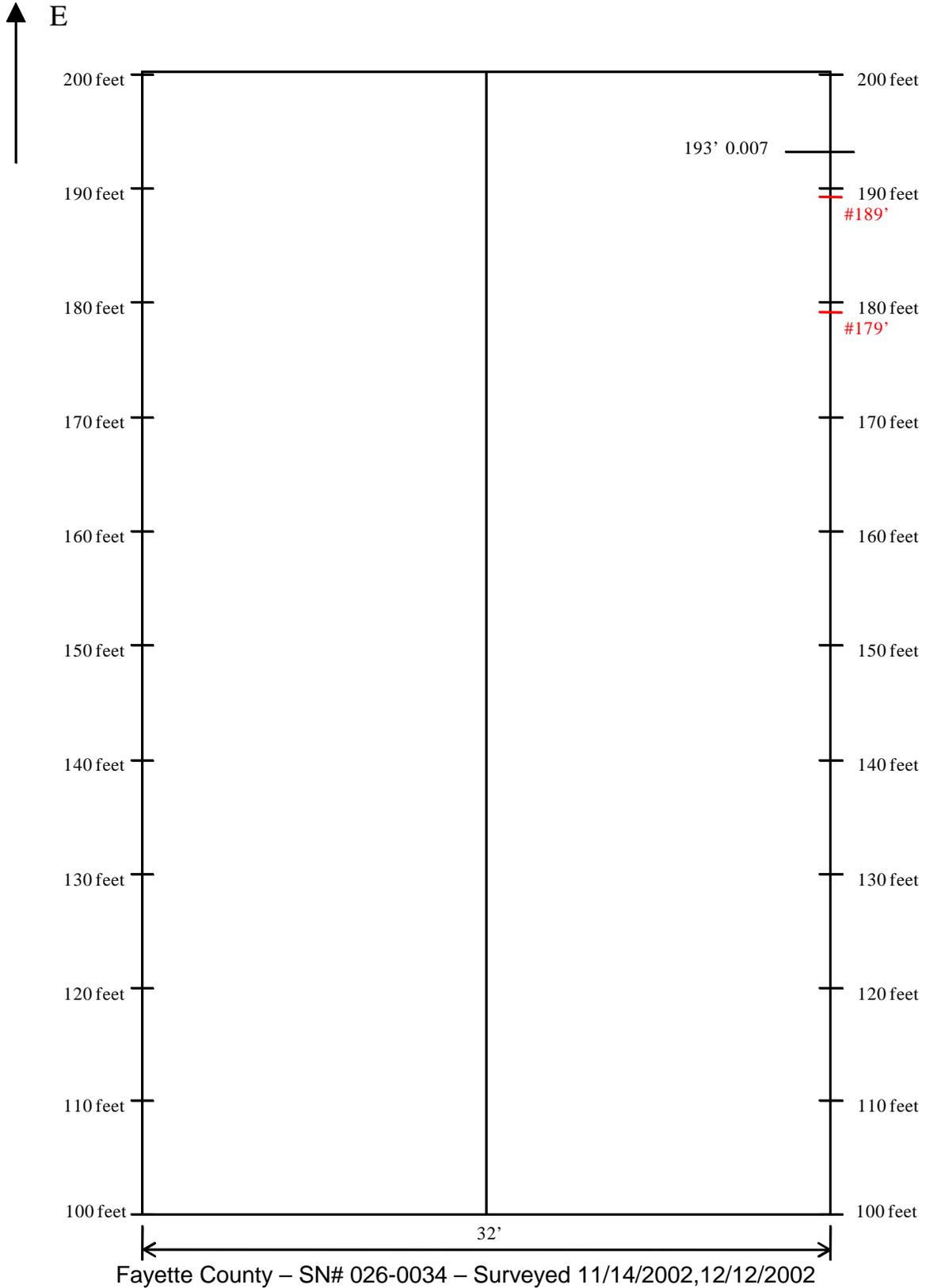
# US 40 & 51 over Kaskaskia River

SN # 026-0034

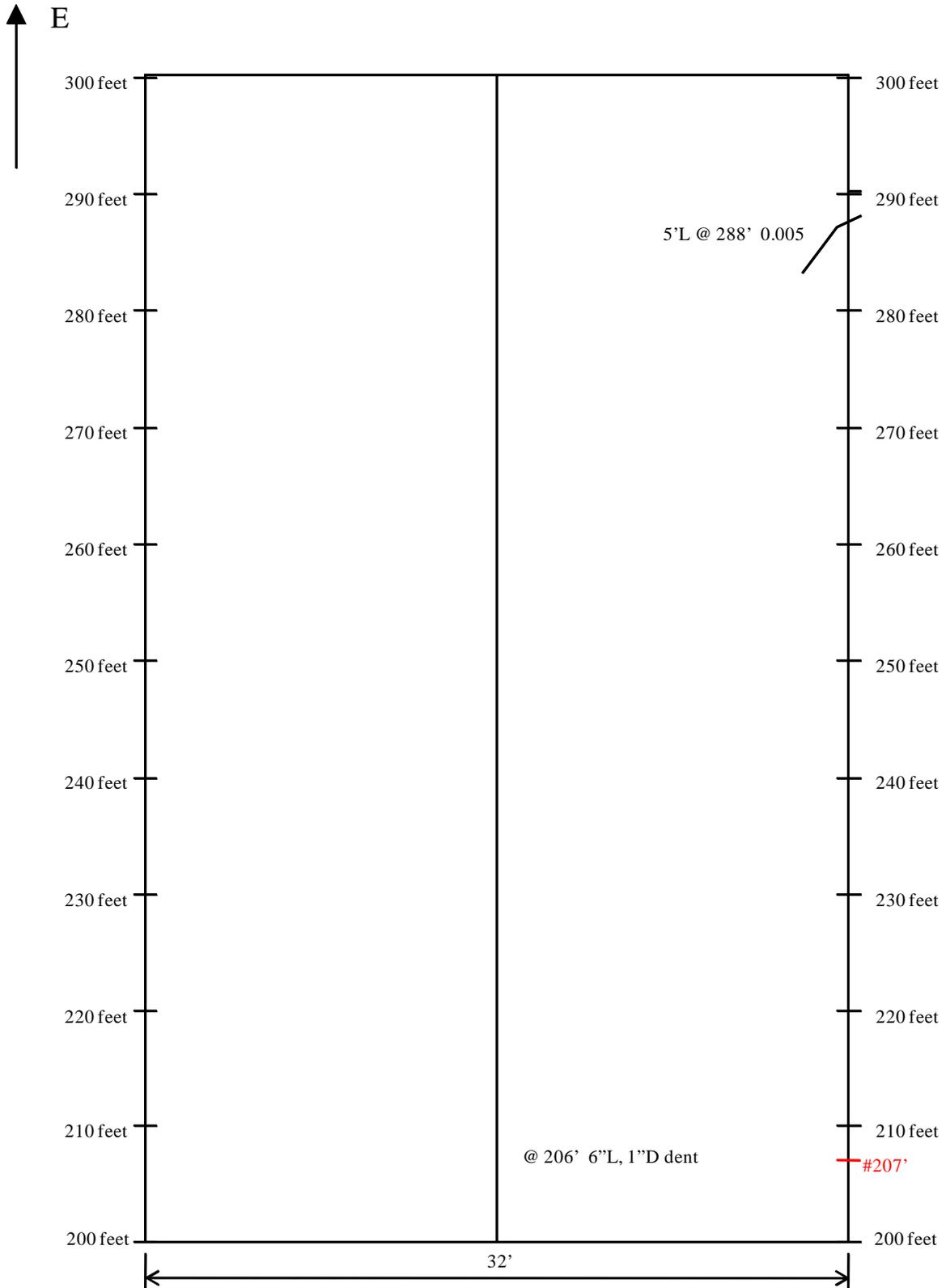


Fayette County – SN# 026-0034 – Surveyed 11/14/2002, 12/12/2002

# US 40 & 51 over Kaskaskia River



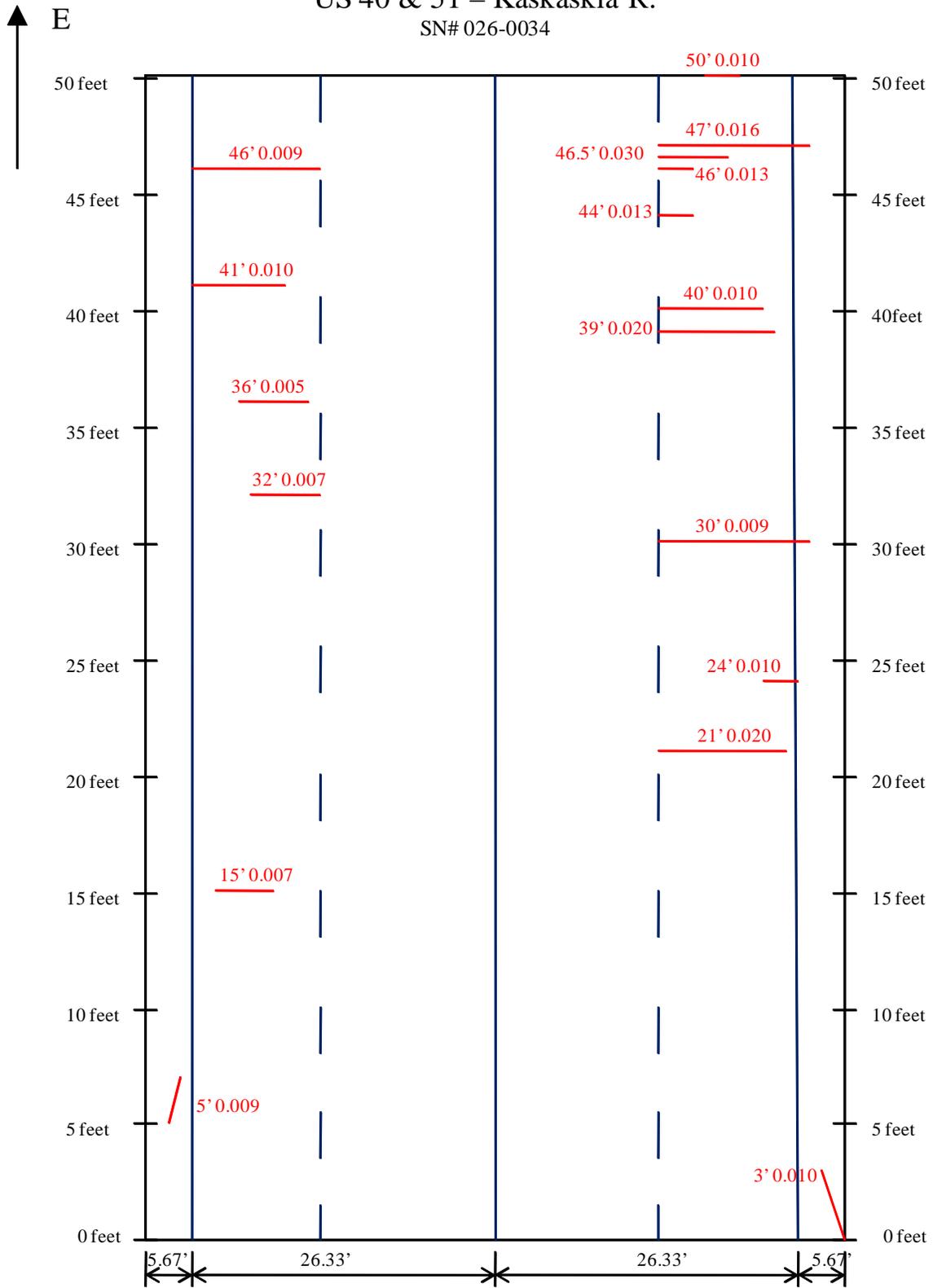
# US 40 & 51 over Kaskaskia River



Fayette County – SN# 026-0034 – Surveyed 11/14/2002, 12/12/2002

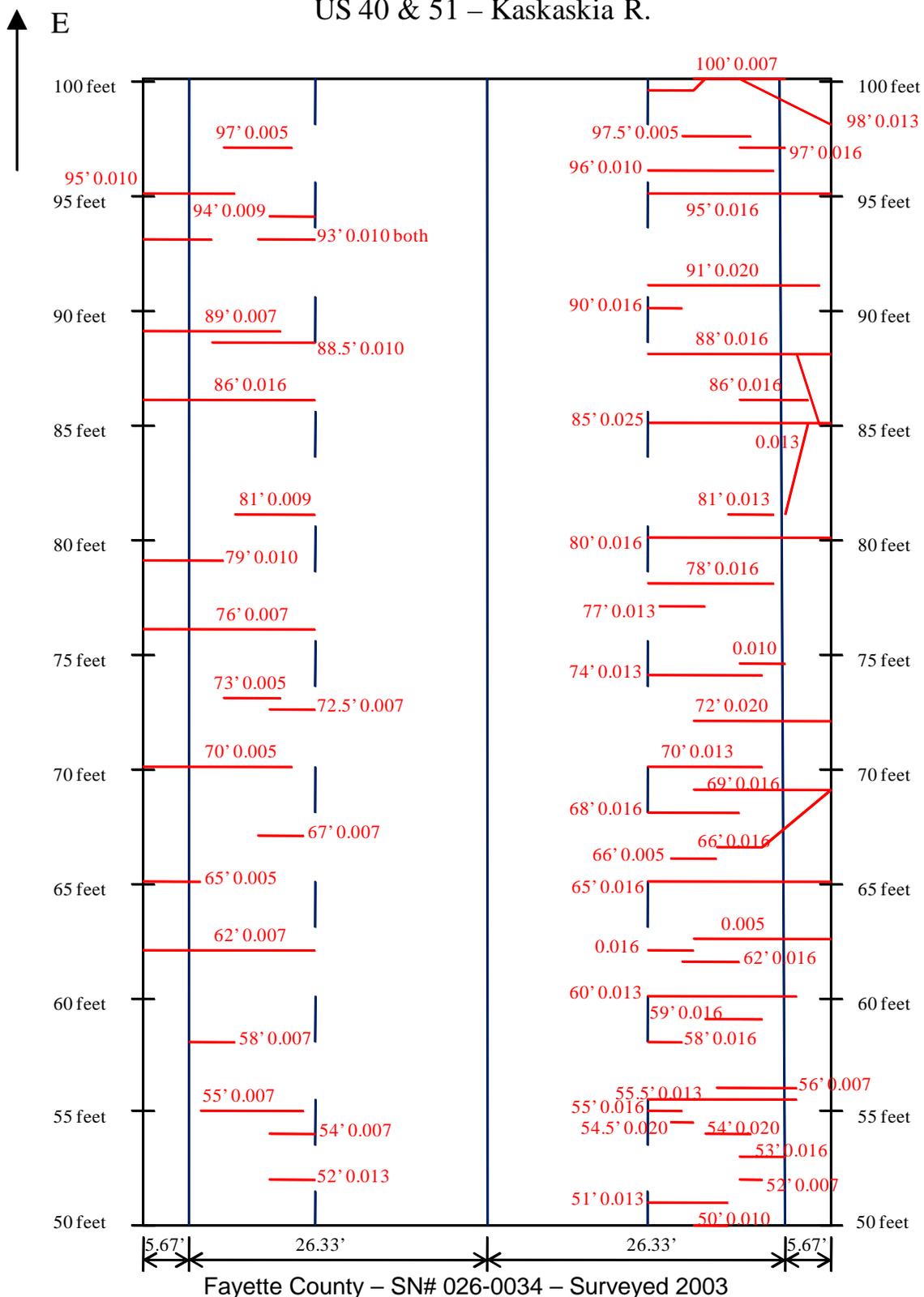


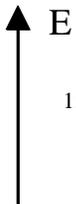
US 40 & 51 – Kaskaskia R.  
SN# 026-0034



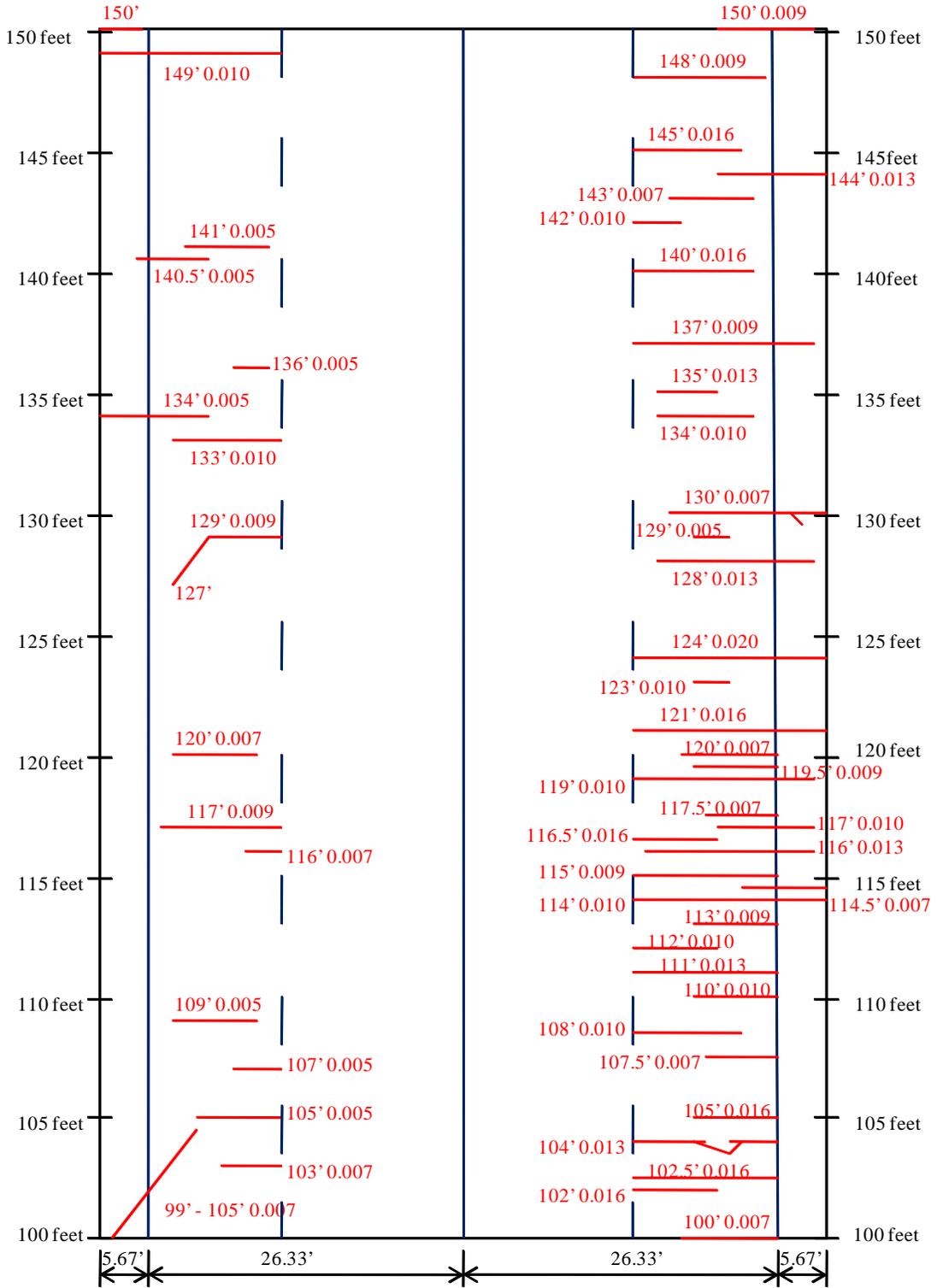
Fayette County – SN# 026-0034 – Surveyed 2003

# US 40 & 51 – Kaskaskia R.

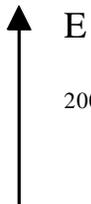




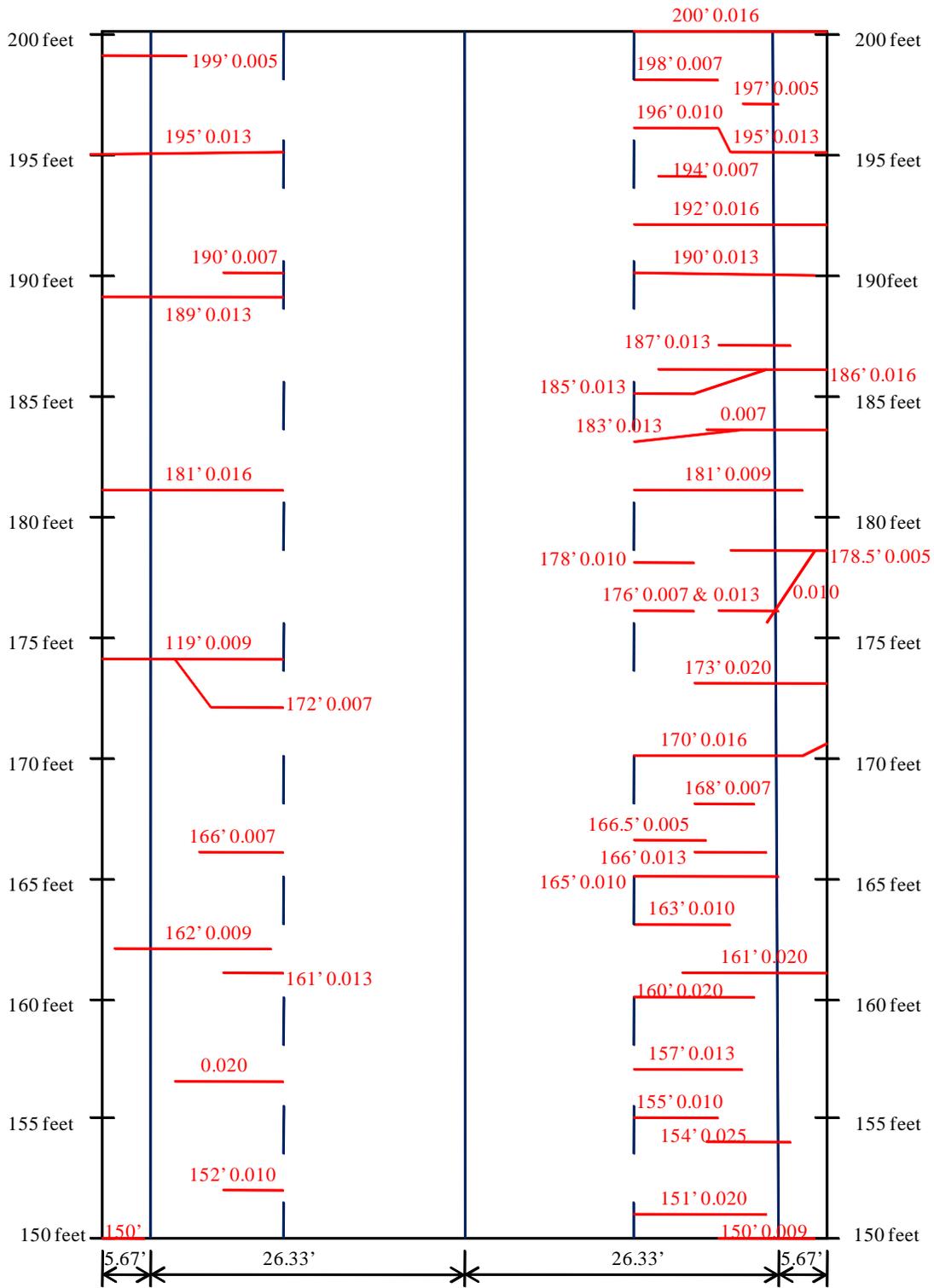
# US 40 & 51 – Kaskaskia R.



Fayette County – SN# 026-0034 – Surveyed 2003



# US 40 & 51 – Kaskaskia R.

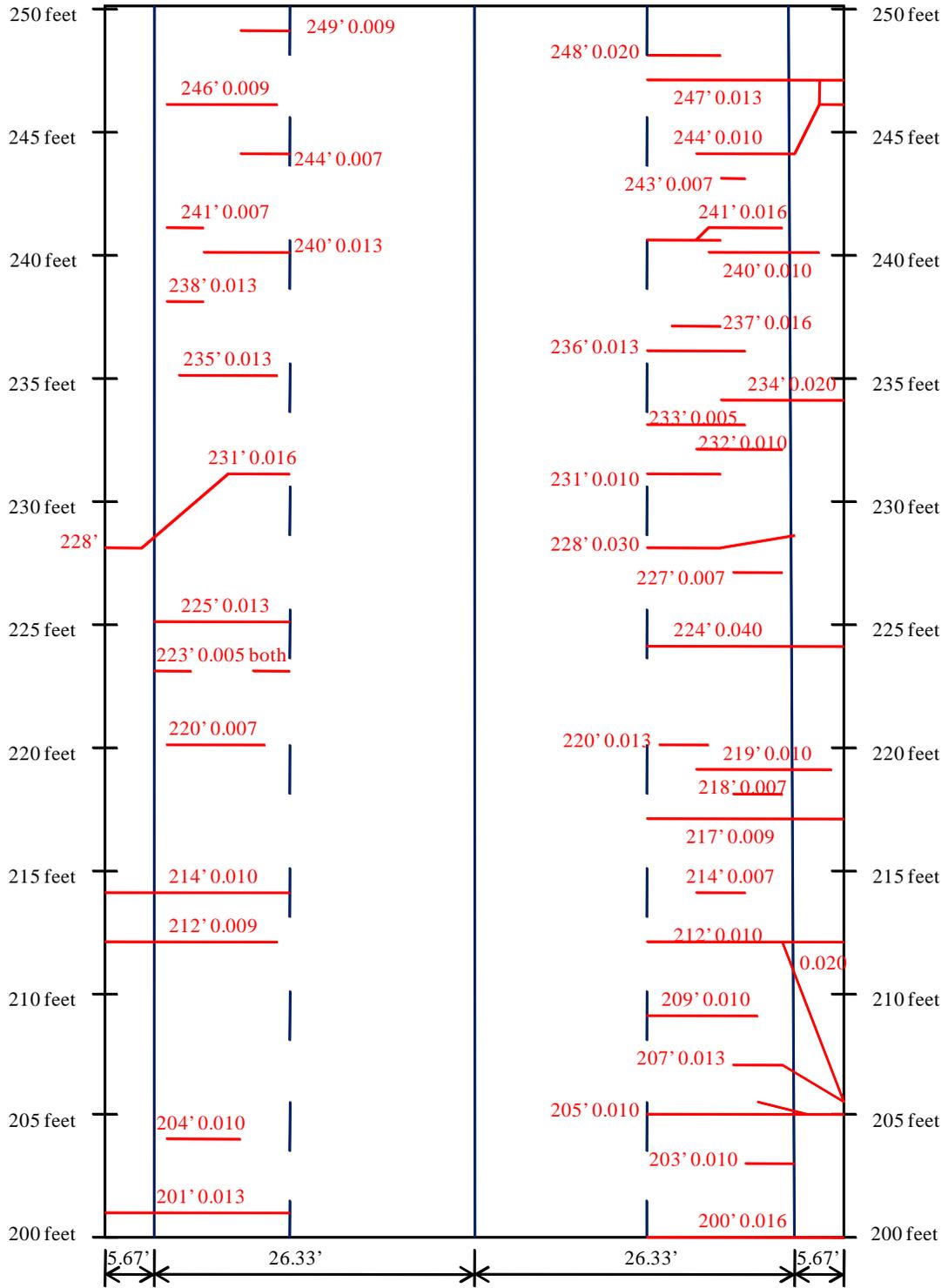


Fayette County - -SN# 026-0034 – Surveyed 2003



E

# US 40 & 51 – Kaskaskia R.

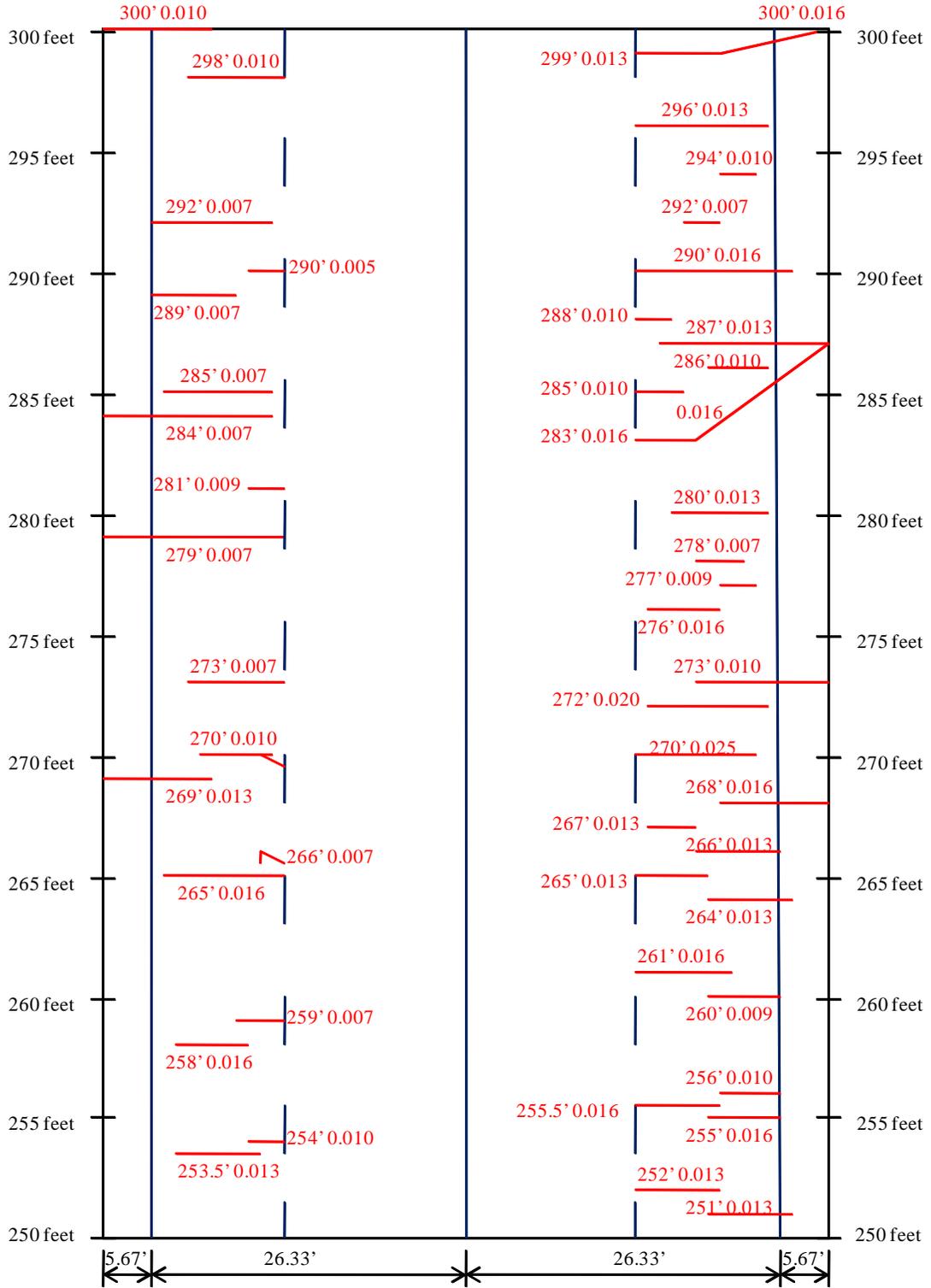


Fayette County – SN# 026-0034 – Surveyed 2003



E

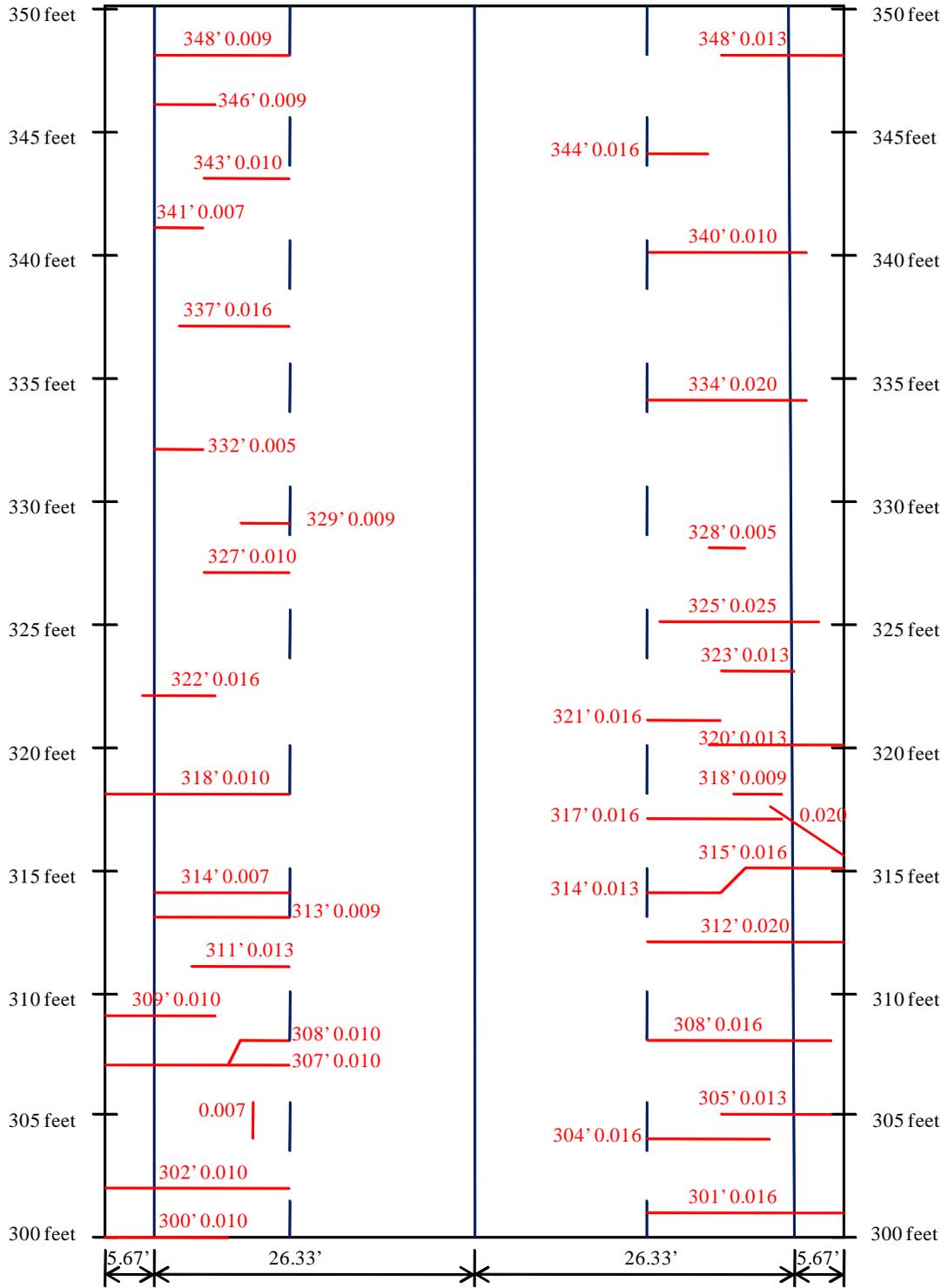
# US 40 & 51 – Kaskaskia R.



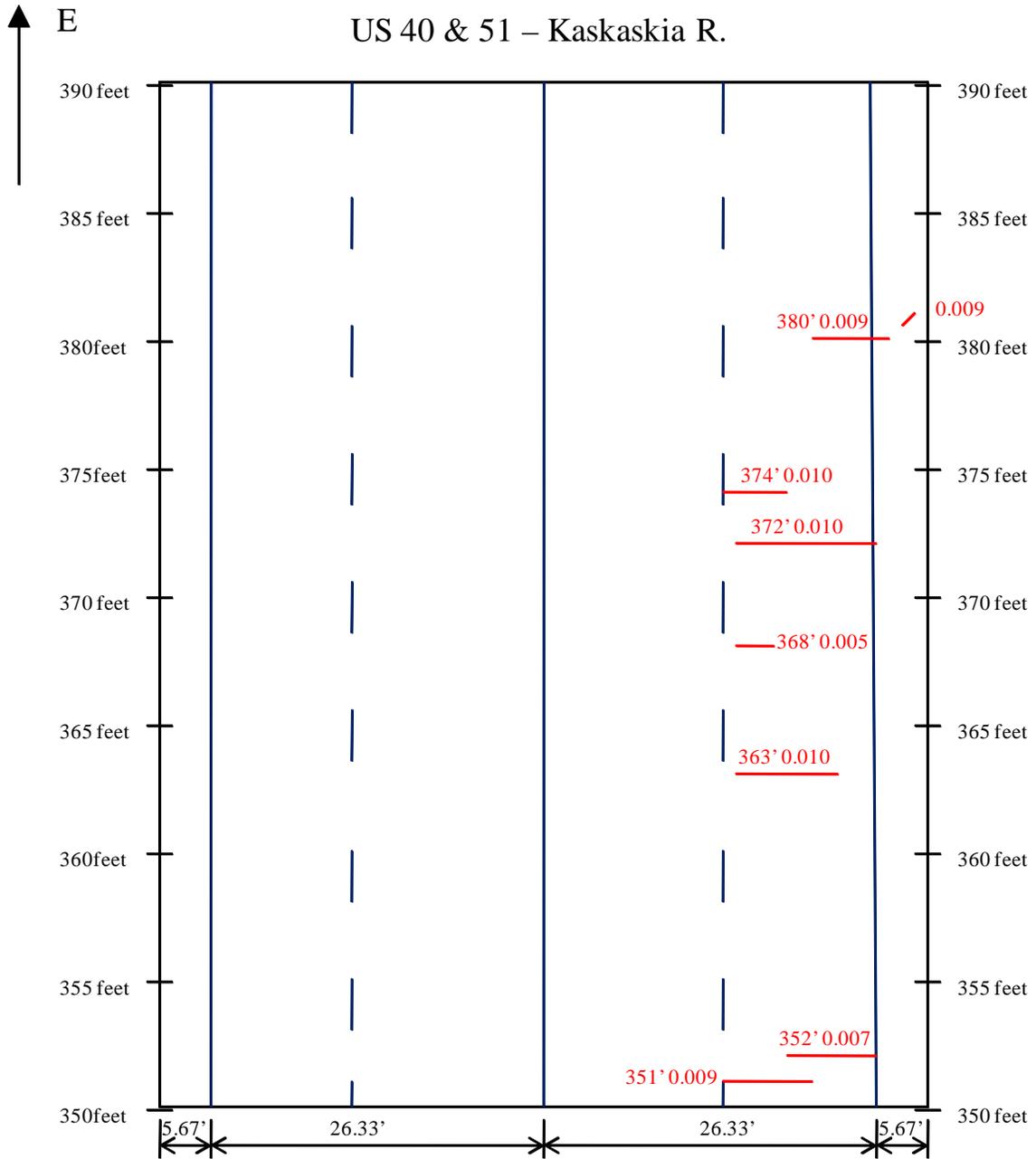
Fayette County – SN# 026-0034 – Surveyed 2003

E

# US 40 & 51 – Kaskaskia R.



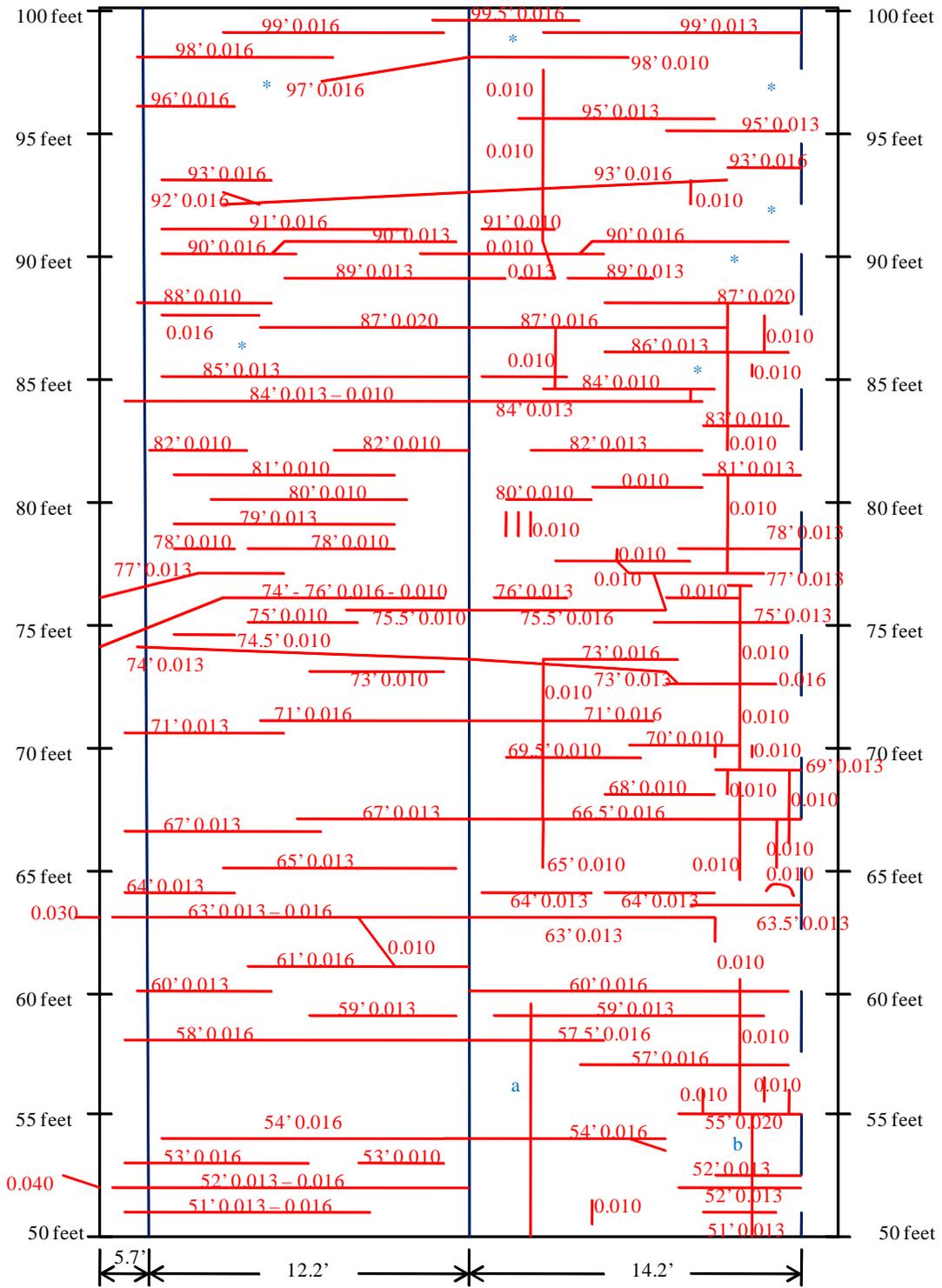
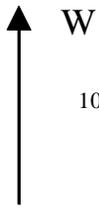
Fayette County – SN# 026-0034 – Surveyed 2003



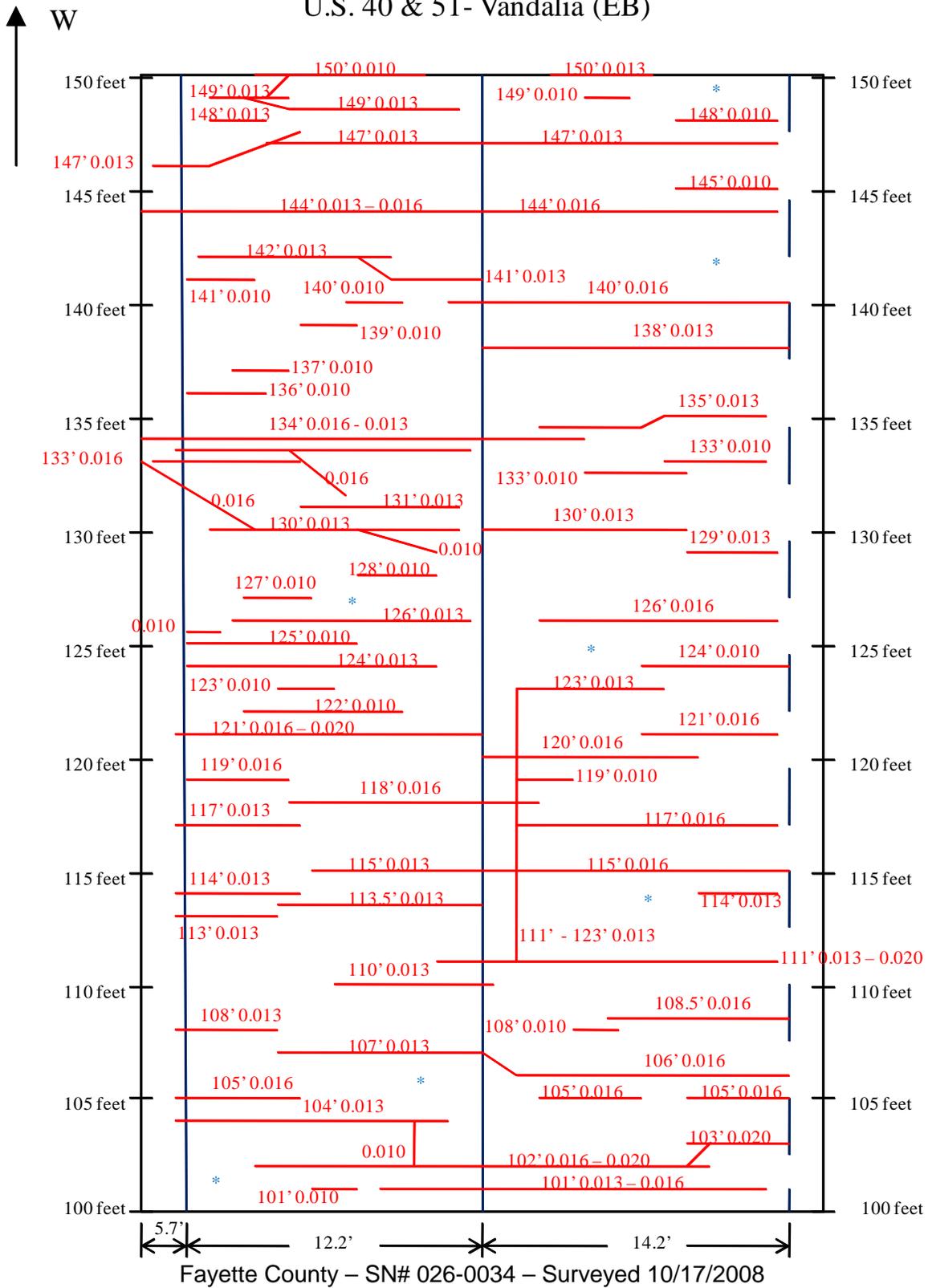
Only the driving lanes of this bridge deck were surveyed because of time constraints and traffic safety concerns. Numerous cracks extended from the driving lanes into the passing lanes.



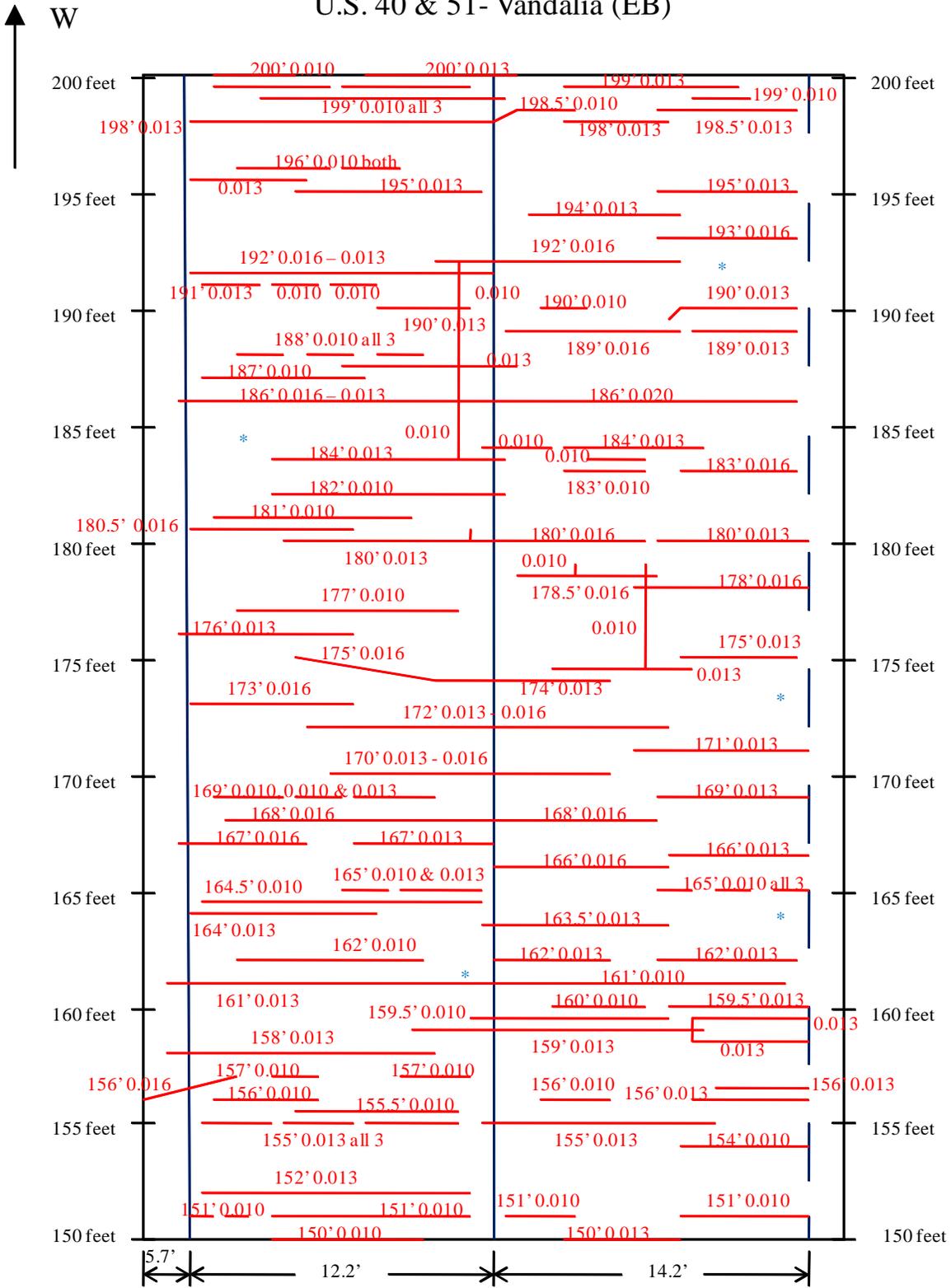
# U.S. 40 & 51- Vandalia (EB)



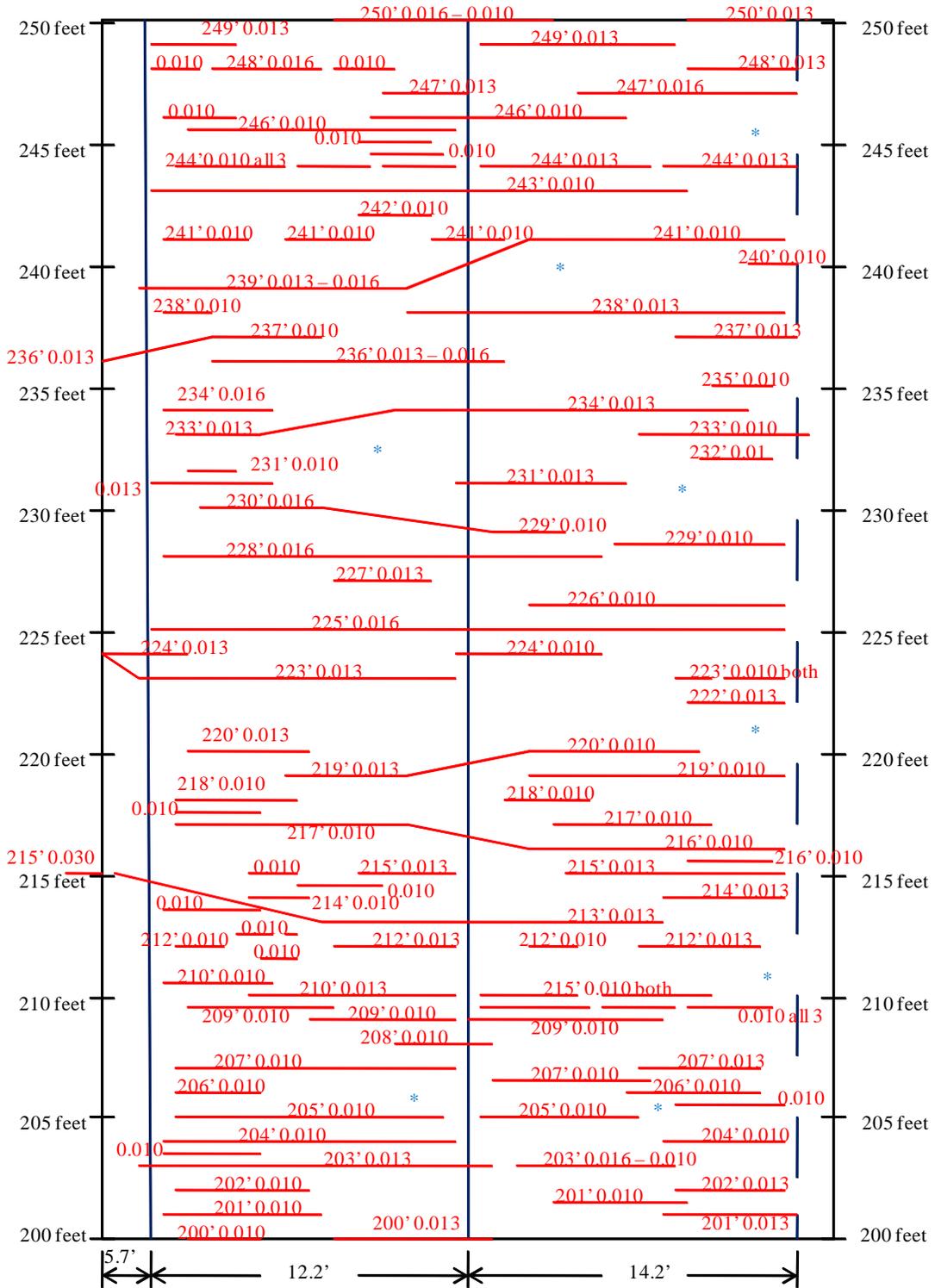
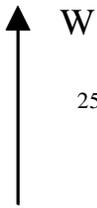
# U.S. 40 & 51- Vandalia (EB)



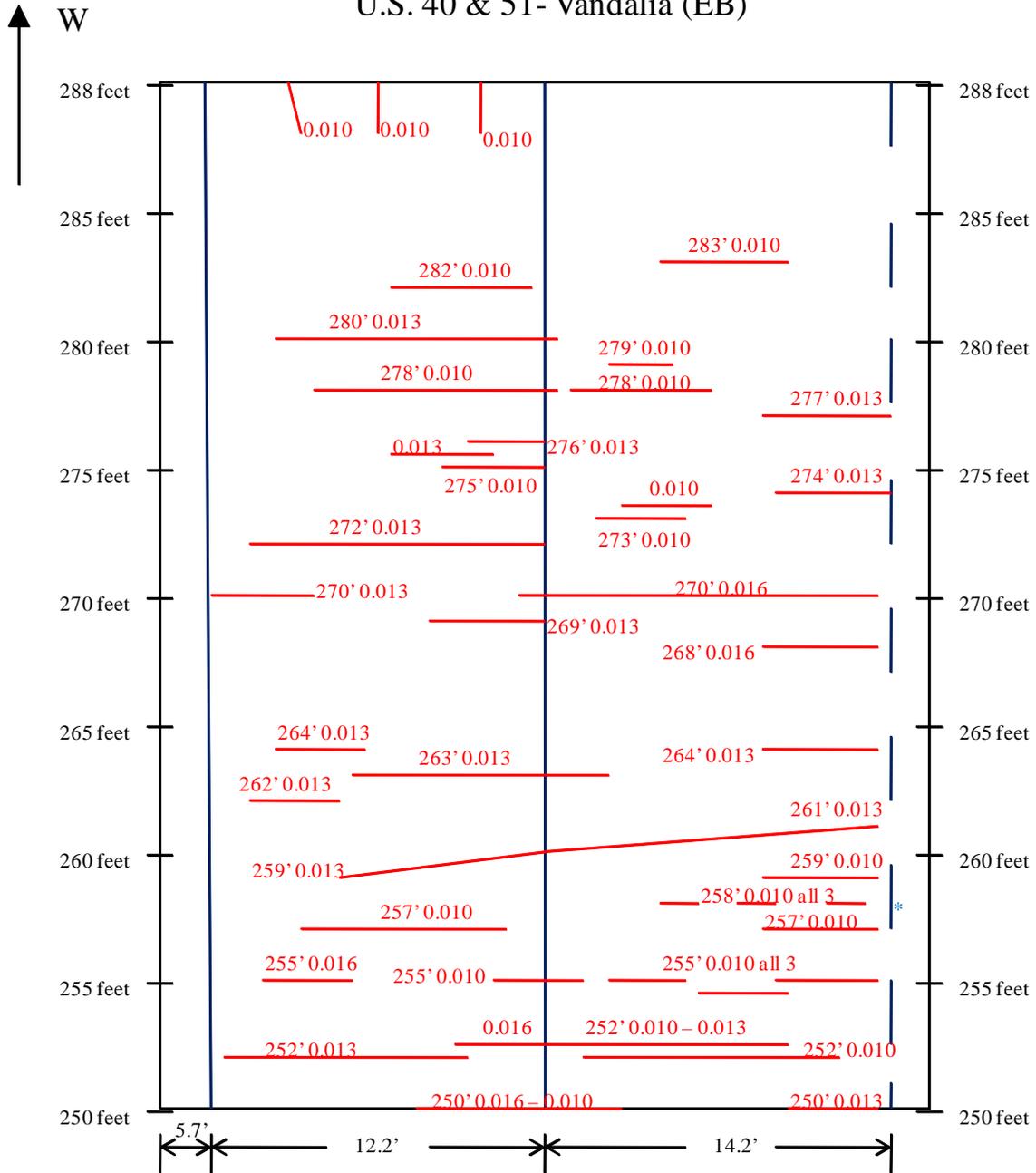
# U.S. 40 & 51- Vandalia (EB)



# U.S. 40 & 51- Vandalia (EB)



## U.S. 40 & 51- Vandalia (EB)



Fayette County – SN# 026-0034 – Surveyed 10/17/2008

The survey did not cover the entire deck because of time constraints.

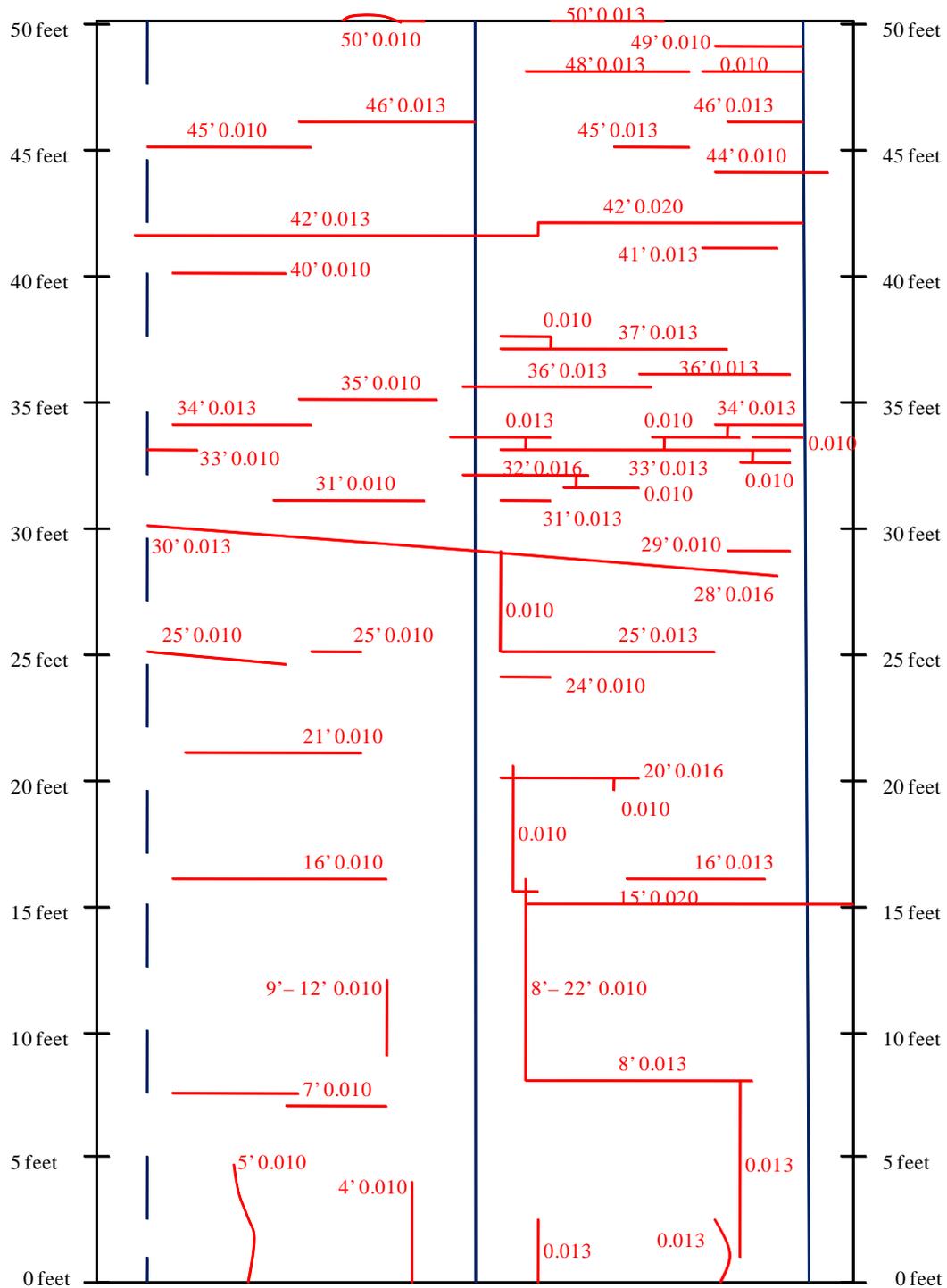
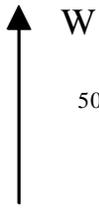
Maintaining traffic safety and minimizing traffic disruptions became more challenging as the survey progressed.

Areas of longitudinal cracking: a= 49' - 59' 0.010, b= 48' - 55' 0.010, c= 46' - 48' 0.010, d= 43' - 48.5' 0.010, e= 42.5' - 45' 0.010, f= 42.5' - 43.5' 0.010

\* This symbol denotes areas of numerous hairline cracks located very close together. The measurements of the cracks were 0.010.

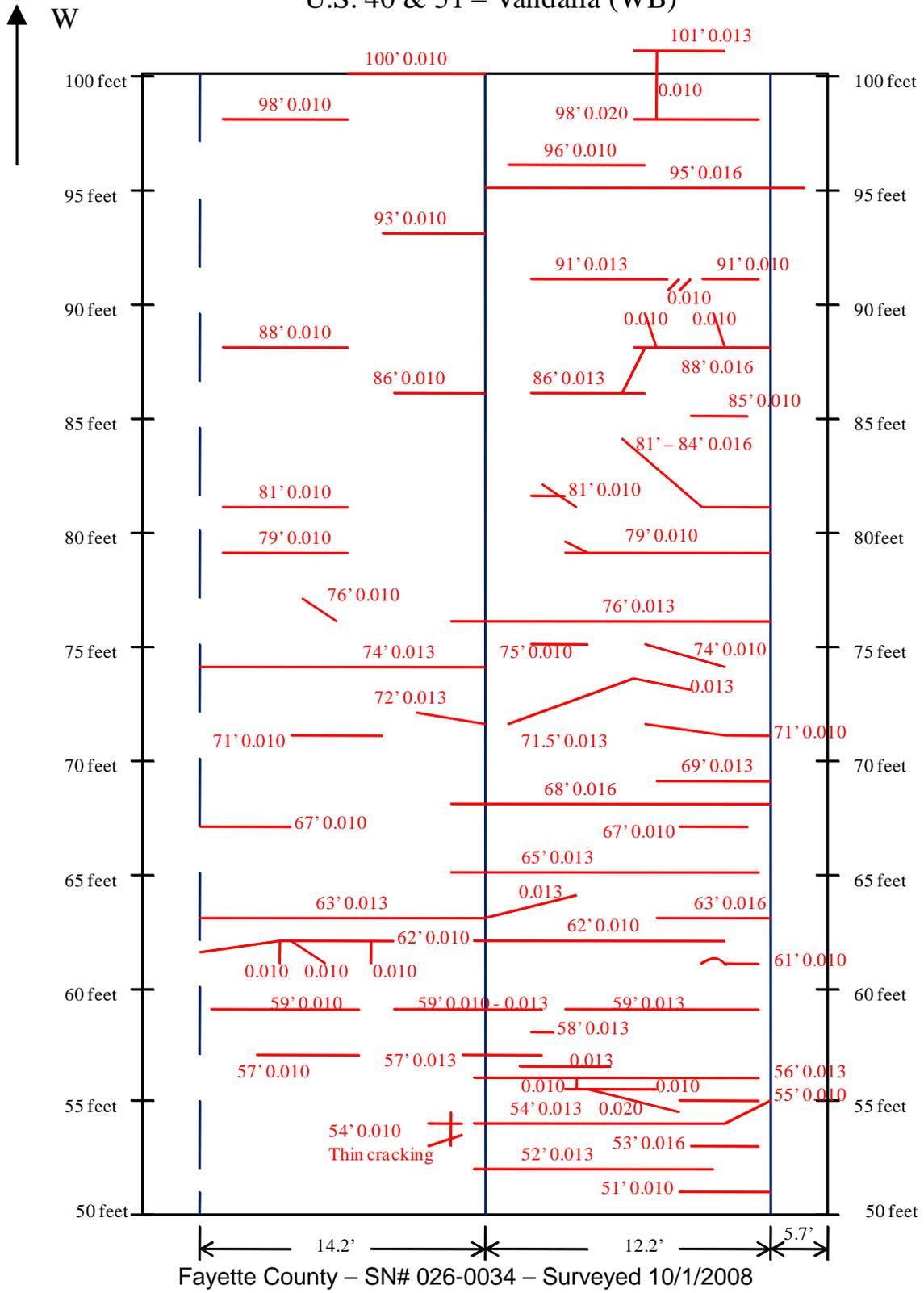
# U.S. 40 & 51- Vandalia (WB)

SN# 026-0034

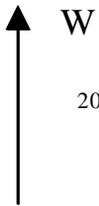


Fayette County – SN# 026-0034 – Surveyed 10/1/2008

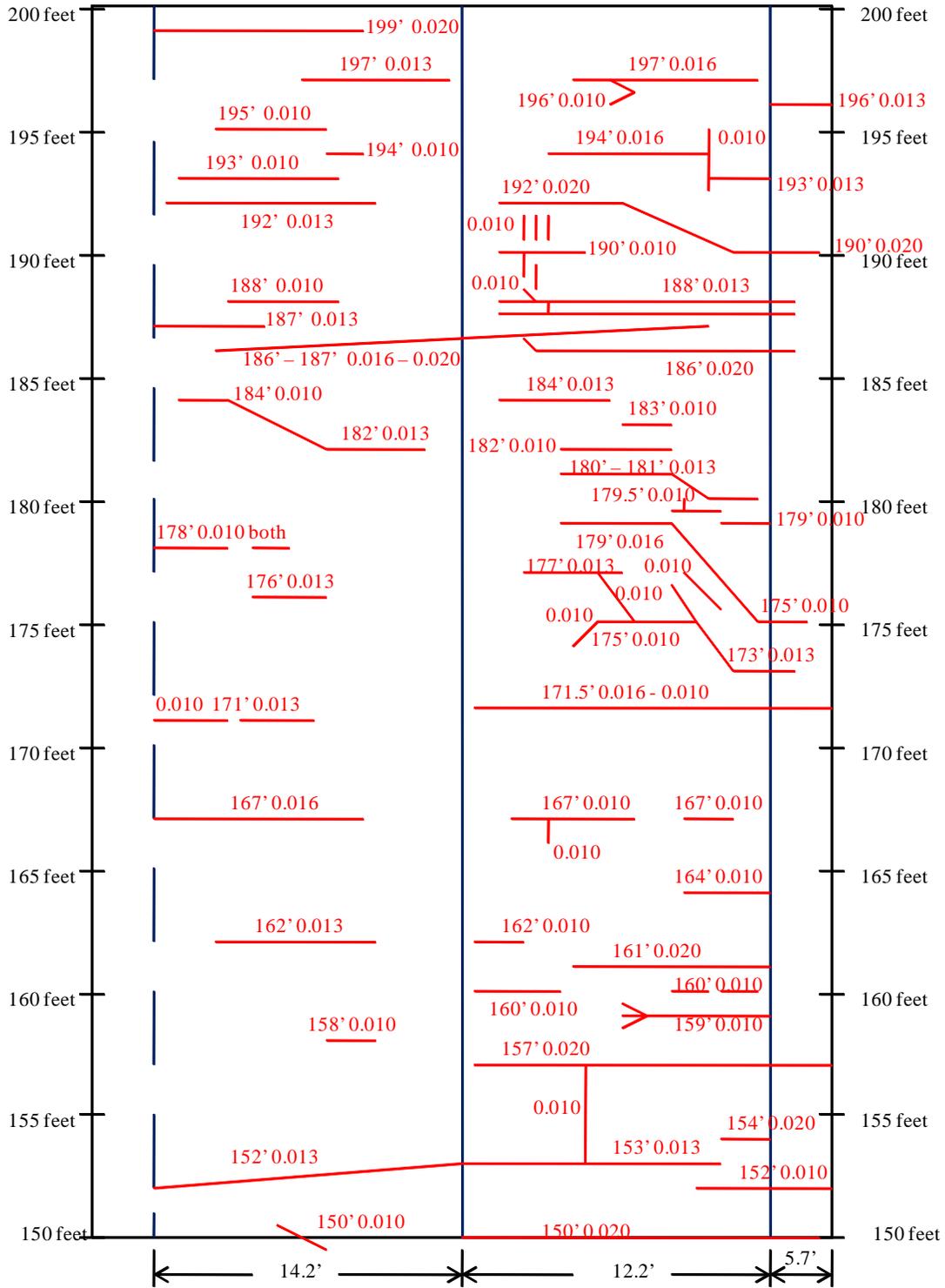
# U.S. 40 & 51 – Vandalia (WB)



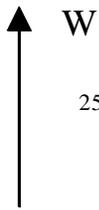




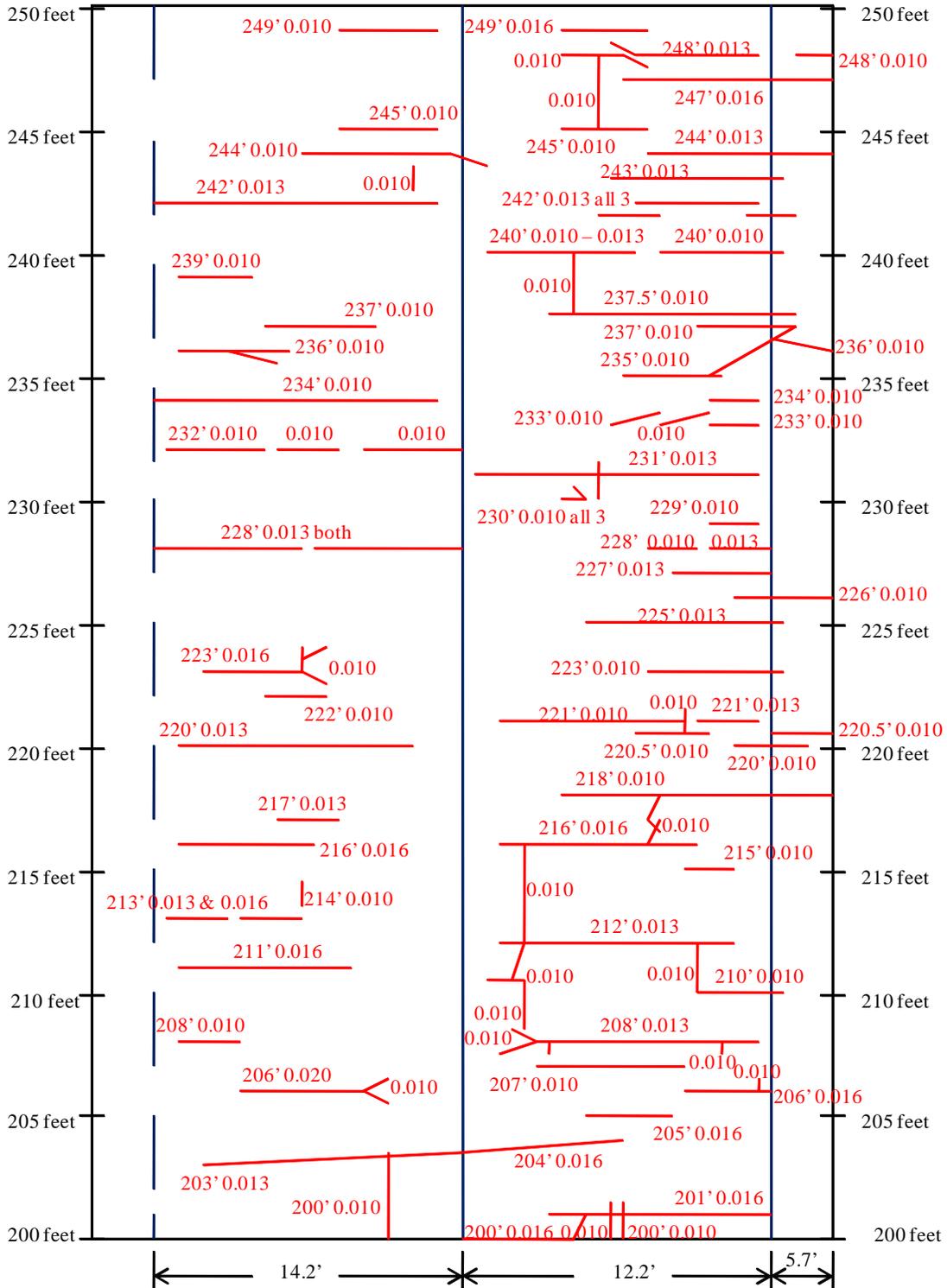
# U.S. 40 & 51 – Vandalia (WB)



Fayette County – SN# 026-0034 – Surveyed 10/1/2008

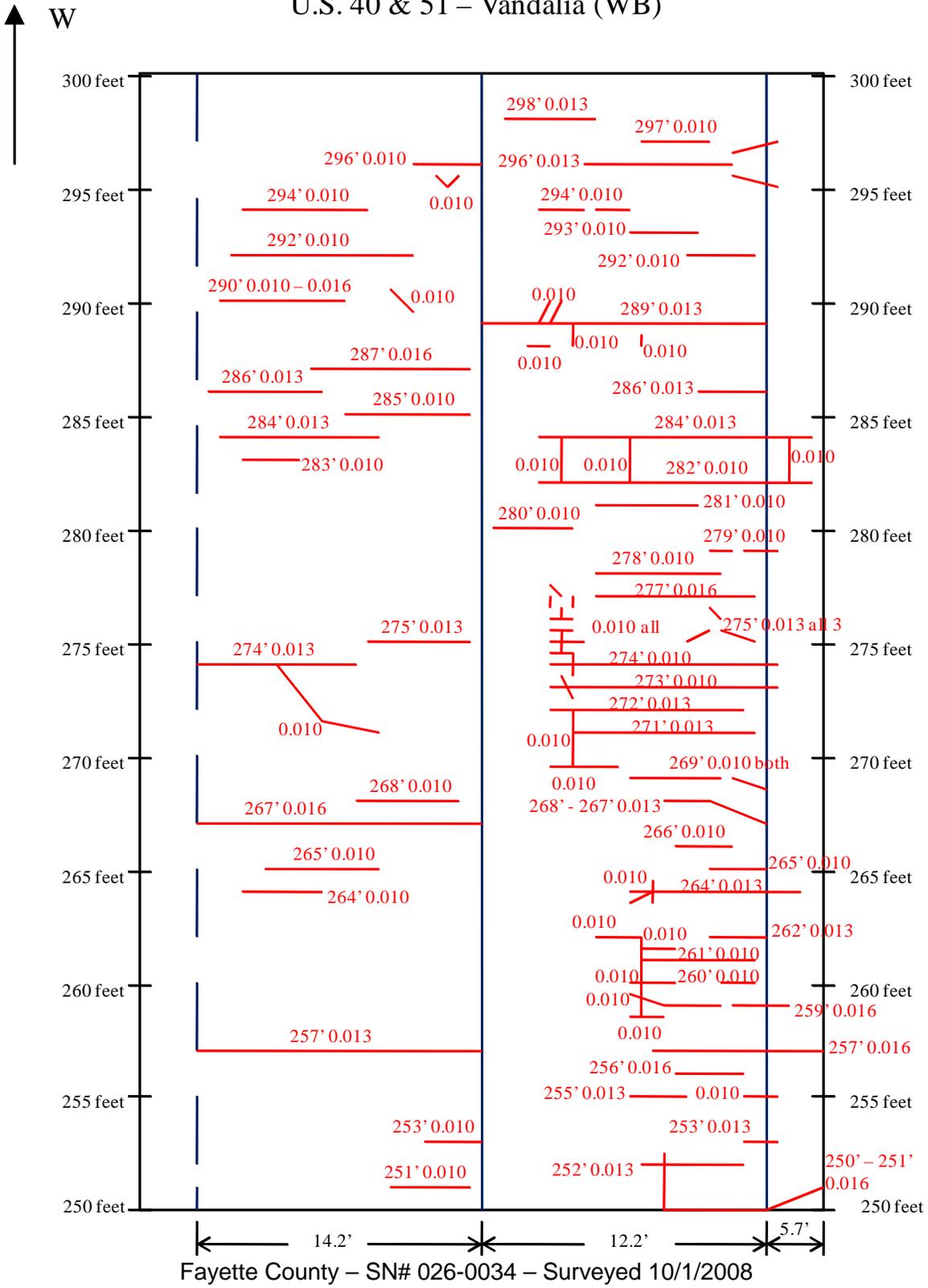


# U.S. 40 & 51 – Vandalia (WB)



Fayette County – SN# 026-0034 – Surveyed 10/1/2008

# U.S. 40 & 51 – Vandalia (WB)





Henderson County



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 036-0053

Responsible District: 4

Number of Spans: 3

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  Semi-Integral  Other

ADT @ time bridge was built: 2,350 (2007)

Skew:  Y  N Angle: \_\_\_\_\_

Inspected By: DAD, DHT, JAB, FHWA

Date Inspected: 6/29/09

Span Lengths See below Total: 68'0"

Deck Width: 40' 0"

Beam Spacing: 12'0"(interior), 8'0"(exterior)

Date of Beam Erection: 2002

Bridge Joint:  Integral  Finger  Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 2002 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: \_\_\_\_\_

Longitudinal Cracking: Longitudinal cracks with wide spacing were observed.

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span Lengths: 1 & 3) 19ft 9in., 2) 26ft 0in.

036-0053 is a slab bridge with the piers acting as the beams and the piers are widely spaced. Not as many cracks were observed with this deck because it was thicker than the other HPC bridge decks.

**Mix Design Information: (from MISTIC)**

Mix Design Number: 84PCCHPC1

Coarse Aggregate Source: Central Stone (CA 11)  Crushed Stone  Gravel

Coarse Aggregate Source: Central Stone (CA 16)  Crushed Stone  Gravel

Fine Aggregate Source: Spring Sand & Gravel Fine Aggregate Source: N/A

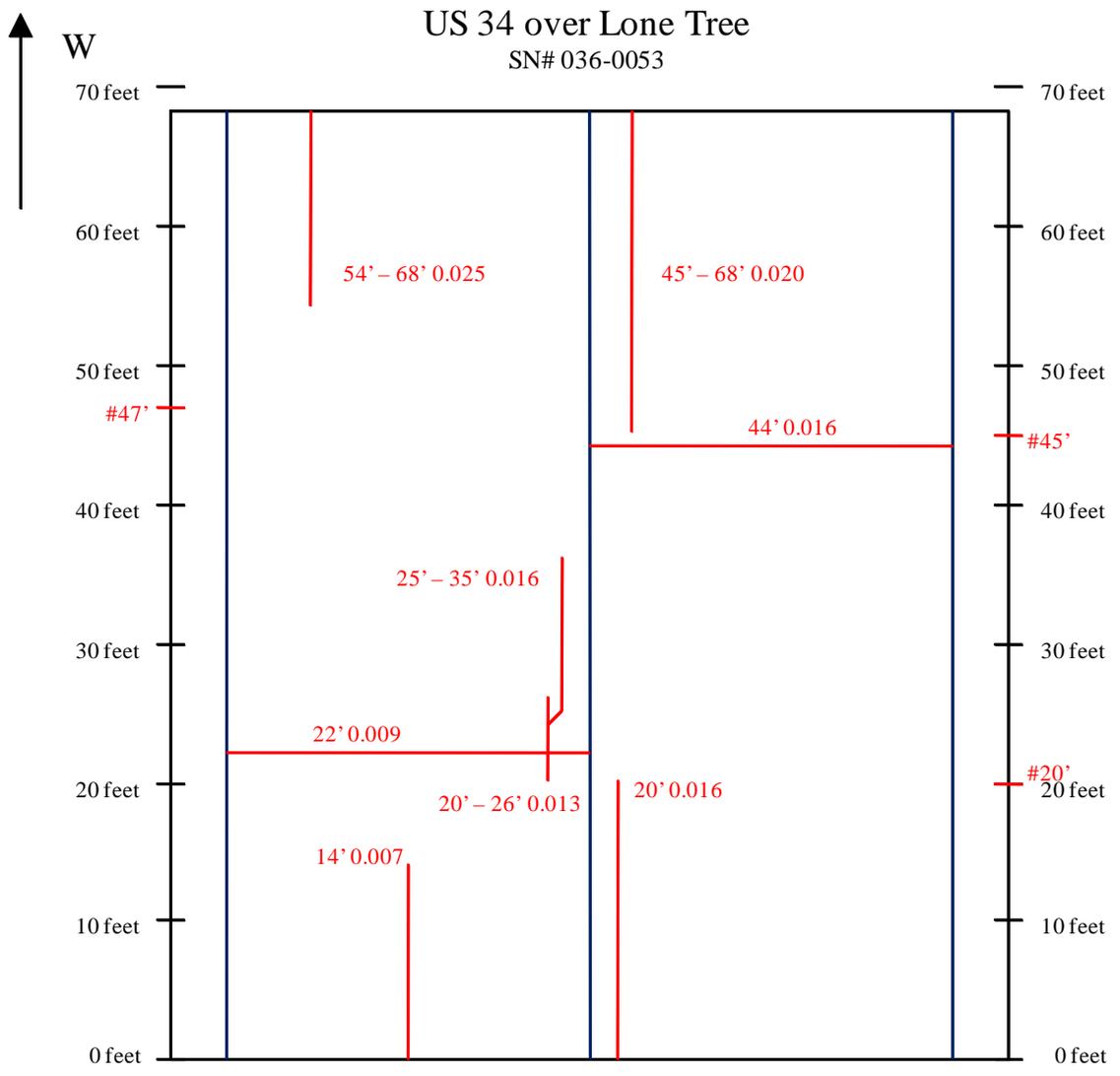
HRM Source: \_\_\_\_\_

Cement Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: ISG Resources, Inc.

Microsilica Source: Elkem Materials, Inc.



Henderson County – SN# 036-0053 – Surveyed 10/20/2003  
 The “#” symbol represents cracks in the parapet only.

Iroquois County



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 038-0207

Responsible District: 3

Number of Spans: 3

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  Semi-Integral  Other

ADT @ time bridge was built: 850 (2007)

Skew:  Y  N Angle: \_\_\_\_\_

Inspected By: DAD, SWL, JAB

Date Inspected: 10/12/11

Span Lengths 9.8m, 20.6m, 9.8m Total: 40.2 m

Deck Width: 9.6m

Beam Spacing: 1.76 m (5 spaces)

Date of Beam Erection: 2000

Bridge Joint:  Integral  Finger  Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 2000 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: Underneath, one crack in corner at east end with nine short transverse cracks. At west end, west span, one crack transverse across bridge. On top, cracks at 3'-4' spacing at west end.

Longitudinal Cracking: On top, two short, tight cracks in westbound lanes. No cracks observed on bottom.

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Mix Design Information: (from MISTIC)**

Mix Design Number: 83PCC2850

Coarse Aggregate Source: Vulcan Materials  Crushed Stone  Gravel

Coarse Aggregate Source: \_\_\_\_\_  Crushed Stone  Gravel

Fine Aggregate Source: Carri Scharf Material Co. Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

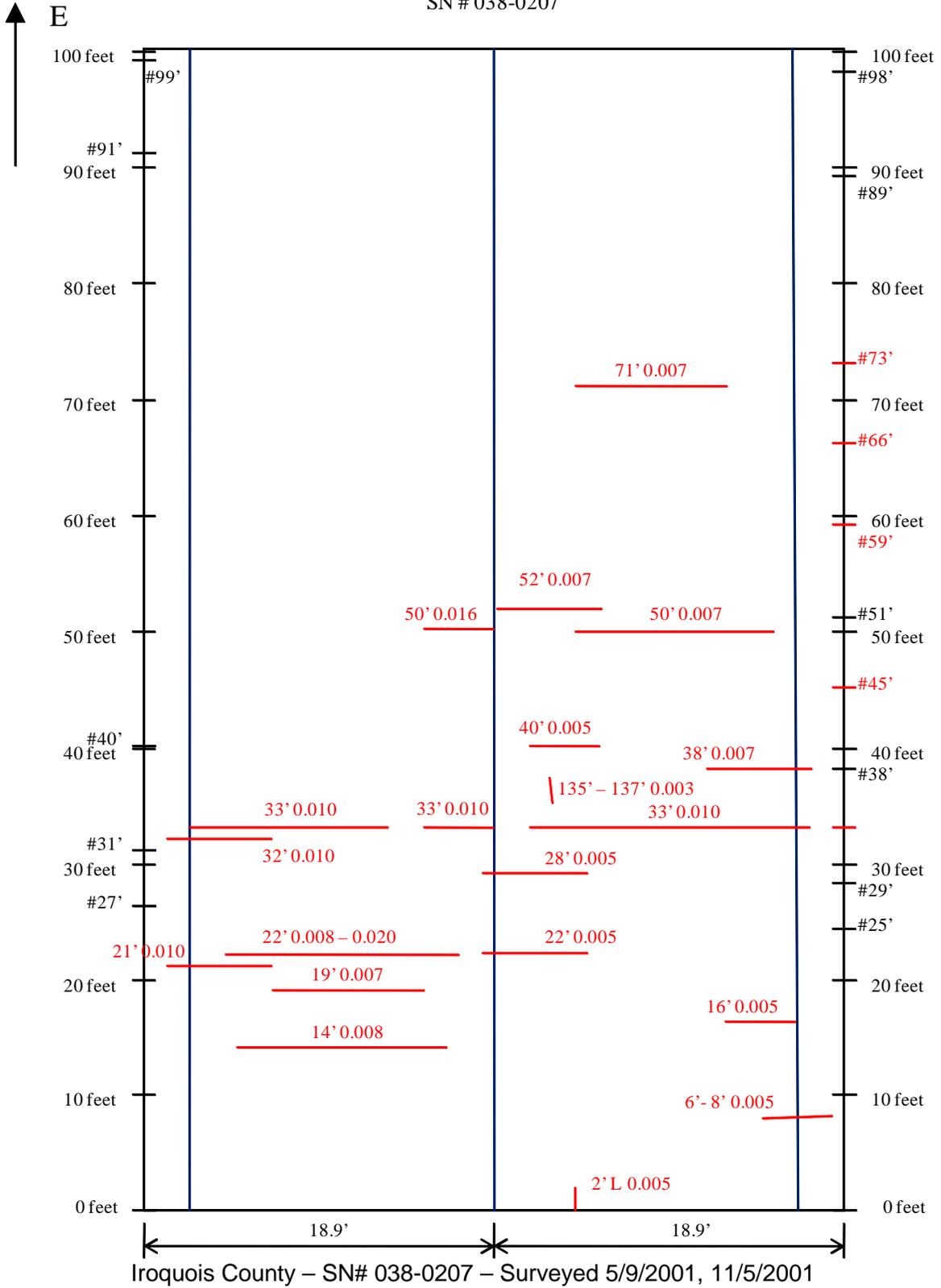
Cement Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

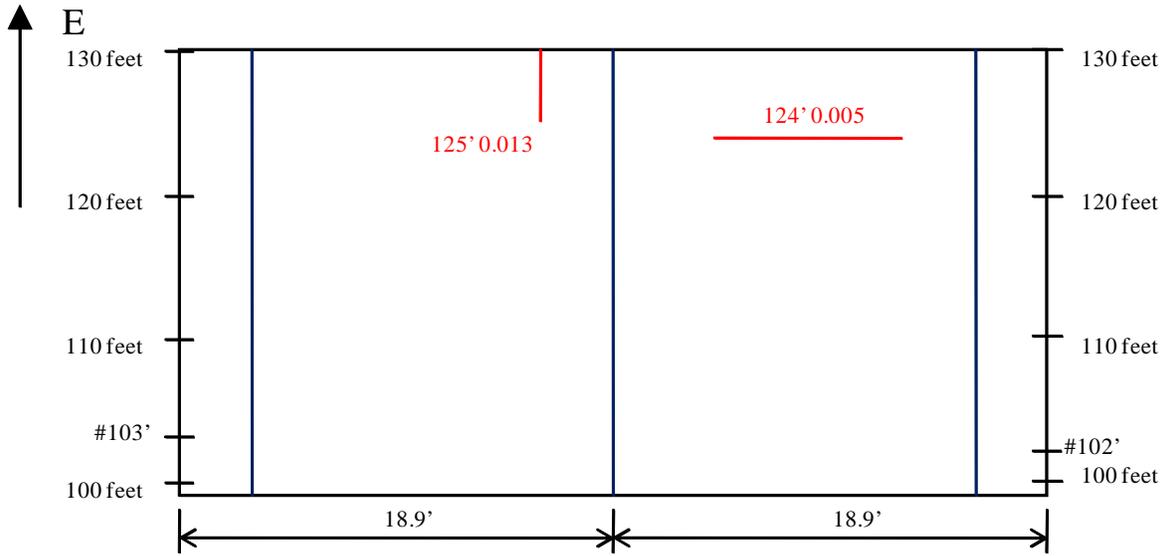
Fly Ash Source: Mineral Resource Tech.

Microsilica Source: Elkem Materials Inc.

Rte 54 Thawville  
SN # 038-0207



# Rte 54 Thawville

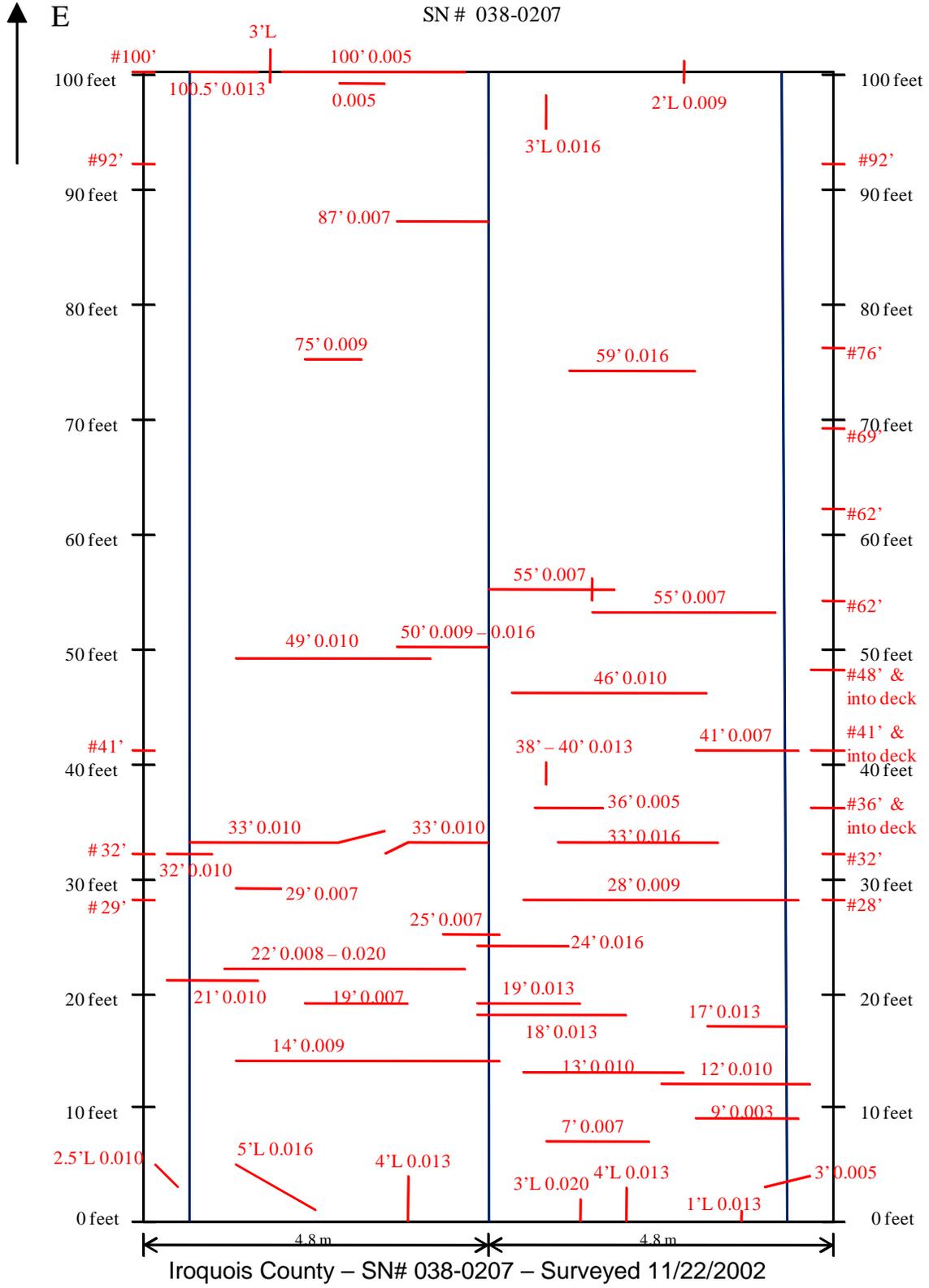


Iroquois County – SN# 038-0207 – Surveyed 5/9/2001, 11/5/2001

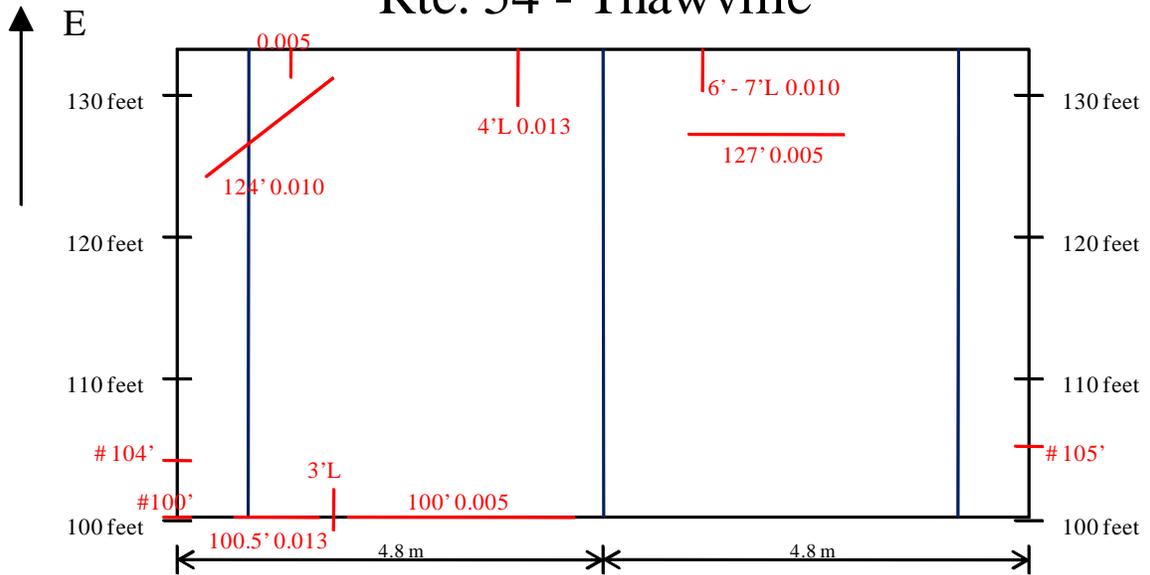
Deck poured on November 03, 2000. The initial survey of this structure showed little to no cracking.

The “#” symbol represents cracks in the parapet only.

Thawville - Rte. 54  
SN # 038-0207



# Rte. 54 - Thawville

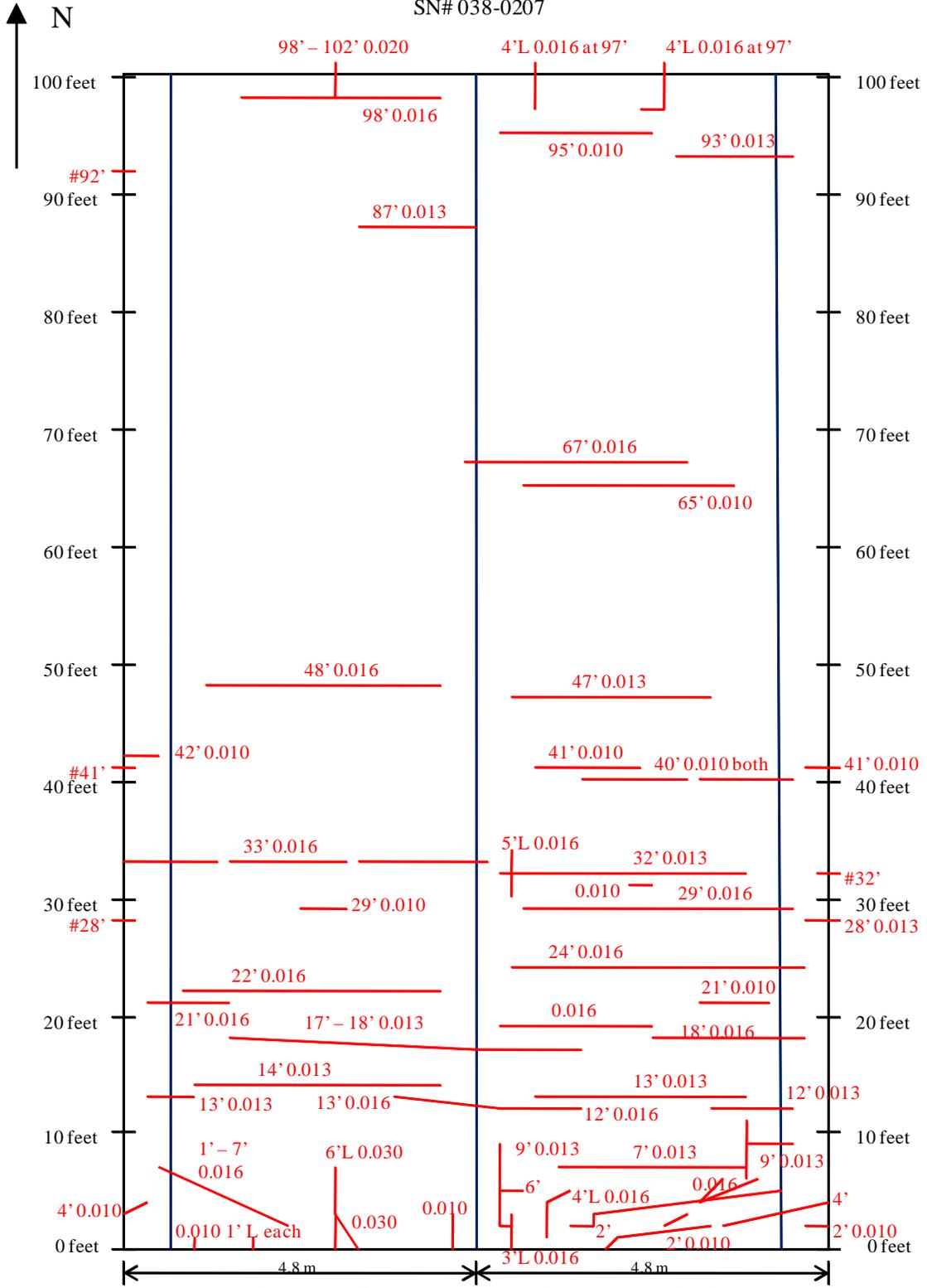


Iroquois County – SN# 038-0207 – Surveyed 11/22/2002

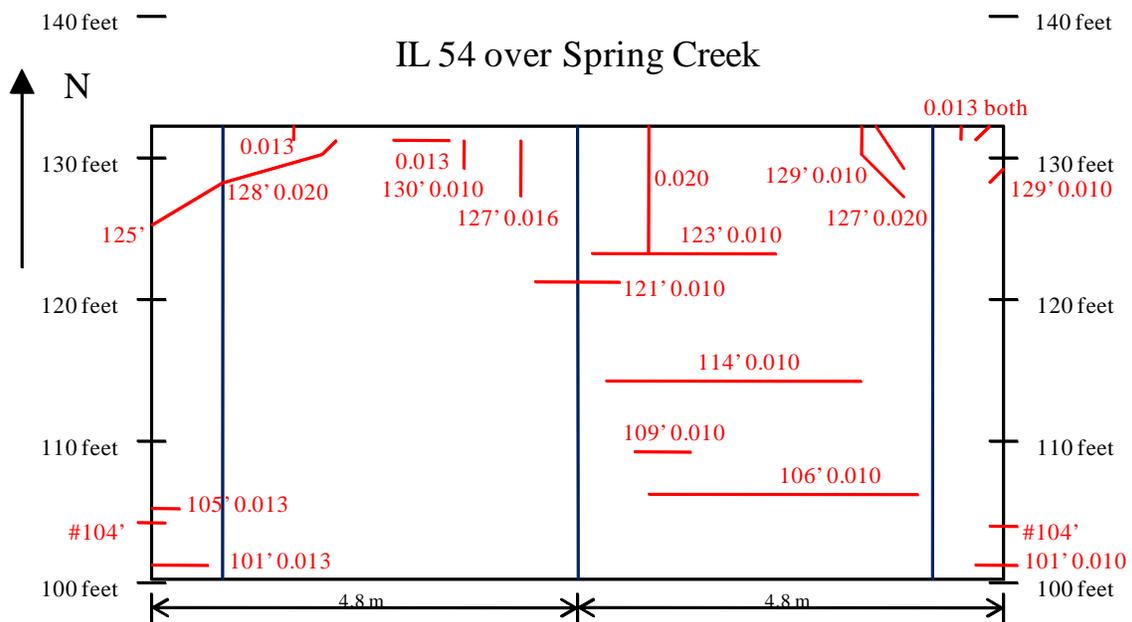
The “#” symbol represents cracks in the parapet only unless otherwise specified.

# IL 54 over Spring Creek

SN# 038-0207



Iroquois County – SN# 038-0207 – Surveyed 10/28/2005



Iroquois County – SN# 038-0207 – Surveyed 10/28/2005  
 The “#” symbol represents cracks in the parapet only.



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 038-0210

Responsible District: 3

Number of Spans: 3

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

ADT @ time bridge was built: 2,100 (2007)

Skew:  Y  N Angle: 10°

Inspected By: DAD, SWL, JAB

Date Inspected: 10/12/11

Span Lengths See below Total: 99ft8½in

Deck Width: 32ft0in.

Beam Spacing: 5'10"

Date of Beam Erection: 2002

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 2002 Stage 2, 2002

**Description of Cracking:**

Average Transverse Crack Distance: Underneath, the spacing varied from 5'-20'. On top, the southbound lane was more cracked than the northbound-at ends, 3'-4' spacing and 5'-6' spacing in middle.

Longitudinal Cracking: Southbound-one longitudinal crack the entire length of bridge with shorter cracks extending from the bridge approaches. Northbound-one longitudinal crack extending from the north bridge approach.

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span Lengths: 1 & 3) 32ft 7in., 2) 32ft 0in.

**Mix Design Information: (from MISTIC)**

Mix Design Number: 83PCC3062

Coarse Aggregate Source: Vulcan Materials  Crushed Stone  Gravel

Coarse Aggregate Source: \_\_\_\_\_  Crushed Stone  Gravel

Fine Aggregate Source: Carri Scharf Material Co. Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

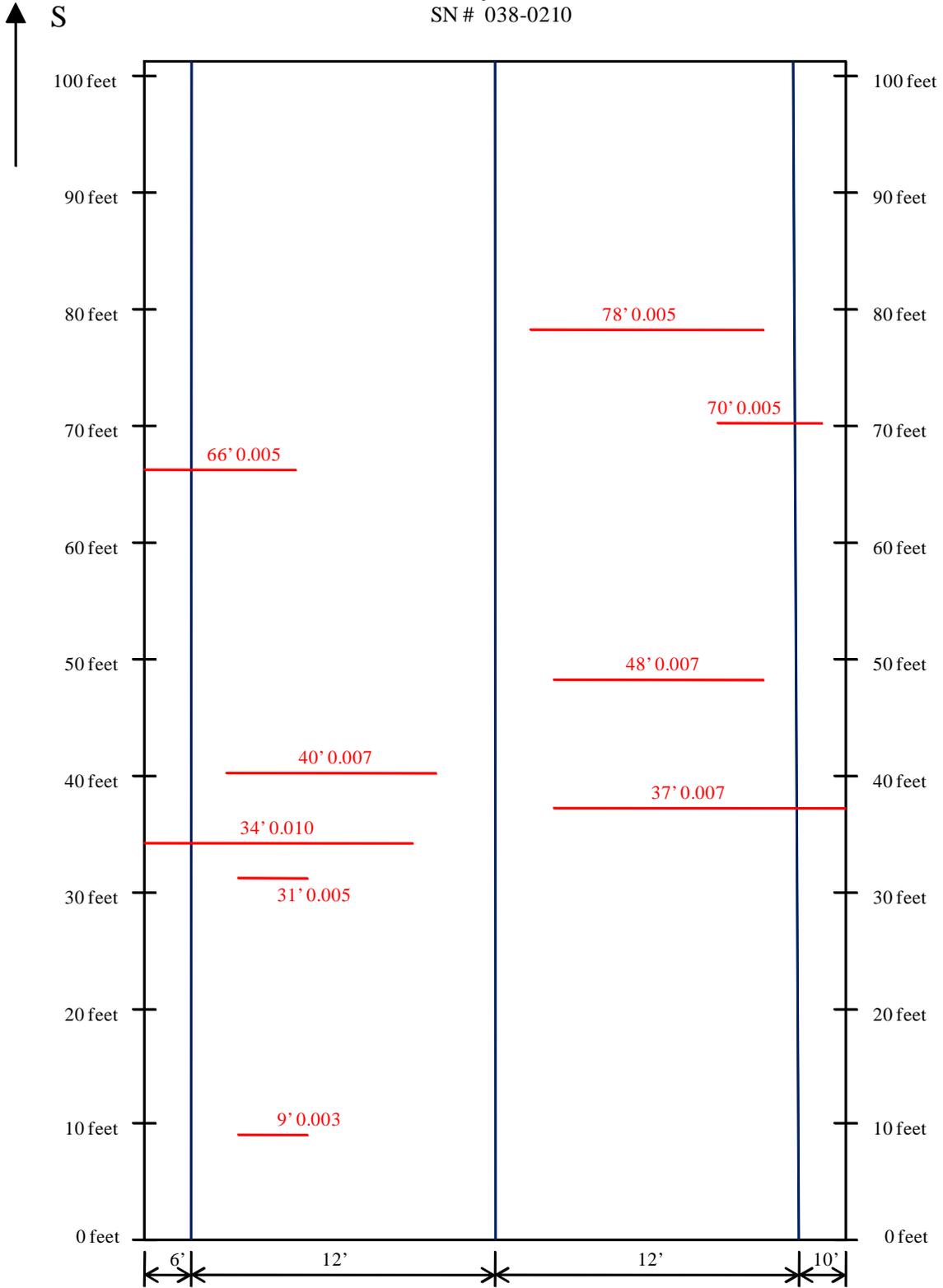
Cement Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: Lafarge N. America

Microsilica Source: Elkem Materials Inc.

Del Ray – US 45  
SN # 038-0210



Iroquois County – SN# 038-0210 – Surveyed 11/22/2002



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 038-0118

Responsible District: 3

Number of Spans: 4

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

ADT @ time bridge was built: 2,100 (2007)

Skew:  Y  N Angle: 10°

Inspected By: DAD, SWL, JAB

Date Inspected: 10/12/11

Span Lengths See below Total: 284'6"

Deck Width: 32ft0in.

Beam Spacing: 5'10"

Date of Beam Erection: 2002

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 2002 Stage 2, 2002

**Description of Cracking:**

Average Transverse Crack Distance: On top, both north and southbound lanes-cracks spaced at 3'-6' on north end, ~2' in middle, and 2'-3' on south end. Underneath, both north and south ends, cracks at 10'-20' spacing.

Longitudinal Cracking: On top, none in northbound lanes. In southbound, a longitudinal crack connected transverse cracking. Underneath, none seen.

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span lengths: 1) 61ft 9in., 2) 78ft 7½in., 3) 78ft 4¾in., 4) 62ft 0¾in.

**Mix Design Information: (from MISTIC)**

Mix Design Number: 83PCC3044

Coarse Aggregate Source: Prairie Material  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: Urban Gravel Co. Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

Cement Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: \_\_\_\_\_

Microsilica Source: Elkem Materials Inc.

Macon County



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 058-0125

Responsible District: 5

Number of Spans: 1

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  Semi-Integral  Other

ADT @ time bridge was built: 9,500 (2007)

Skew:  Y  N Angle: 18°

Inspected By: DAD, DHT, JAB

Date Inspected: 7/22/09

Span Lengths 24.38m Total: 24.4m

Deck Width: 12.0m

Beam Spacing: 2.22m

Date of Beam Erection: 2000

Bridge Joint:  Integral  Finger  Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 2000 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: Some transverse cracking about 4' – 6' apart was observed under the deck but it was less noticeable near the abutments.

Longitudinal Cracking: \_\_\_\_\_

Bridge Joint Cracking / Integral Abutment Cracking: Local restraint cracking from integral abutment was seen under the bridge deck. Maybe, typical integral abutment cracks at the ends located on top of the bridge deck.

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: Nearly the same amount of "globally" cracking was observed on both 058-0125 and 058-0126.

**Other Observations:**

Abutment and Deck Instrumented

**Mix Design Information: (from MISTIC)**

Mix Design Number: 85PCC6097

Coarse Aggregate Source: Material Service CA 11  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: Vulcan Materials FA 01 Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

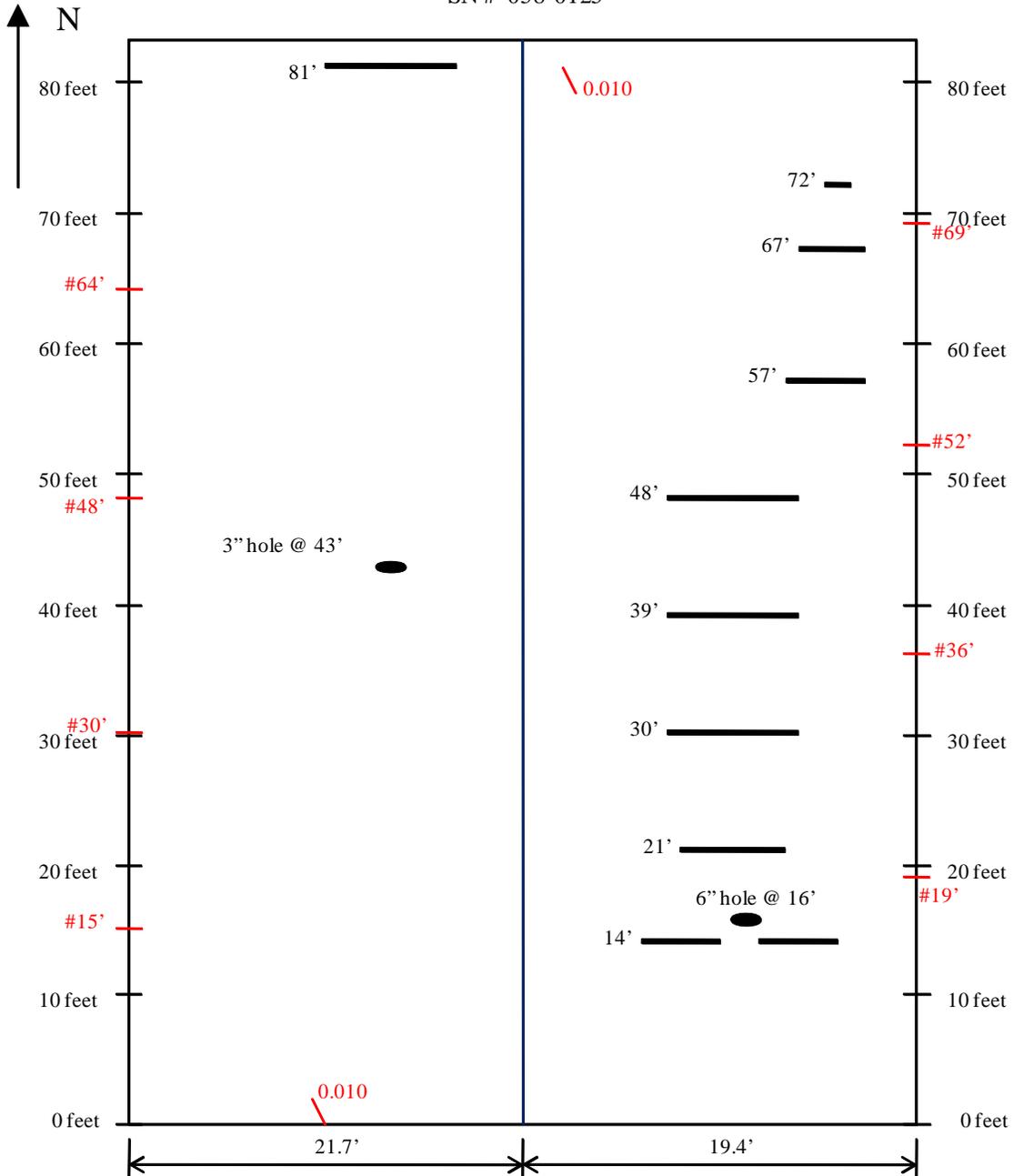
Cement Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: ISG Resources, Inc.

Microsilica Source: W. R. Grace & Company

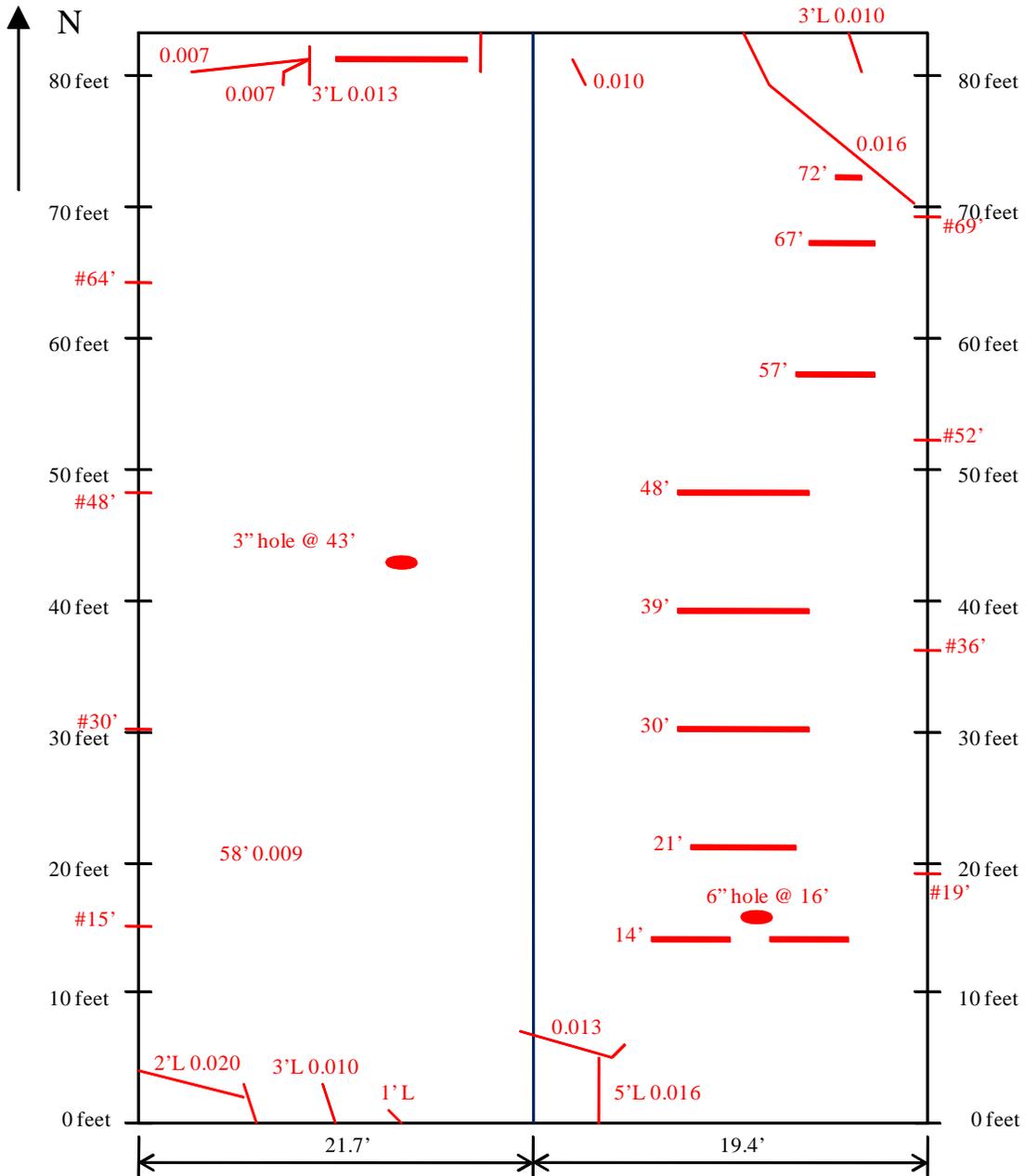
Macon U. S. 51 – NB  
SN# 058-0125



Macon County – SN# 058-0125 – Surveyed 5/7/2001, 10/19/2001

This bridge deck was poured on October 12, 2000. The initial survey showed no cracking. The thicker lines represent areas of popped out aggregate. The “#” symbol represents cracks in the parapet only.

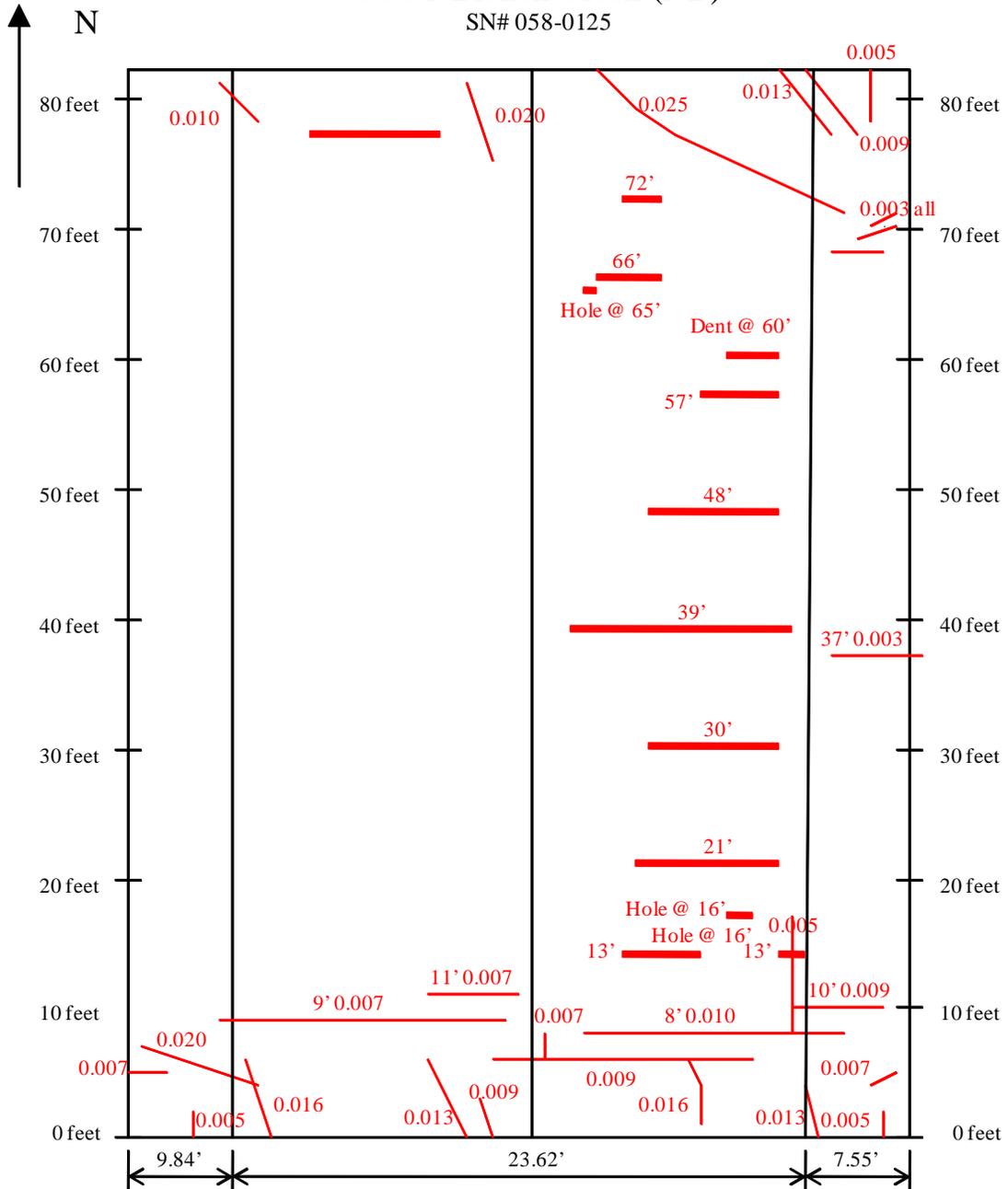
Macon U. S. 51 – NB  
SN # 058-0125



Macon County – SN# 058-0125 – Surveyed 10/31/2002

The “#” symbol represents cracks in the parapet only. The thicker lines represent areas of popped out aggregate.

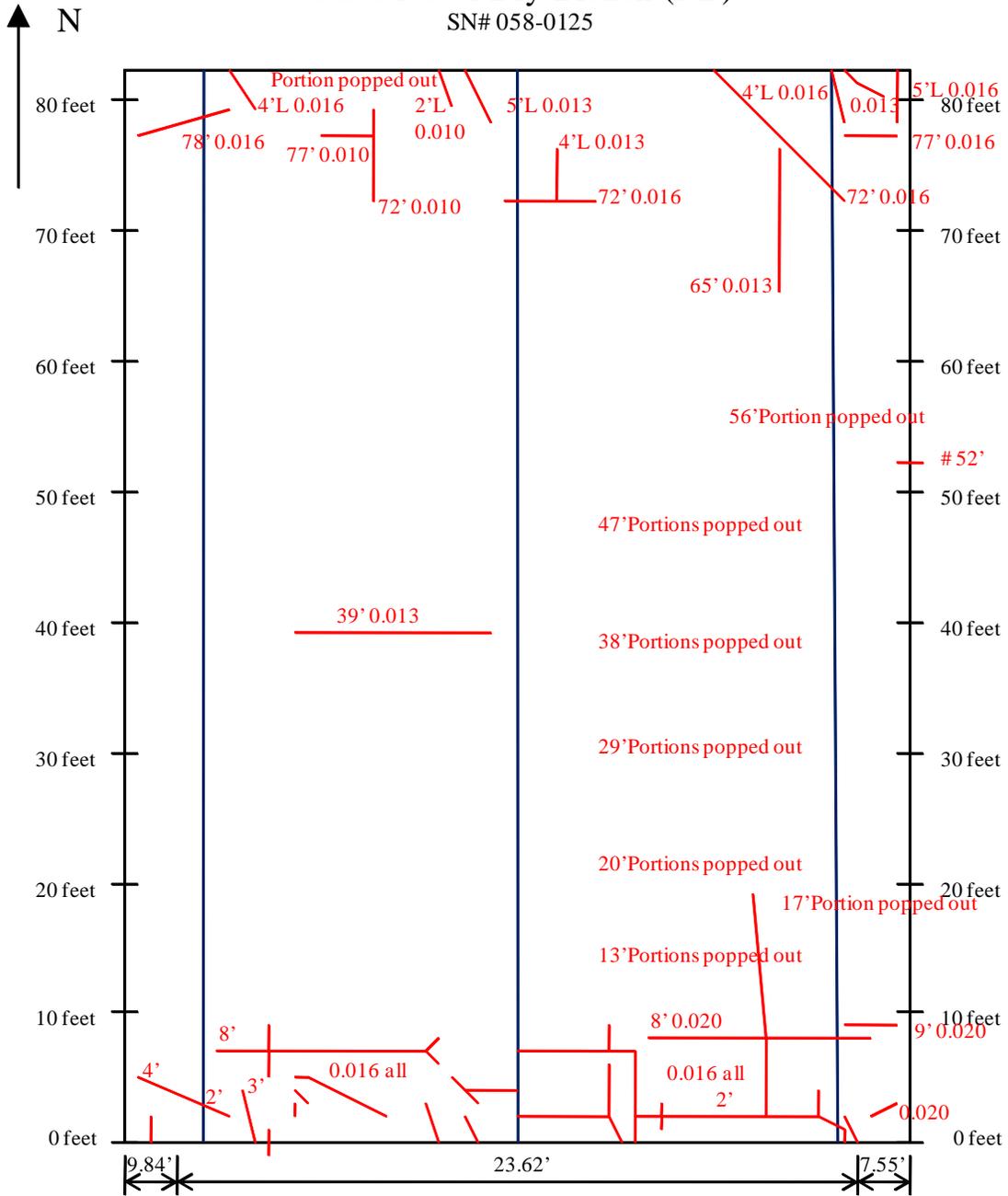
US 51-Branch Creek (NB)  
SN# 058-0125



Macon County – SN# 058-0125 – Surveyed 10/7/2003  
The thick red lines represent portions popped out unless otherwise noted.

# U.S. 51 over Dry Branch (NB)

SN# 058-0125



Macon County – SN# 058-0125 – Surveyed 10/25/2005  
 Some portions of the bridge deck in the driving lane were popped out.  
 The “#” means parapet only.



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 058-0126

Responsible District: 5

Number of Spans: 1

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

ADT @ time bridge was built: 9,500 (2007)

Skew:  Y  N Angle: 18°

Inspected By: DAD, DHT, JAB

Date Inspected: 7/22/09

Span Lengths 24.38m Total: 24.4m

Deck Width: 12.0m

Beam Spacing: 2.22m

Date of Beam Erection: 2000

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 2000 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: Some transverse cracking was observed but it was less noticeable near the ends.

Longitudinal Cracking: \_\_\_\_\_

Bridge Joint Cracking / Integral Abutment Cracking: Local restraint cracking from integral abutment was seen under the bridge deck. Maybe, typical integral abutment cracks at the ends located on top of the bridge deck.

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: Nearly the same amount of "globally" cracking was observed on both 058-0125 and 058-0126.

**Other Observations:**

Abutment and Deck Instrumented

058-0126 appeared to have less cracking than 058-0125.

**Mix Design Information: (from MISTIC)**

Mix Design Number: 85PCC6096

Coarse Aggregate Source: Material Service CA 11  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: Vulcan Materials FA 01 Fine Aggregate Source: N/A

HRM Source: Engelhard Corporation

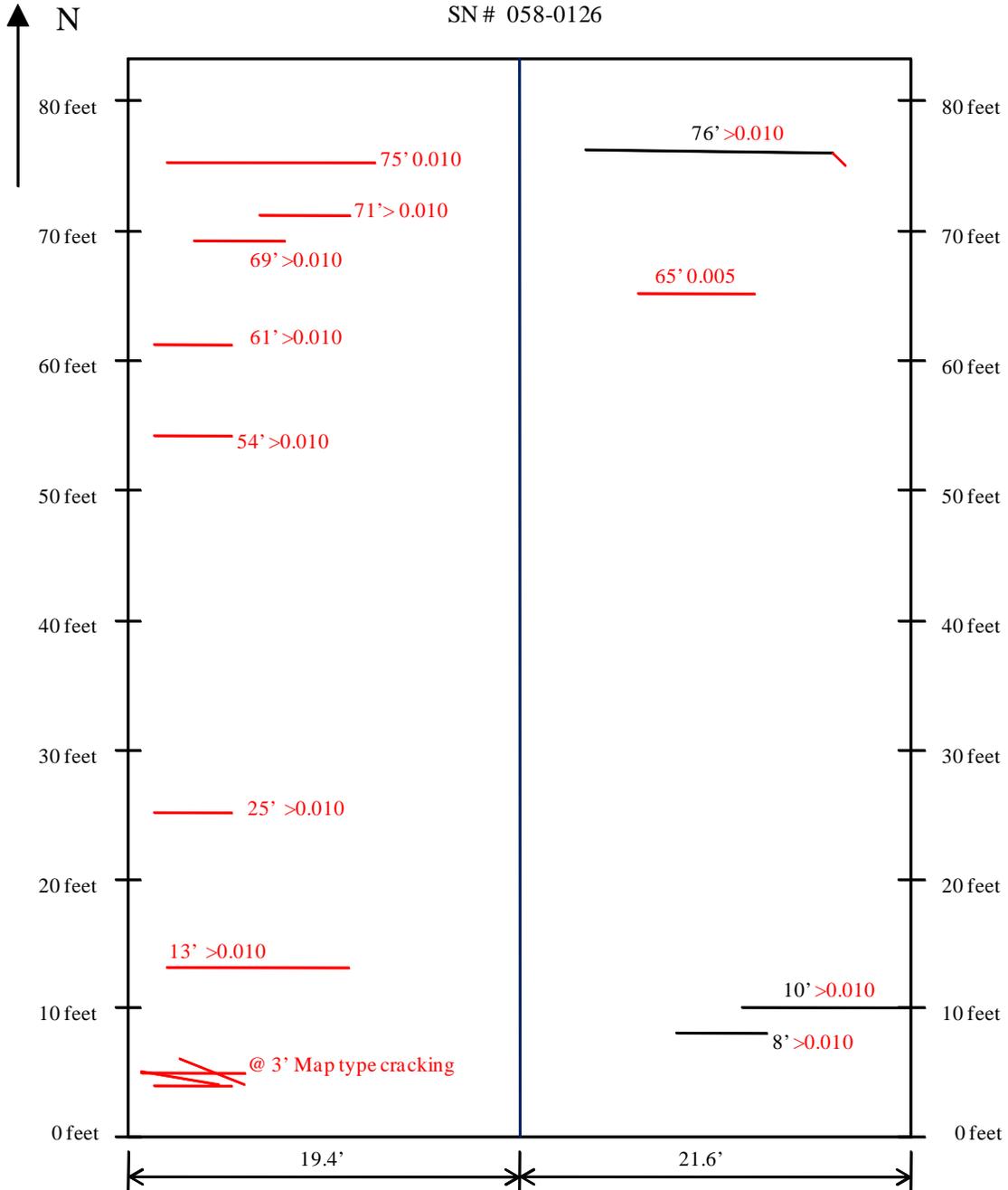
Cement Source: \_\_\_\_\_

GGBF Slag Source: N/A

Fly Ash Source: ISG Resources, Inc.

Microsilica Source: N/A

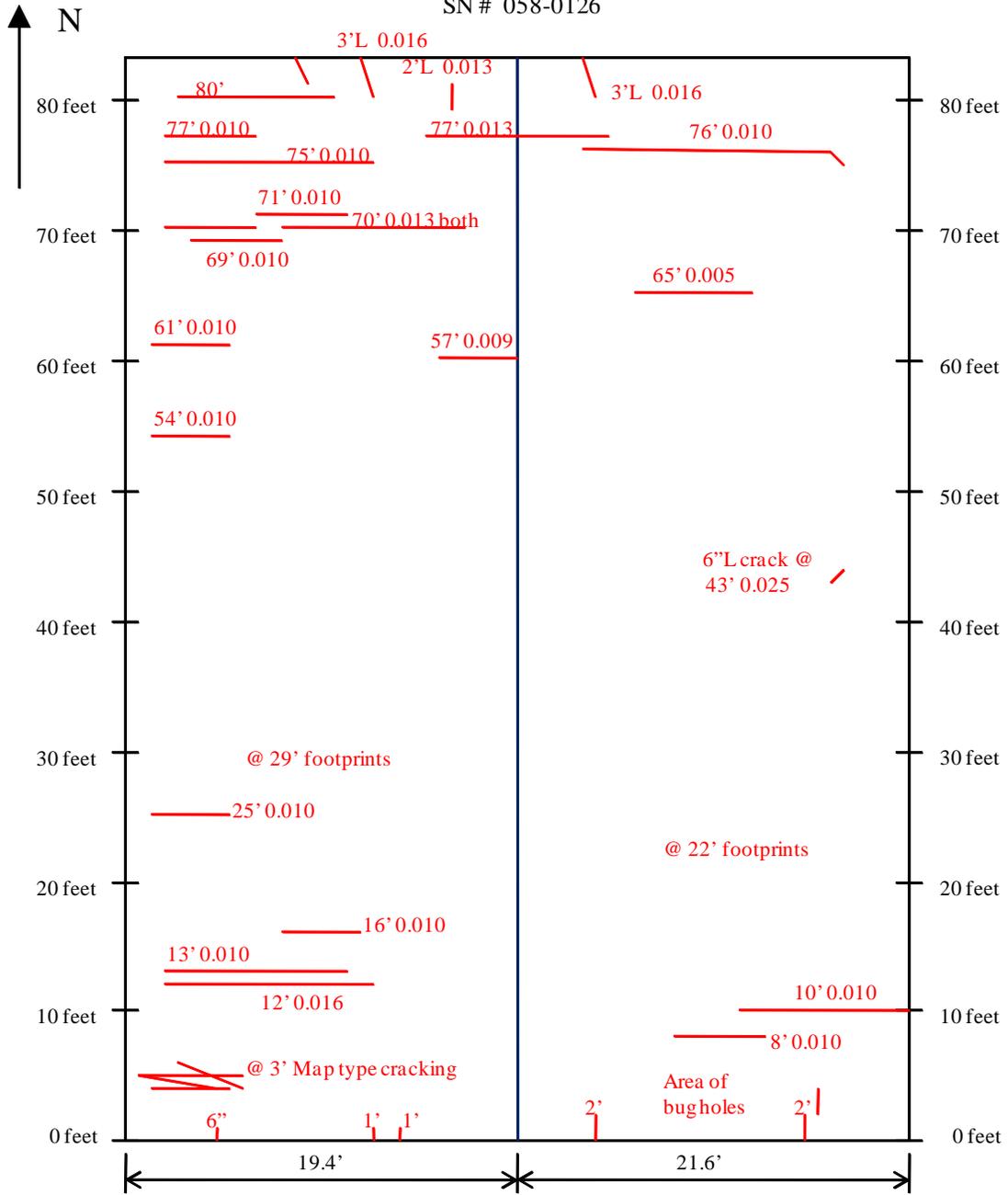
Macon U. S. 51 – SB  
SN# 058-0126



Macon County – SN# 058-0126 – Surveyed 5/7/2001, 10/19/2001  
Deck poured on October 03, 2000. No initial survey was conducted due the dirty surface.

# Macon U. S. 51 – SB

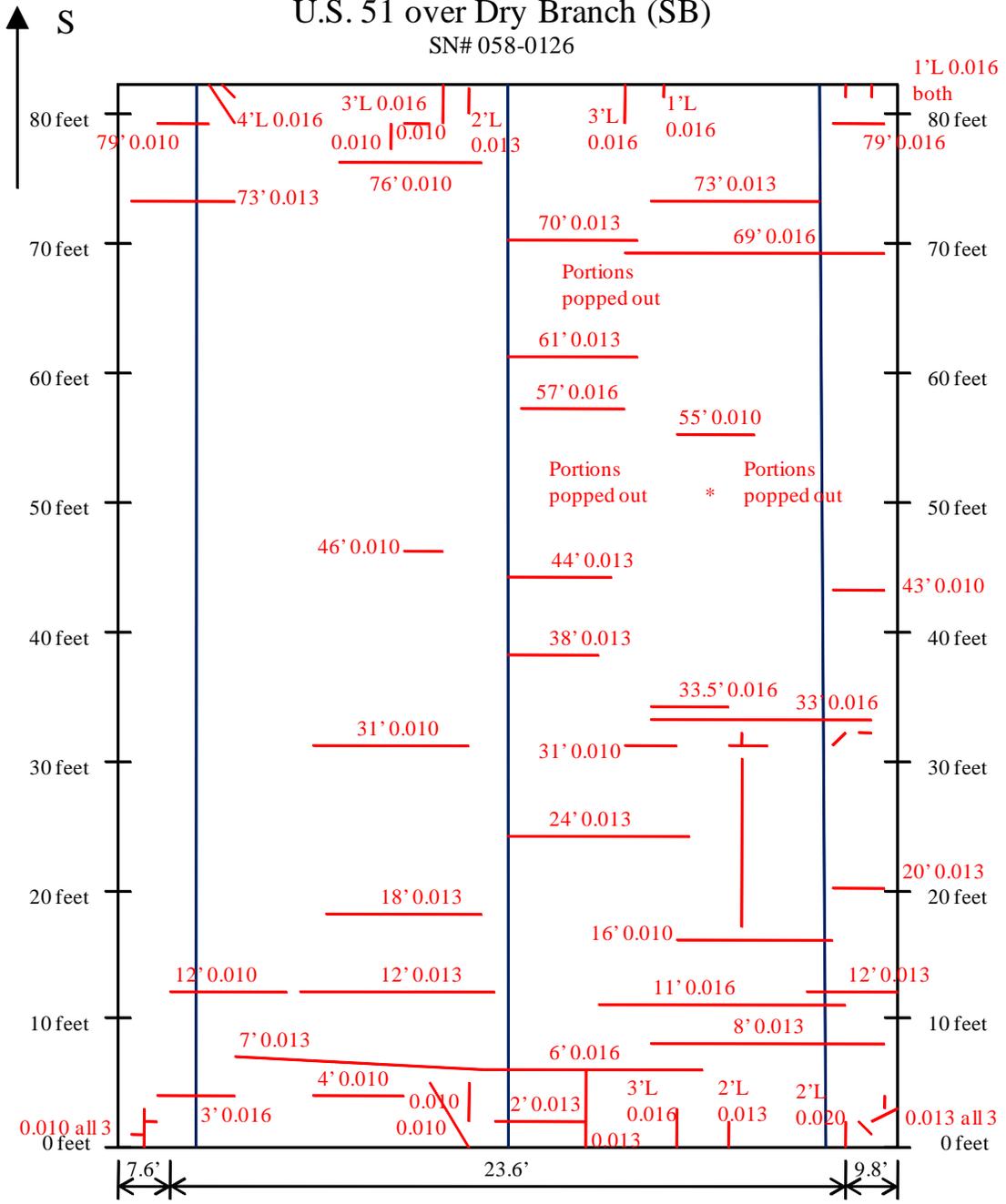
SN# 058-0126



Macon County – SN# 058-0126 – Surveyed 10/31/2002



**U.S. 51 over Dry Branch (SB)**  
SN# 058-0126



Macon County – SN# 058-0126 – Surveyed 10/25/2005  
Some portions of the bridge deck in the driving lane were popped out.  
The “\*” symbol denotes a footprint.

Madison County



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 060-0108

Responsible District: 8

Number of Spans: 4

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

ADT @ time bridge was built: 9,500 (2007)

Skew:  Y  N Angle: \_\_\_\_\_

Inspected By: DAD,DHT,JAB

Date Inspected: 6/9/10

Span Lengths See below Total: 68.1m

Deck Width: 10.48m

Beam Spacing: 1.93m

Date of Beam Erection: 2000

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 2000 Stage 2, 2000

**Description of Cracking:**

Average Transverse Crack Distance: On top, cracking present at 4'-5' spacing. On bottom, some cracking present at 20'-22' spacing.

Longitudinal Cracking: \_\_\_\_\_

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span lengths: 1&4) 12.8m, 2&3) 20.5m

Southbound deck instrumented

**Mix Design Information: (from MISTIC)**

Mix Design Number: 88PCC1570

Coarse Aggregate Source: Columbia Quarry Co.  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: Keyesport S. & G. #2 Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

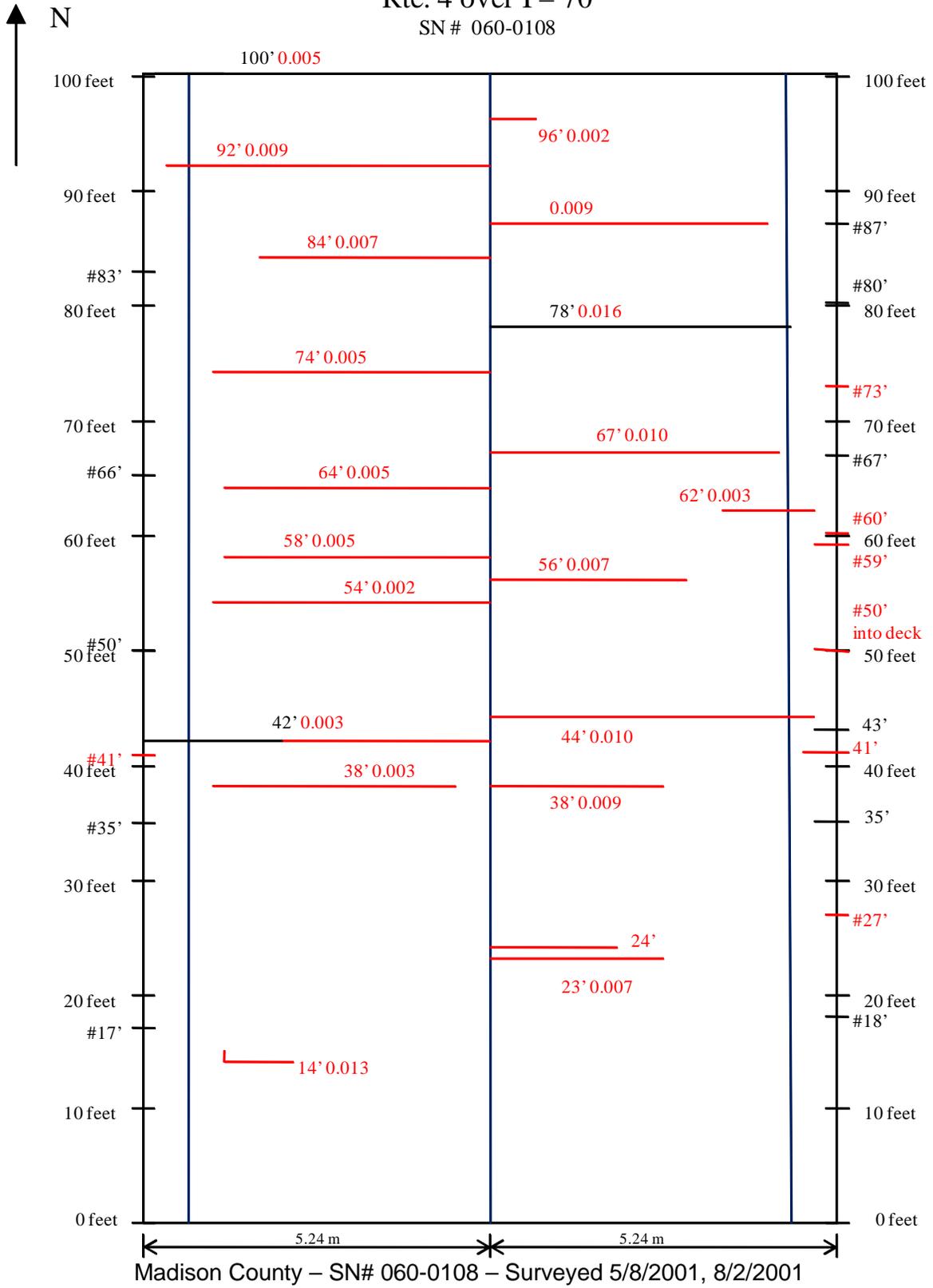
Cement Source: \_\_\_\_\_

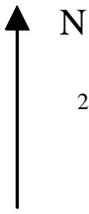
GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: Mineral Resource Tech

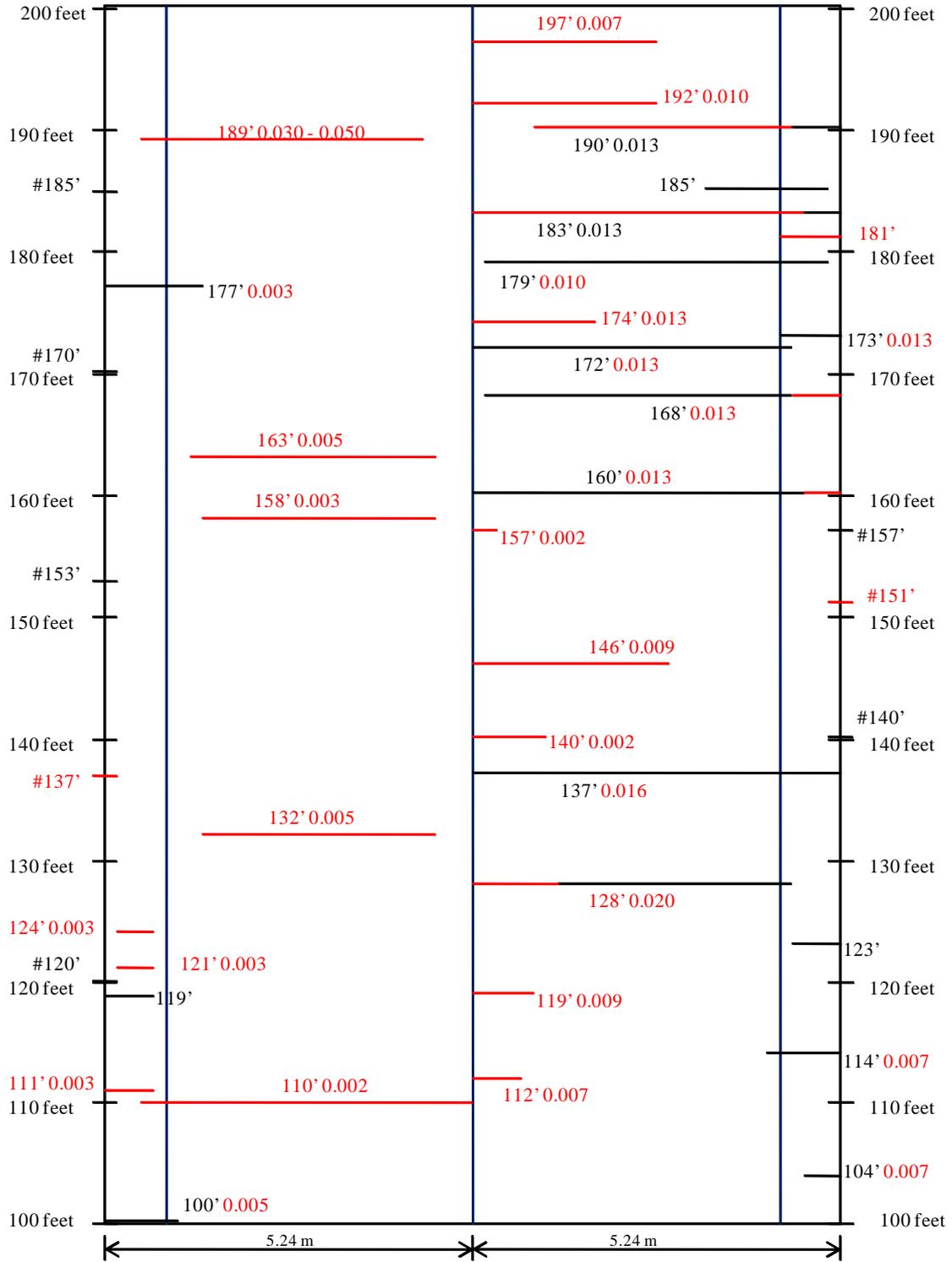
Microsilica Source: Elkem Materials Inc

Rte. 4 over I – 70  
SN # 060-0108



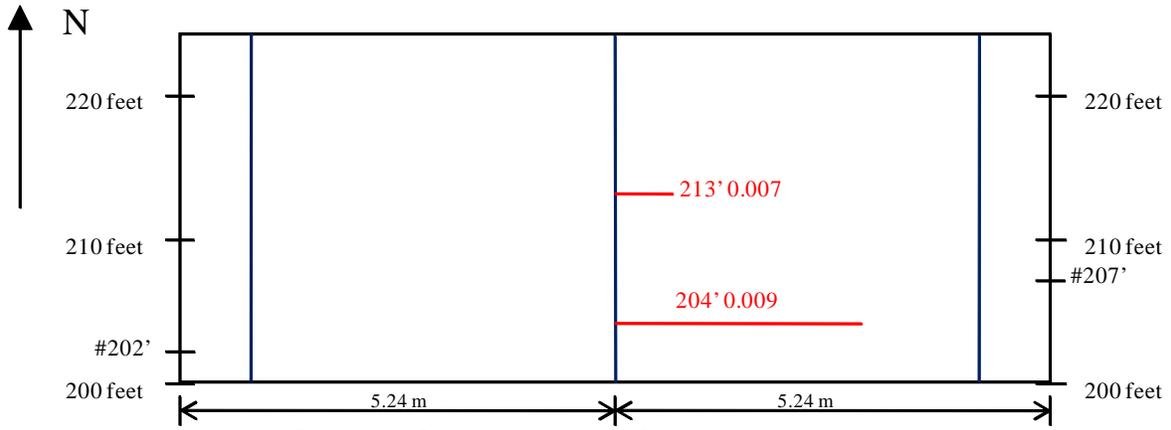


Rte. 4 over I - 70



Madison County – SN# 060-0108 – Surveyed 5/8/2001, 8/2/2001

### Rte. 4 over I - 70

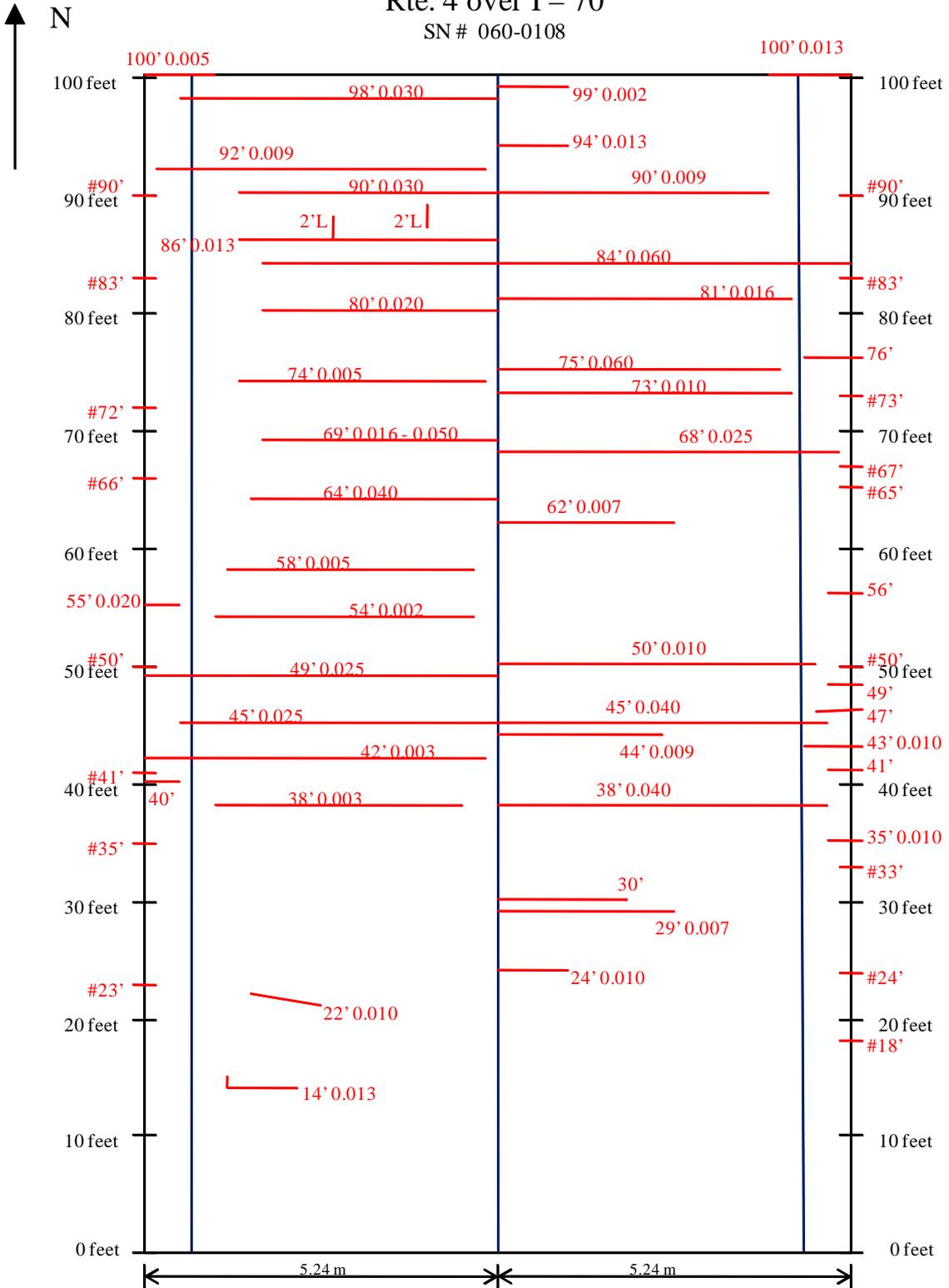


Madison County – SN# 060-0108 – Surveyed 5/8/2001, 8/2/2001

The initial survey of the southbound lane showed only one transverse crack.  
The initial survey of the northbound lane showed five hairline transverse cracks.

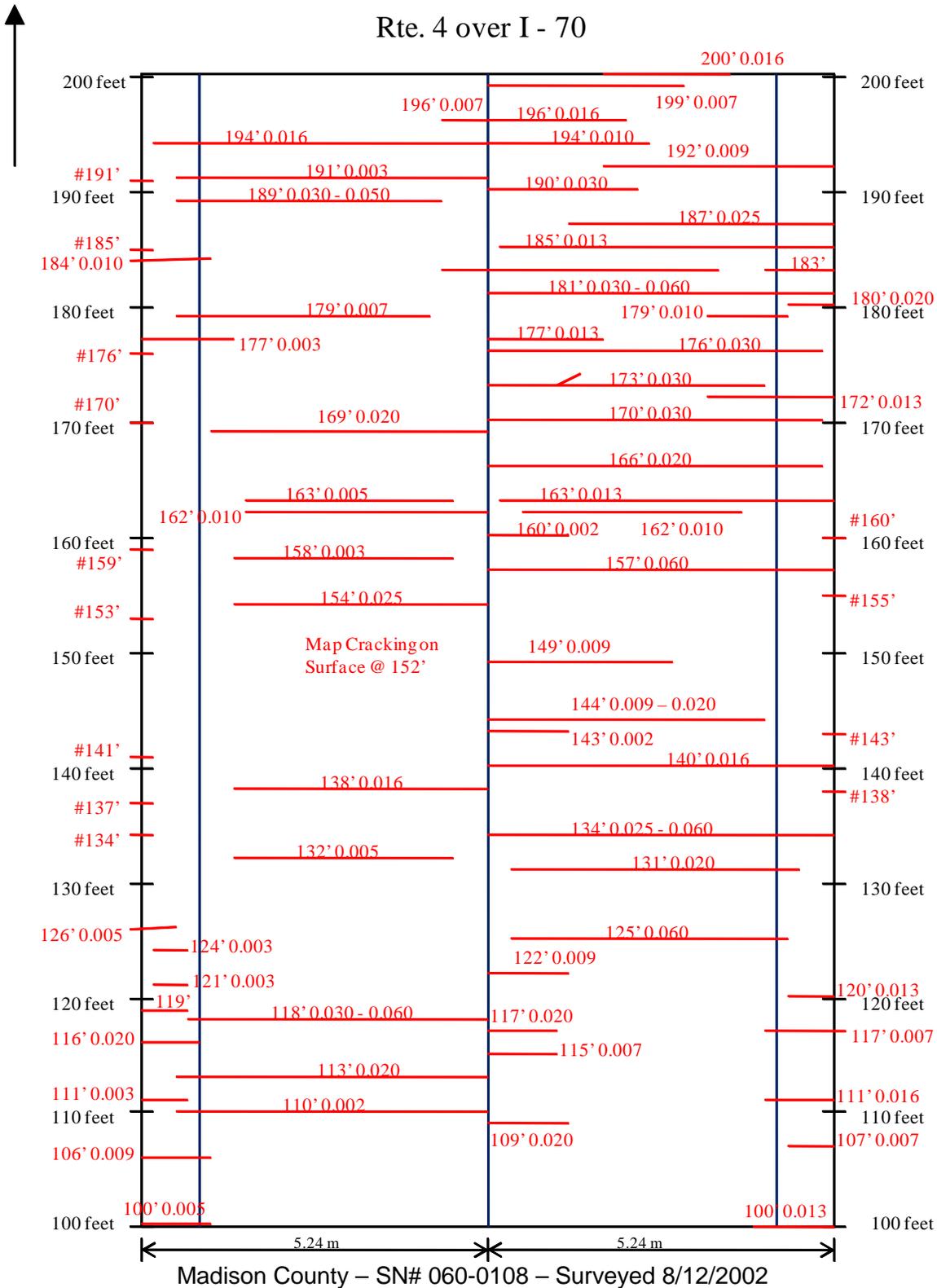
The “#” symbol represents cracks in the parapet only.

Rte. 4 over I – 70  
SN # 060-0108

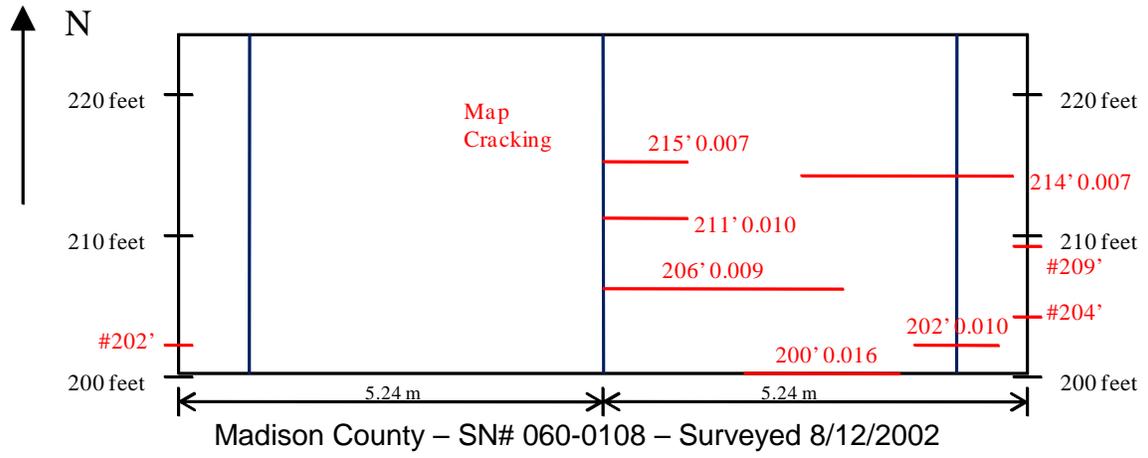


Madison County – SN# 060-0108 – Surveyed 8/12/2002

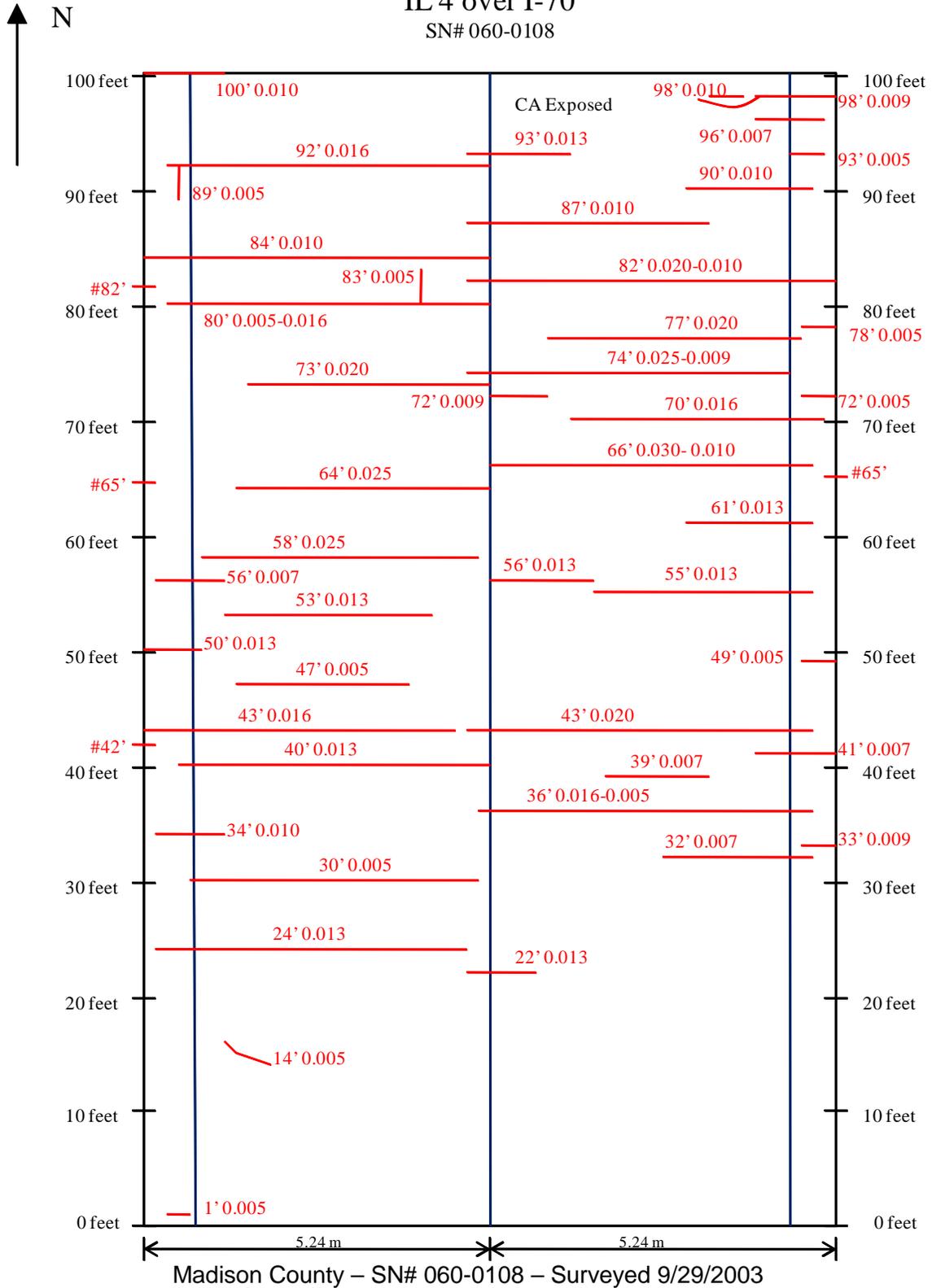
# Rte. 4 over I - 70

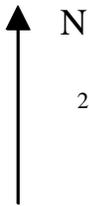


Rte. 4 over I - 70

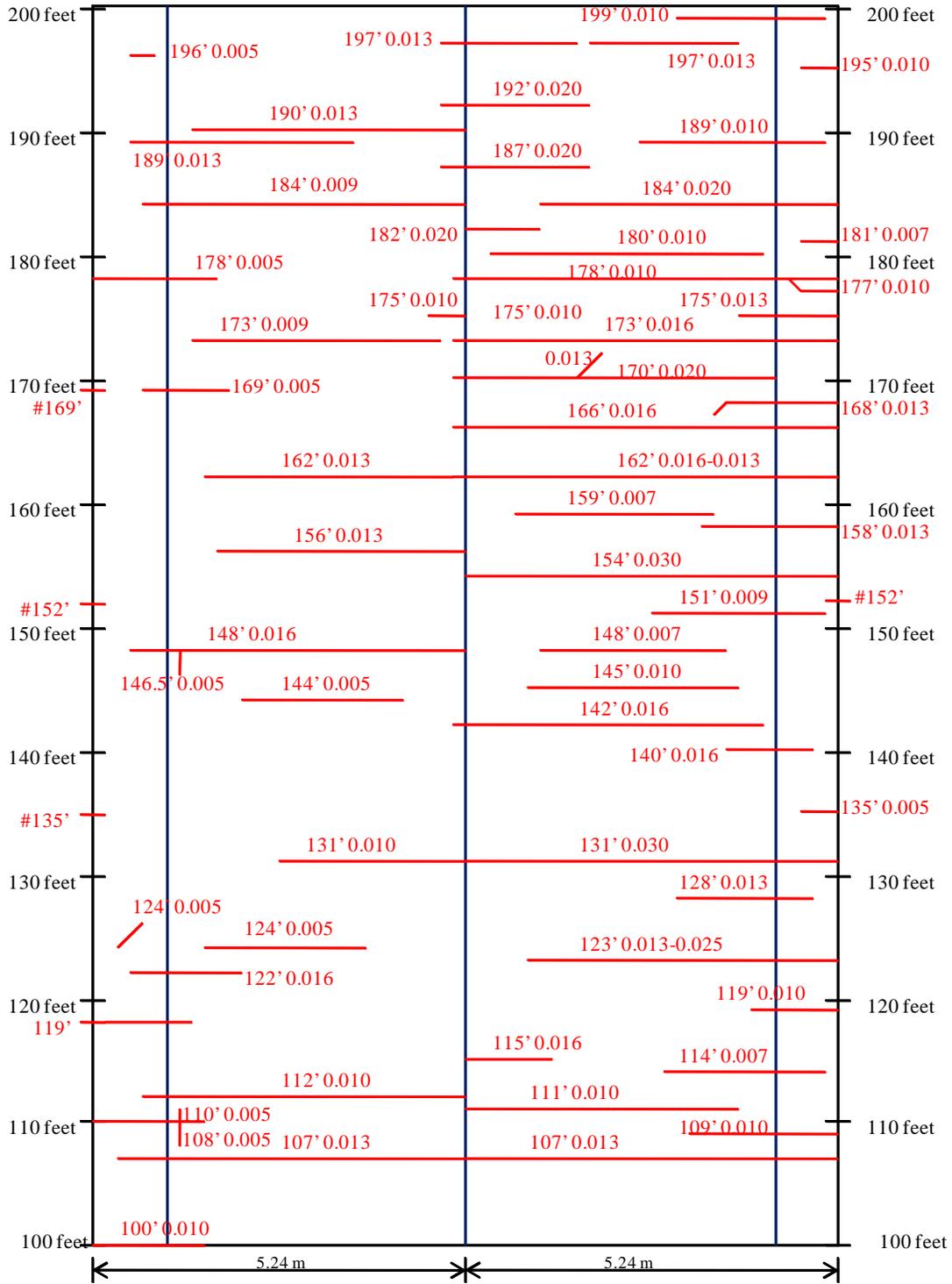


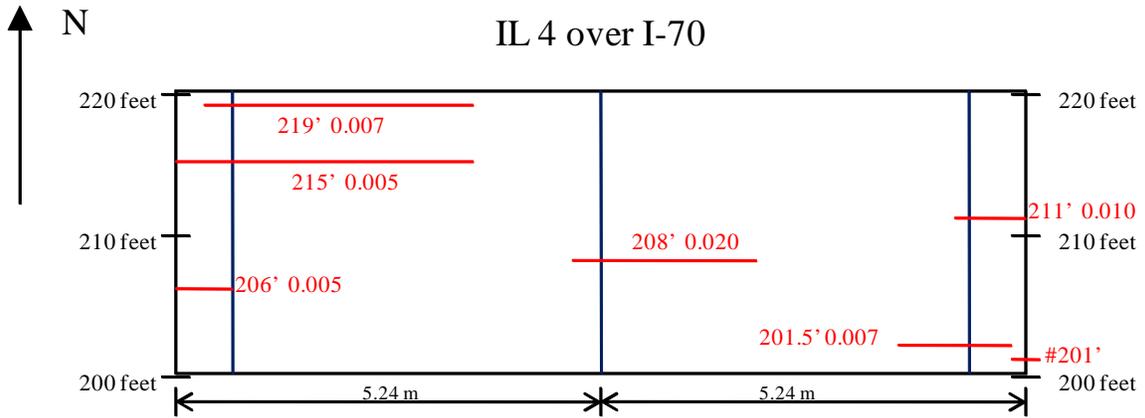
IL 4 over I-70  
SN# 060-0108





### IL 4 over I-70



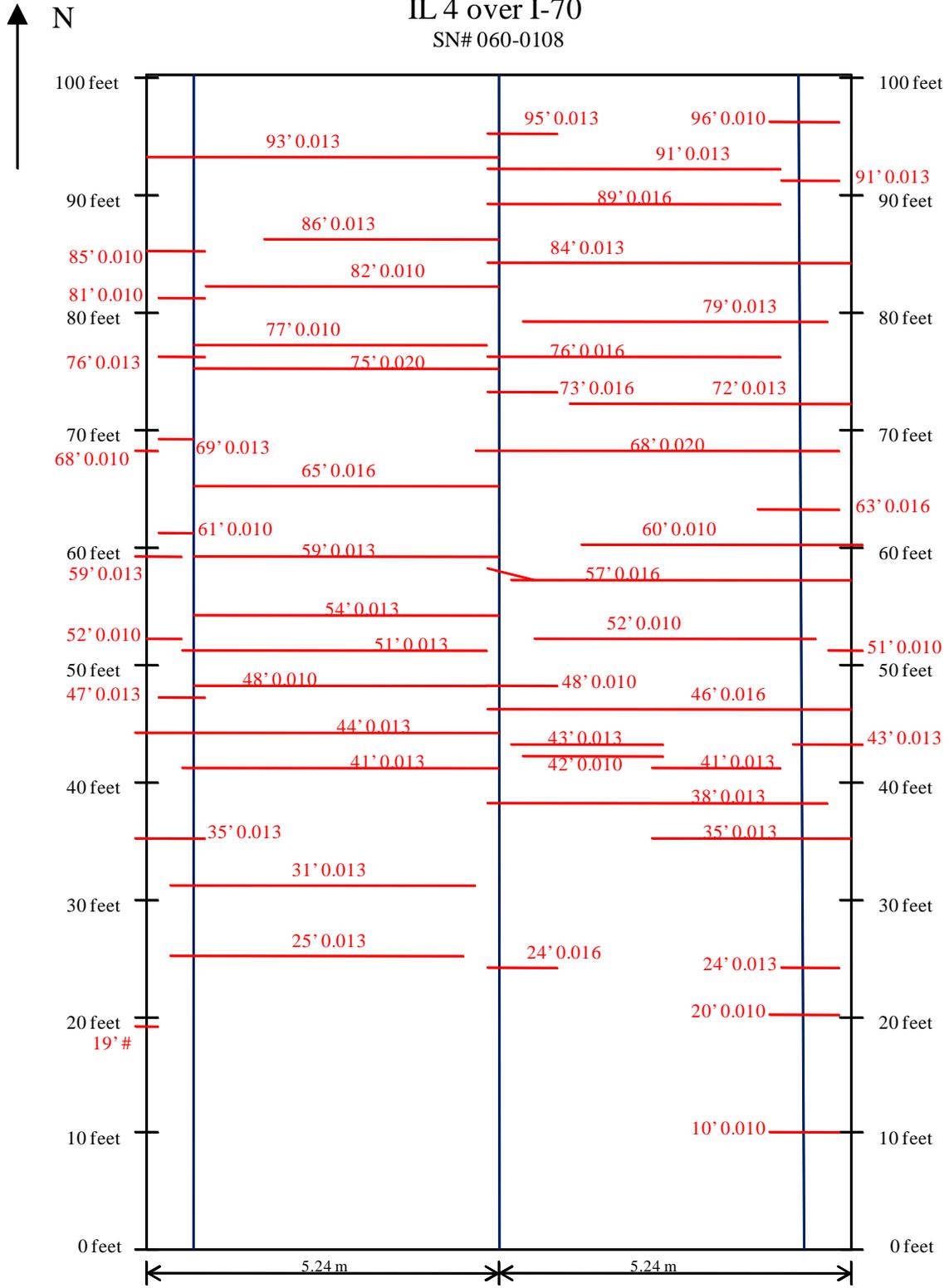


Madison County – SN# 060-0108 – Surveyed 9/29/2003

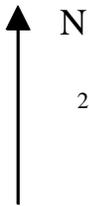
This was a partial deck survey due to time constraints and traffic conditions.

The “#” symbol represents cracks in the parapet only.

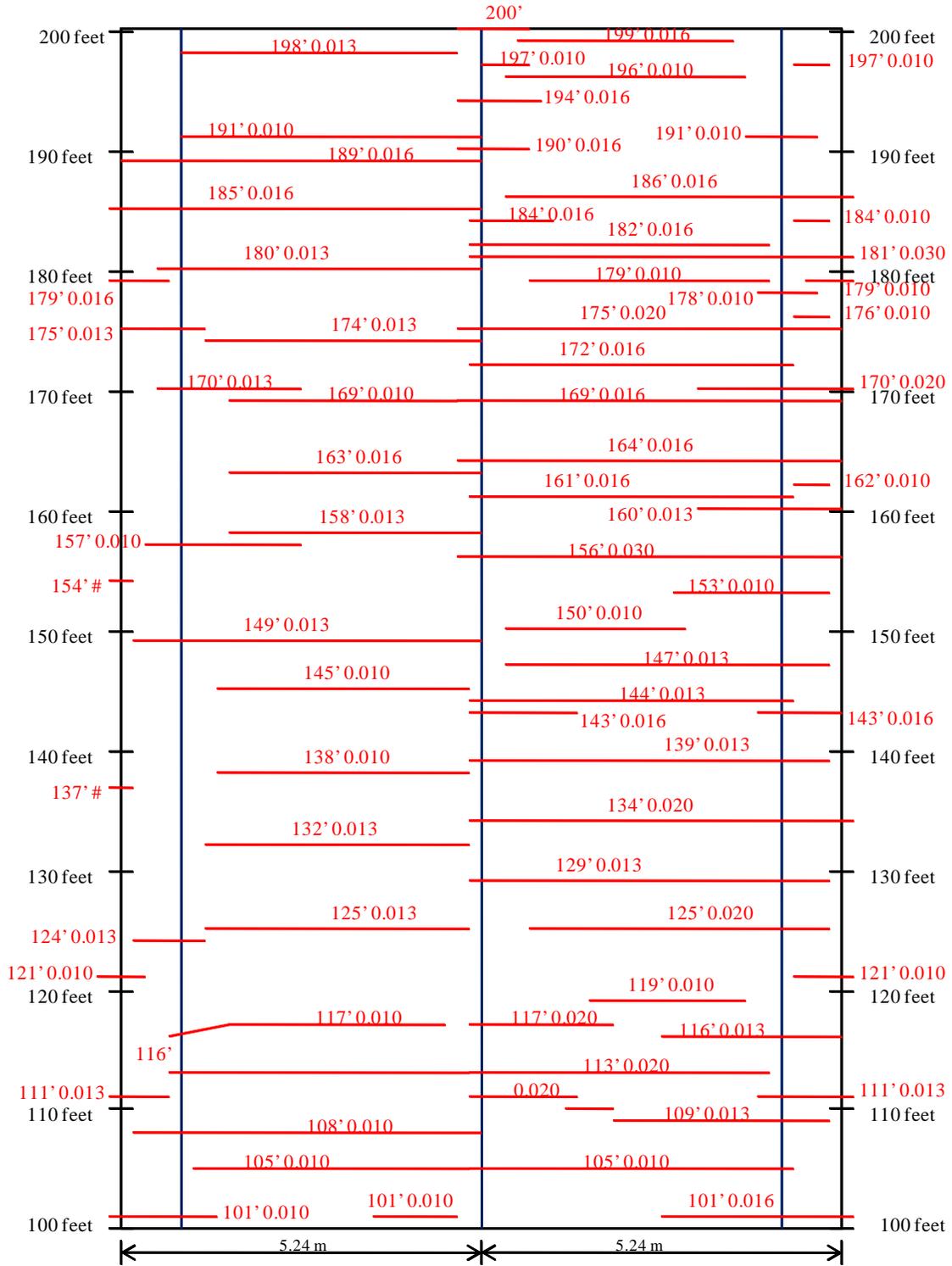
IL 4 over I-70  
SN# 060-0108



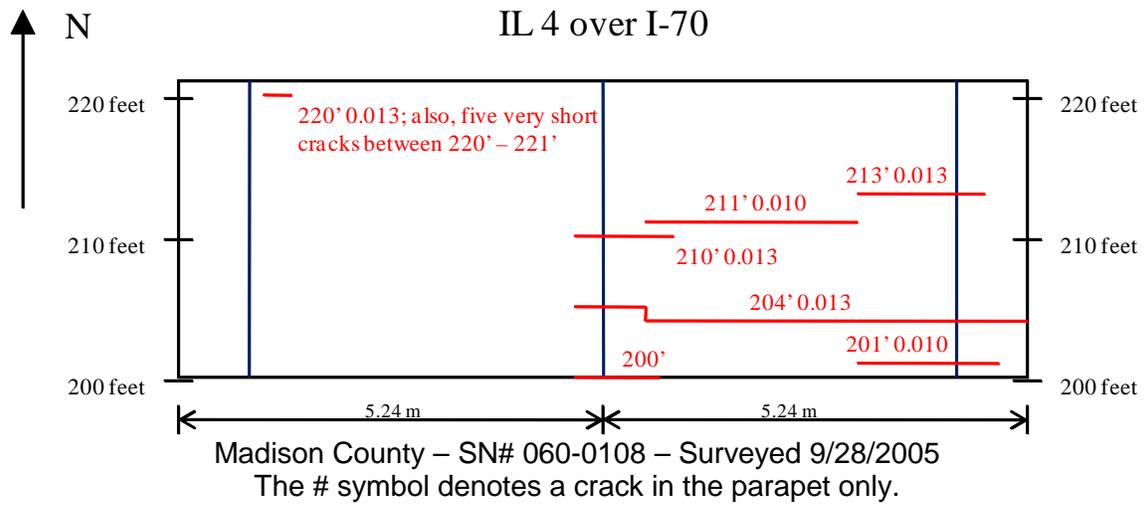
Madison County – SN# 060-0108 – Surveyed 9/28/2005



### IL 4 over I-70



Madison County - SN# 060-0108 - Surveyed 9/28/2005





**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 060-0151

Responsible District: 8

Number of Spans: 4

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  Semi-Integral  Other

ADT @ time bridge was built: 8,300 (2007)

Skew:  Y  N Angle: 5°

Inspected By: DAD,DHT,JAB

Date Inspected: 6/9/10

Span Lengths See below Total: 69.1m

Deck Width: 10.48m

Beam Spacing: 1.93m

Date of Beam Erection: 2000

Bridge Joint:  Integral  Finger  Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 2000 Stage 2, 2000

**Description of Cracking:**

Average Transverse Crack Distance: On top, cracks present at 2'-4' spacing. On bottom, cracks present at 4'-6' spacing.

Longitudinal Cracking: \_\_\_\_\_

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span lengths: 1) 12.6m, 2&3) 20.58m, 4) 13.9m

Northbound deck instrumented

Steel beams were from 1963.

**Mix Design Information: (from MISTIC)**

Mix Design Number: 88PCC1571

Coarse Aggregate Source: Columbia Quarry Co.  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: Keyesport S. & G. #2 Fine Aggregate Source: N/A

HRM Source: Engelhard Corp.

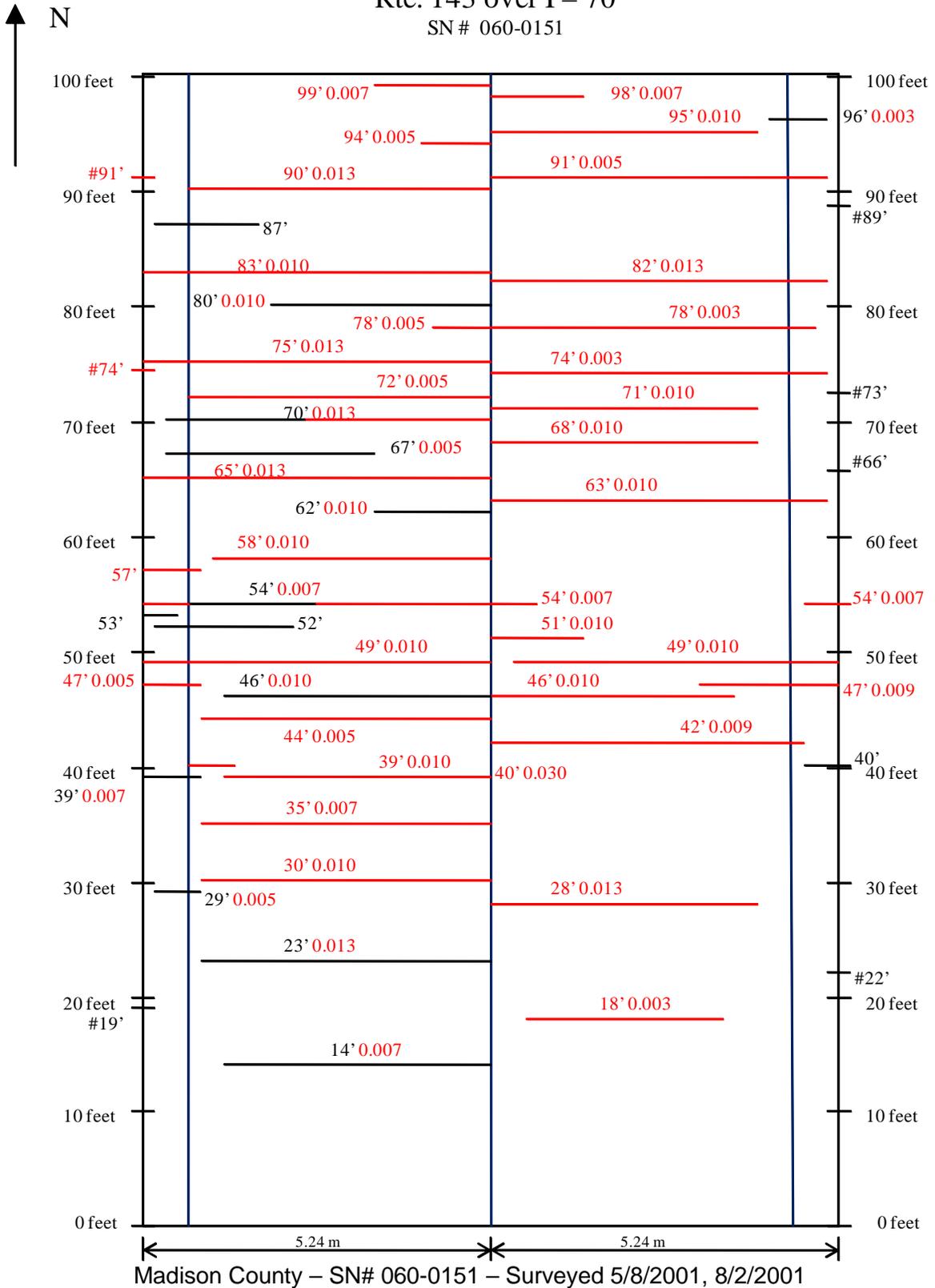
Cement Source: \_\_\_\_\_

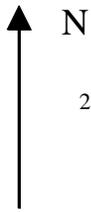
GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: Mineral Resource Tech

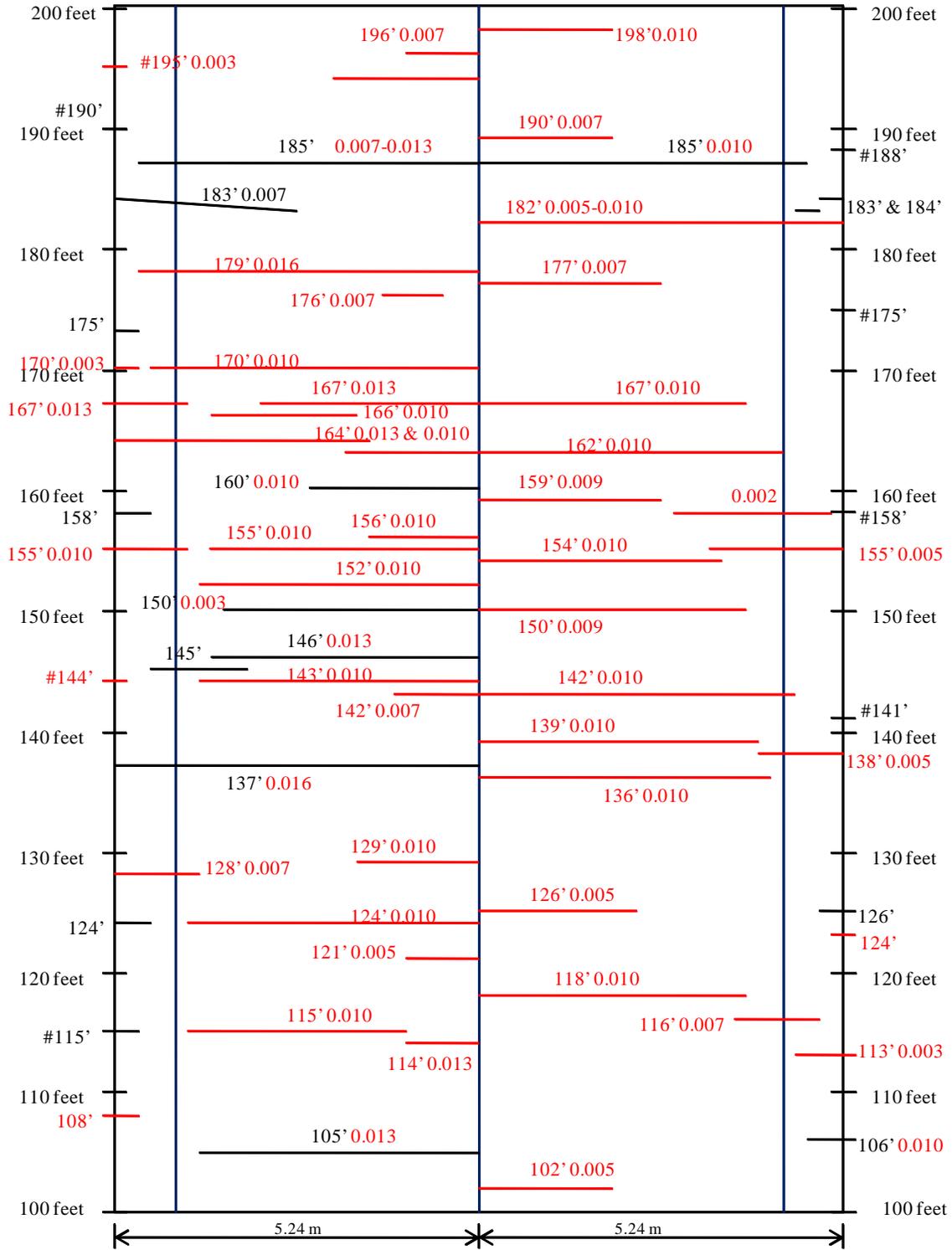
Microsilica Source: \_\_\_\_\_

Rte. 143 over I – 70  
SN # 060-0151

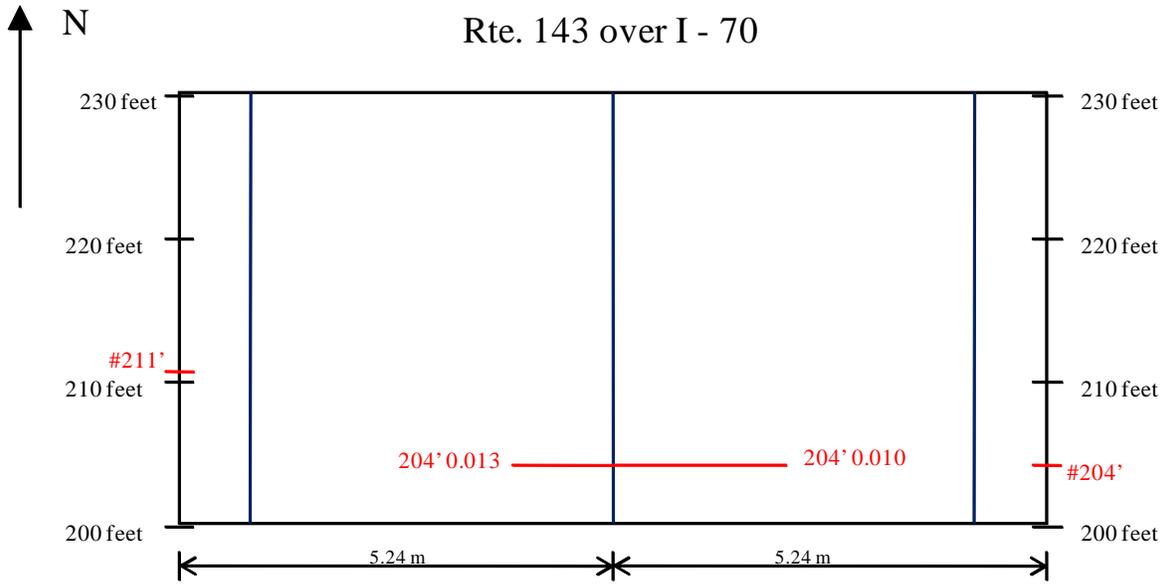




# Rte. 143 over I - 70

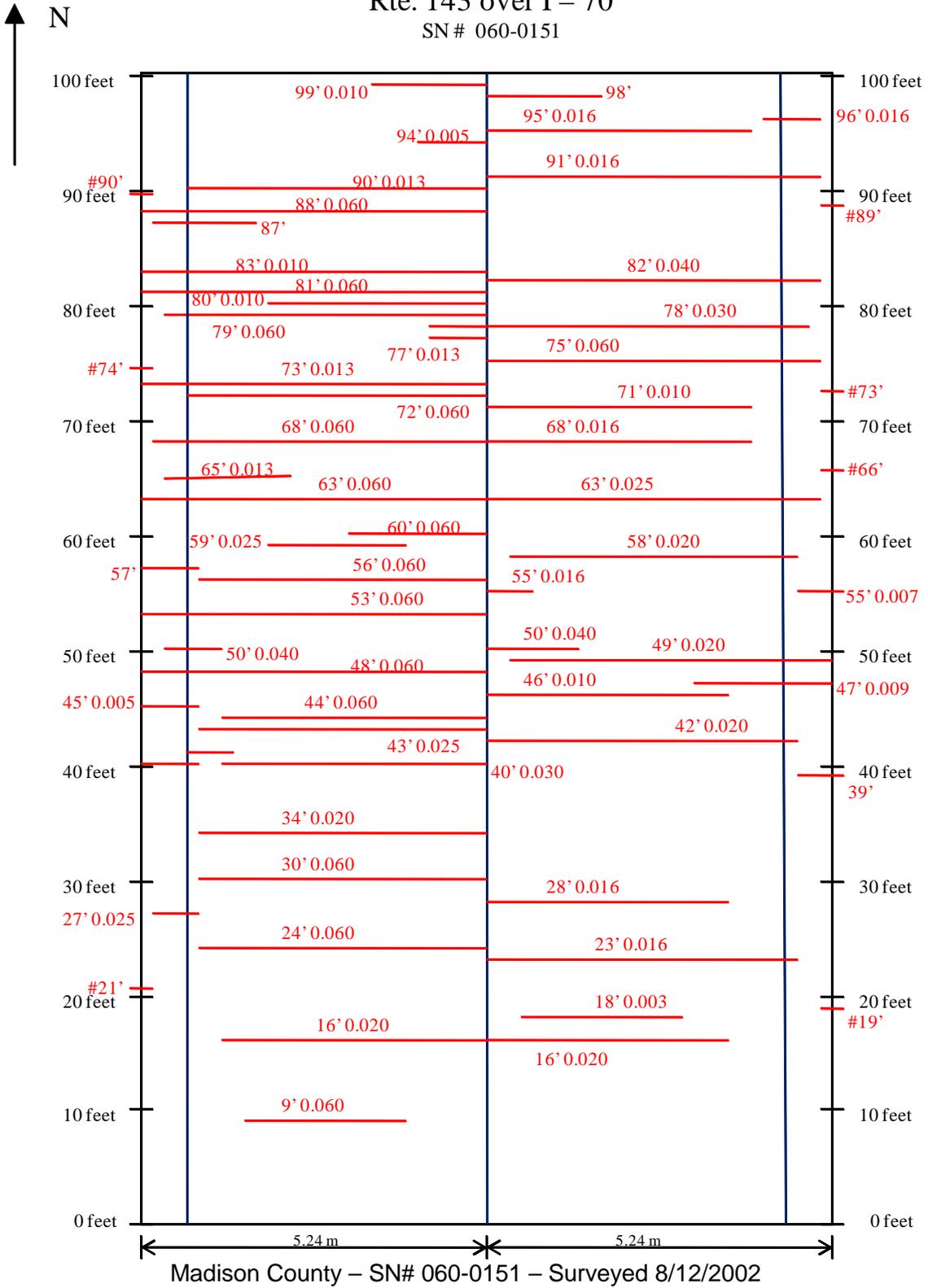


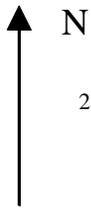
Madison County – SN# 060-0151 – Surveyed 5/8/2001, 8/2/2001



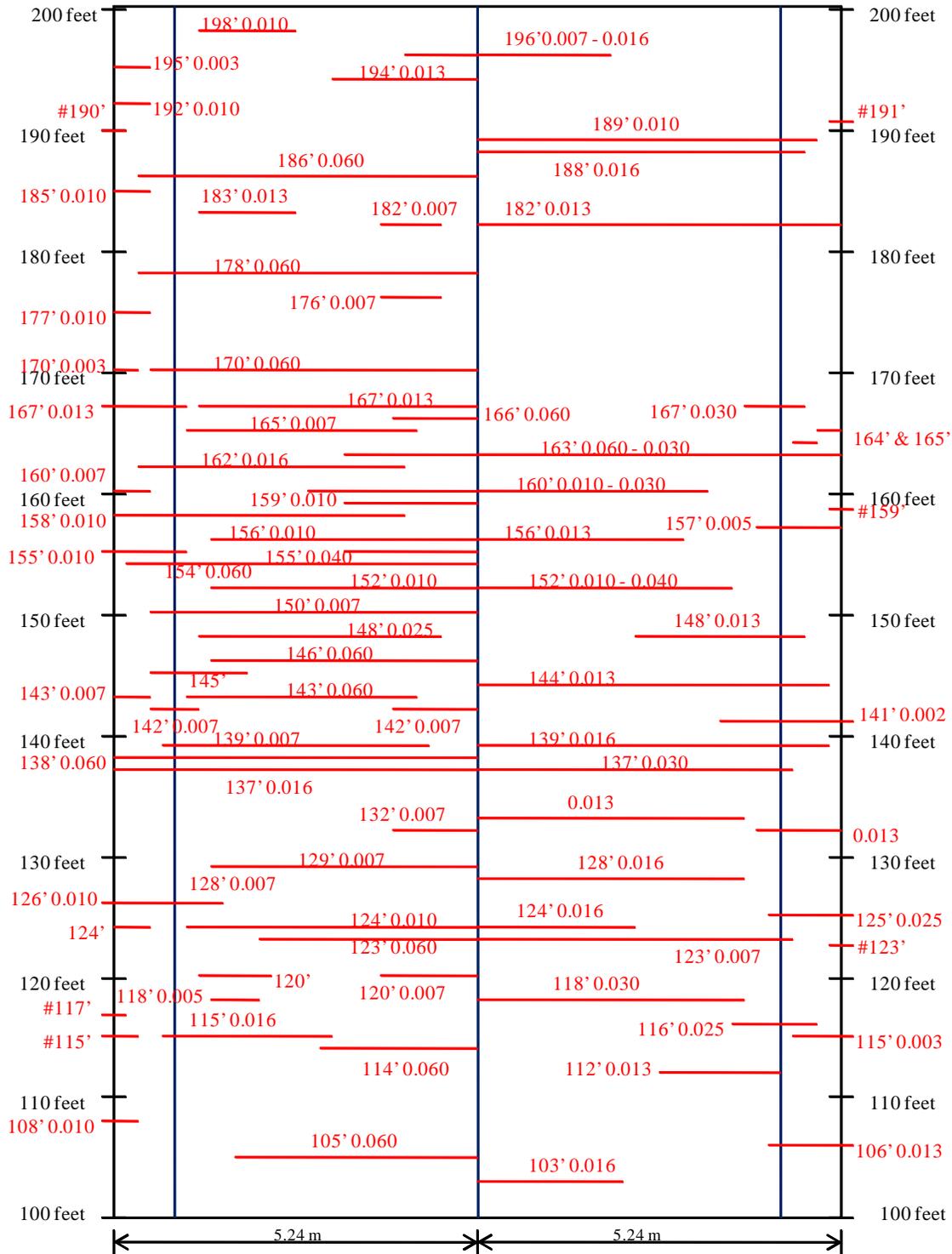
Madison County – SN# 060-0151 – Surveyed 5/8/2001, 8/2/2001  
 The initial bridge deck survey showed five hairline transverse cracks.  
 The “#” symbol represents cracks in the parapet only.

Rte. 143 over I – 70  
SN# 060-0151

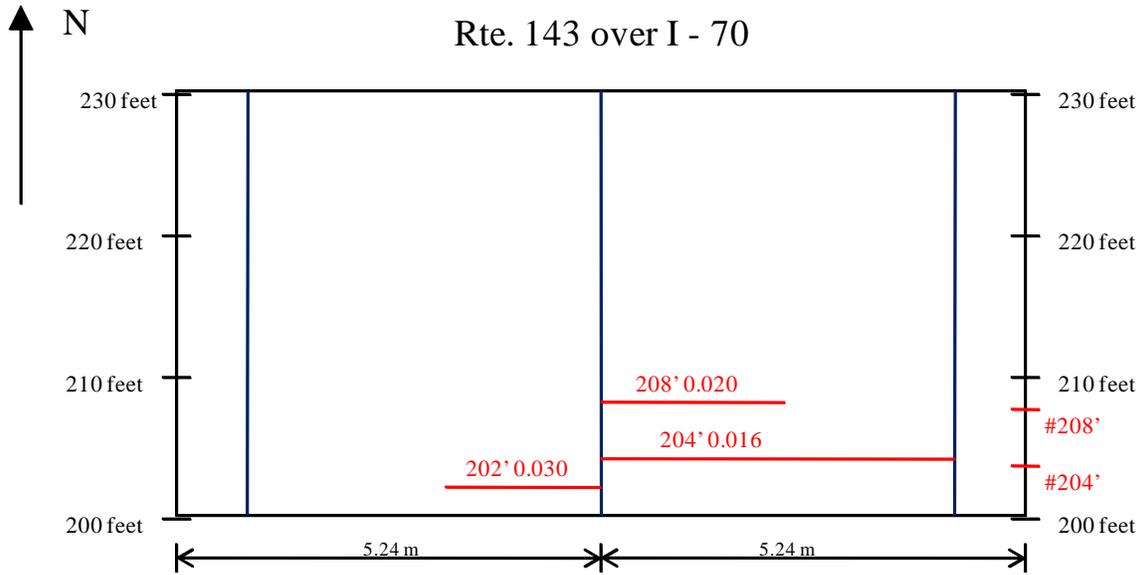




# Rte. 143 over I - 70

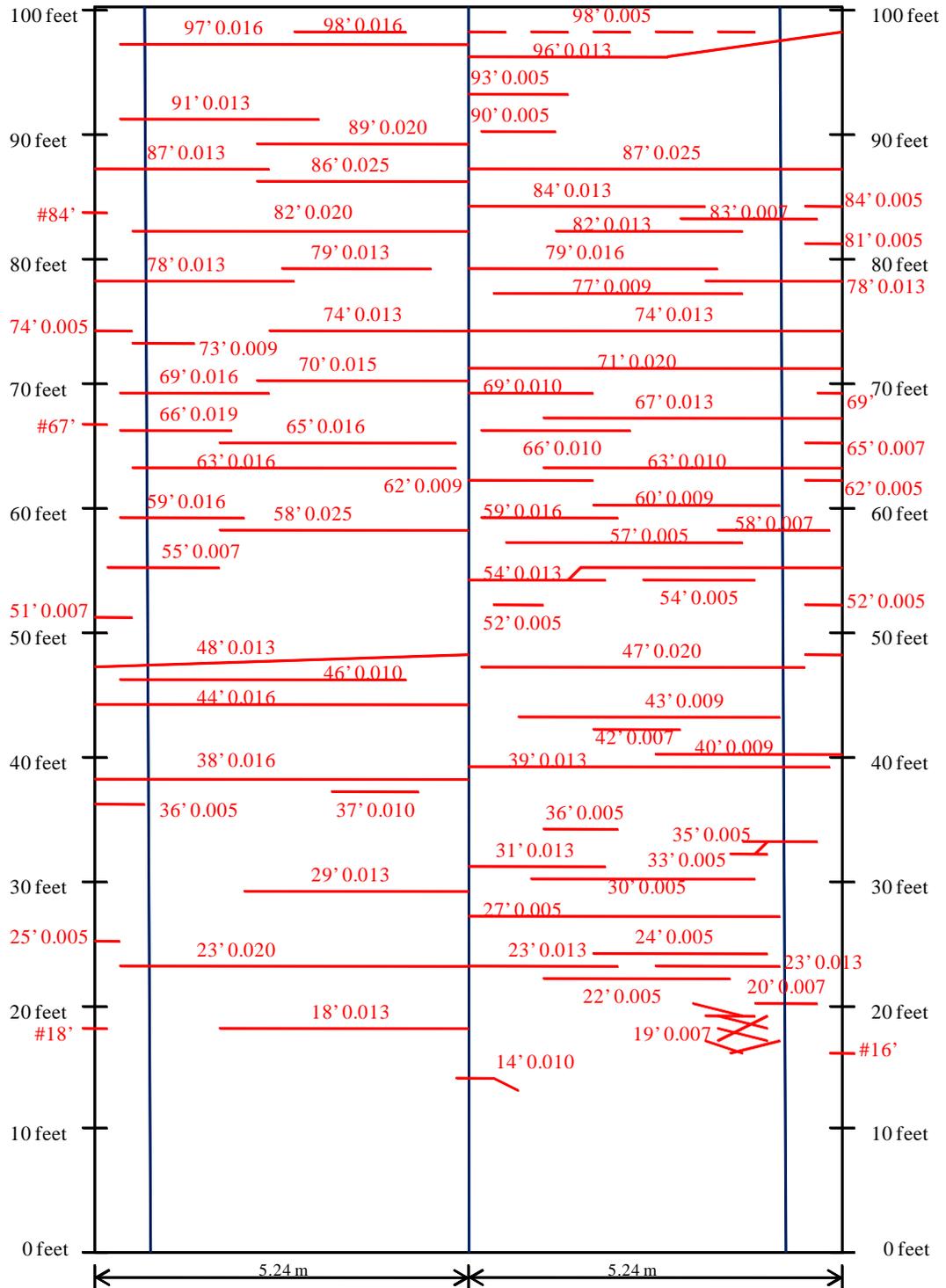
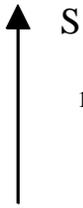


Madison County – SN# 060-0151 – Surveyed 8/12/2002

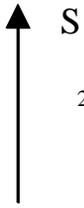


Madison County – SN# 060-0151 – Surveyed 8/12/2002  
 The “#” symbol represents cracks in the parapet only.

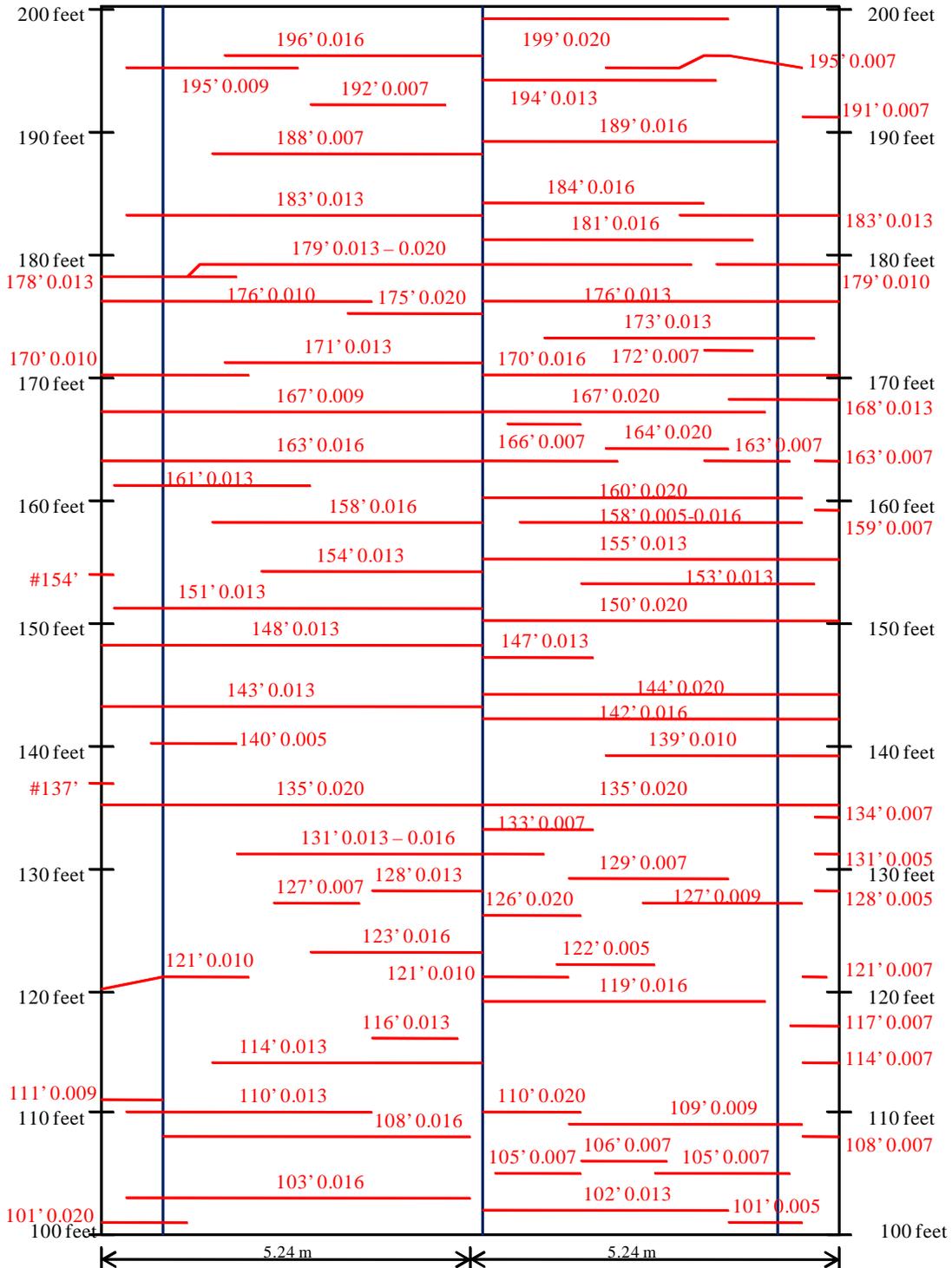
IL 143 over I-70  
SN# 060-0151



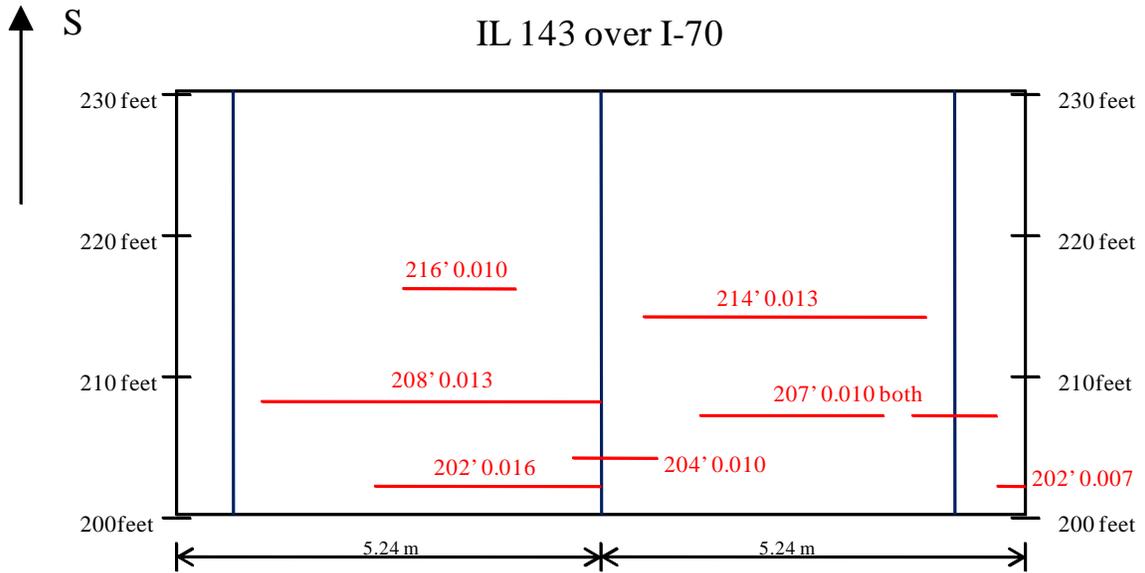
Madison County – SN# 060-0151 – Surveyed 9/29/2003



# IL 143 over I-70

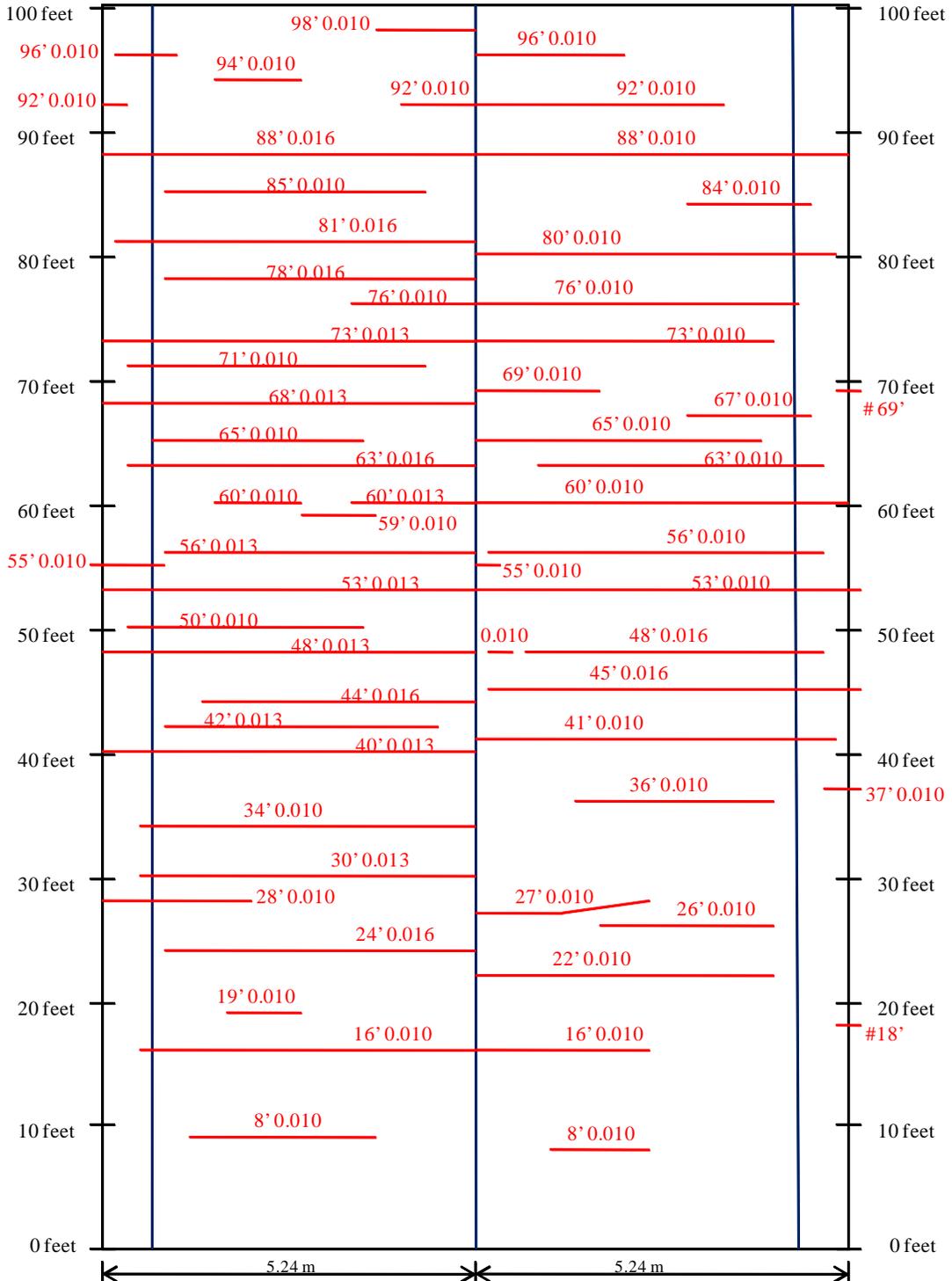
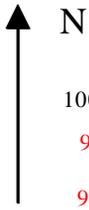


Madison County – SN# 060-0151 – Surveyed 9/29/2003

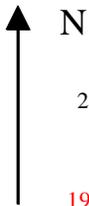


Madison County – SN# 060-0151 – Surveyed 9/29/2003  
 The “#” symbol represents cracks in the parapet only.

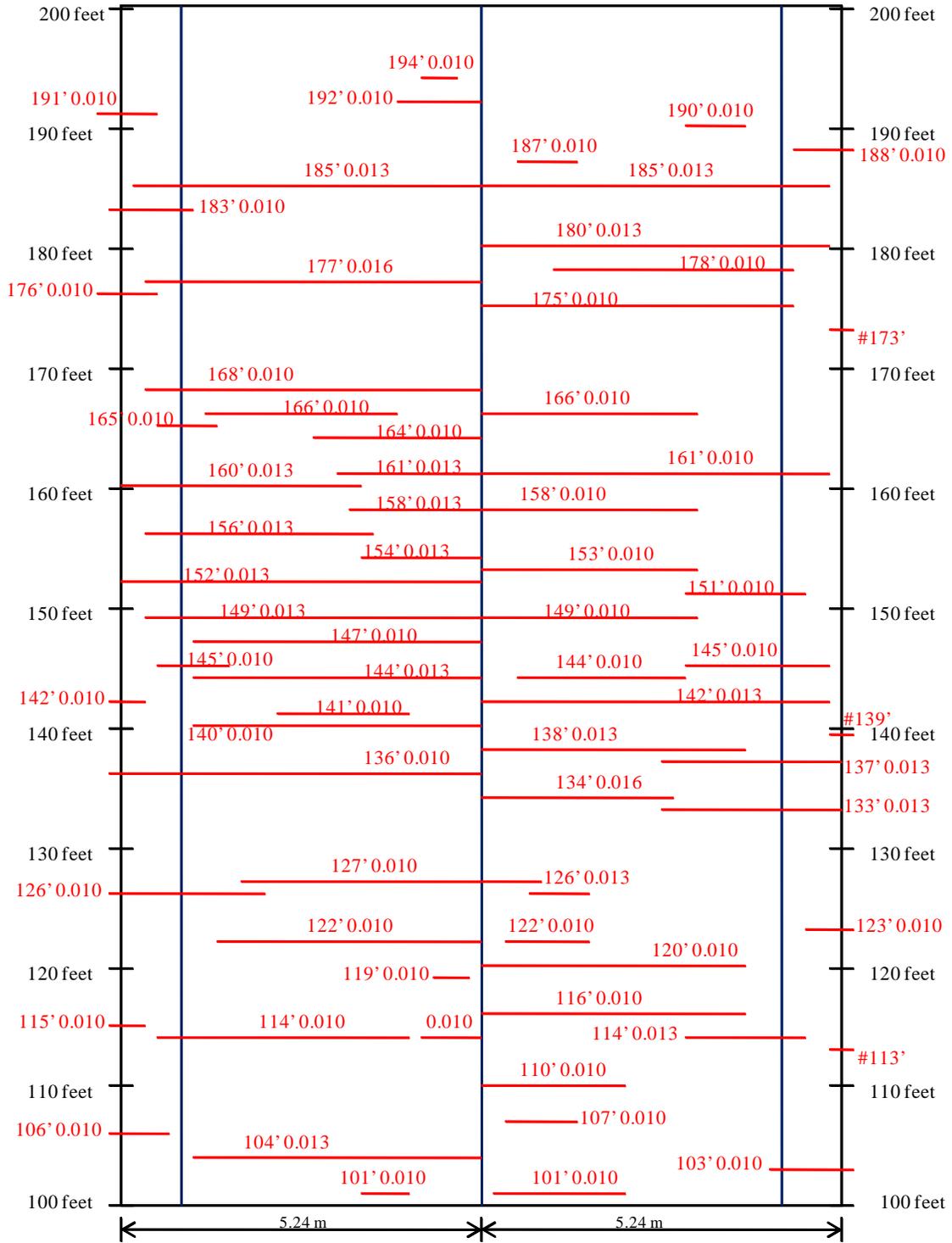
IL 143 over I – 70  
SN# 060-0151



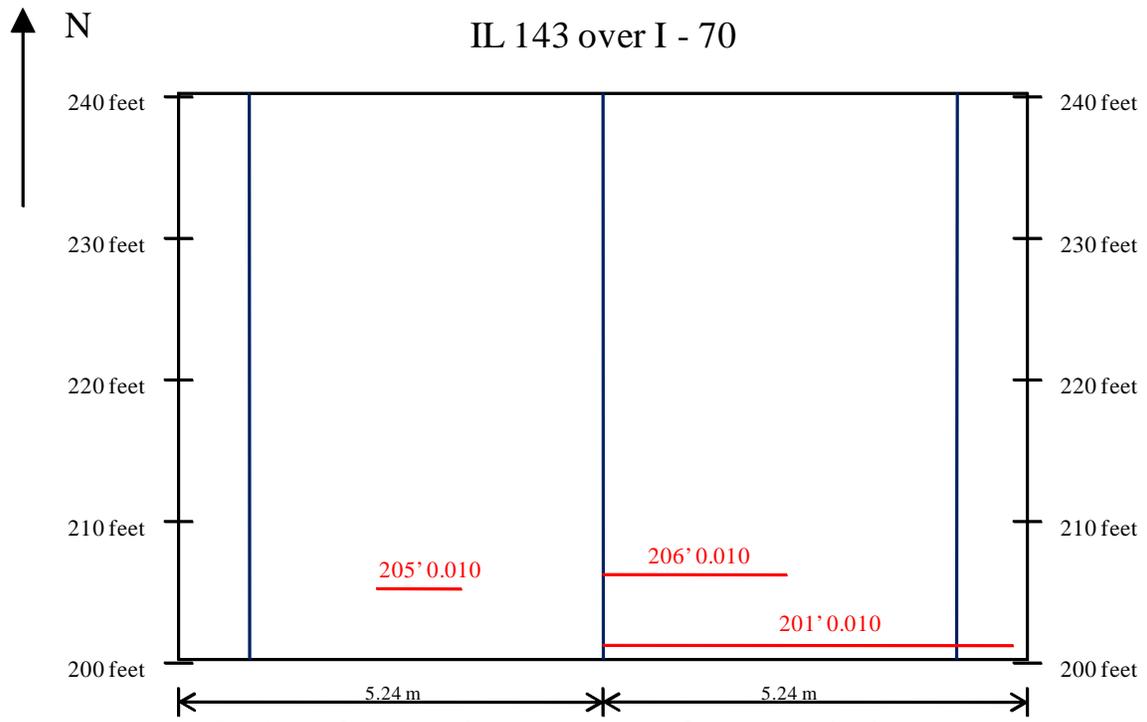
Madison County – SN# 060-0151 – Surveyed 9/28/2005



# IL 143 over I - 70



Madison County – SN# 060-0151 – Surveyed 9/28/2005



Madison County – SN# 060-0151 – Surveyed 9/28/2005  
 The “#” symbol represents cracks in the parapet only.



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 060-0004

Responsible District: 8

Number of Spans: 3

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  Semi-Integral  Other

ADT @ time bridge was built: 5,100 (2007)

Skew:  Y  N Angle: 38°16'00"

Inspected By: DAD,DHT,JAB

Date Inspected: 6/9/10

Span Lengths See below Total: 206'10¾"

Deck Width: 32'

Beam Spacing: 6'0"

Date of Beam Erection: 2002

Bridge Joint:  Integral  Finger  Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 2002 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: On top, cracking at 1'-3' spacing. On bottom, cracking at 3'-5' spacing in north and middle span.

Longitudinal Cracking: \_\_\_\_\_

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span lengths: 1&3) 61' 2", 2) 78'9"

Steel beams were from 1939.

**Mix Design Information: (from MISTIC)**

Mix Design Number: 86PCC2985

Coarse Aggregate Source: Material Service  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: Sang-Chris S & G Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

Cement Source: \_\_\_\_\_

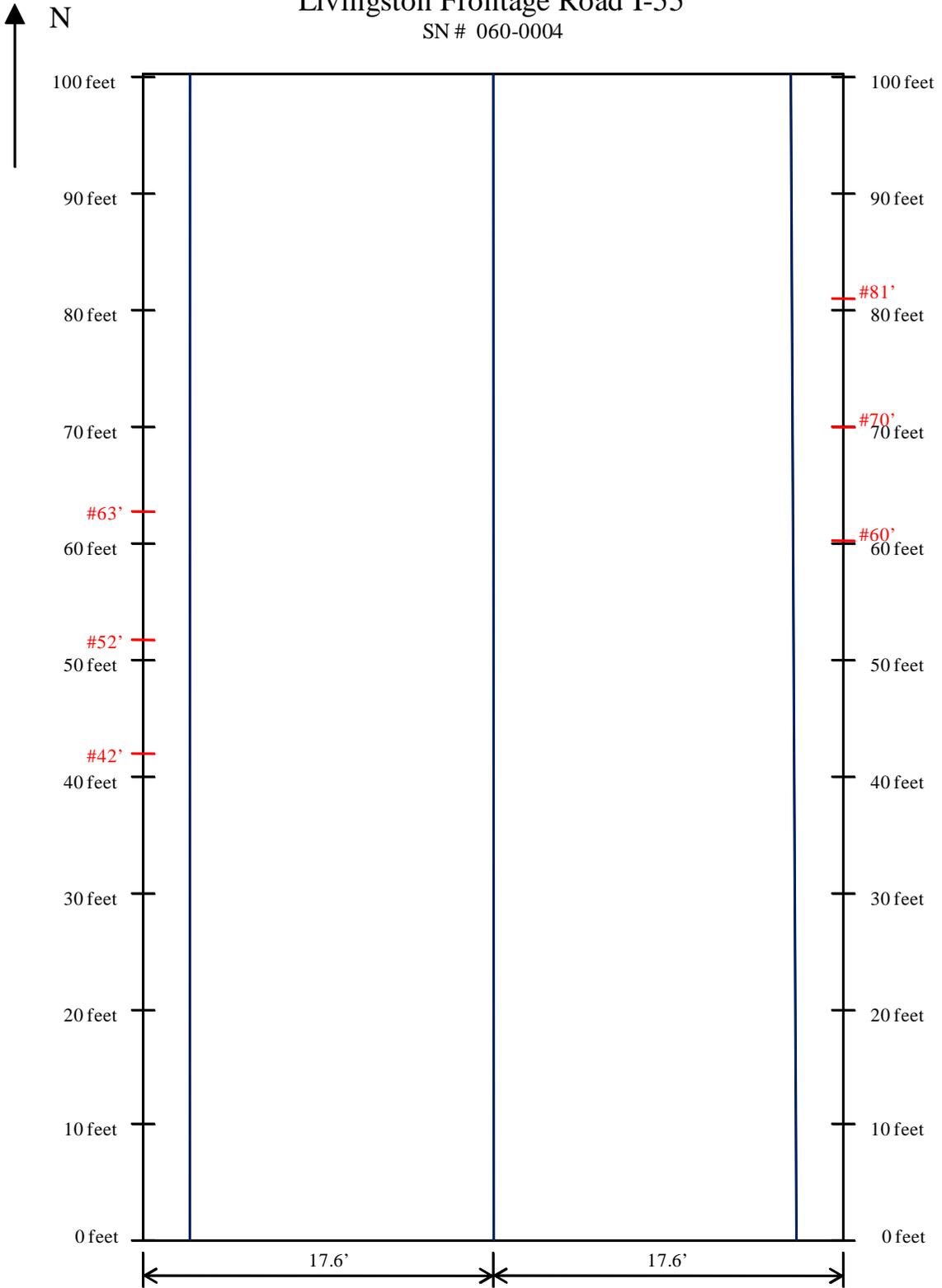
GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: Headwaters Resources

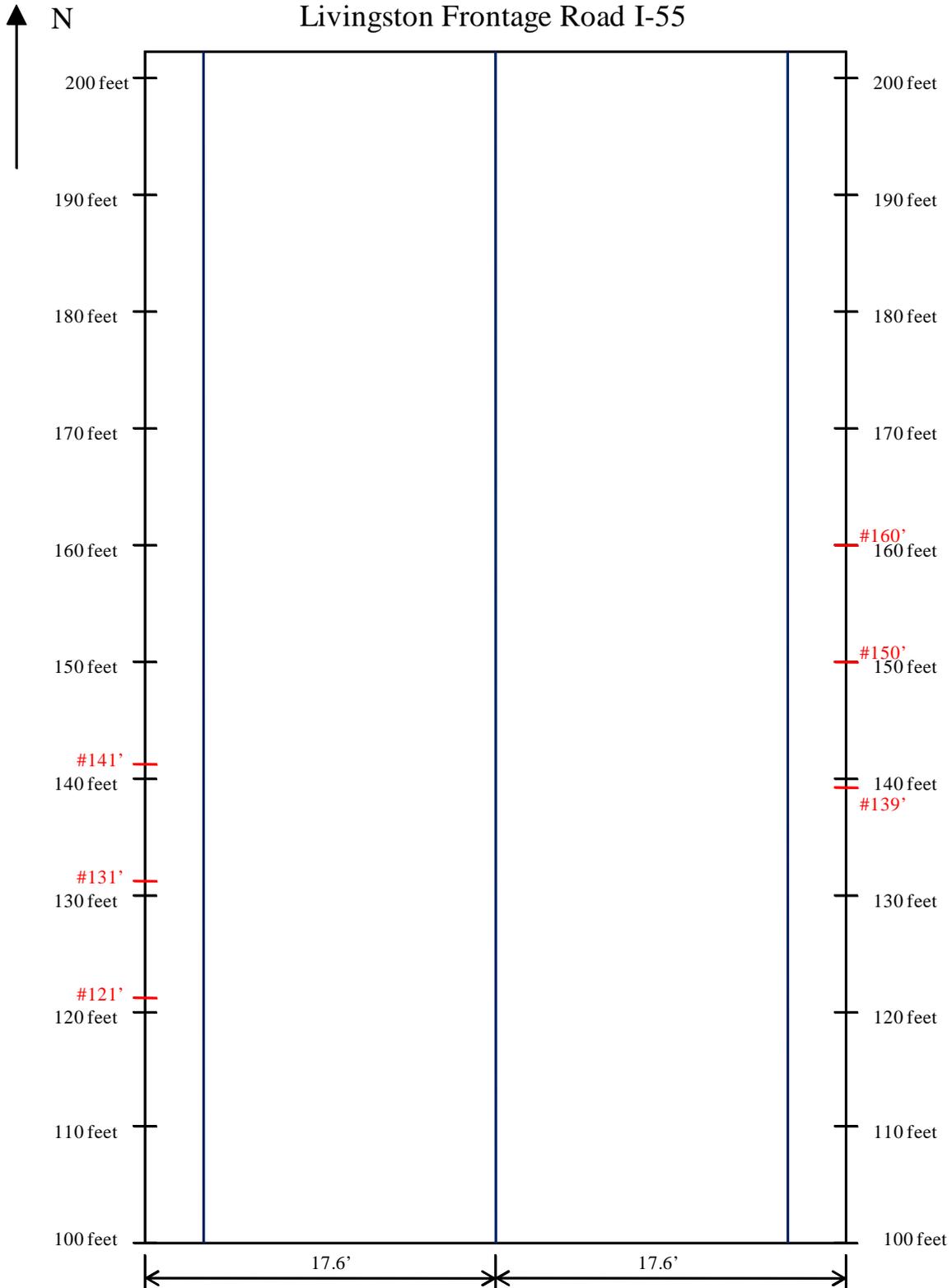
Microsilica Source: Elkem Materials Inc.

# Livingston Frontage Road I-55

SN # 060-0004

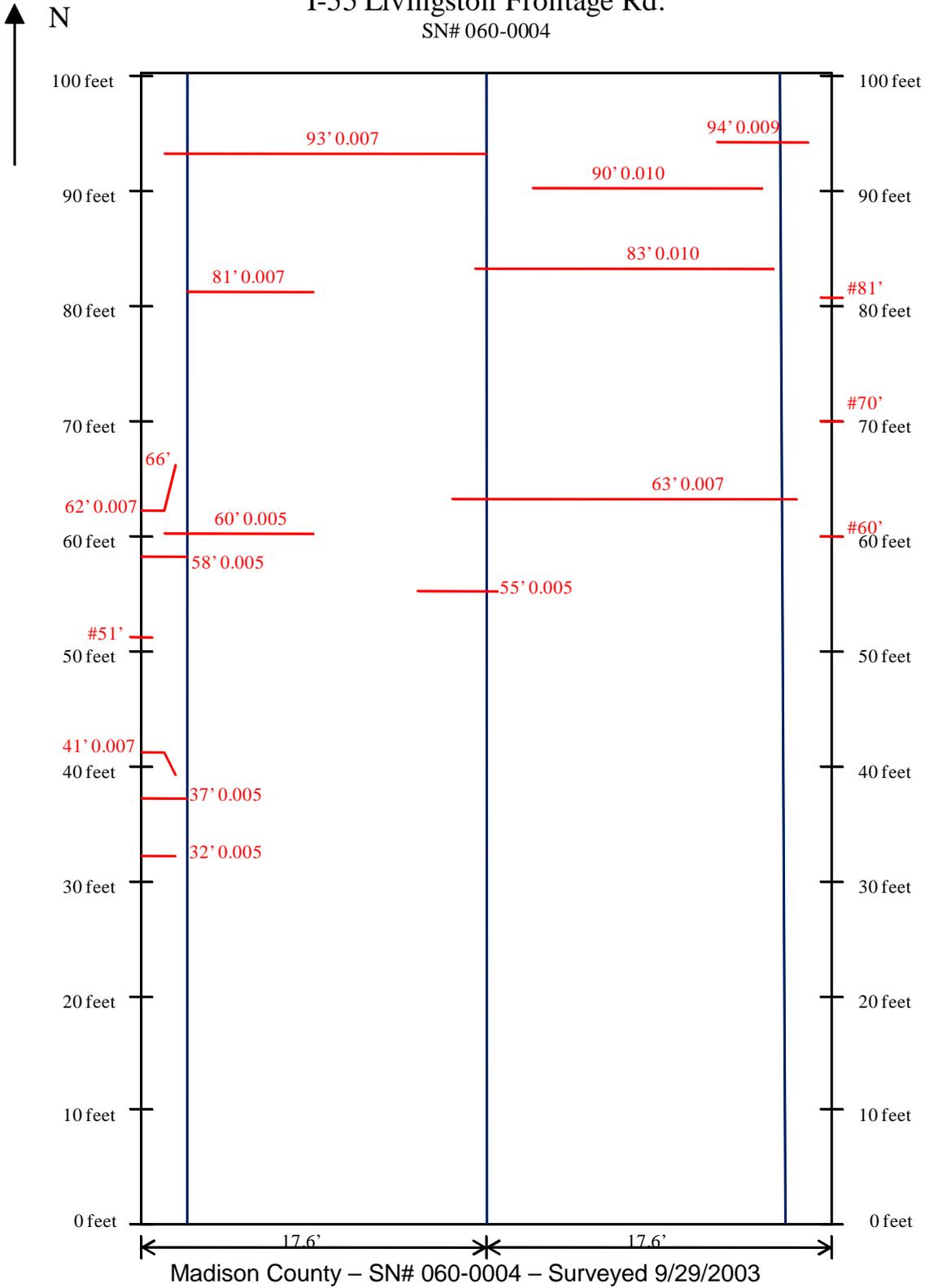


Madison County – SN# 060-0004 – Surveyed 8/12/2002



Madison County – SN# 060-0004 – Surveyed 8/12/2002  
 The “#” symbol represents cracks in the parapet only.

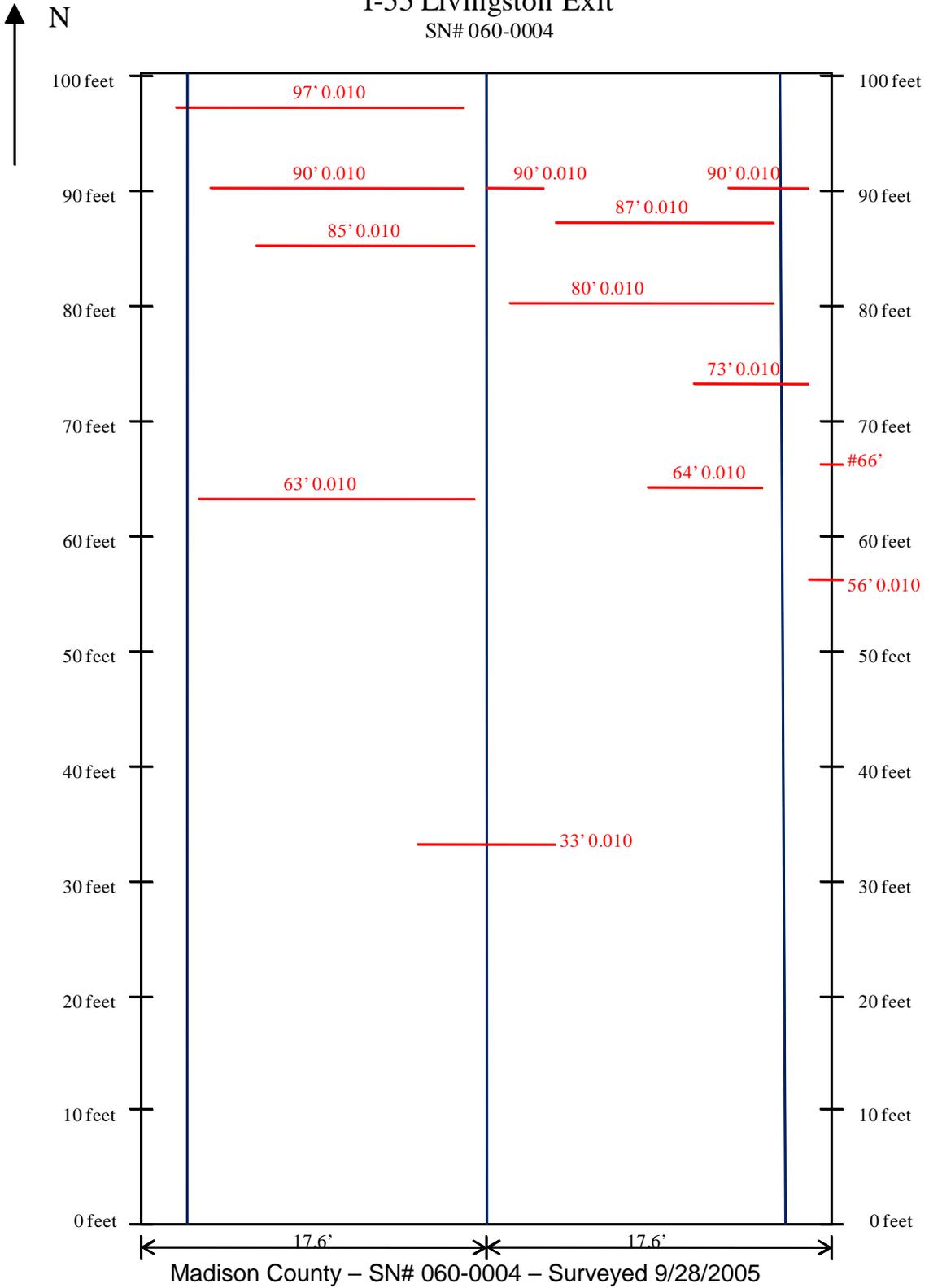
I-55 Livingston Frontage Rd.  
SN# 060-0004



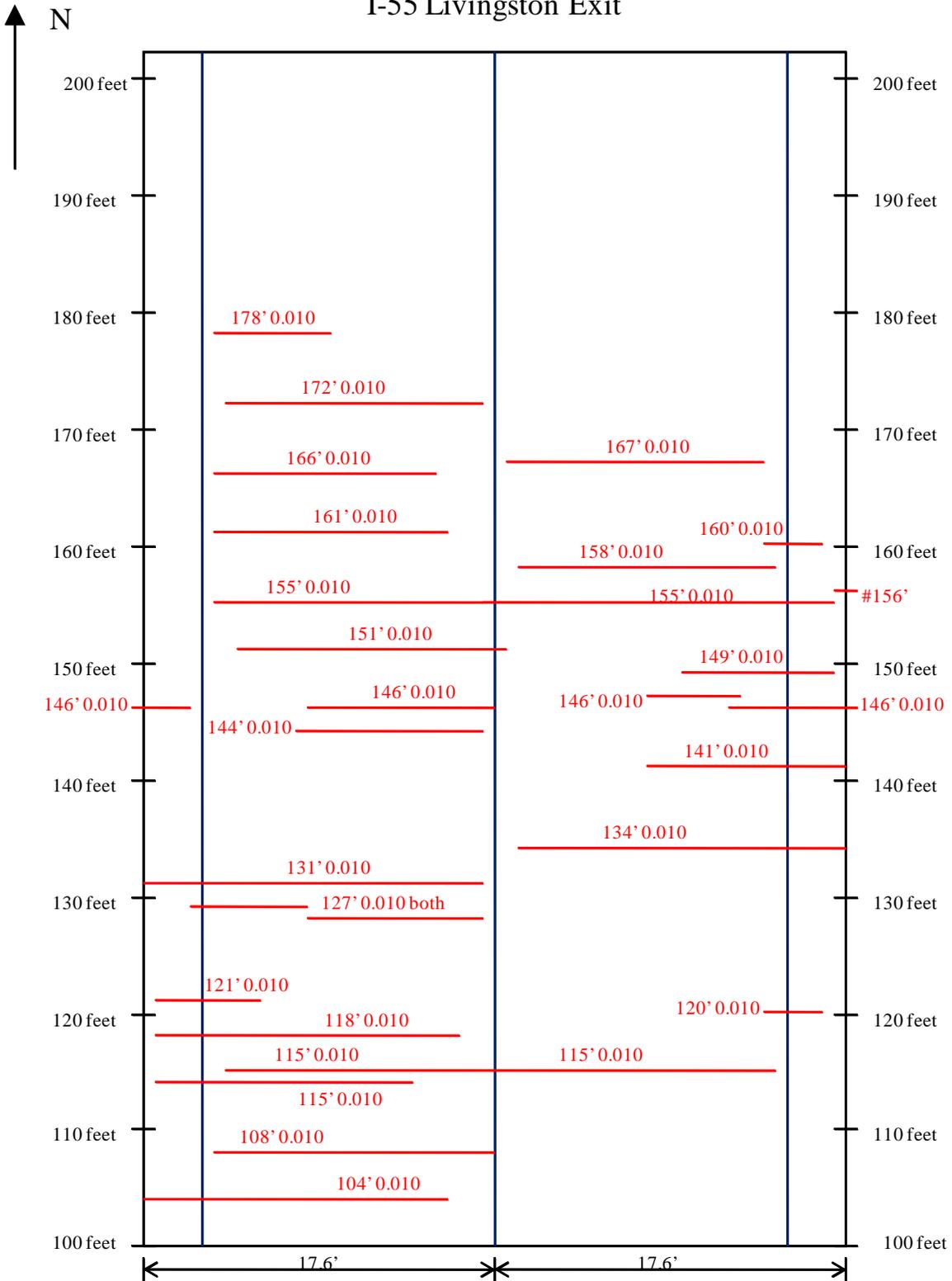


# I-55 Livingston Exit

SN# 060-0004



# I-55 Livingston Exit



Madison County – SN# 060-0004 – Surveyed 9/28/2005  
 The “#” symbol represents cracks in the parapet only.

## Mason/Menard County



# Illinois Department of Transportation

## High Performance Concrete Bridge Deck Inspection Feedback

Structure Number: 065-0501

Responsible District: 6

Number of Spans: 10

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

ADT @ time bridge was built: 1,900 (2007)

Skew:  Y  N Angle: 35°

Inspected By: DAD, DHT, JAB, FHWA

Date Inspected: 6/29/09

Span Lengths See below Total: 1341'8"

Deck Width: 32'

Beam Spacing: 5'10" & 9'0"

Date of Beam Erection: 2002

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 2002 Stage 2, \_\_\_\_\_

### Description of Cracking:

Average Transverse Crack Distance: The center spans used steel beams. The spans with steel beams had cracks 6' to 7' apart, 2' to 3' apart at times. The approach spans used PPC-I beams and had few cracks.

Longitudinal Cracking: none

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

### Other Observations:

Span lengths: PPC-I beams: (1 & 10) 96'9"; (2, 8, & 9) 97'8"; (3 & 7) 98'5½"; Steel beams: (4 & 6) 201'2¼"; (5) 240'0"

### Mix Design Information: (from MISTIC)

Mix Design Number: 86PCC3034

Coarse Aggregate Source: Central Stone (CM 11)  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: Otter Creek S & G Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

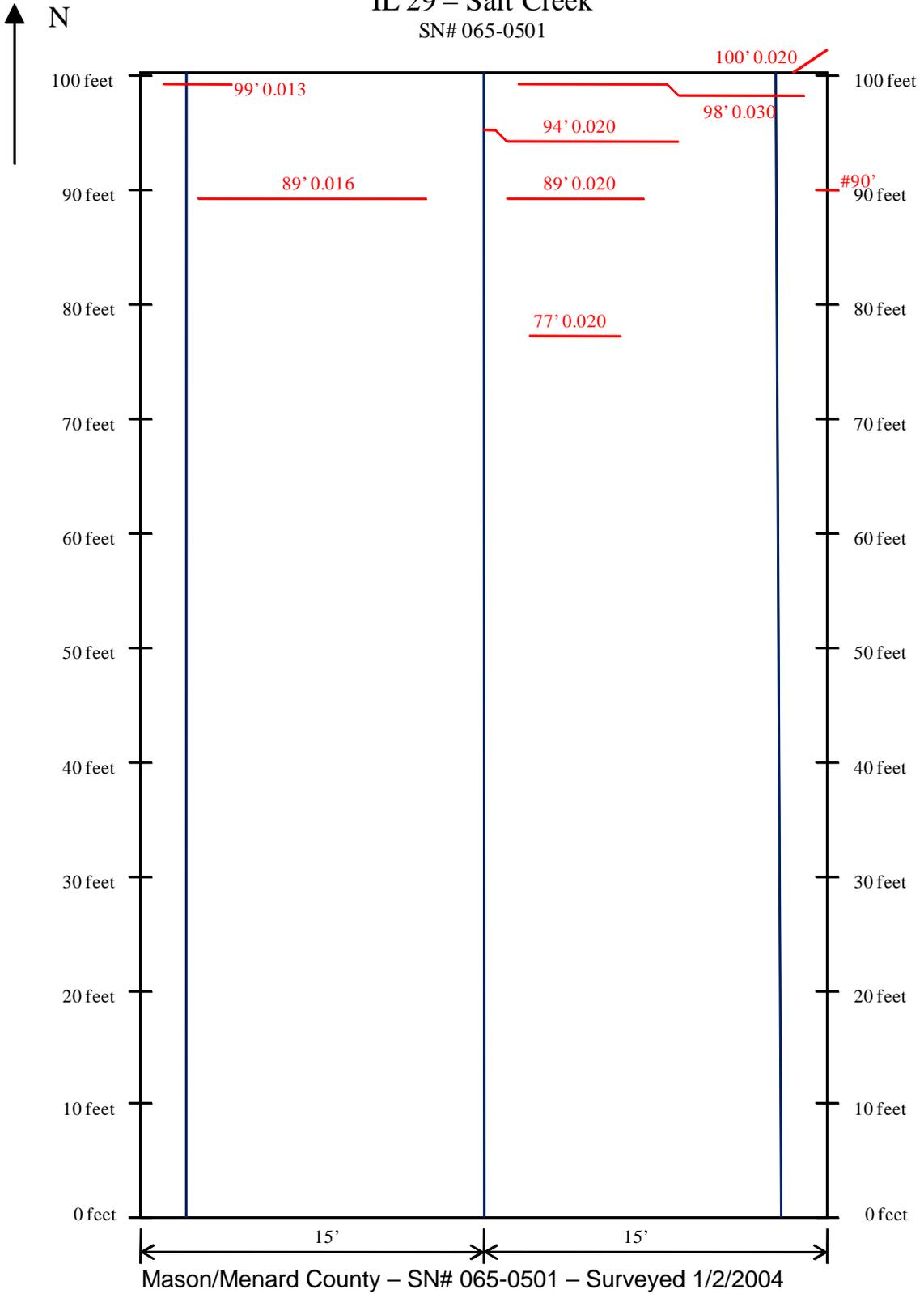
Cement Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

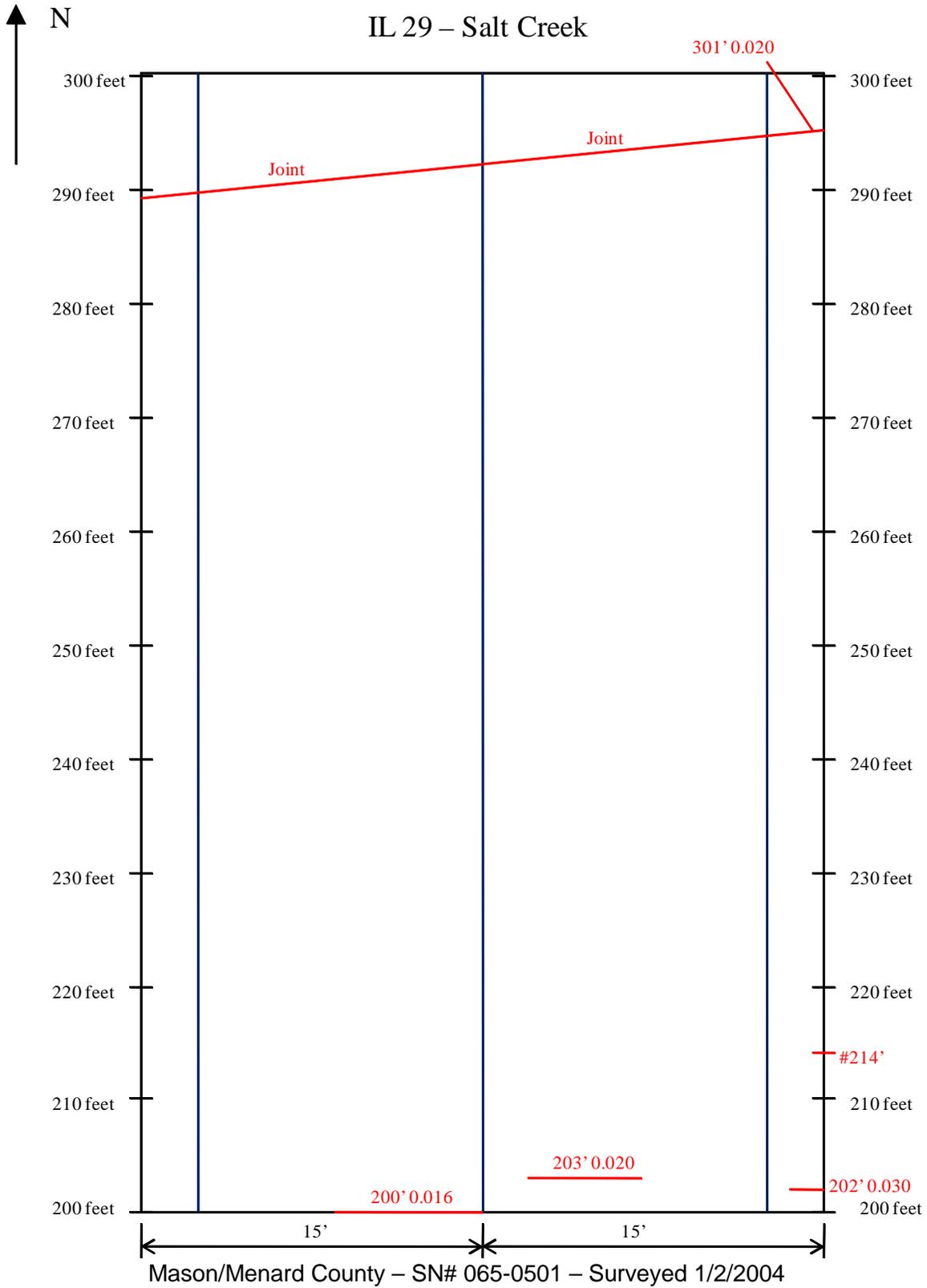
Fly Ash Source: \_\_\_\_\_

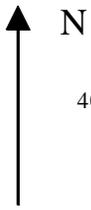
Microsilica Source: Elkem Materials Inc.

IL 29 – Salt Creek  
SN# 065-0501

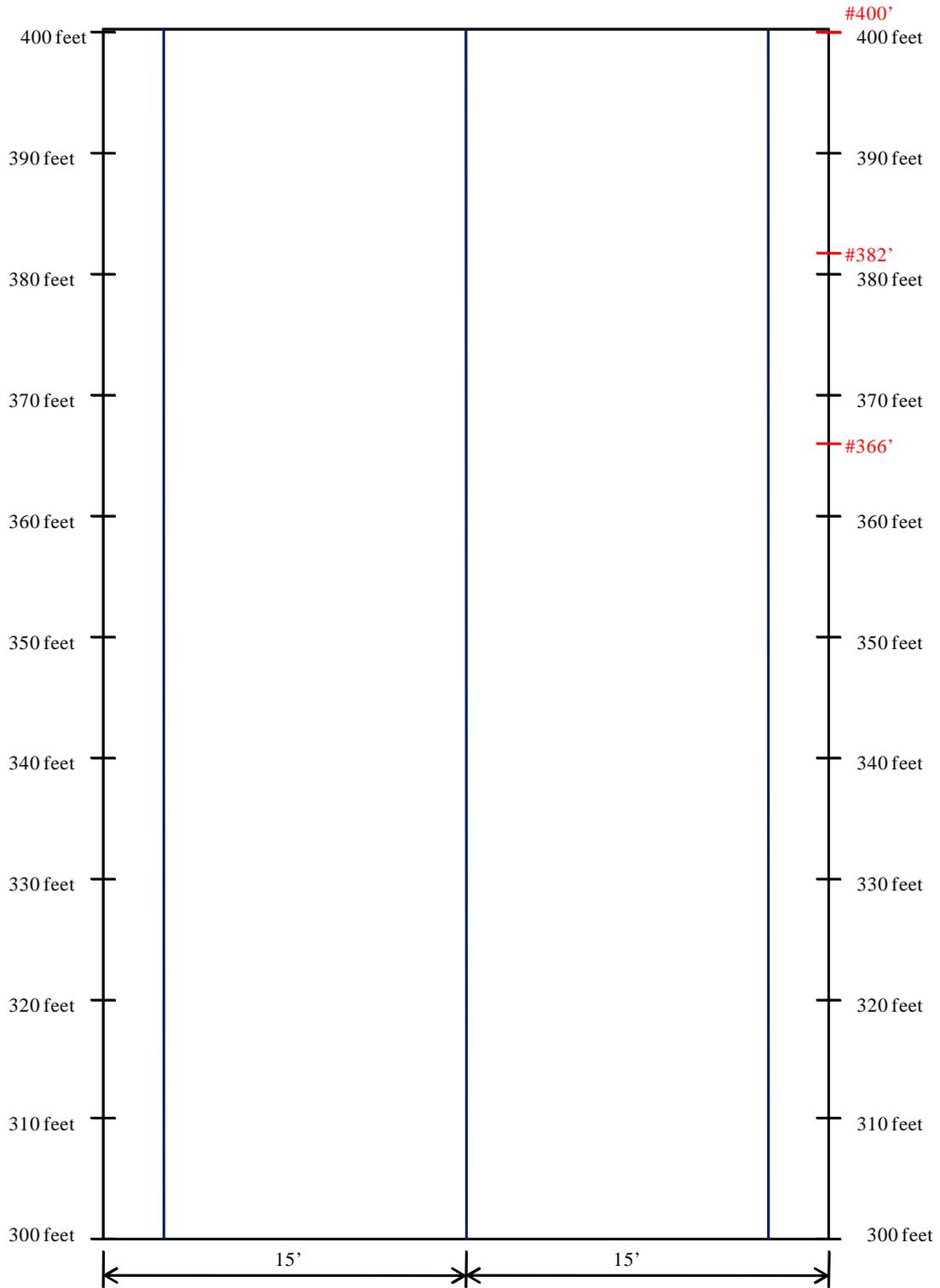




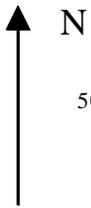




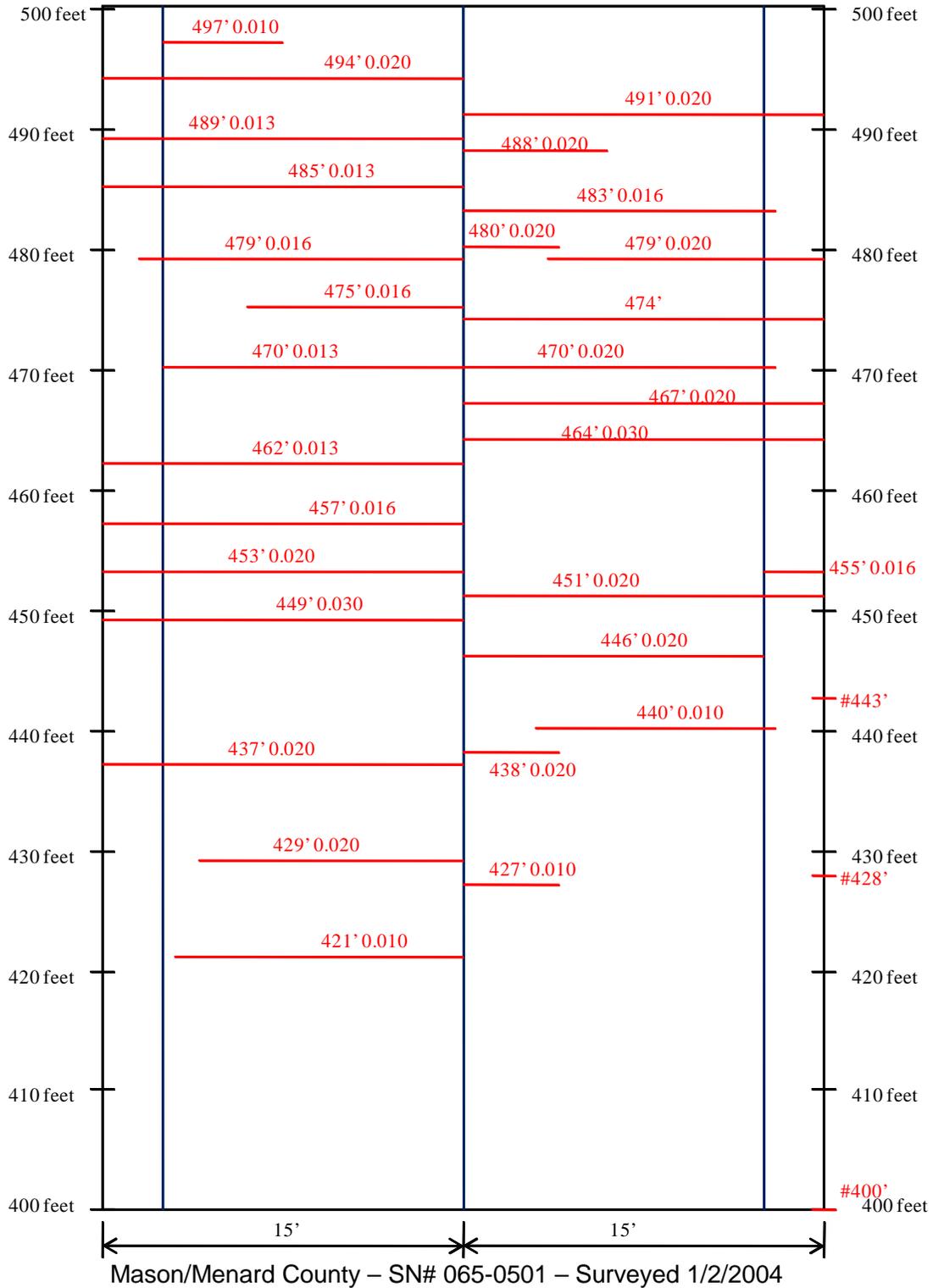
# IL 29 – Salt Creek



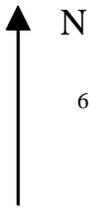
Mason/Menard County – SN# 065-0501 – Surveyed 1/2/2004



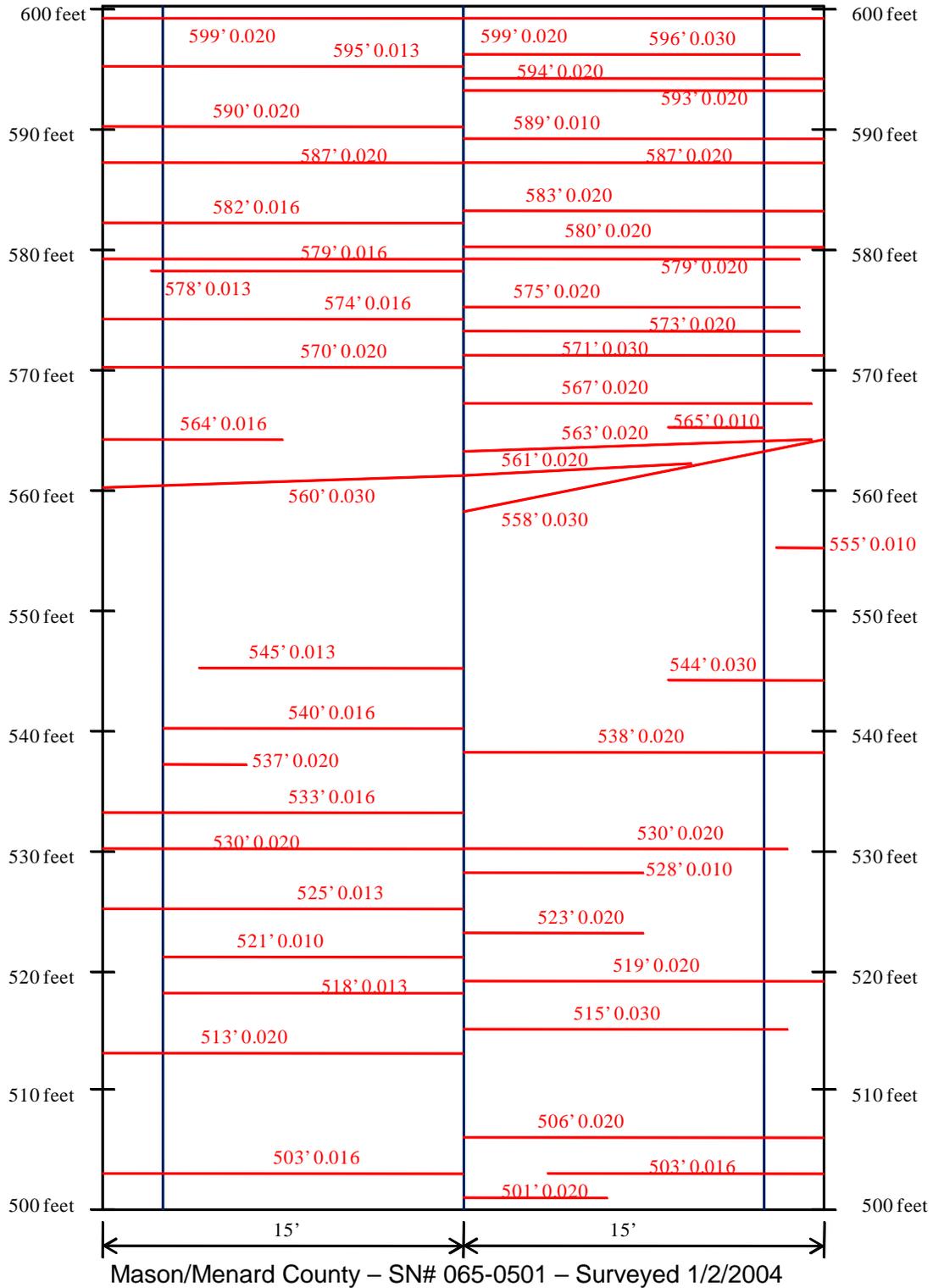
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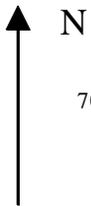


Mason/Menard County – SN# 065-0501 – Surveyed 1/2/2004

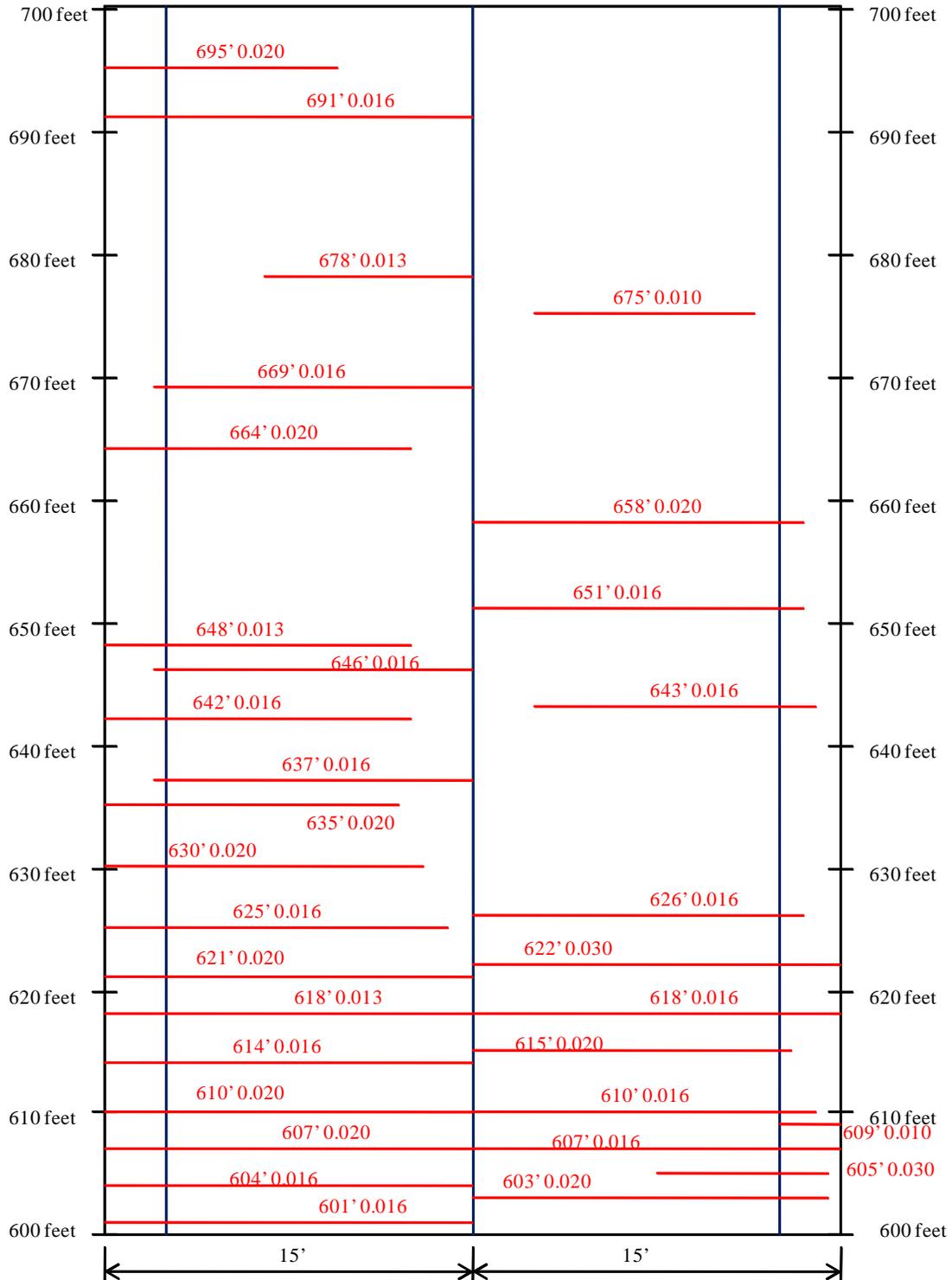


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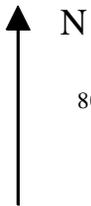




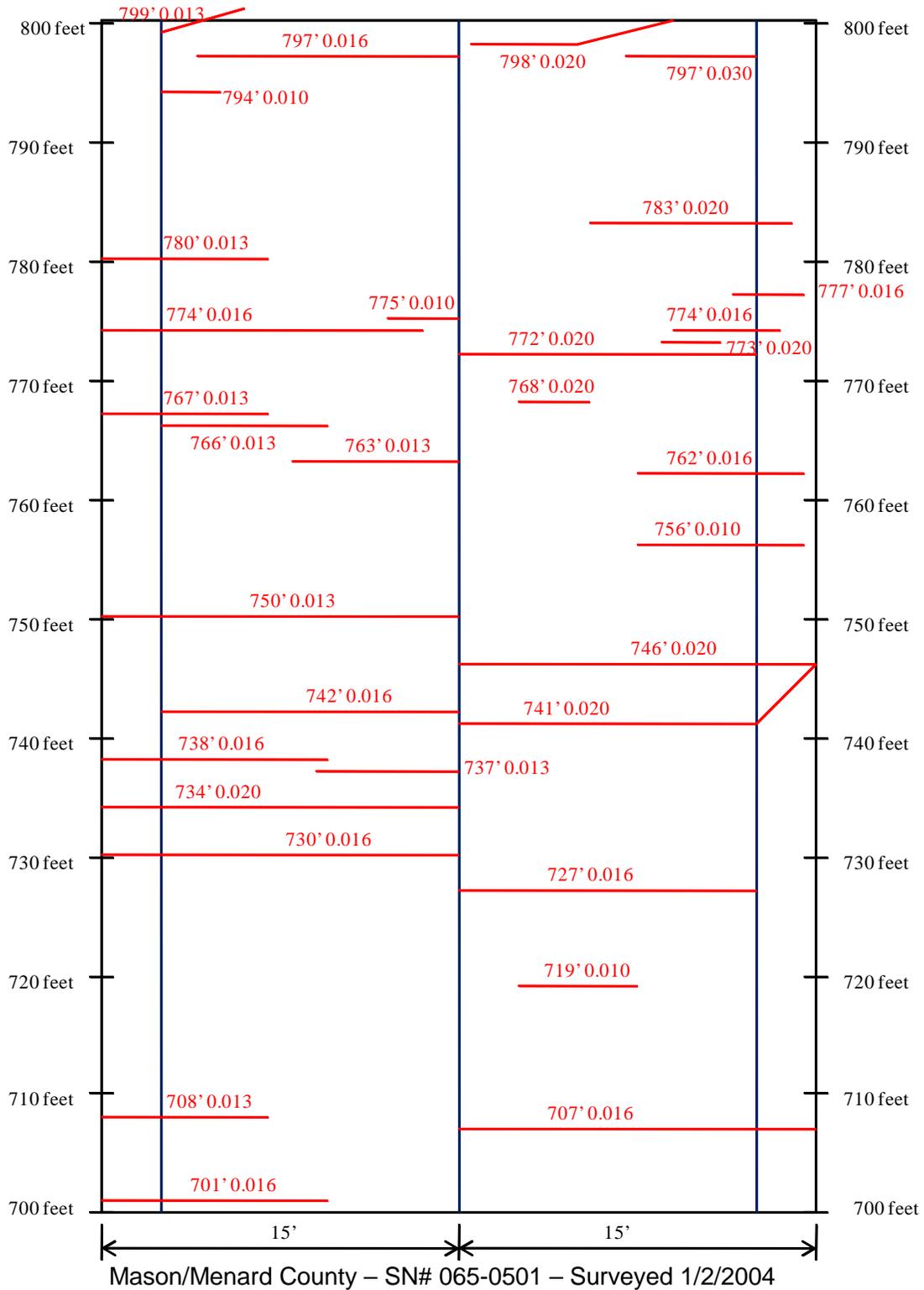
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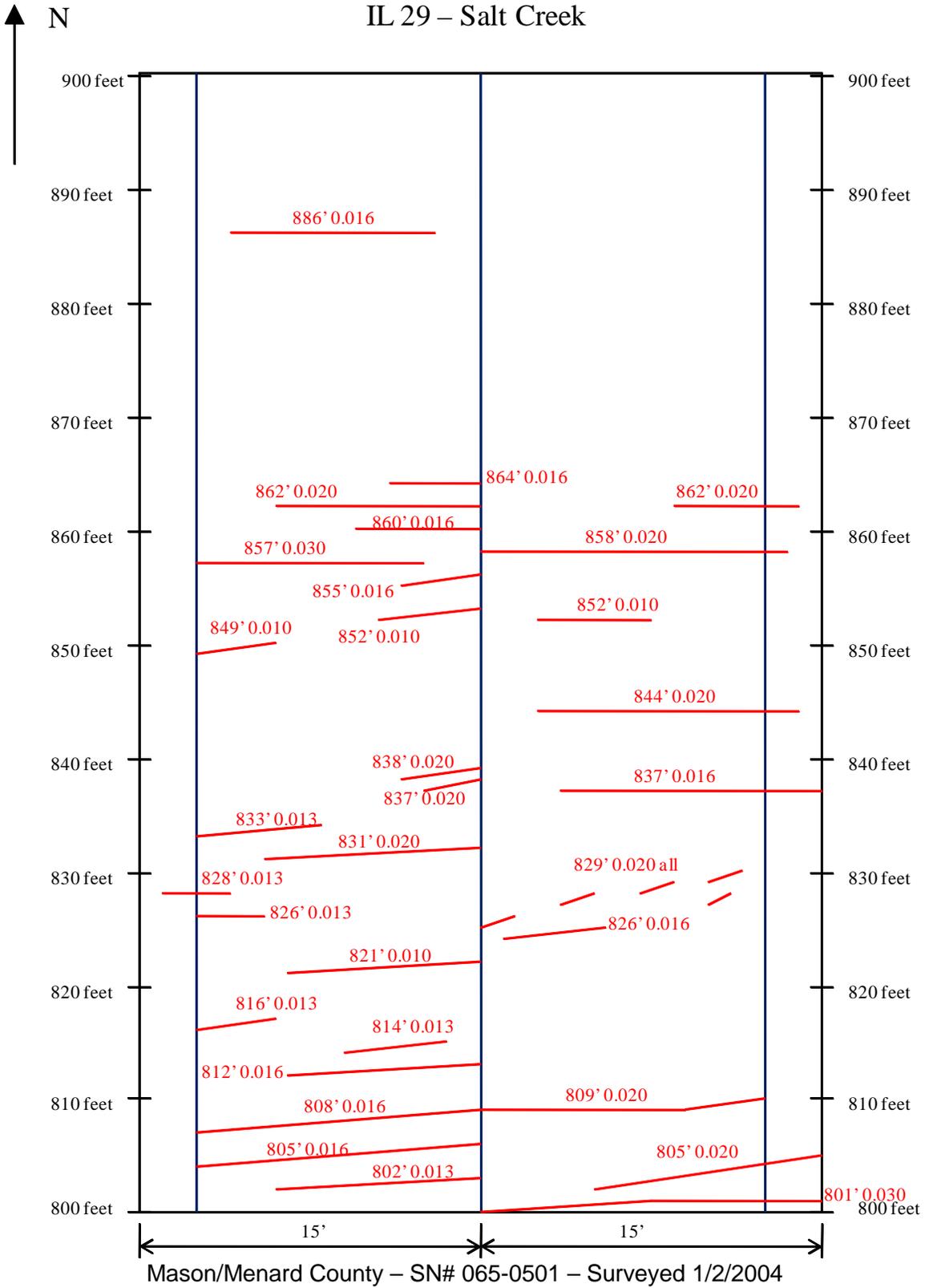
Mason/Menard County – SN# 065-0501 – Surveyed 1/2/2004

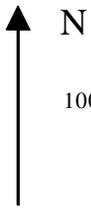


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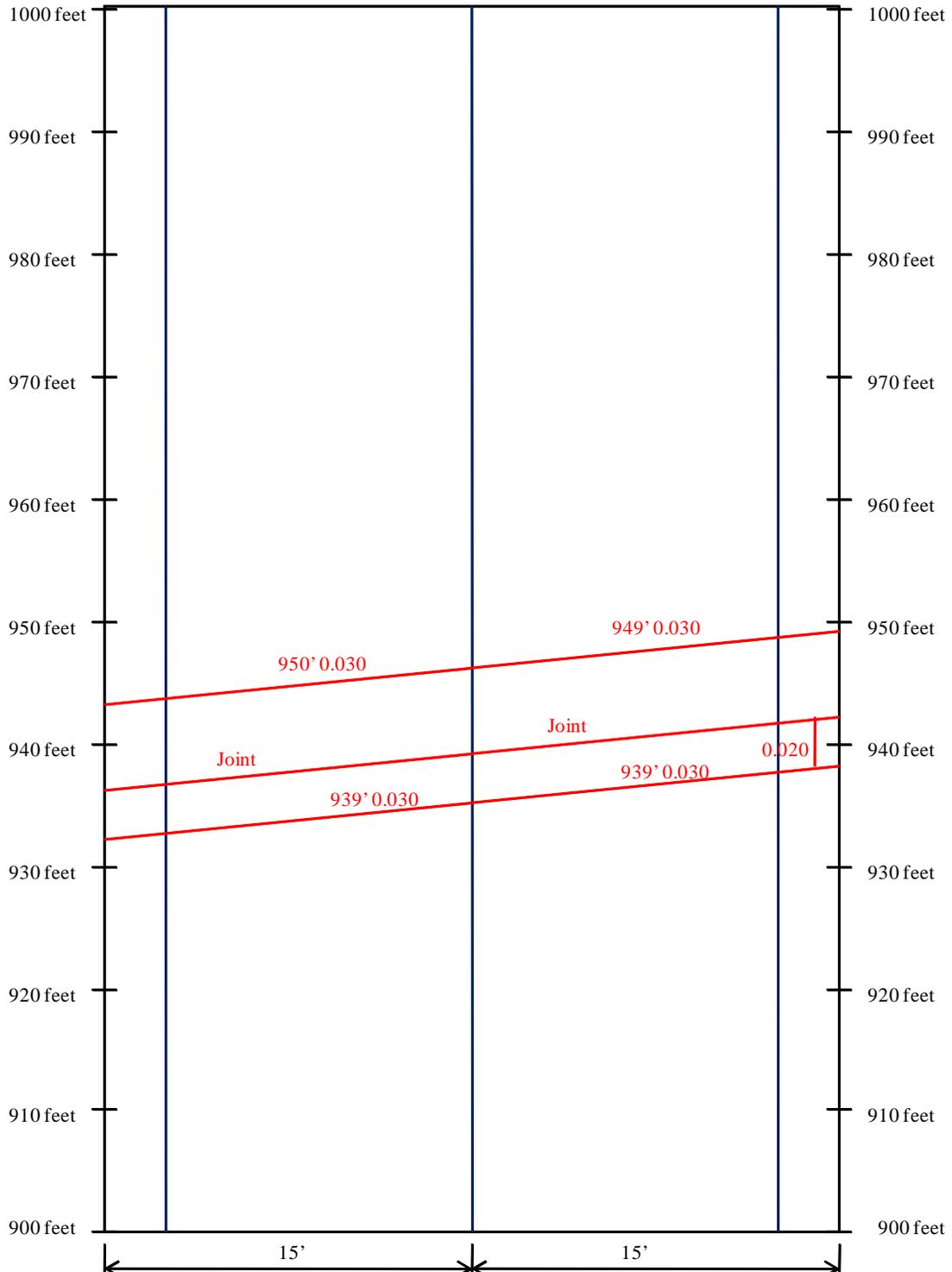


# IL 29 – Salt Creek

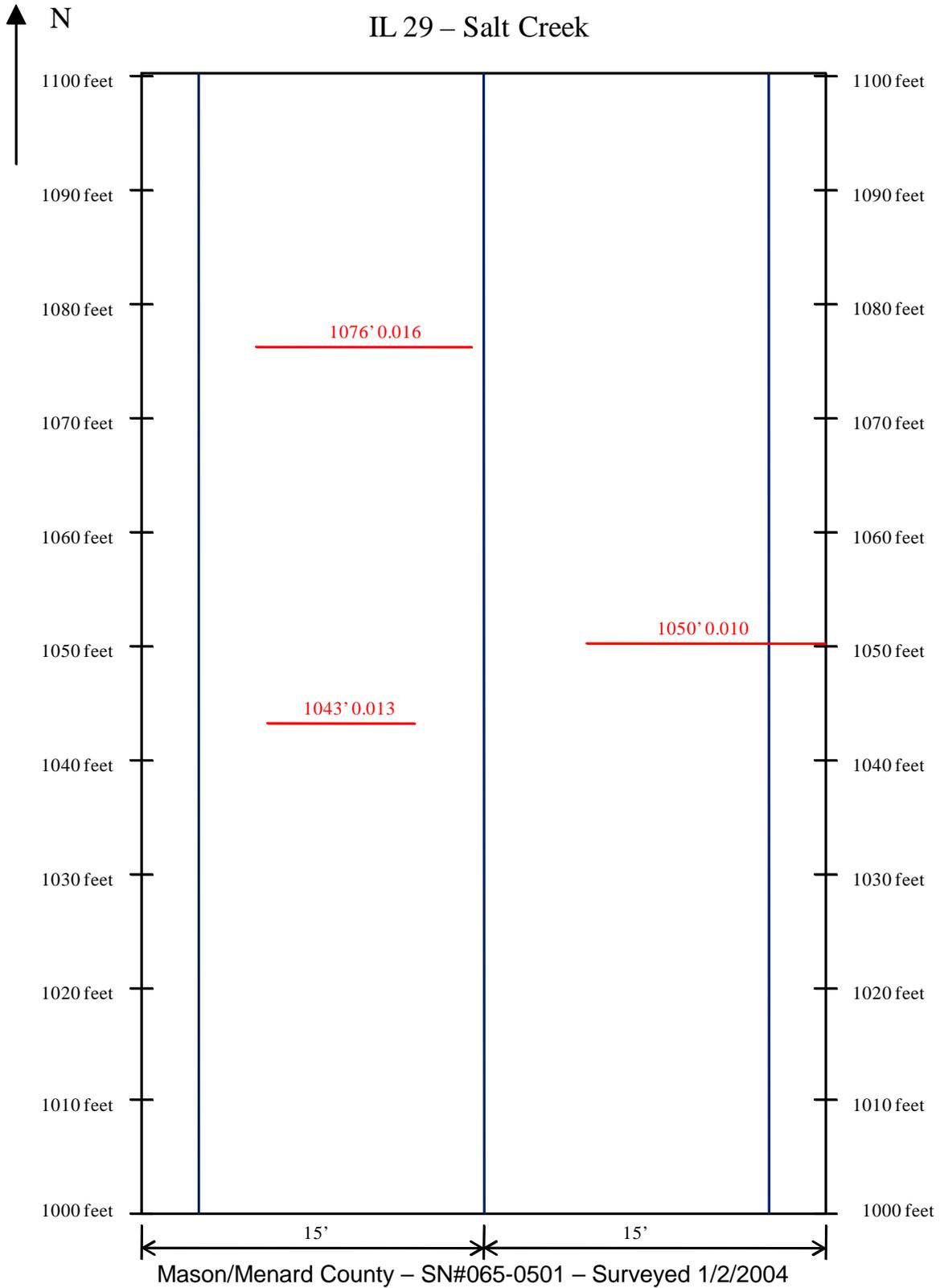


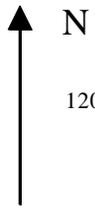


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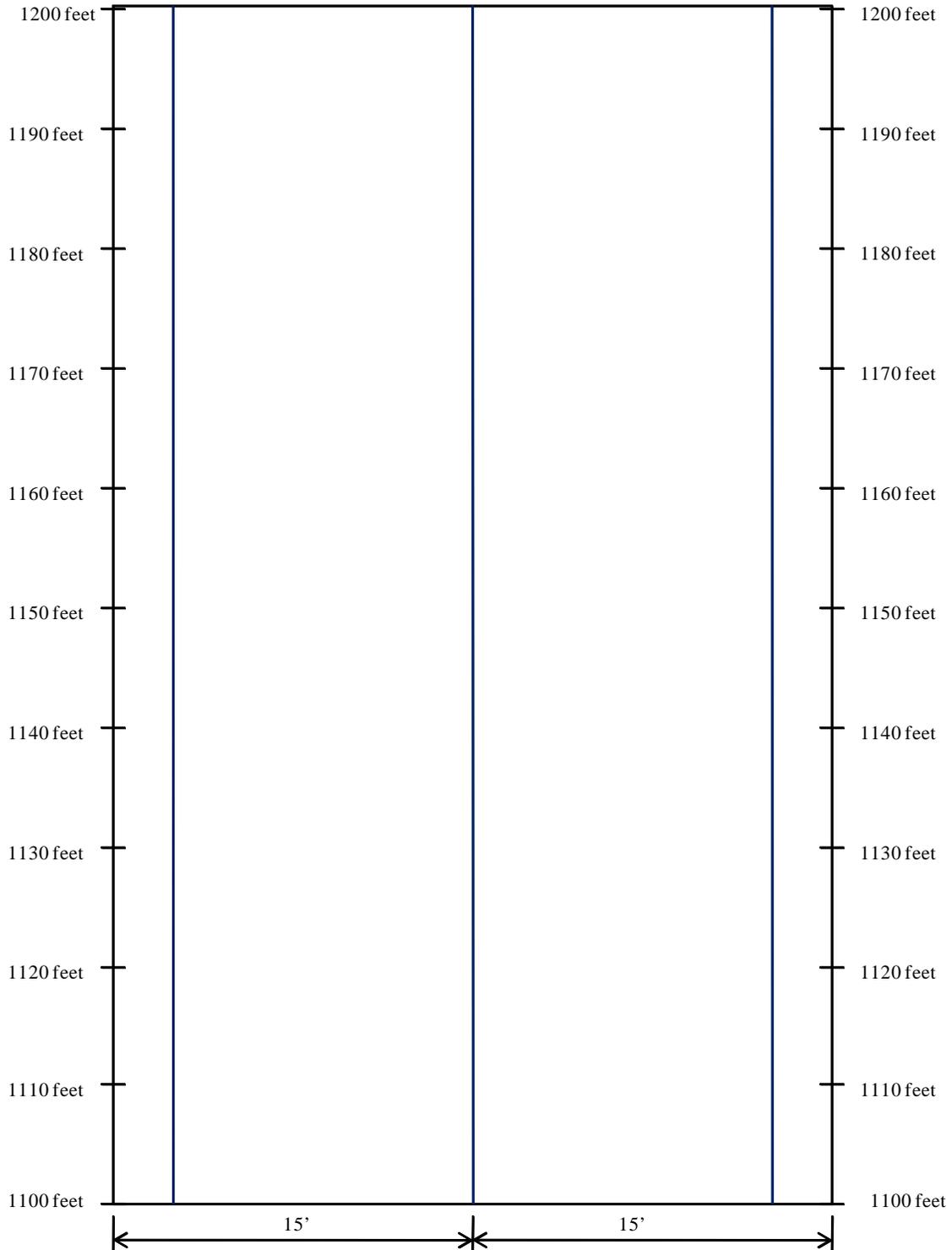


Mason/Menard County – SN# 065-0501 – Surveyed 1/2/2004

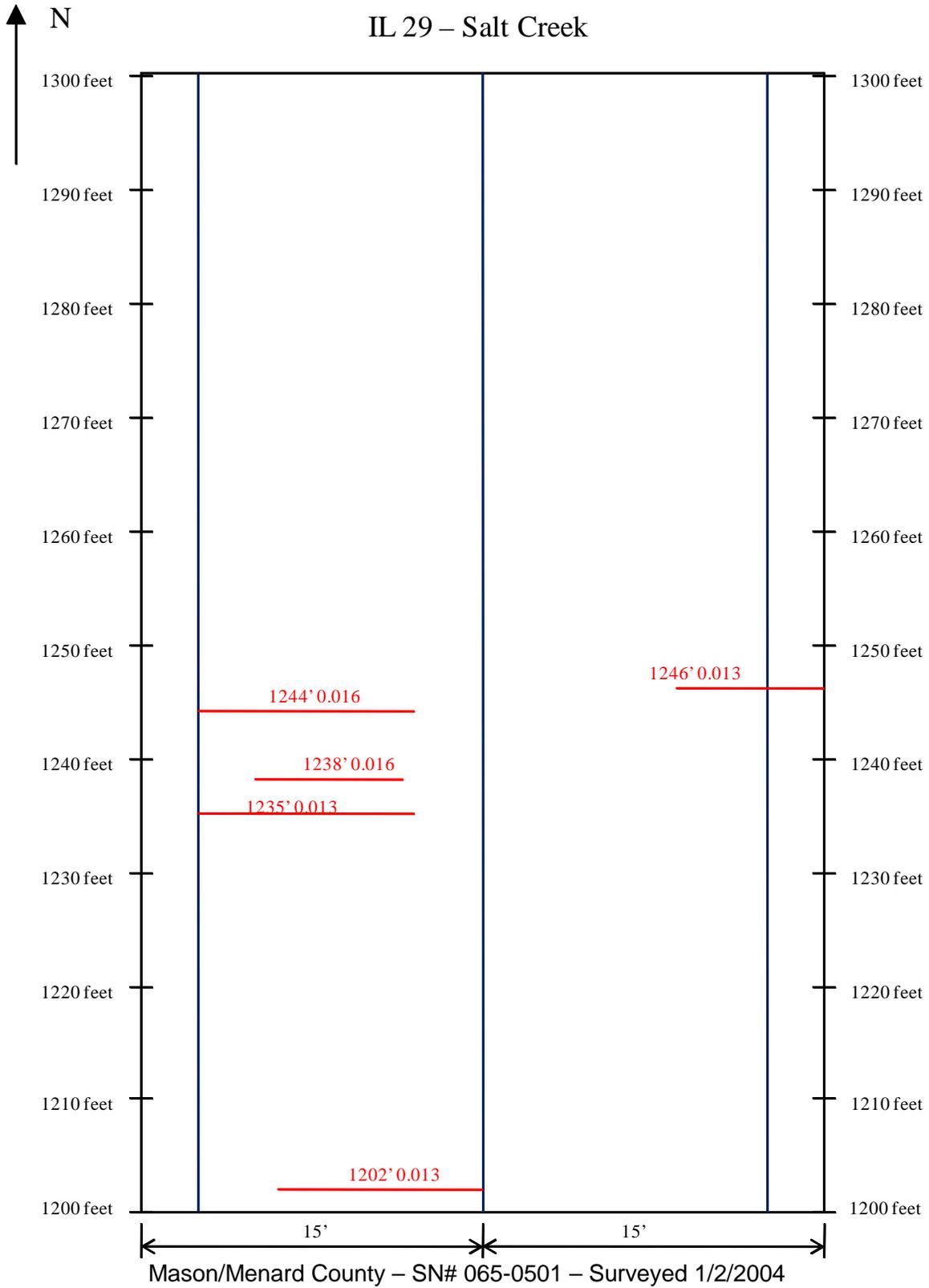


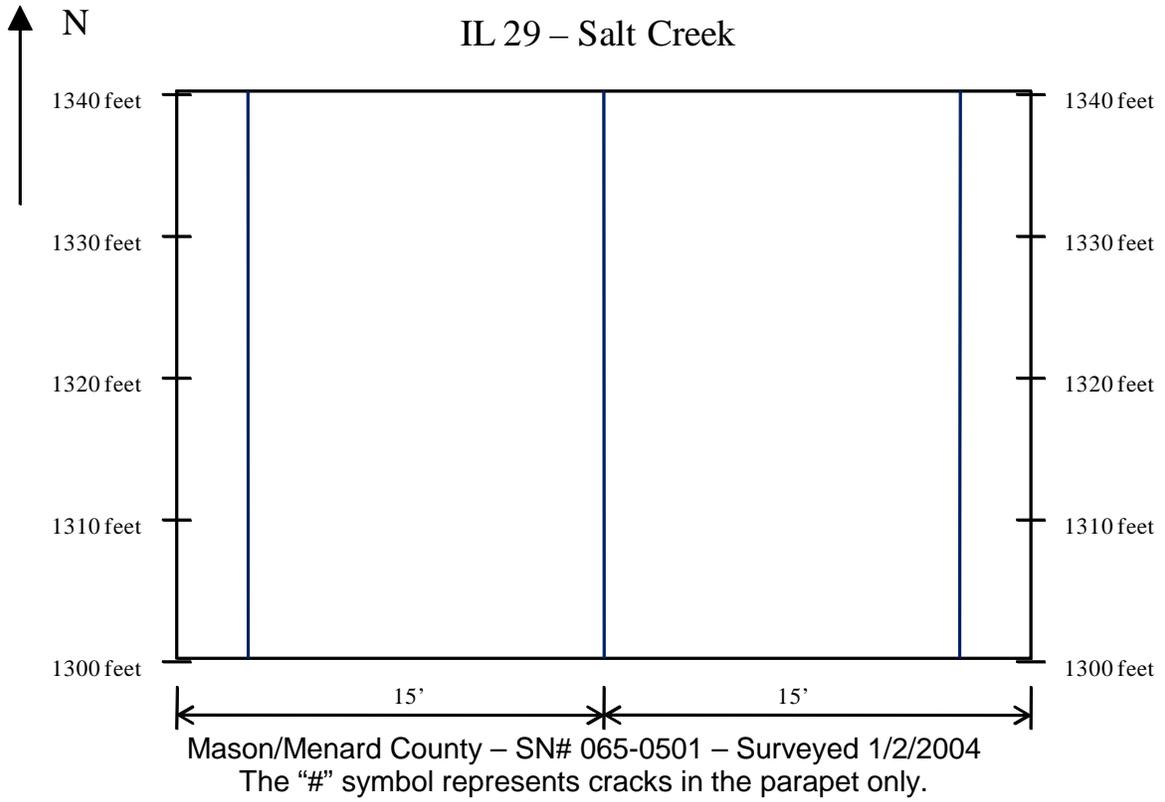


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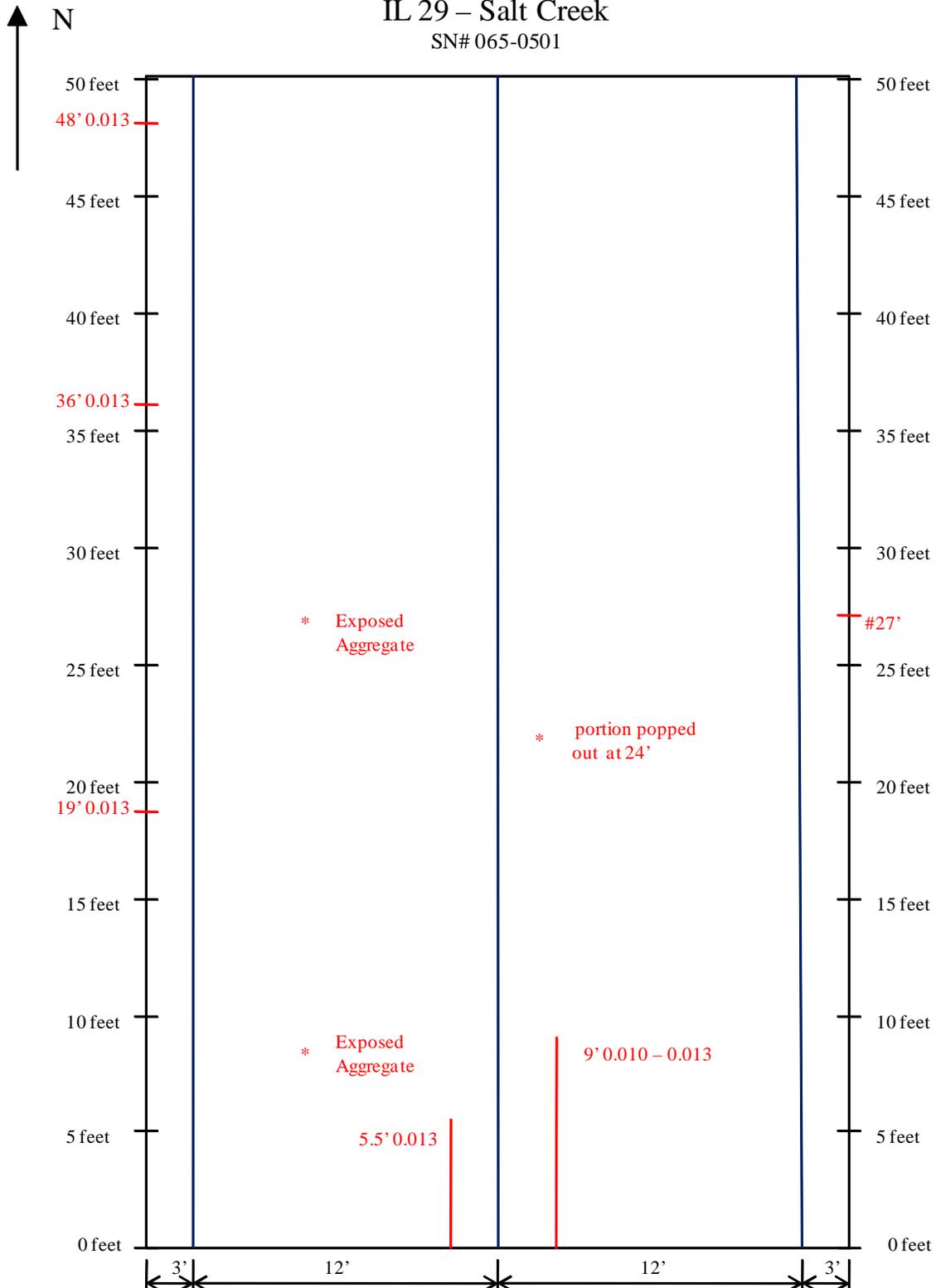


Mason/Menard County – SN# 065-0501 – Surveyed 1/2/2004

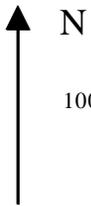




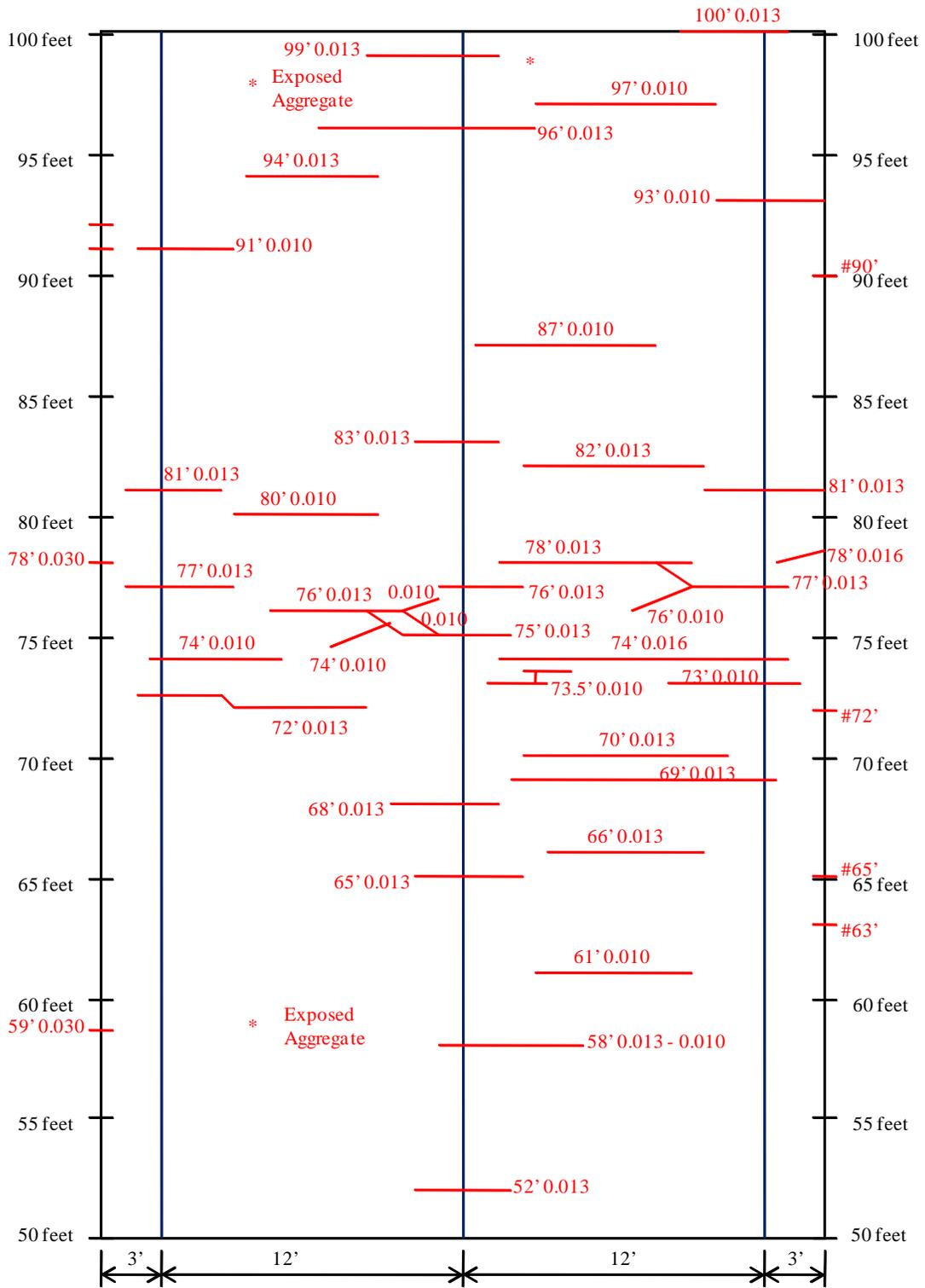
IL 29 – Salt Creek  
SN# 065-0501



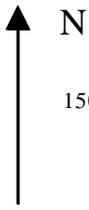
Mason/Menard County – SN# 065-0501 – Surveyed 10/2/2008, 10/20/2008



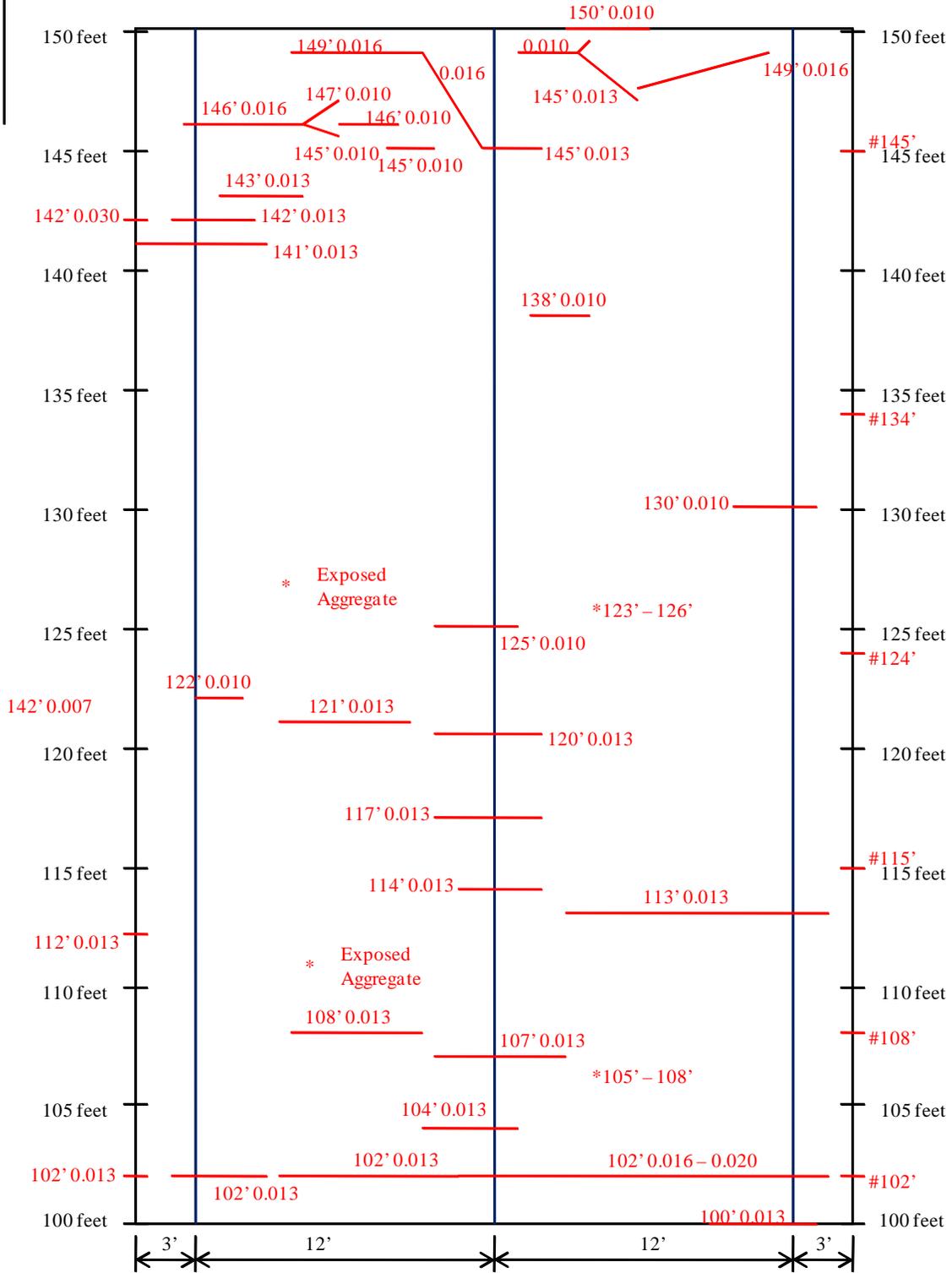
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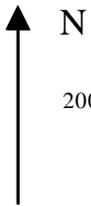
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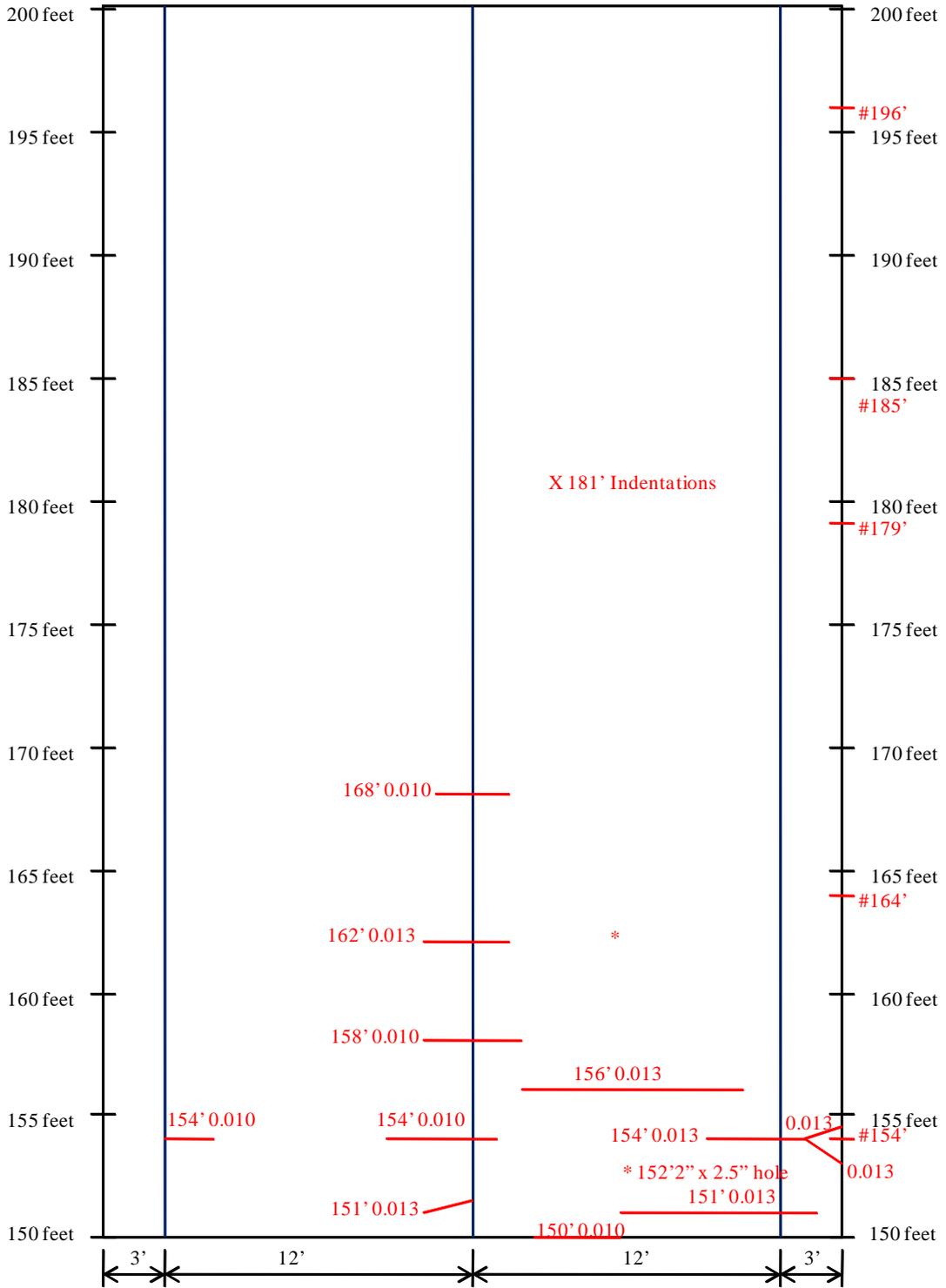
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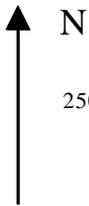
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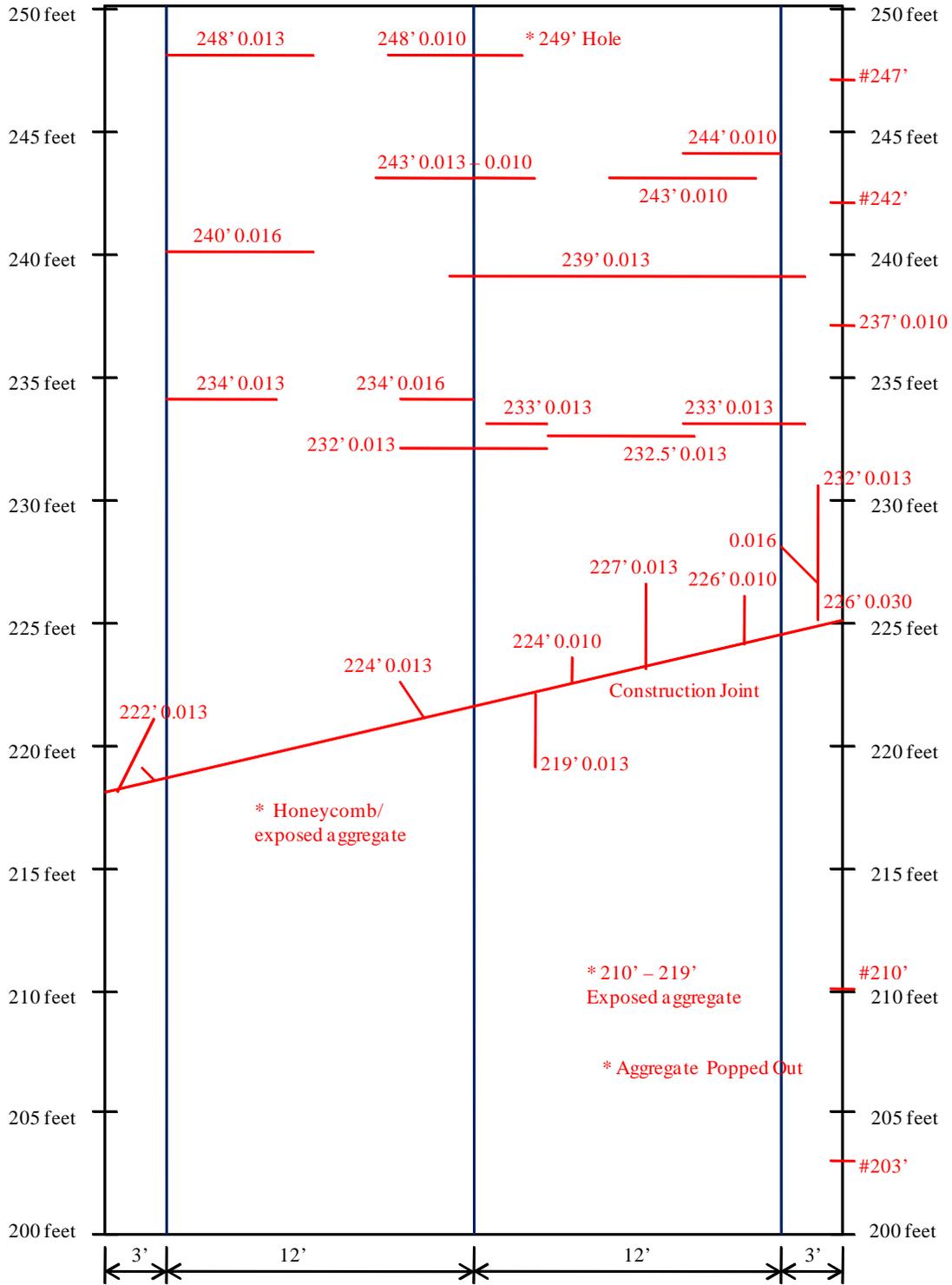
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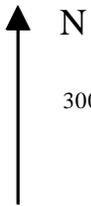
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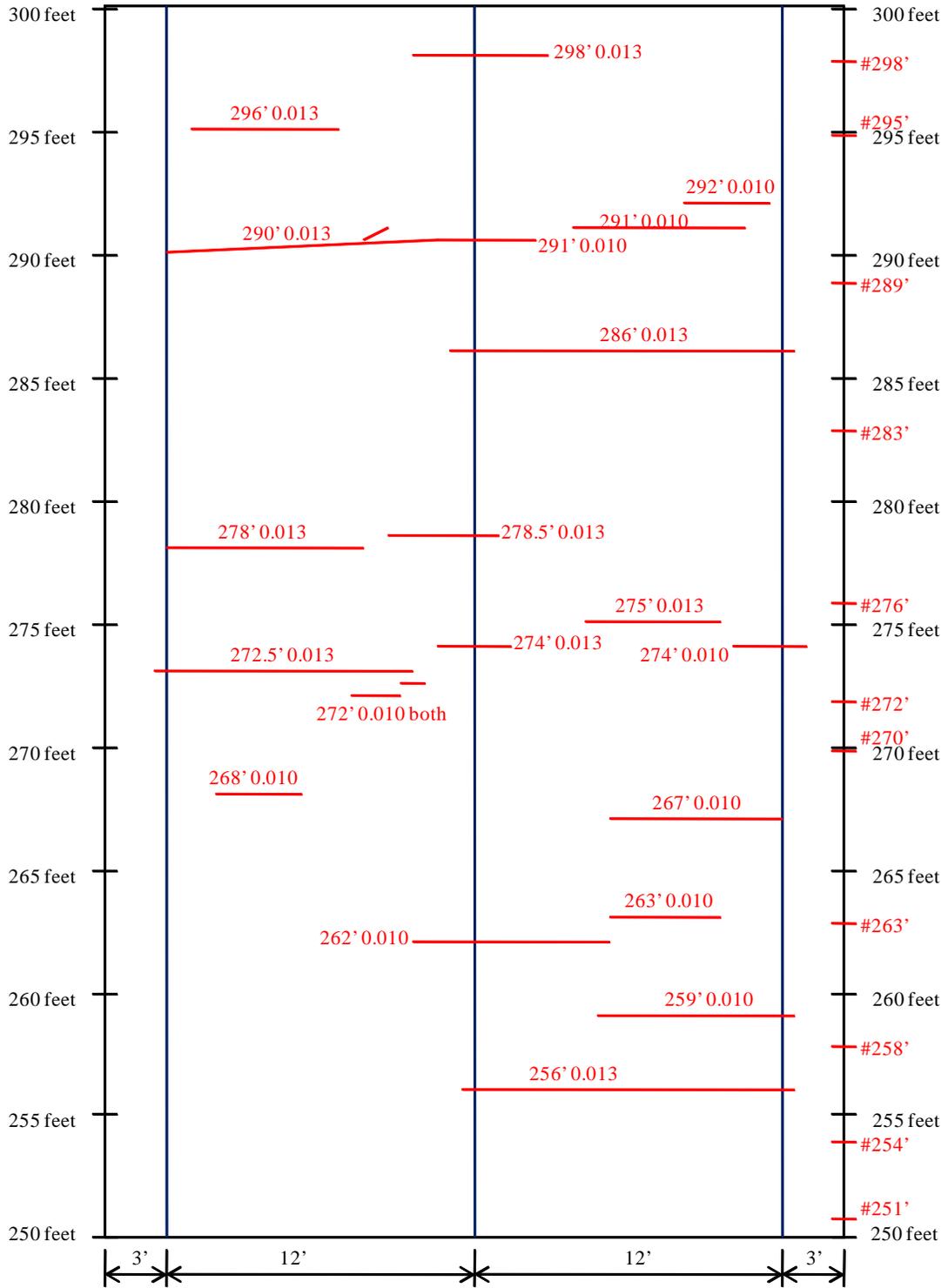
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Mason/Menard County – SN# 065-0501 – Surveyed 10/2/2008, 10/20/2008



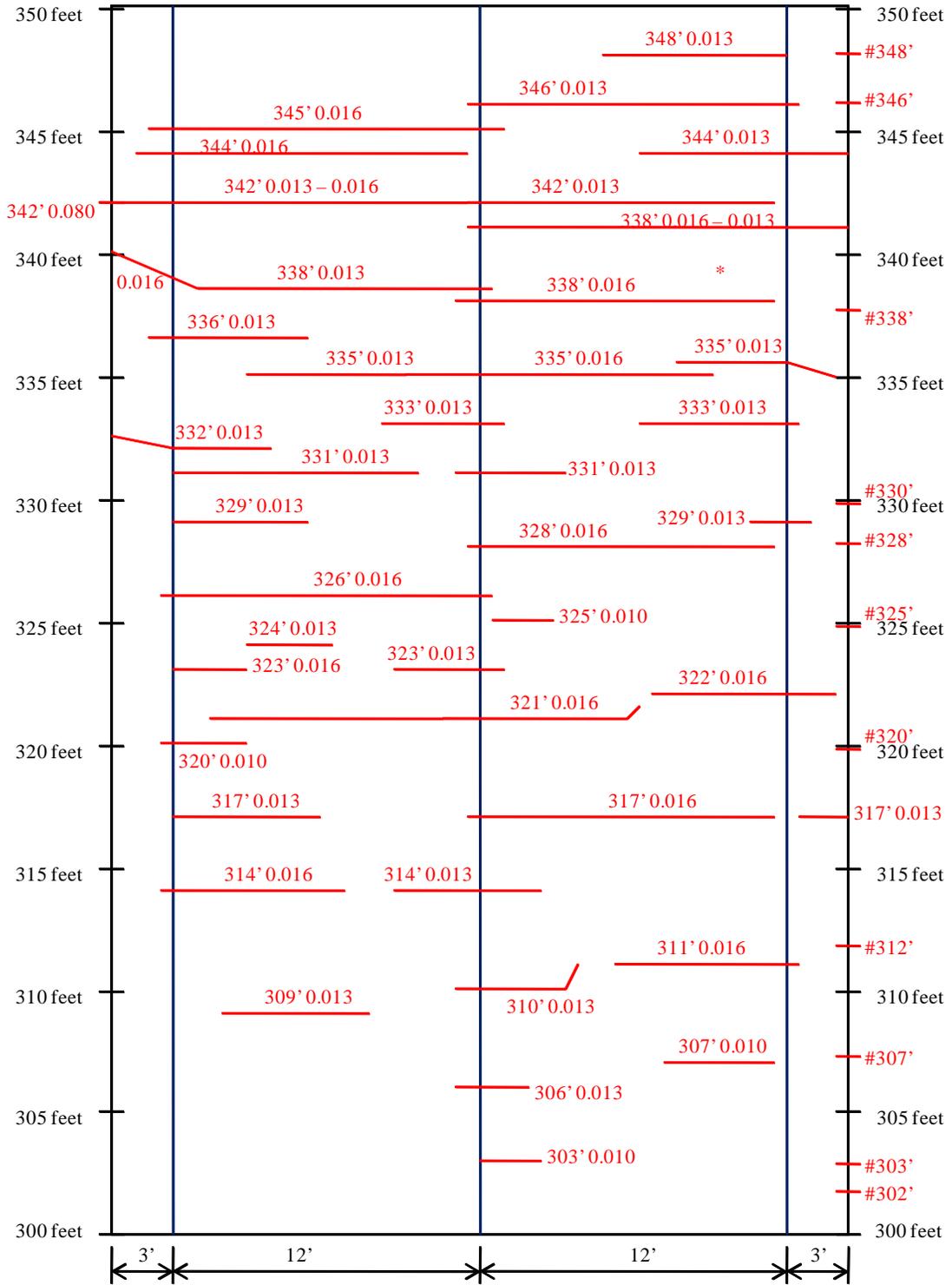
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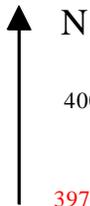
Mason/Menard County – SN# 065-0501 – Surveyed 10/2/2008, 10/20/2008



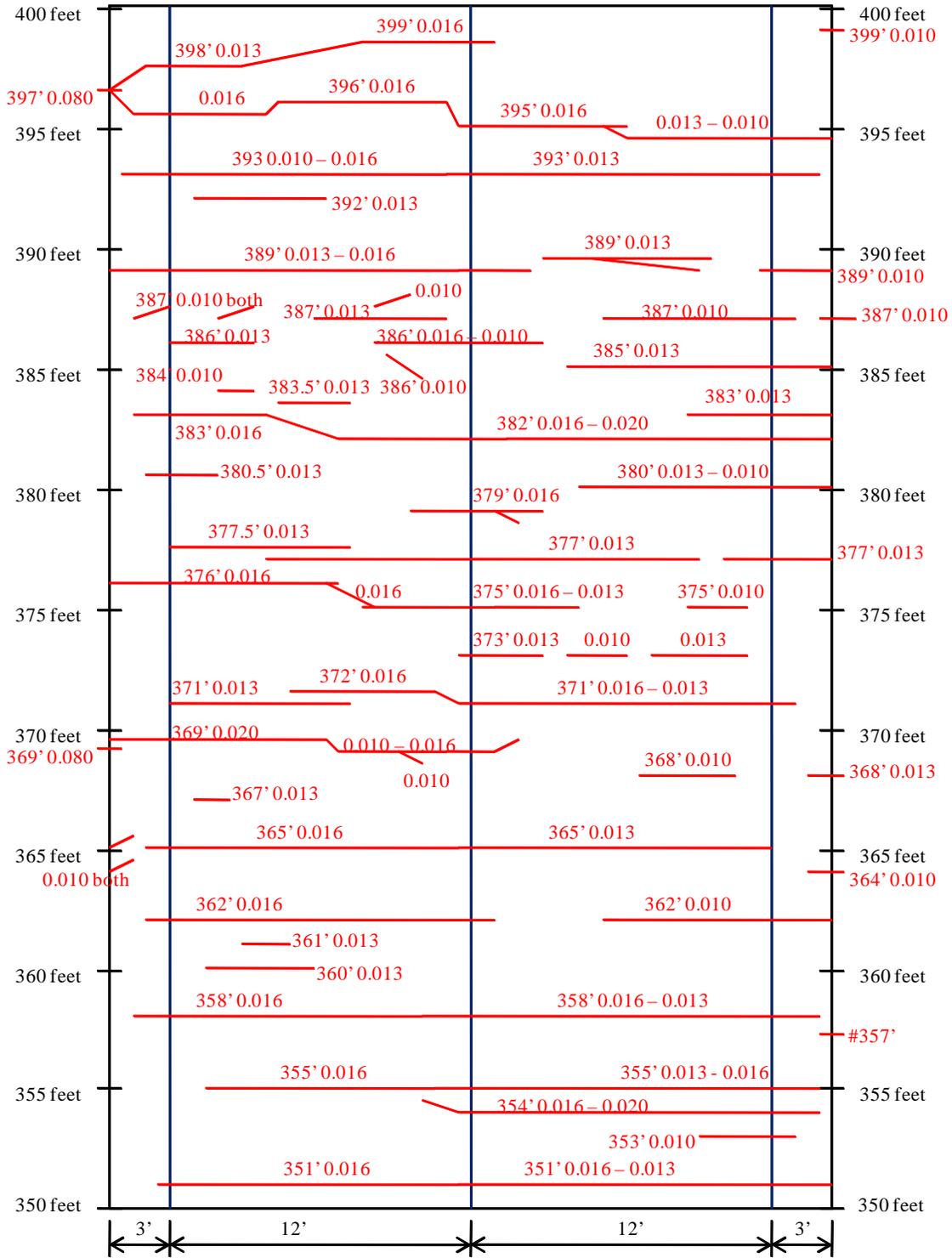
# IL 29 – Salt Creek



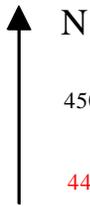
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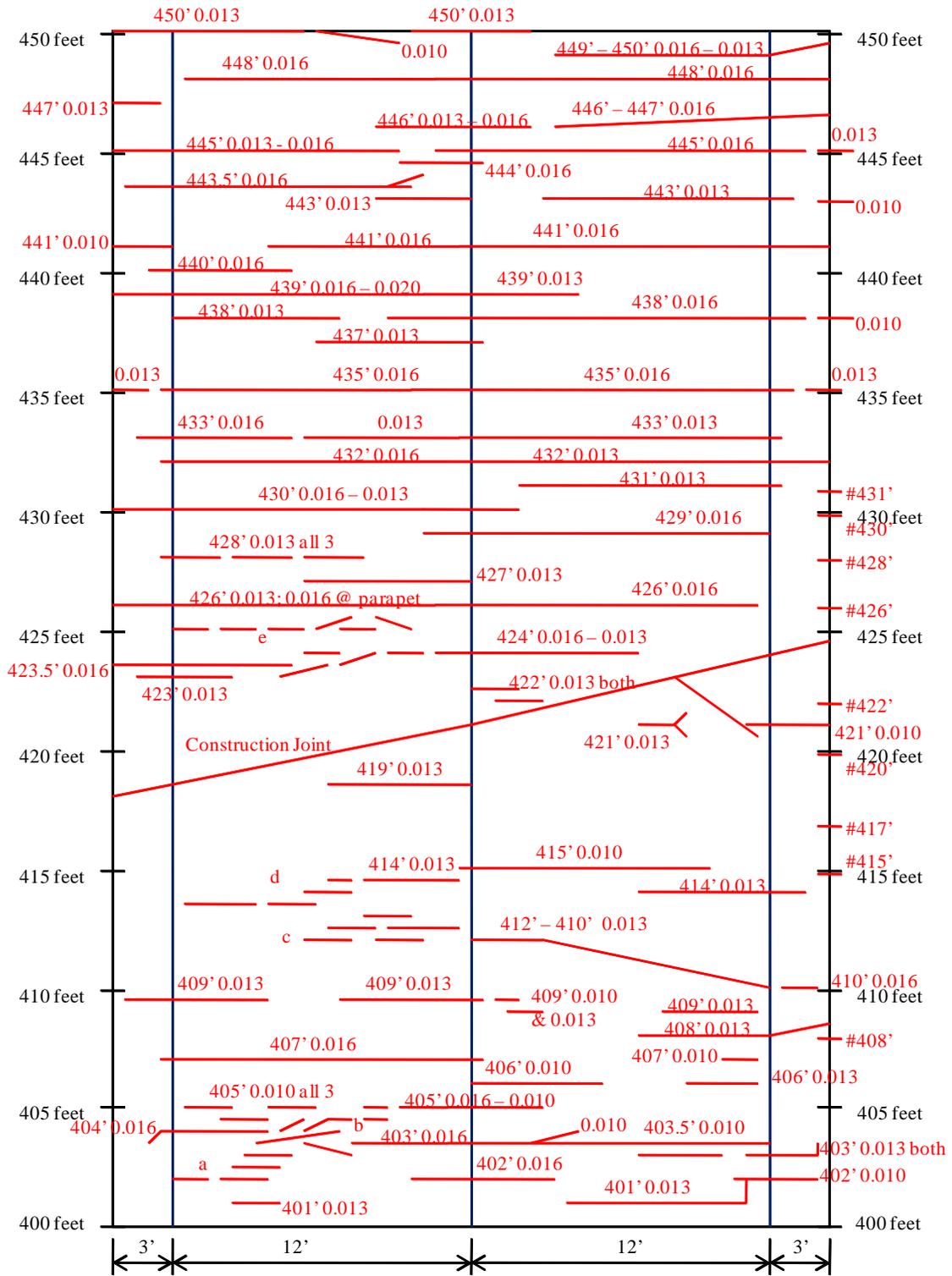
# IL 29 – Salt Creek



Mason/Menard County – SN# 065-0501 – Surveyed 10/2/2008, 10/20/2008



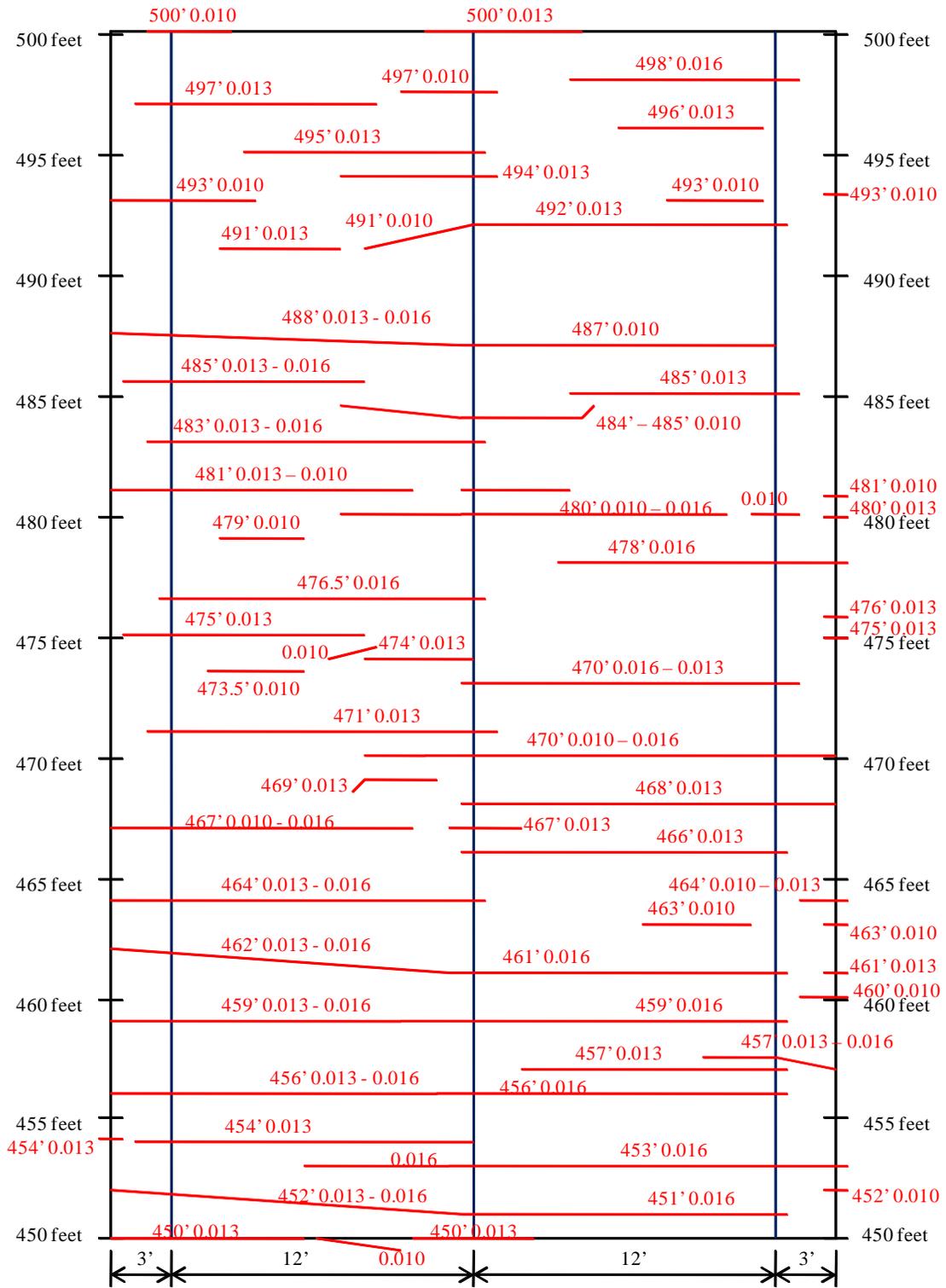
# IL 29 – Salt Creek



Mason/Menard County – SN# 065-0501 – Surveyed 10/2/2008, 10/20/2008



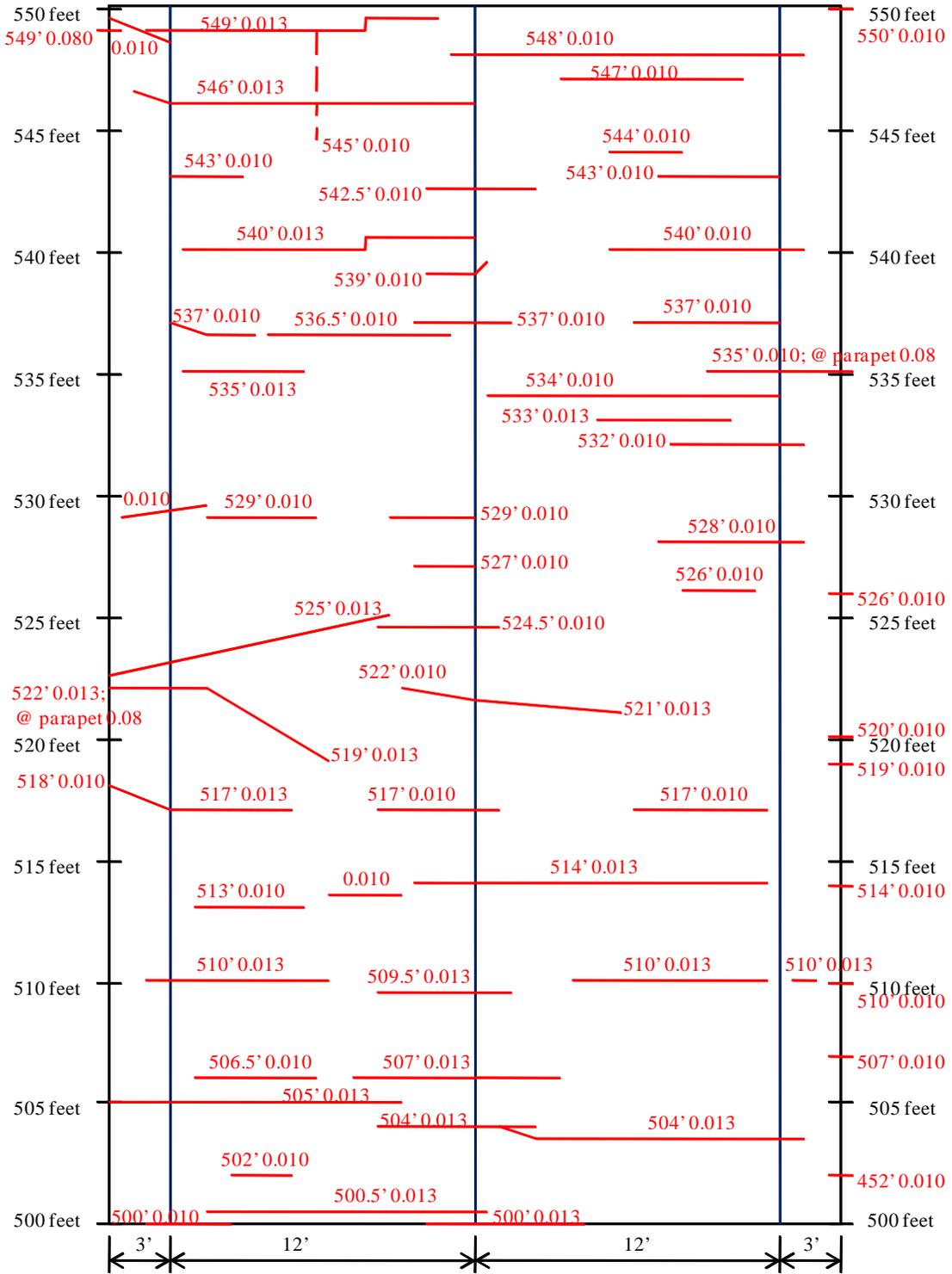
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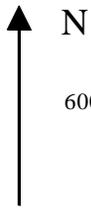
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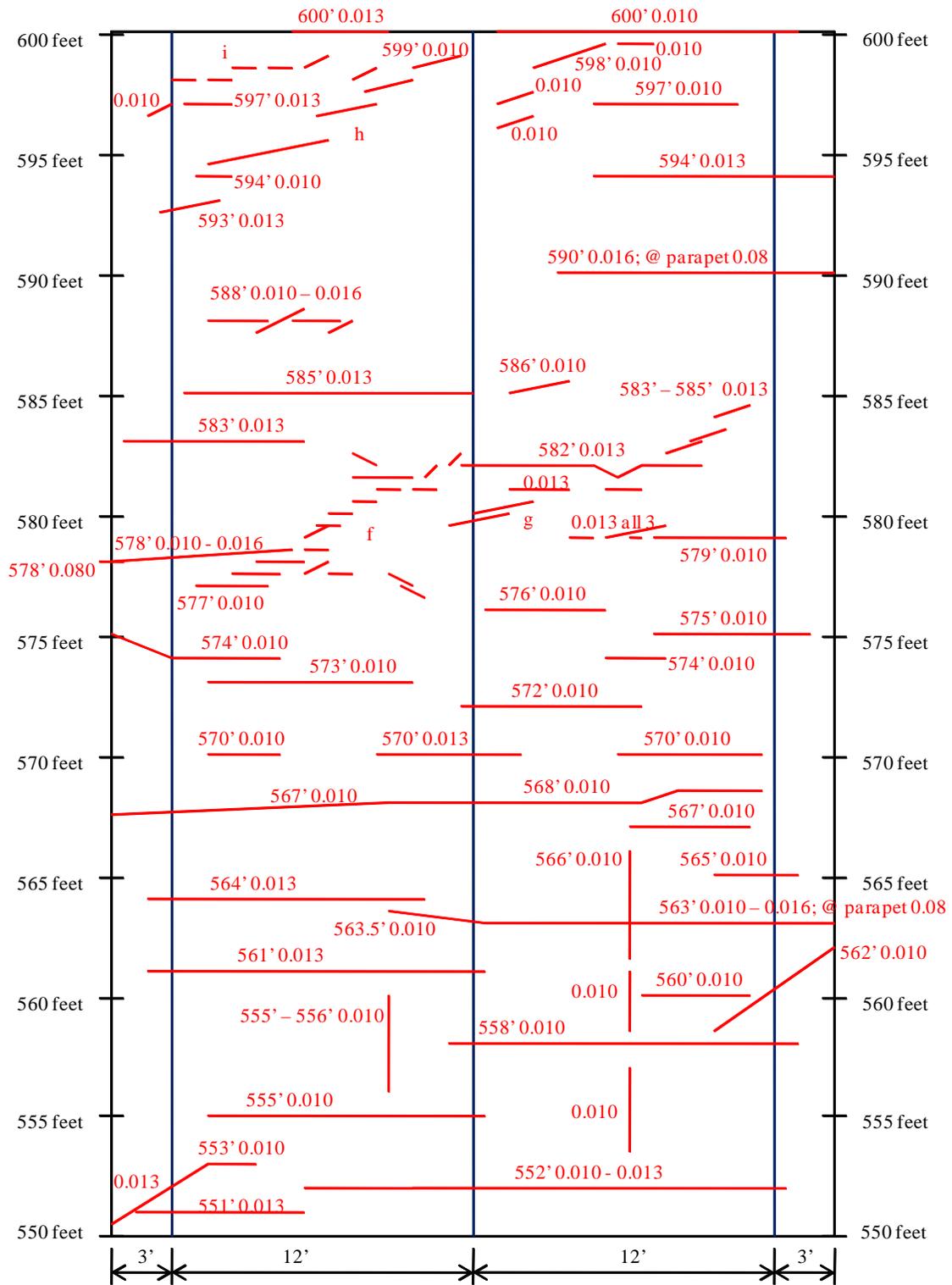
# IL 29 – Salt Creek



Mason/Menard County – SN# 065-0501 – Surveyed 10/2/2008, 10/20/2008



# IL 29 – Salt Creek



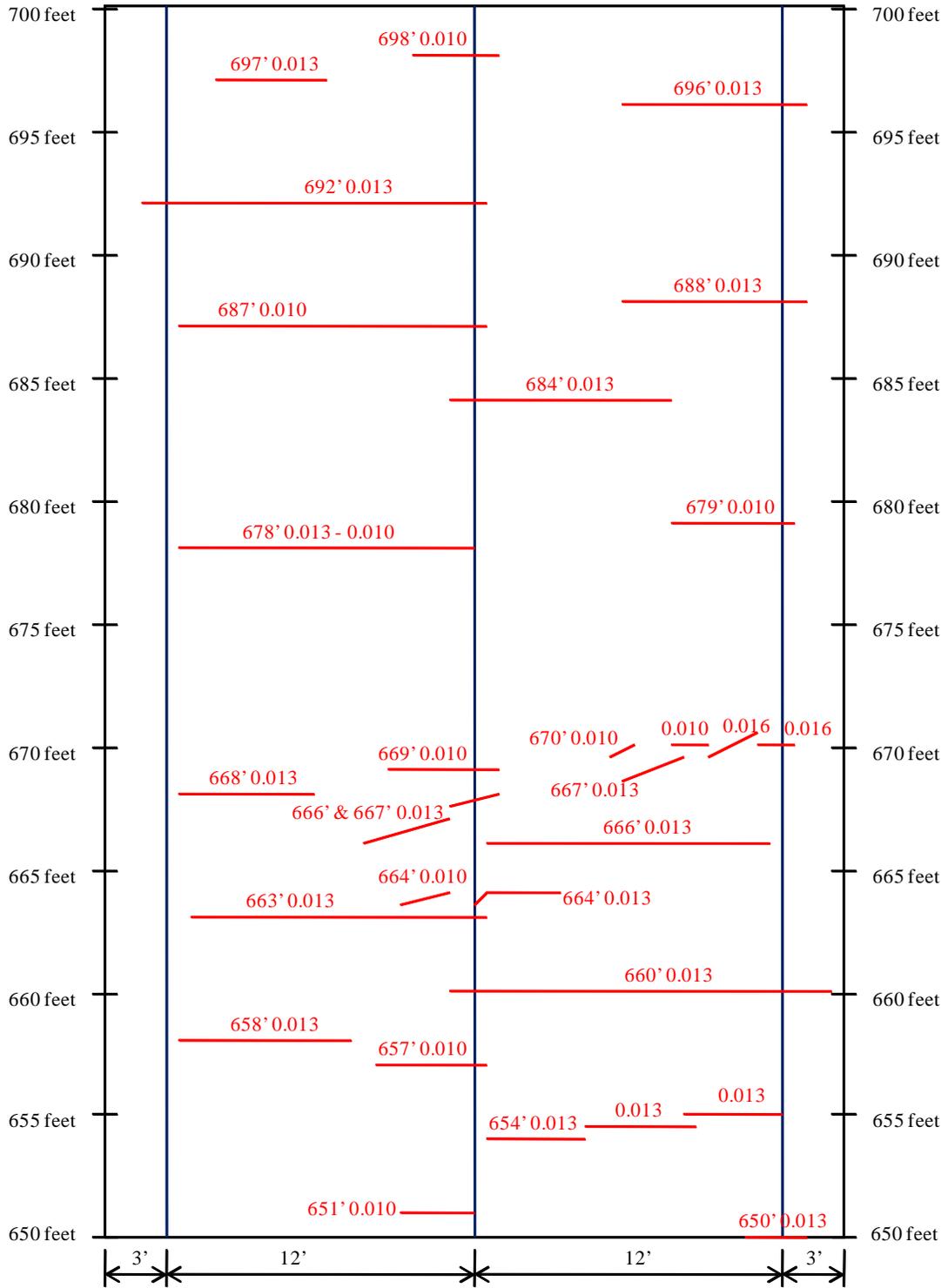
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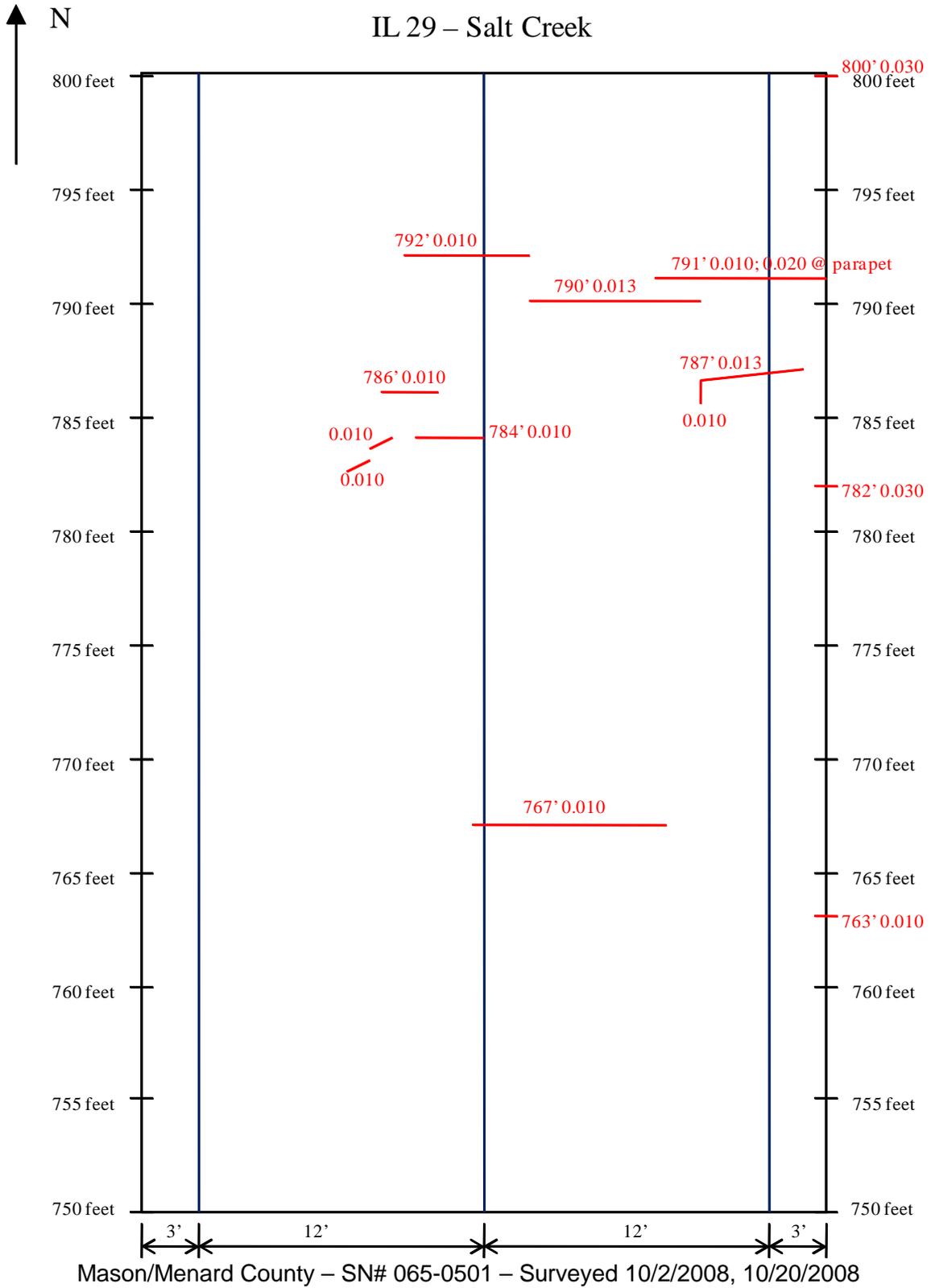
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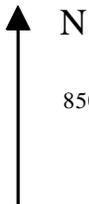
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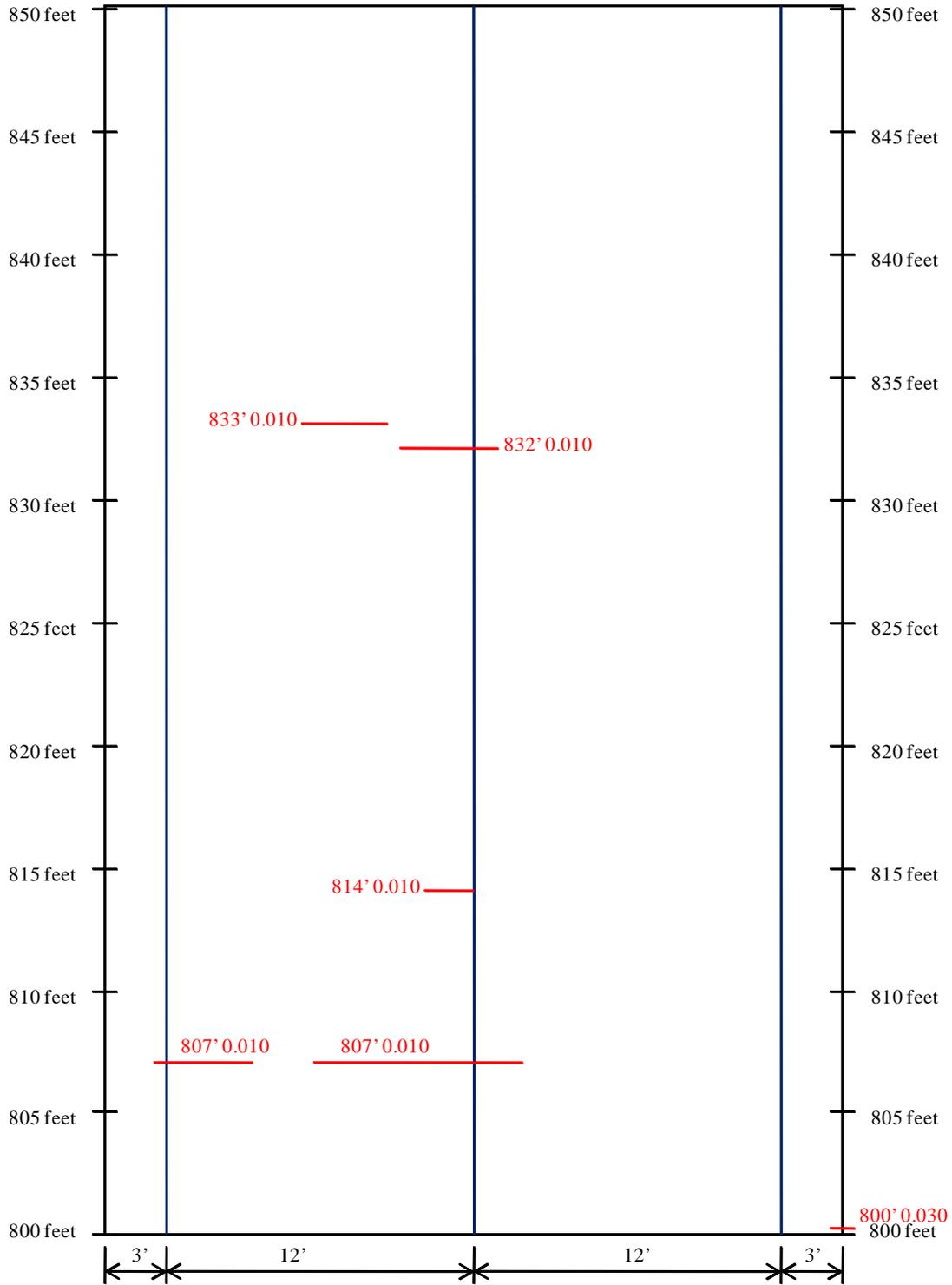
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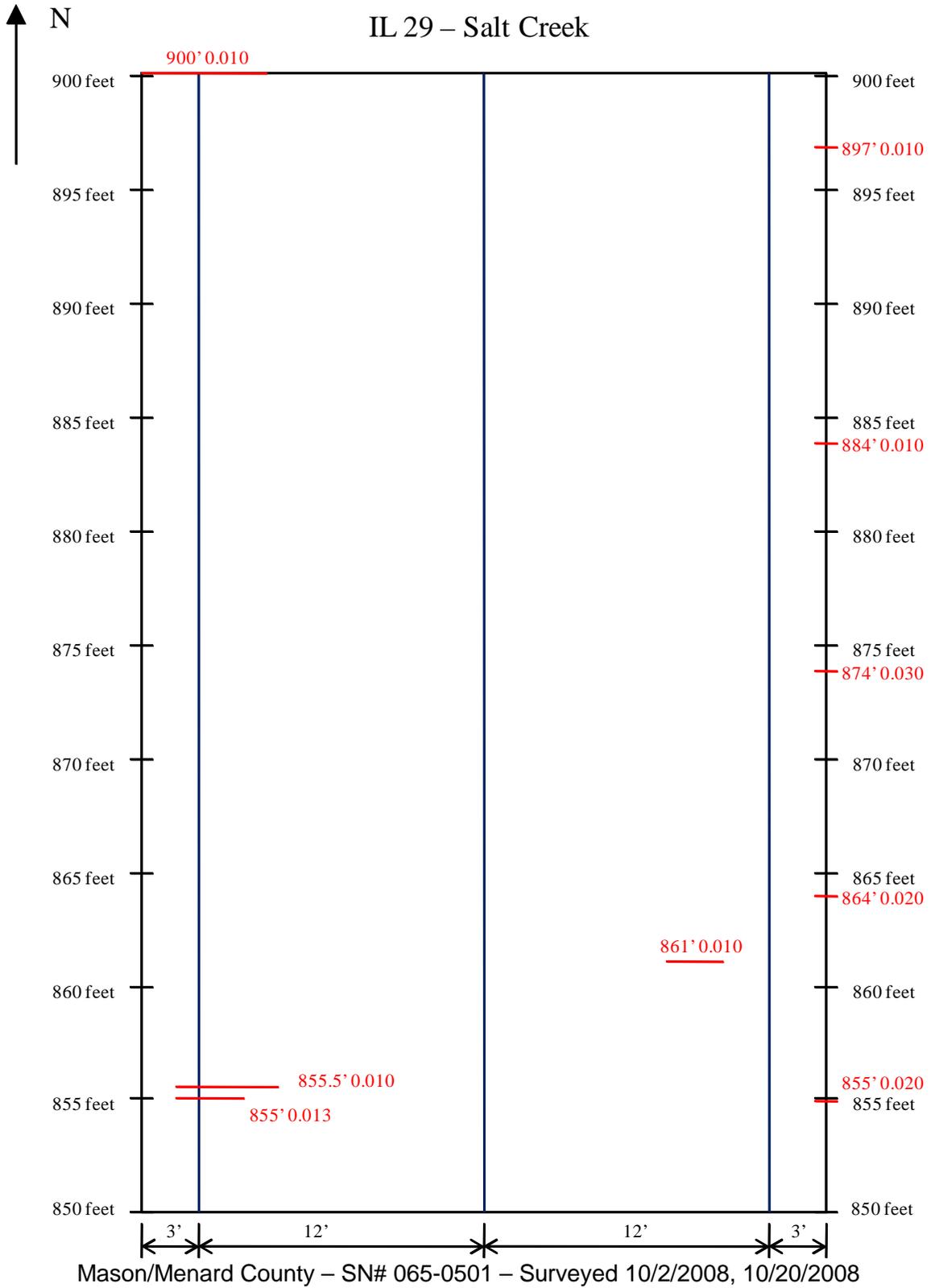


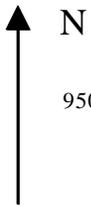


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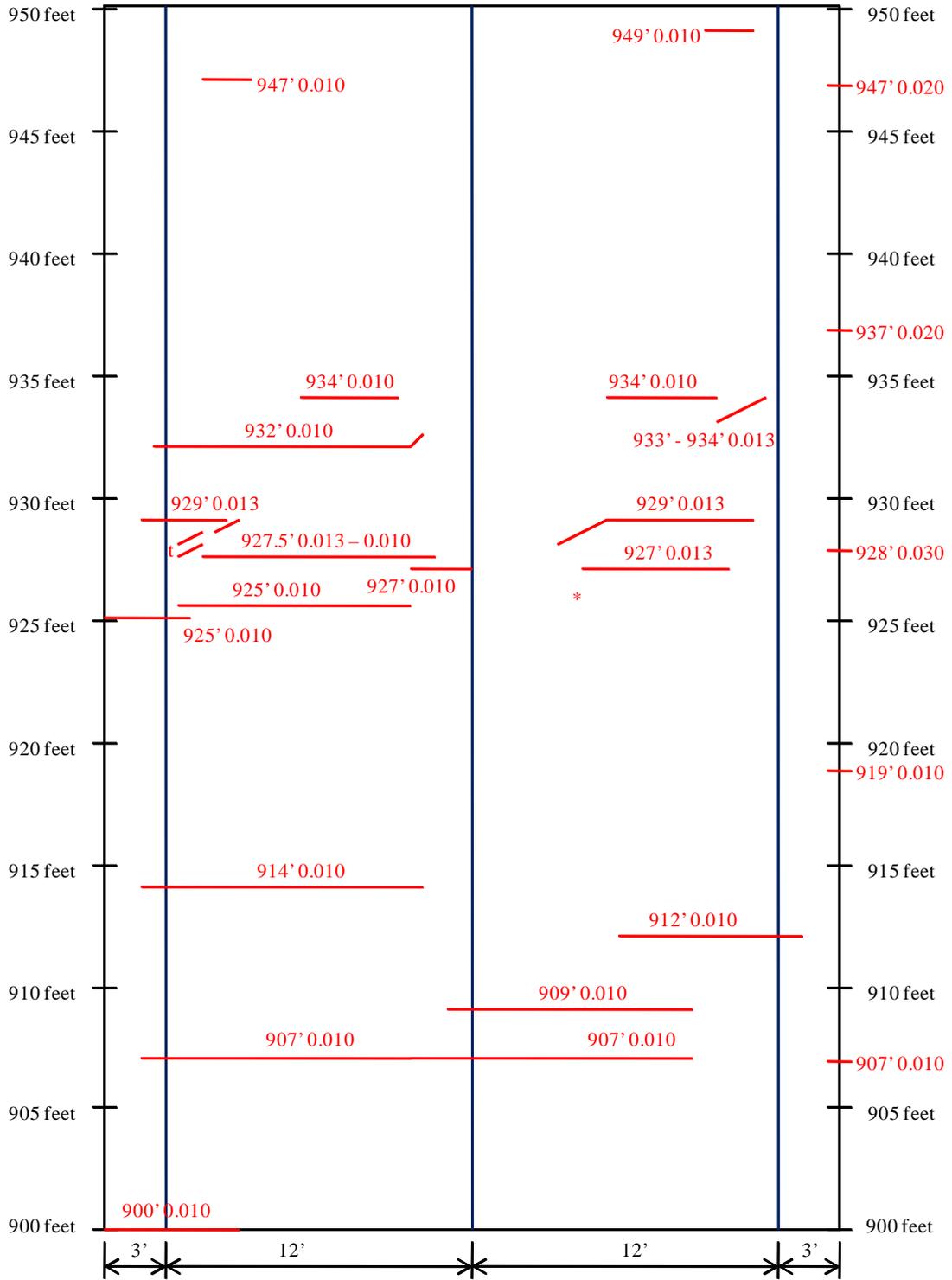


Mason/Menard County – SN# 065-0501 – Surveyed 10/2/2008, 10/20/2008





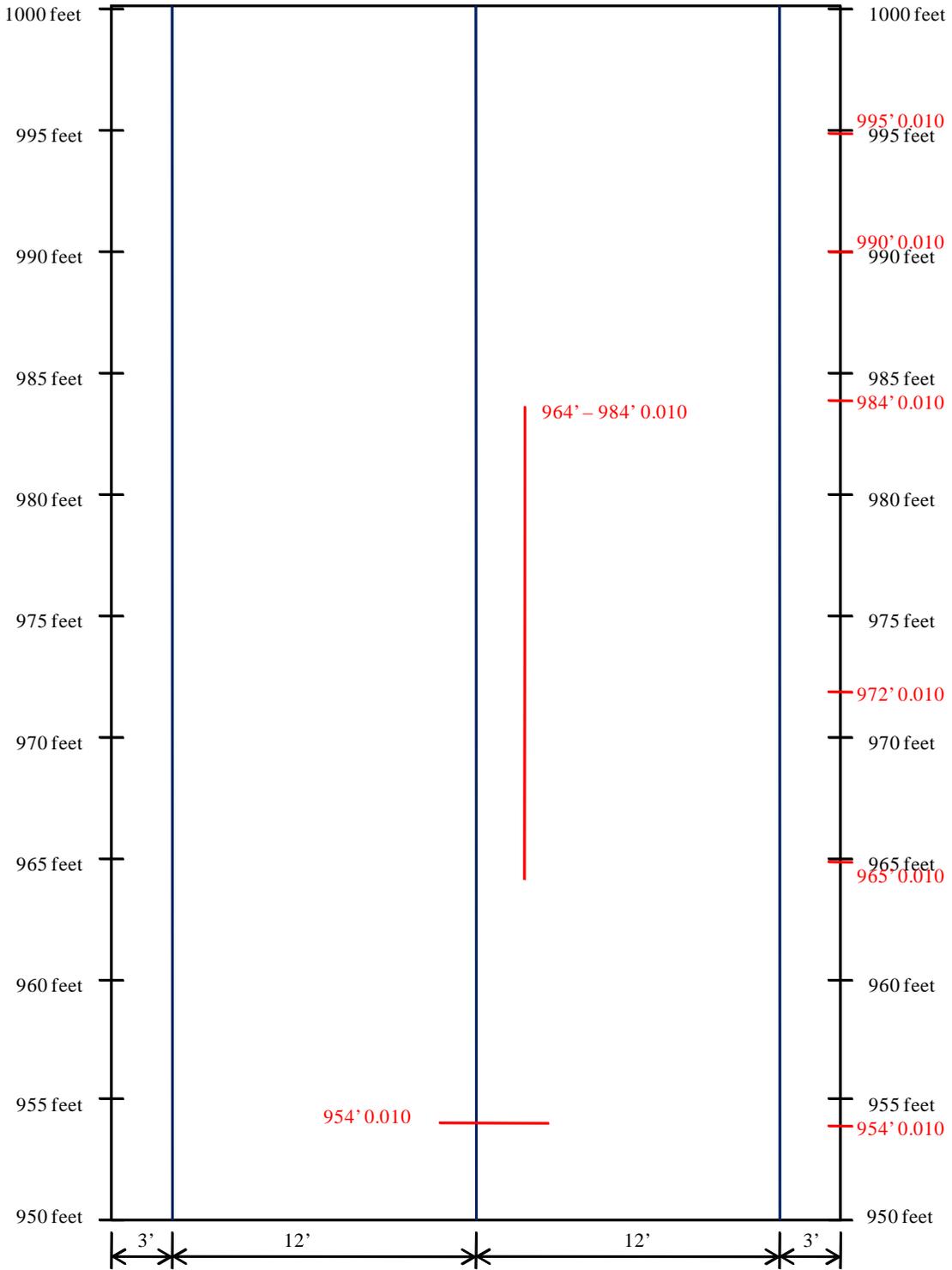
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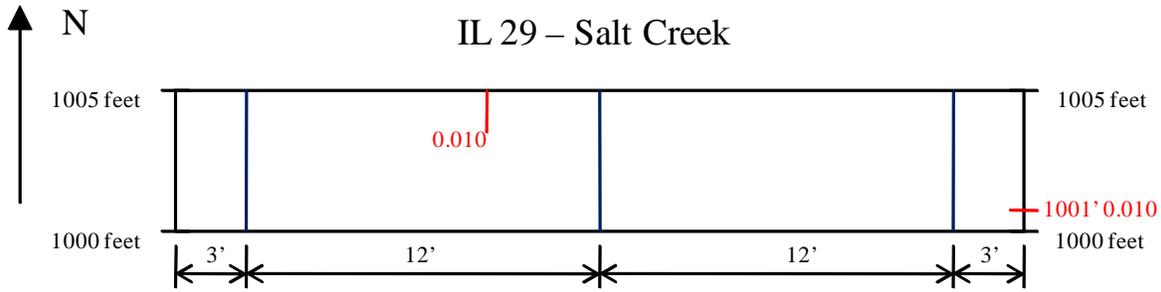
Mason/Menard County – SN# 065-0501 – Surveyed 10/2/2008, 10/20/2008

N

# IL 29 – Salt Creek



Mason/Menard County – SN# 065-0501 – Surveyed 10/2/2008, 10/20/2008



Mason/Menard County – SN# 065-0501 – Surveyed 10/2/2008, 10/20/2008  
 The “#” symbol represents cracks in the parapet only.

- \* Unless otherwise noted, the areas marked with this symbol contained exposed aggregate.
- A Northbound lane, from 402’ – 403’, the cracks measured from 0.013 – 0.016
- B Northbound lane, from 403’ – 405’, all the cracks measured 0.010.
- C Northbound lane, from 412’ – 413’, the cracks measured from 0.010, 0.013 – 0.016.
- D Northbound lane, from 413.5’ – 414’, all the cracks measured 0.013.
- E Northbound lane, from 423.5’ – 425’, the cracks measured from 0.010 – 0.013.
- F Northbound lane, from 577’ – 581.5’, the cracks measured from 0.010 – 0.013.
- G Southbound lane, from 580’ – 582’, all the cracks measured 0.010.
- H Northbound lane, from 594’ – 599’, all the cracks measured 0.013.
- I Northbound lane, from 597’ – 600’, the cracks measured from 0.010 – 0.013.
- J Southbound lane, from 601’ – 607’, the cracks measured from 0.010, 0.013 – 0.016.
- K Northbound lane, from 602’ – 603’, the cracks measured from 0.010 – 0.013.
- L Northbound lane, from 605’ – 607’, all the cracks measured 0.013.
- M Southbound lane, from 608’ – 613’, the cracks measured from 0.010, 0.013 – 0.016.
- N Northbound lane, from 609’ – 611’, all the cracks measured 0.010.
- O Northbound lane, from 612’ – 617’, the cracks measured from 0.010 – 0.013.
- P Southbound lane, from 617.5’ – 625’, the cracks measured from 0.010 – 0.013.
- Q Northbound lane, from 622’ – 625’, the cracks measured from 0.010, 0.013 – 0.016.
- R Southbound lane, from 626.5’ – 629’, all the cracks measured 0.010.
- S Northbound lane, from 628’ – 631’, the cracks measured from 0.010 – 0.013.
- T Southbound lane, from 643’ – 644’, all the cracks measured 0.013.
- U Northbound lane, around 644’, all the cracks measured 0.010.
- V Southbound lane, from 927.5’ – 928’, all the cracks measured 0.010.

McLean County



Structure Number: 057-6301

Inspected By: DAD, JAB

Responsible District: 3

Date Inspected: 08/05/11

Number of Spans: 8

Span Lengths See below Total: 647'8"

Deck Width: 30'0"

Beam Type:  PPC-I  Steel  Other

Beam Spacing: \_\_\_\_\_

Date of Beam Erection: 2004

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: 13,000 (2007)

Stage Construction:  Y  N

Skew:  Y  N Angle: \_\_\_\_\_

Pour Dates: Stage 1, 2004 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: On top of deck, on the interior spans, cracks at approximately 4' spacing were observed. Underneath, approximate crack spacing observed was 5 – 6' on interior and 7 – 8' on ends.

Longitudinal Cracking: \_\_\_\_\_

Bridge Joint Cracking / Integral Abutment Cracking: In a bridge joint, under the deck, cracking, concrete spalling with exposed corroded reinforcement was observed.

Cracking over Piers: Under the deck, the cracking was more closely spaced near the piers.

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span Lengths: 2 @ 75ft 0in., 4 @ 75ft 9in., 2 @ 95ft 0in.

**Mix Design Information: (from MISTIC)**

Mix Design Number: 83PCC3346

Coarse Aggregate Source: Valley View Indust.

Crushed Stone  Gravel

Coarse Aggregate Source: N/A

Crushed Stone  Gravel

Fine Aggregate Source: Rowe Constr. Co.

Fine Aggregate Source: N/A

Cement Source: \_\_\_\_\_

HRM Source: \_\_\_\_\_

Fly Ash Source: Mineral Resource Tech.

GGBF Slag Source: \_\_\_\_\_

Microsilica Source: Elkem Materials Inc.

## Sangamon County



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 084-0065

Inspected By: DAD, DHT, JAB

Responsible District: 6

Date Inspected: 6/9/10

Number of Spans: 3

Span Lengths See below Total: 44.6m

Deck Width: 12.2m

Beam Type:  PPC-I  Steel  Other

Beam Spacing: 2.26m

Date of Beam Erection: 2000

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: 4,850 (2007)

Stage Construction:  Y  N

Skew:  Y  N Angle: 30°

Pour Dates: Stage 1, 2000 Stage 2, 2000

**Description of Cracking:**

Average Transverse Crack Distance: In westbound lanes, transverse cracks present at 5'-6' spacing.

In eastbound lanes, transverse cracks present at 8'-9' spacing. Span 1 and span 2 not too cracked.

Longitudinal Cracking: On top, cracking was along floor drains. On top, longitudinal (mapping) cracks were visible.

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: Noticeable difference in cracking between Stages I and II.

**Other Observations:**

Span lengths: 1&3) 14.1m, 2)14.4m

Stage I, the westbound lanes, used 86PCC2064 mix design and Stage II, the eastbound lanes, uses 86PCC2065 mix design. The information for both mix designs is listed below.

**Mix Design Information: (from MISTIC)**

Mix Design Number: 86PCC2064&2065

Coarse Aggregate Source: Material Service(CA 11) (86PCC2064)  Crushed Stone  Gravel

Coarse Aggregate Source: Central Stone(CA 11) (86PCC2065)  Crushed Stone  Gravel

Fine Aggregate Source: Clear Lake S & Fine Aggregate Source: Otter Creek S &

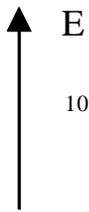
HRM Source: \_\_\_\_\_

Cement Source: \_\_\_\_\_

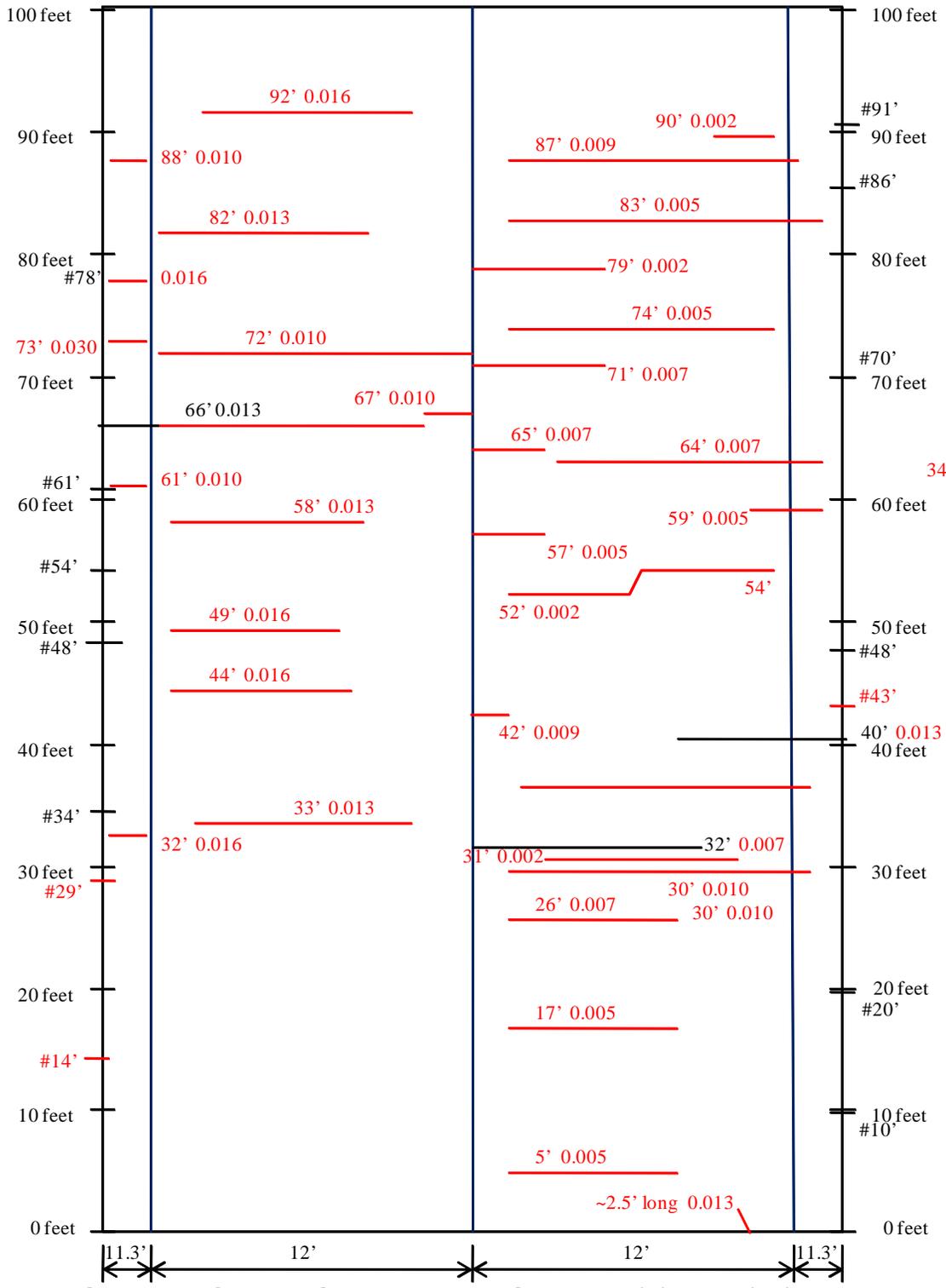
GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: Mineral Resource Tech(Both)

Microsilica Source: W.R. Grace & Co.(Both)

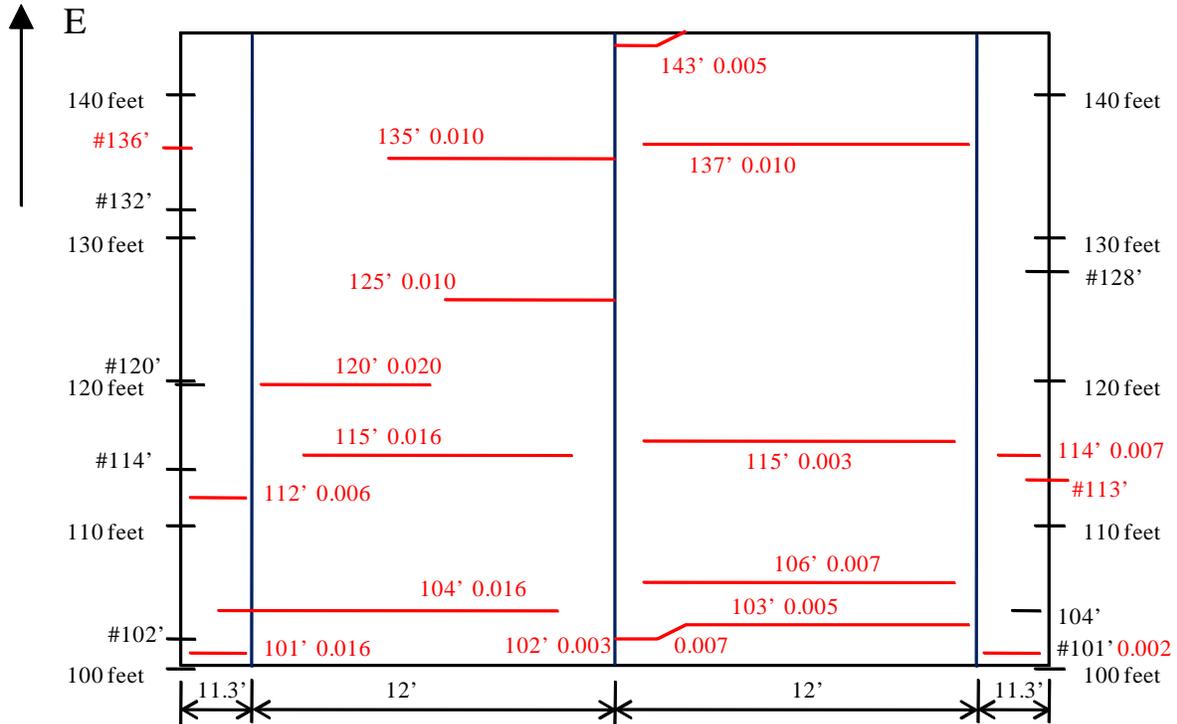


IL 104 over Brush Creek  
SN # 084-0065



Sangamon County – SN# 084 -0065 – Surveyed 5/7/2001, 8/15/2001

## IL 104 over Brush Creek

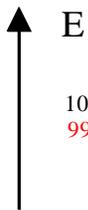


Sangamon County – SN# 084-065 – Surveyed 5/7/2001, 8/15/2001

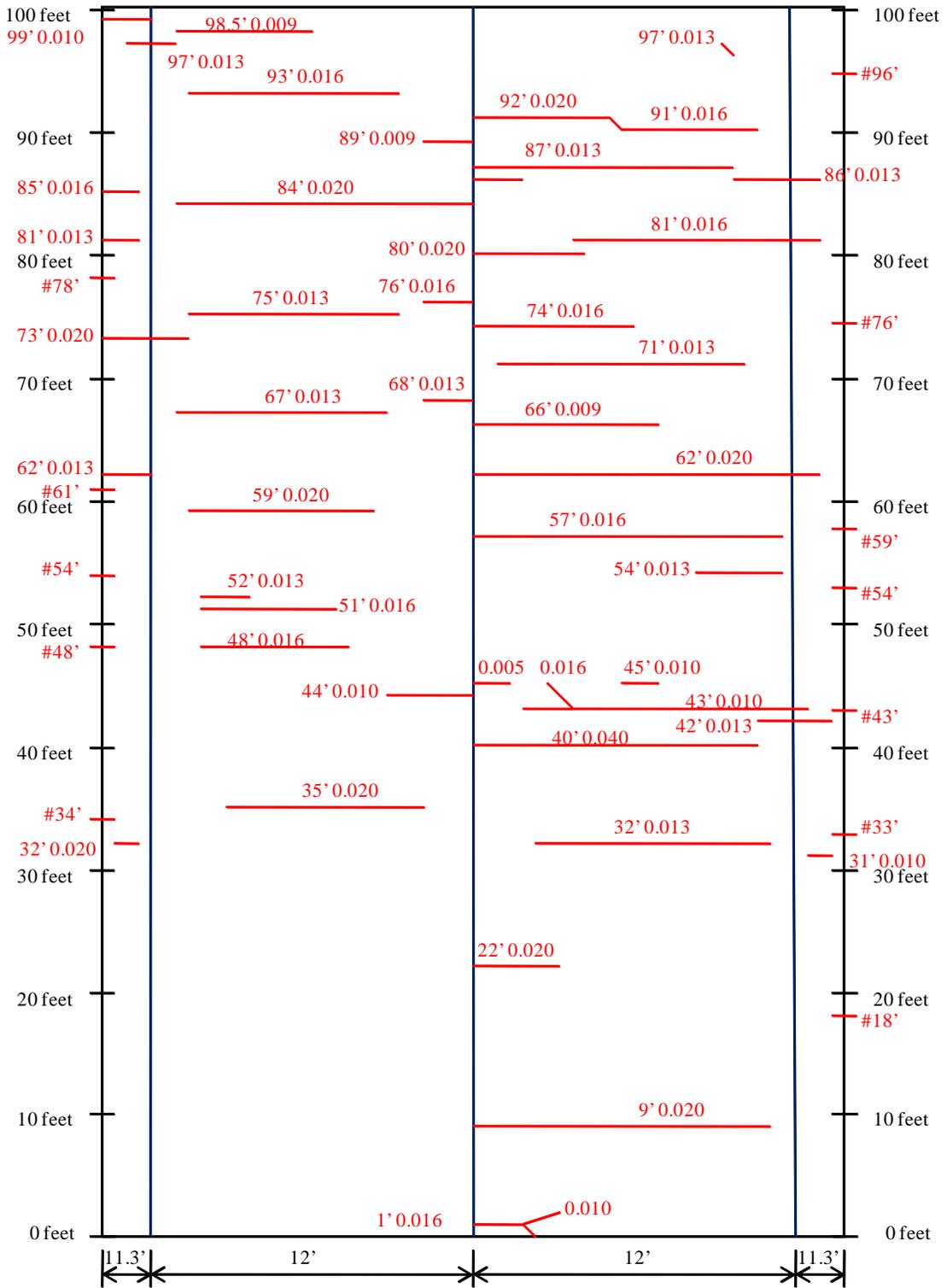
The initial survey of the westbound lane showed 33 hairline transverse cracks.

The initial survey of the eastbound lane showed 21 hairline transverse cracks.

The “#” symbol represents cracks in the parapet only.

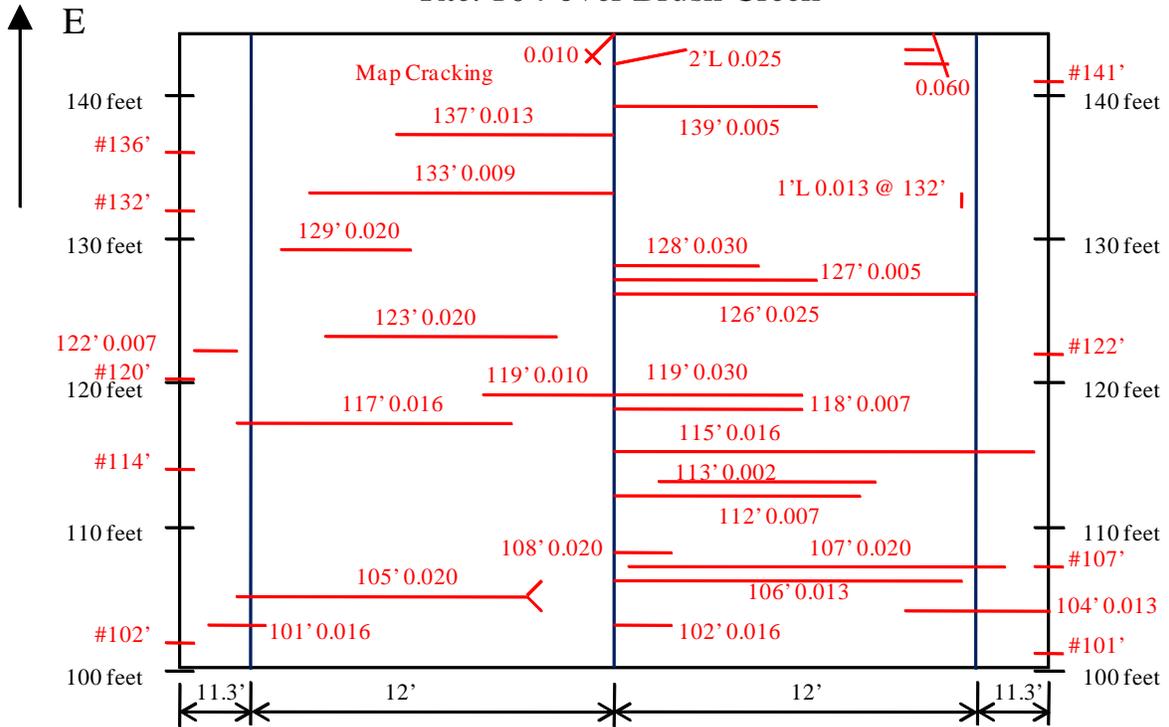


Rte. 104 over Brush Creek  
SN # 084-0065



Sangamon County - SN# 084-0065 - Surveyed 9/3/2002

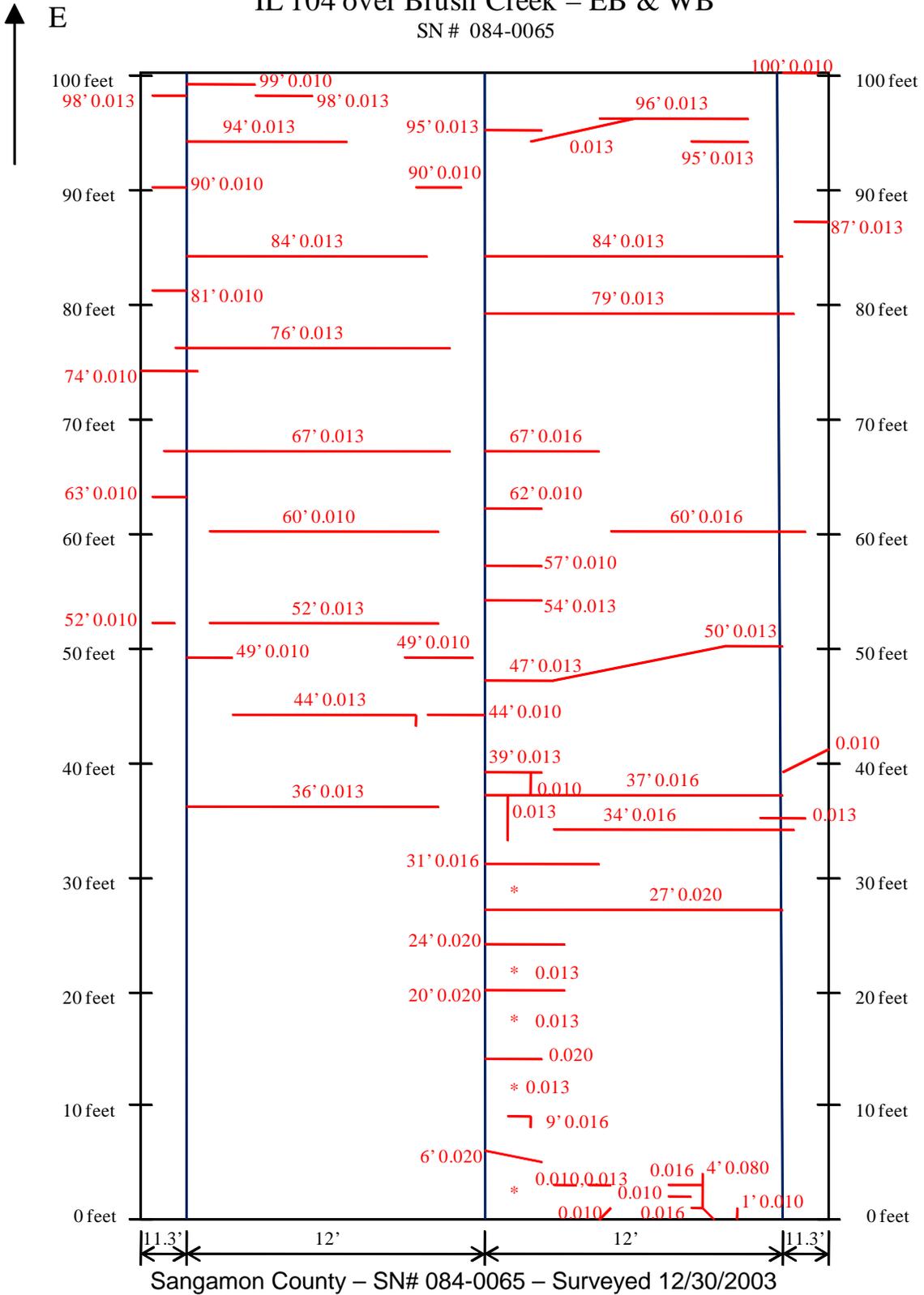
# Rte. 104 over Brush Creek



Sangamon County – SN# 084-0065 – Surveyed 9/3/2002

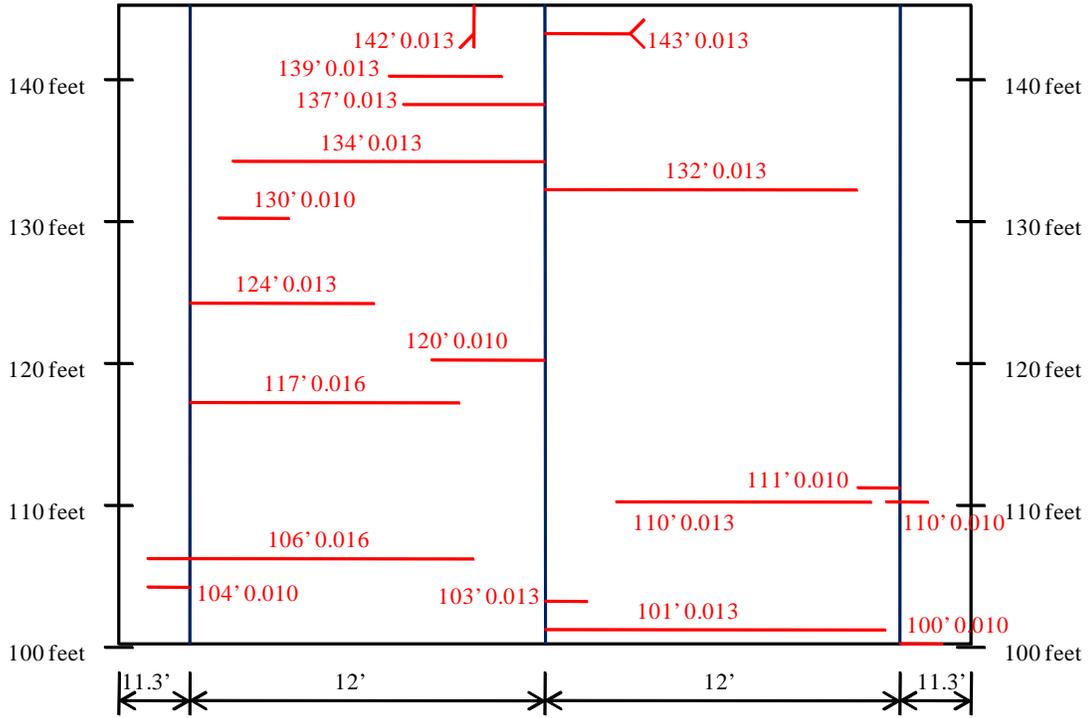
The “#” symbol represents cracks in the parapet only.

IL 104 over Brush Creek – EB & WB  
SN # 084-0065



↑ E

### IL 104 over Brush Creek – EB & WB

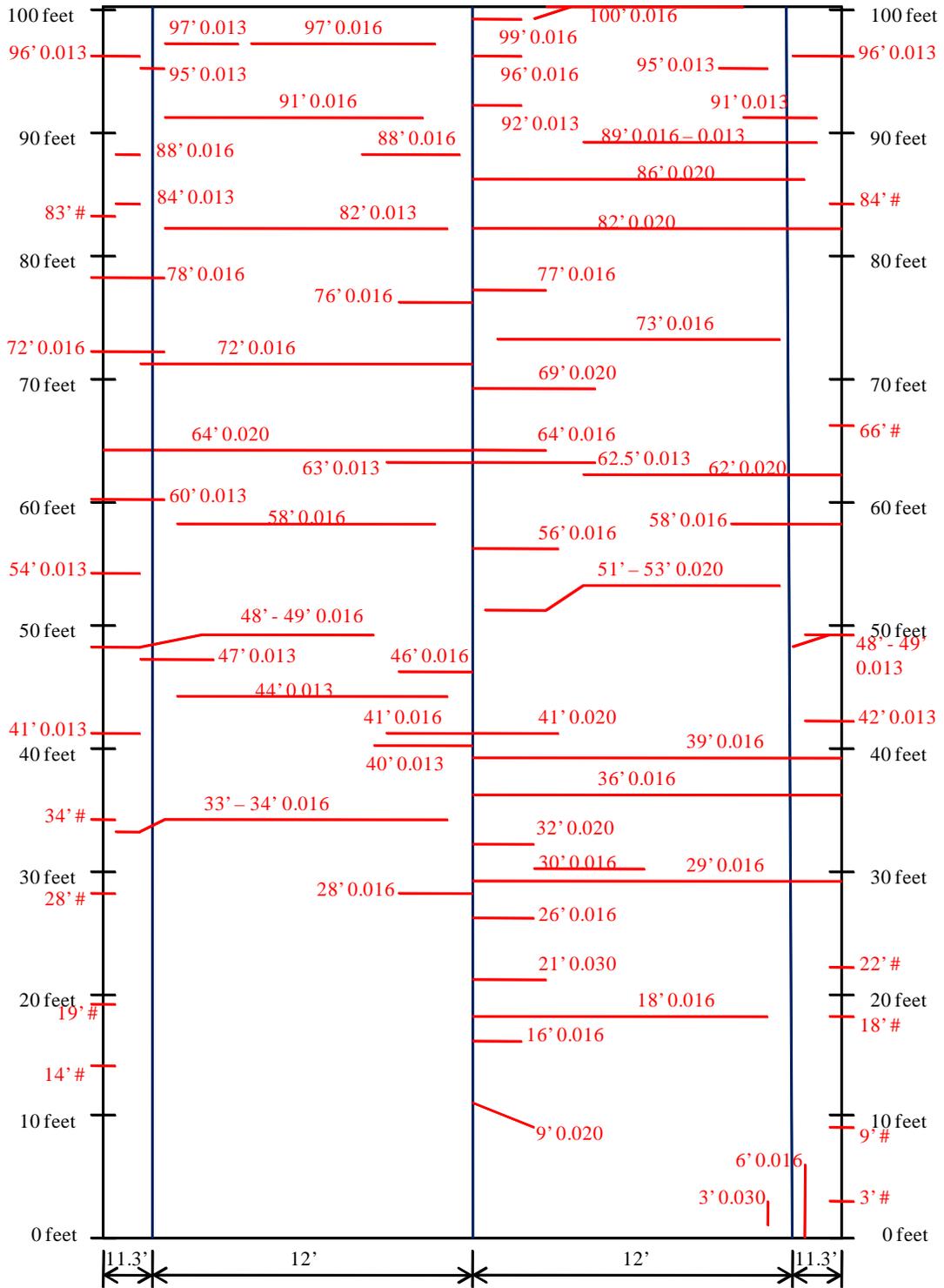


Sangamon County – SN# 084-0065 – Surveyed 12/30/2003

\* Denotes areas of interconnected hairline cracks, sometimes resembling a spider web.

# IL 104 over Brush Creek

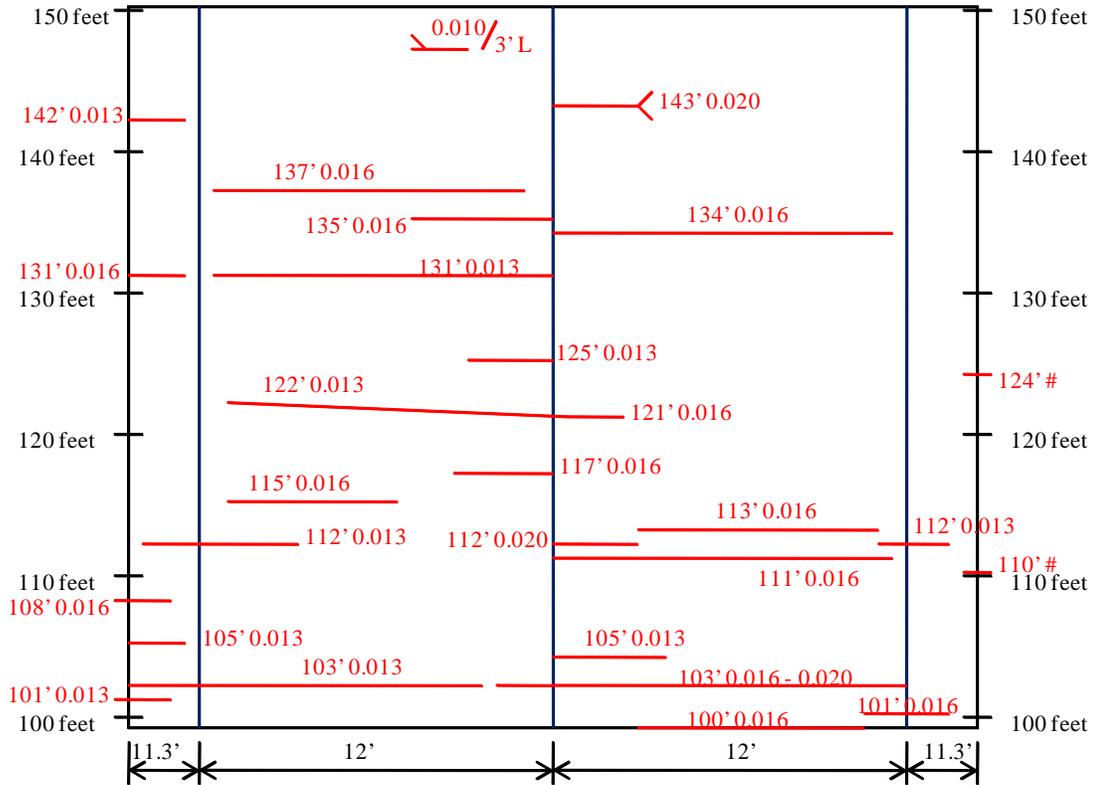
SN# 084-0065



Sangamon County – SN# 084-0065 – Surveyed 9/26/2005

E ↑

### IL 104 over Brush Creek



Sangamon County – SN# 084-0065 – Surveyed 9/26/2005

Map cracking was observed in the eastbound lane near the centerline from 9' to 89'.

The “#” symbol represents cracks in the parapet only.



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 084-0500NB&084-0499SB

Inspected By: DAD, DHT, CRB, JAB

Responsible District: 6

Date Inspected: 5/24/2010

Number of Spans: 5

Span Lengths See below Total: 220.2m

Deck Width: 36.0m

Beam Type:  PPC-I  Steel  Other

Beam Spacing: 2.44m

Date of Beam Erection: 2001 & 2002

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: 34,600 (2007)

Stage Construction:  Y  N

Skew:  Y  N Angle: \_\_\_\_\_

Pour Dates: Stage 1, 2001 Stage 2, 2002

**Description of Cracking:**

Average Transverse Crack Distance: Southbound Lanes: 3' spacing; northbound lanes: 2' – 3' spacing. Cracks were sealed with epoxy. Southbound: underneath bridge deck, from outside to inside, 5'-6' or less spacing; northbound: underneath bridge deck, spacing of cracks similar to southbound.

Longitudinal Cracking: \_\_\_\_\_

Bridge Joint Cracking / Integral Abutment Cracking: Cracking near southwest abutment.

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Span lengths: 1) 36.8m, 2 through 4) 48.2m, 5 36.8m

Southbound segment 9 instrumented

The bridge is in good shape with southbound and northbound lanes exhibiting equivalent cracking.

**Mix Design Information: (from MISTIC)**

Mix Design Number: 86PCC2764

Coarse Aggregate Source: Central Stone  Crushed Stone  Gravel

Coarse Aggregate Source: N/A  Crushed Stone  Gravel

Fine Aggregate Source: Buckhart Sand & Gravel Fine Aggregate Source: N/A

HRM Source: \_\_\_\_\_

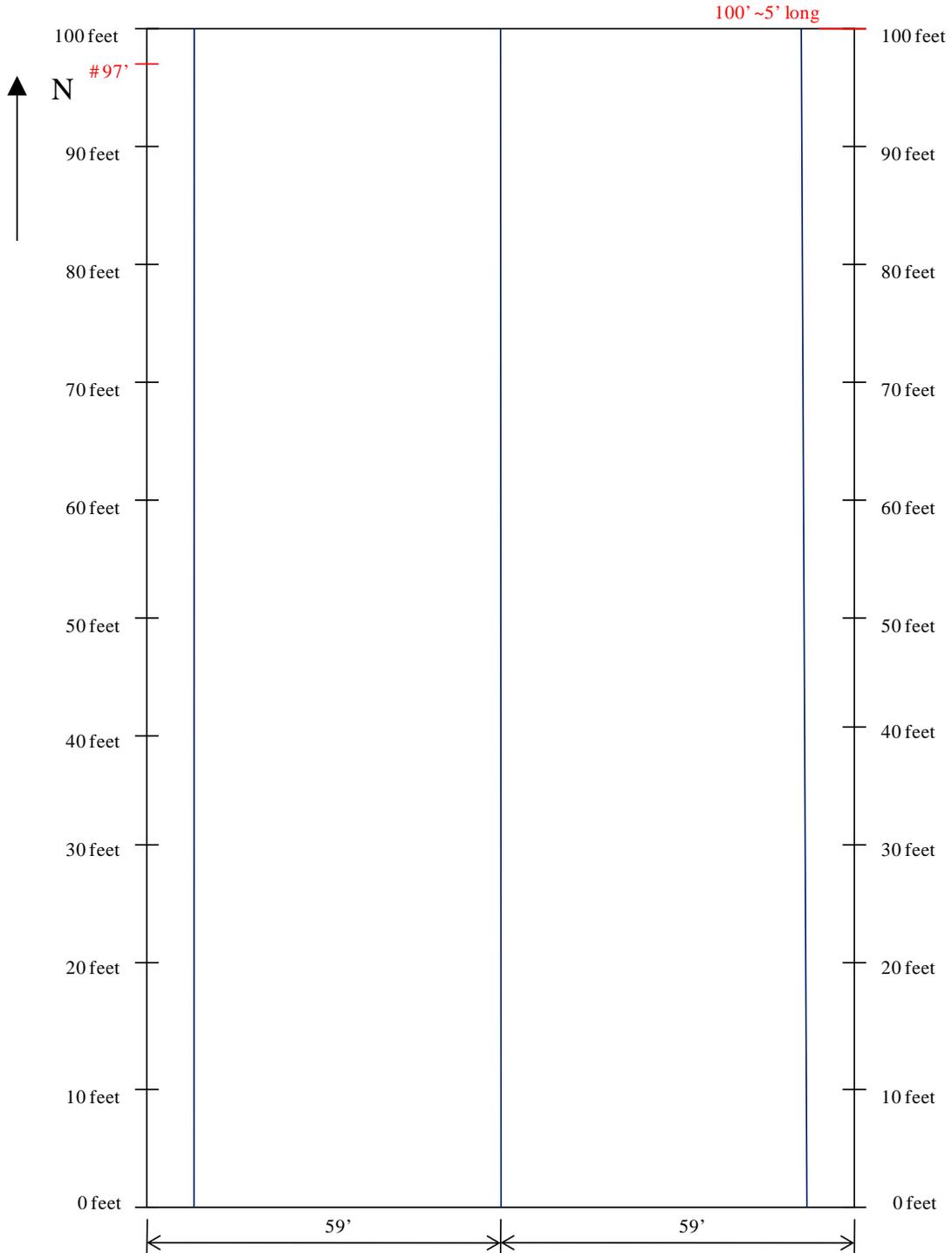
Cement Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: Mineral Resource Tech

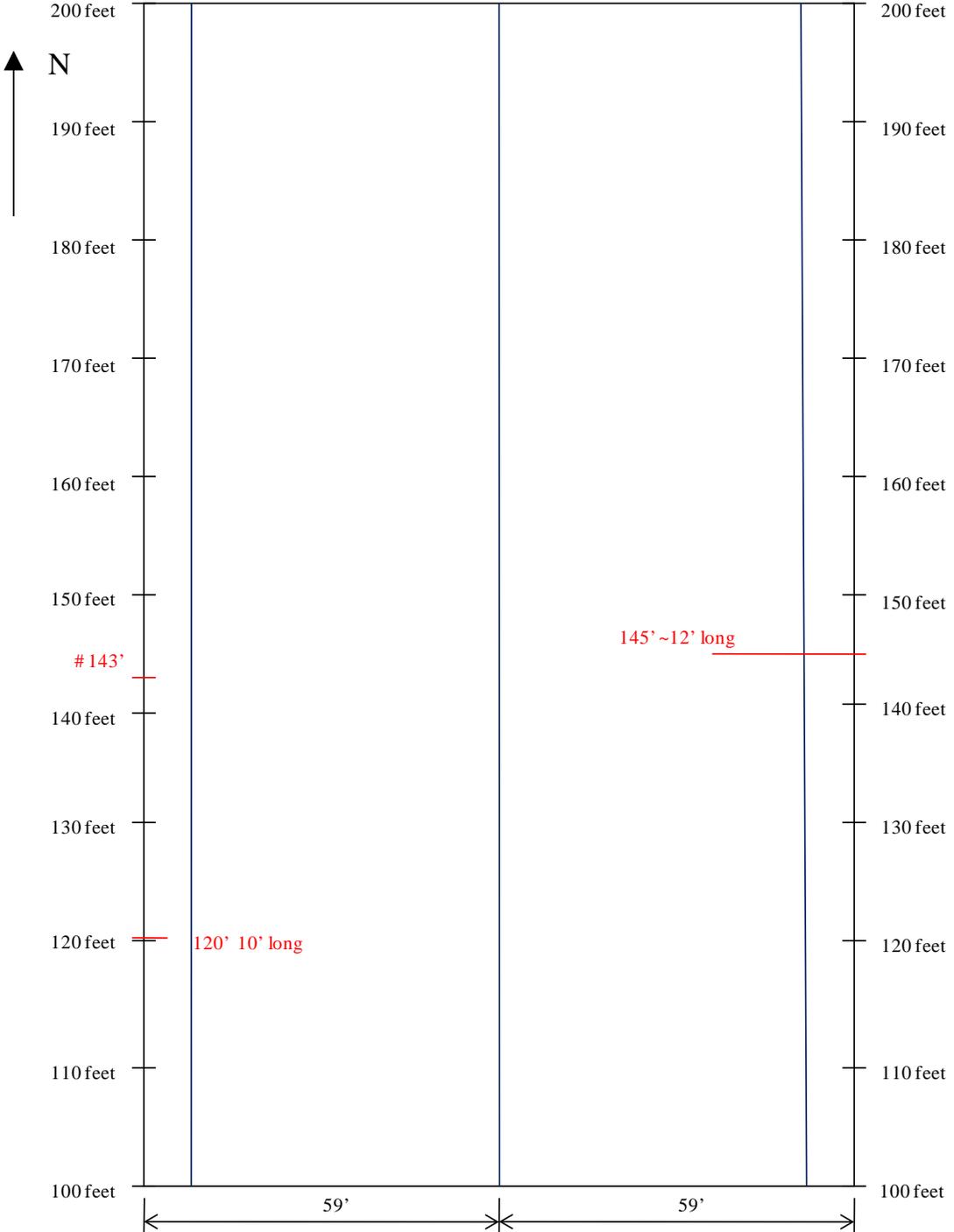
Microsilica Source: W. R. Grace and Company

# I-55 over Lake Springfield



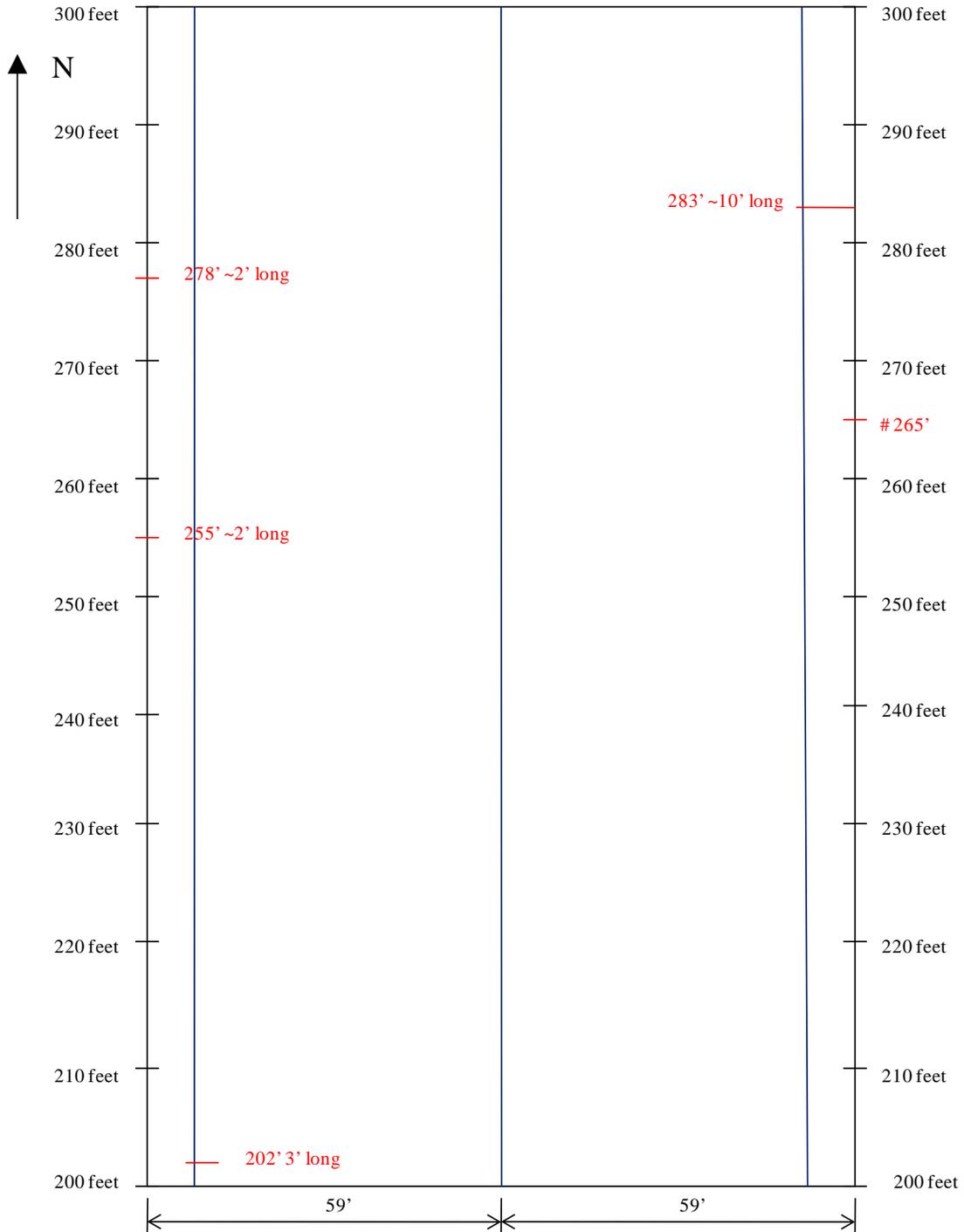
Sangamon County – SN# 084-0500 NB – Surveyed 5/7/2002  
Sangamon County – SN# 084-0499 SB – Surveyed 5/7/2002

# I- 55 over Lake Springfield



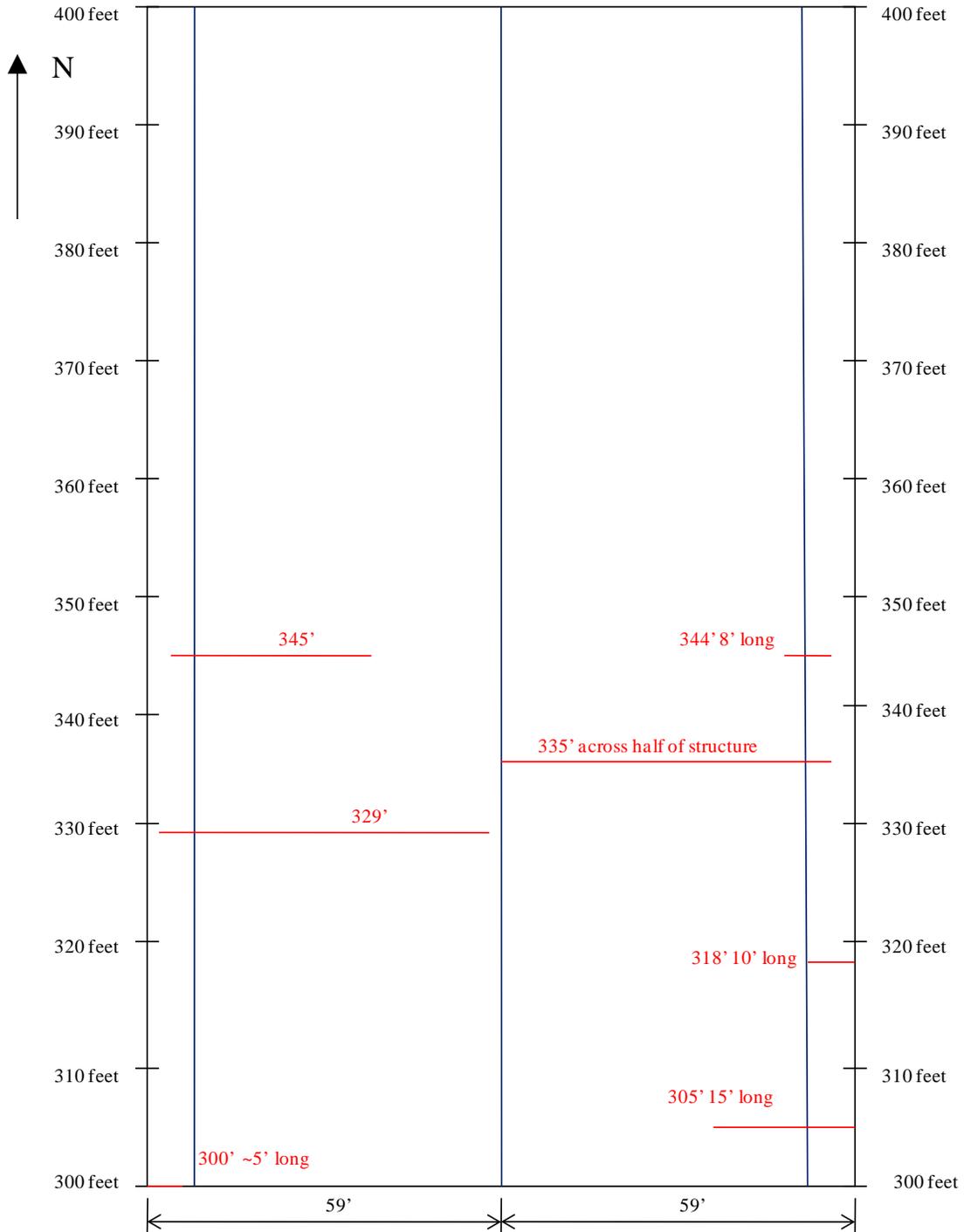
Sangamon County – SN# 084-0500 NB – Surveyed 5/7/2002  
 Sangamon County – SN# 084-0499 SB – Surveyed 5/7/2002

# I-55 over Lake Springfield



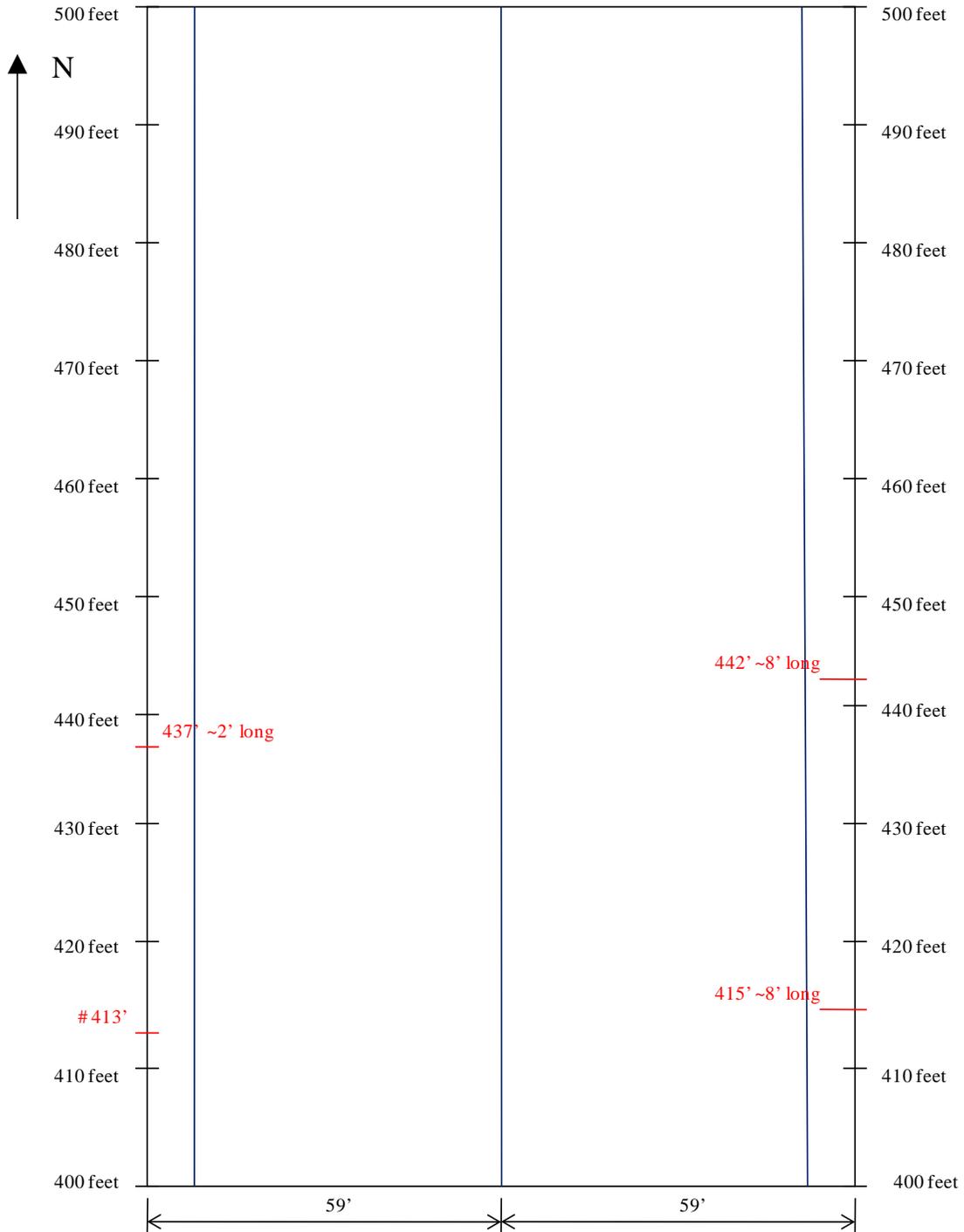
Sangamon County – SN# 084-0500 NB – Surveyed 5/7/2002  
Sangamon County – SN# 084-0499 SB – Surveyed 5/7/2002

# I-55 over Lake Springfield



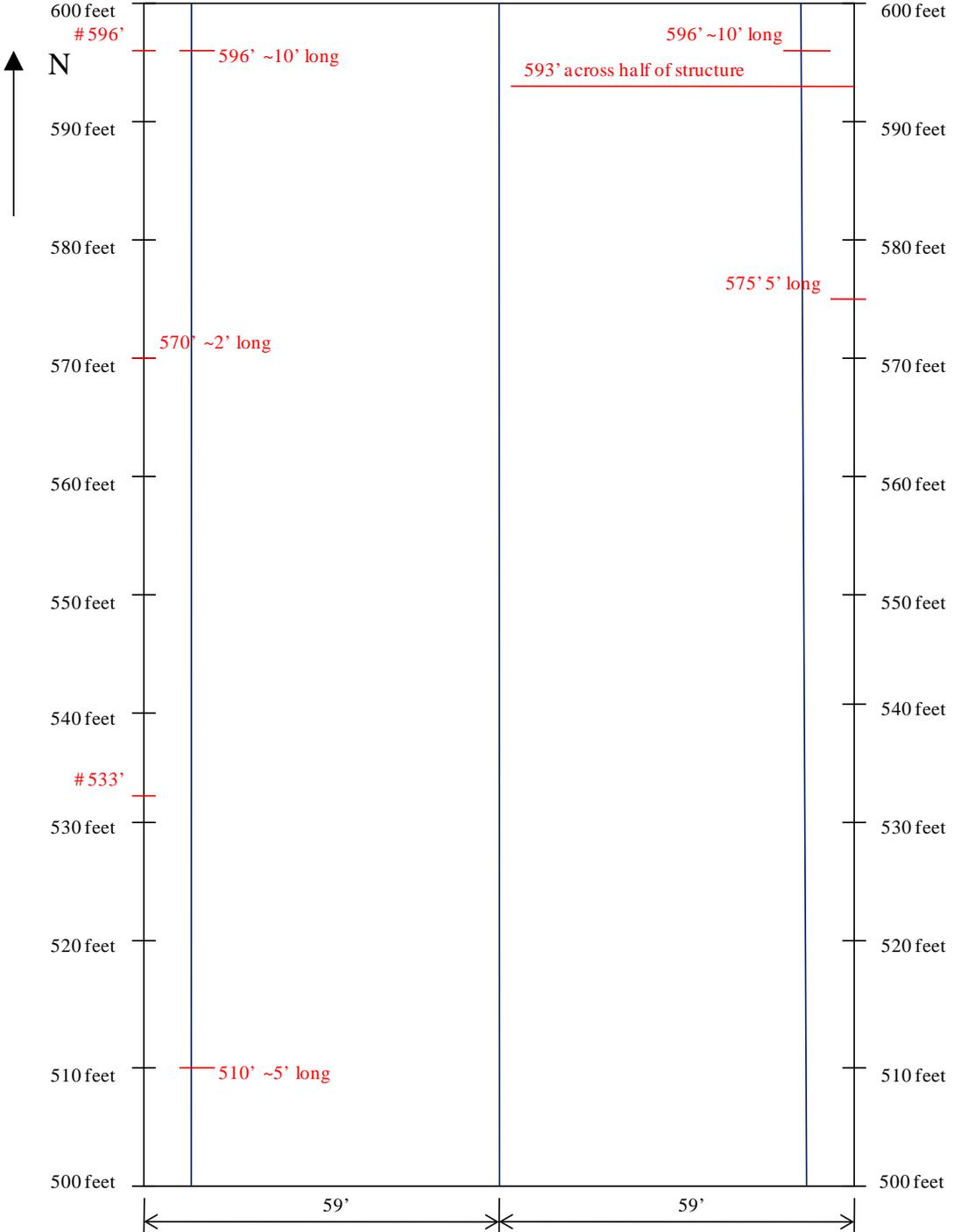
Sangamon County – SN# 084-0500 NB – Surveyed 5/7/2002  
Sangamon County – SN# 084-0499 SB – Surveyed 5/7/2002

# I-55 over Lake Springfield



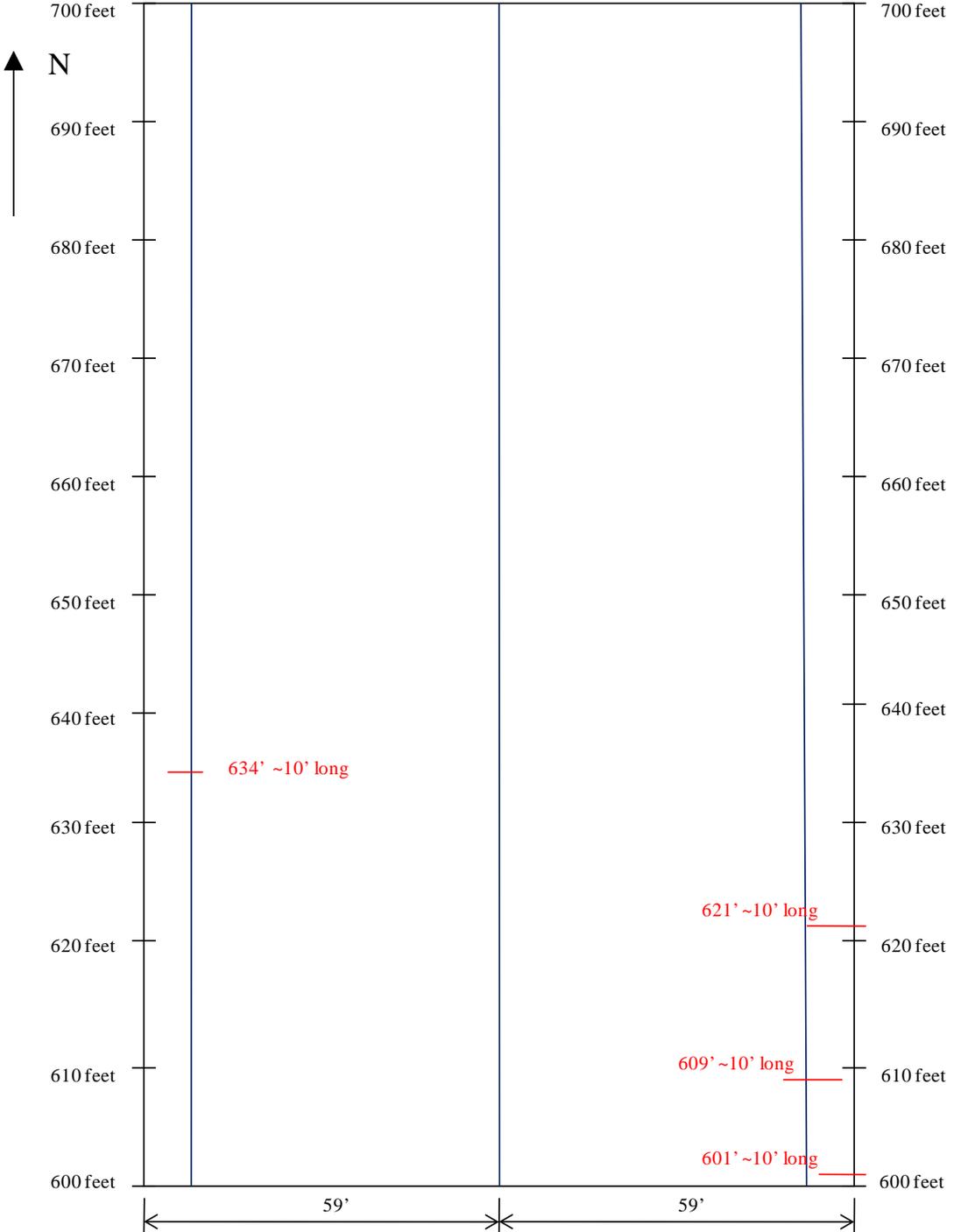
Sangamon County – SN# 084-0500 NB – Surveyed 5/7/2002  
Sangamon County – SN# 084-0499 SB – Surveyed 5/7/2002

# I-55 over Lake Springfield



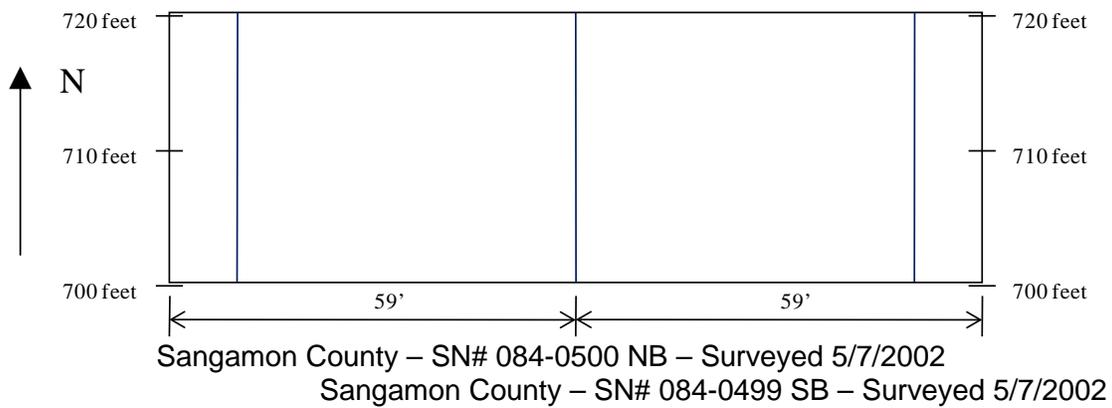
Sangamon County – SN# 084-0500 NB – Surveyed 5/7/2002  
 Sangamon County – SN# 084-0499 SB – Surveyed 5/7/2002

# I- 55 over Lake Springfield



Sangamon County – SN# 084-0500 NB – Surveyed 5/7/2002  
 Sangamon County – SN# 084-0499 SB – Surveyed 5/7/2002

## I-55 over Lake Springfield



The “#” symbol represents cracks in the parapet only.

This bridge deck was poured on various days. The last pour date was 4/5/2002.

No Detailed Distress Surveys were conducted on this structure after 2002 because the high average daily traffic (ADT) made maintaining traffic safety and minimizing traffic disruptions challenging.

Will County



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 099-4638

Responsible District: 1

Number of Spans: 3

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

ADT @ time bridge was built: 24,700 (2007)

Skew:  Y  N Angle: 30°

Inspected By: DAD, JAB

Date Inspected: 8/24/11

Span Lengths 24.1ft,26.5ft,24.1ft Total: 74.8ft

Deck Width: 82.3ft

Beam Spacing: 3.3ft

Date of Beam Erection: 2002

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: Stage 1, 2002 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: Approximately six transverse cracks observed under the bridge deck. On Top, NB, cracks observed at 1'-2' spacings in midspan and 4'-5' spacings on ends and more cracks in SB.

Longitudinal Cracking: Longitudinal cracking observed extending from joints at the north end.

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

SB lanes had more cracking on ends than NB. In SB, cracking observed 1'-2' apart in midspan and 3'-4' on ends.

**Mix Design Information: (from MISTIC)**

Mix Design Number: 71PCCFR05

Coarse Aggregate Source: Material Service  Crushed Stone  Gravel

Coarse Aggregate Source: n/a  Crushed Stone  Gravel

Fine Aggregate Source: Midwest Material Fine Aggregate Source: n/a

Cement Source: \_\_\_\_\_ HRM Source: Engelhard Corporation

Fly Ash Source: \_\_\_\_\_ GGBF Slag Source: Holcim (US) Inc.

Microsilica Source: \_\_\_\_\_

Winnebago County



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 101-0175

Inspected By: DAD, JAB

Responsible District: 2

Date Inspected: 8/22/11

Number of Spans: 1

Span Lengths 85'0" Total: 85'0"

Deck Width: 40'0"

Beam Type:  PPC-I  Steel  Other

Beam Spacing: 6'3"

Date of Beam Erection: 2002

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: 13,000 (2007)

Stage Construction:  Y  N

Skew:  Y  N Angle: 9°

Pour Dates: Stage 1, 2002 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: Transverse cracking was observed under and above the bridge deck, more than Structure Number 101-0176.

Longitudinal Cracking: \_\_\_\_\_

Bridge Joint Cracking / Integral Abutment Cracking: Longitudinal cracking observed near bridge joints, extending into bridge deck.

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

More cracking observed on this structure than the structure numbered 101-0176. The parapets on this structure were badly cracked.

**Mix Design Information: (from MISTIC)**

Mix Design Number: 72PCC7926

Coarse Aggregate Source: Rogers R-M & Materials  Crushed Stone  Gravel

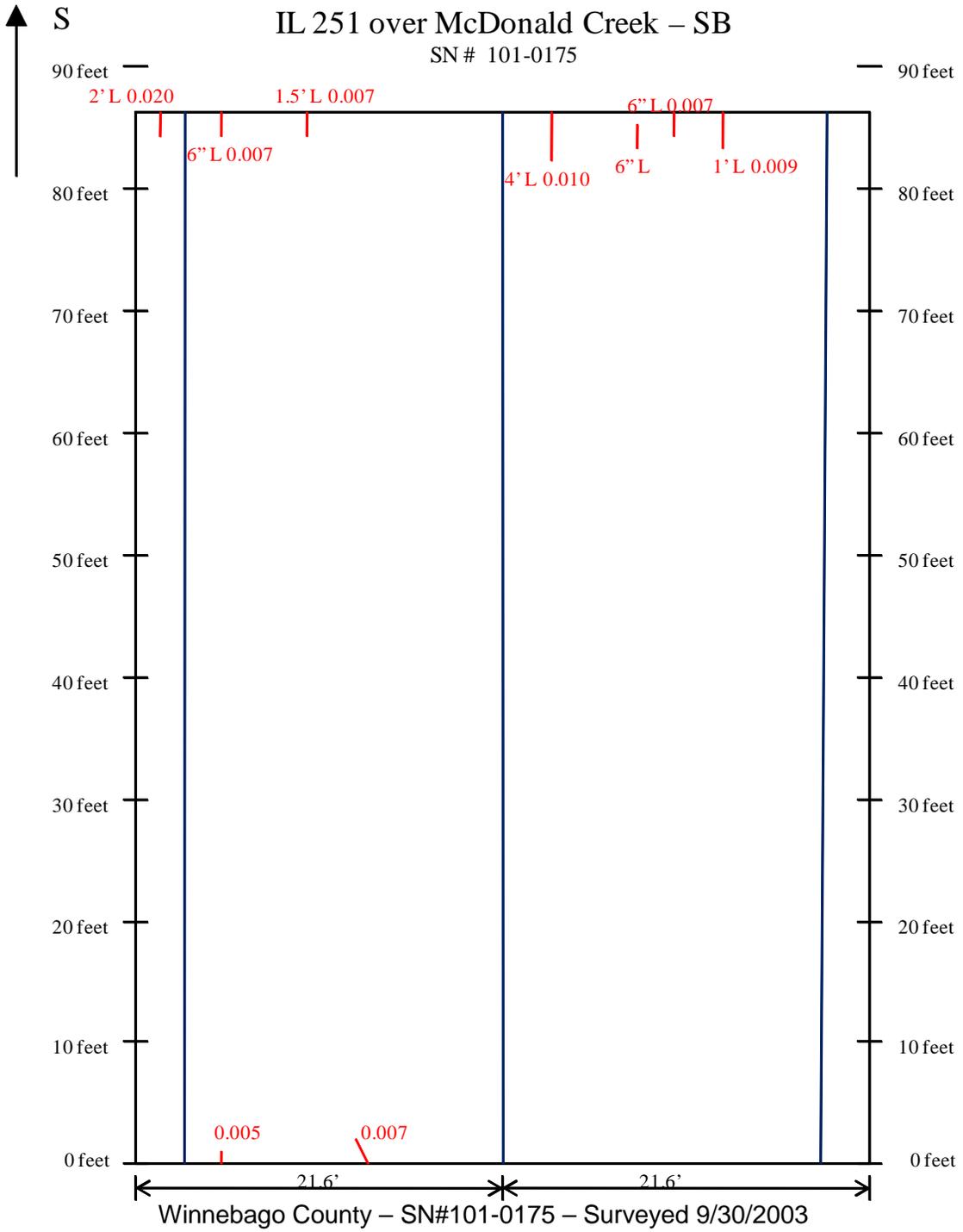
Coarse Aggregate Source: n/a  Crushed Stone  Gravel

Fine Aggregate Source: Rogers R-M & Materials Fine Aggregate Source: \_\_\_\_\_

Cement Source: Lone Star Industries HRM Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: Mineral Resource Technologies Microsilica Source: W.R. Grace & Co.





**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 101-0176

Inspected By: DAD, JAB

Responsible District: 2

Date Inspected: 8/22/11

Number of Spans: 1

Span Lengths 85'0" Total: 85'0"

Deck Width: 40'0"

Beam Type:  PPC-I  Steel  Other

Beam Spacing: 6'3"

Date of Beam Erection: 2002

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: 13,000 (2007)

Stage Construction:  Y  N

Skew:  Y  N Angle: 9°

Pour Dates: Stage 1, 2002 Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: Very little cracking observed above and below deck. Corner cracking was observed near north abutment under the deck.

Longitudinal Cracking: None observed underneath.

Bridge Joint Cracking / Integral Abutment Cracking: Some longitudinal cracking observed at bridge joint near approaches above deck.

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Conventional Mix Design-Did not use HPC

Cracking observed on North and South bridge approach pavements. No cracking observed in the parapets.

**Mix Design Information: (from MISTIC)**

Mix Design Number: 72PCC9223

Coarse Aggregate Source: Rogers R-M & Materials  Crushed Stone  Gravel

Coarse Aggregate Source: n/a  Crushed Stone  Gravel

Fine Aggregate Source: Rogers R-M & Materials Fine Aggregate Source: \_\_\_\_\_

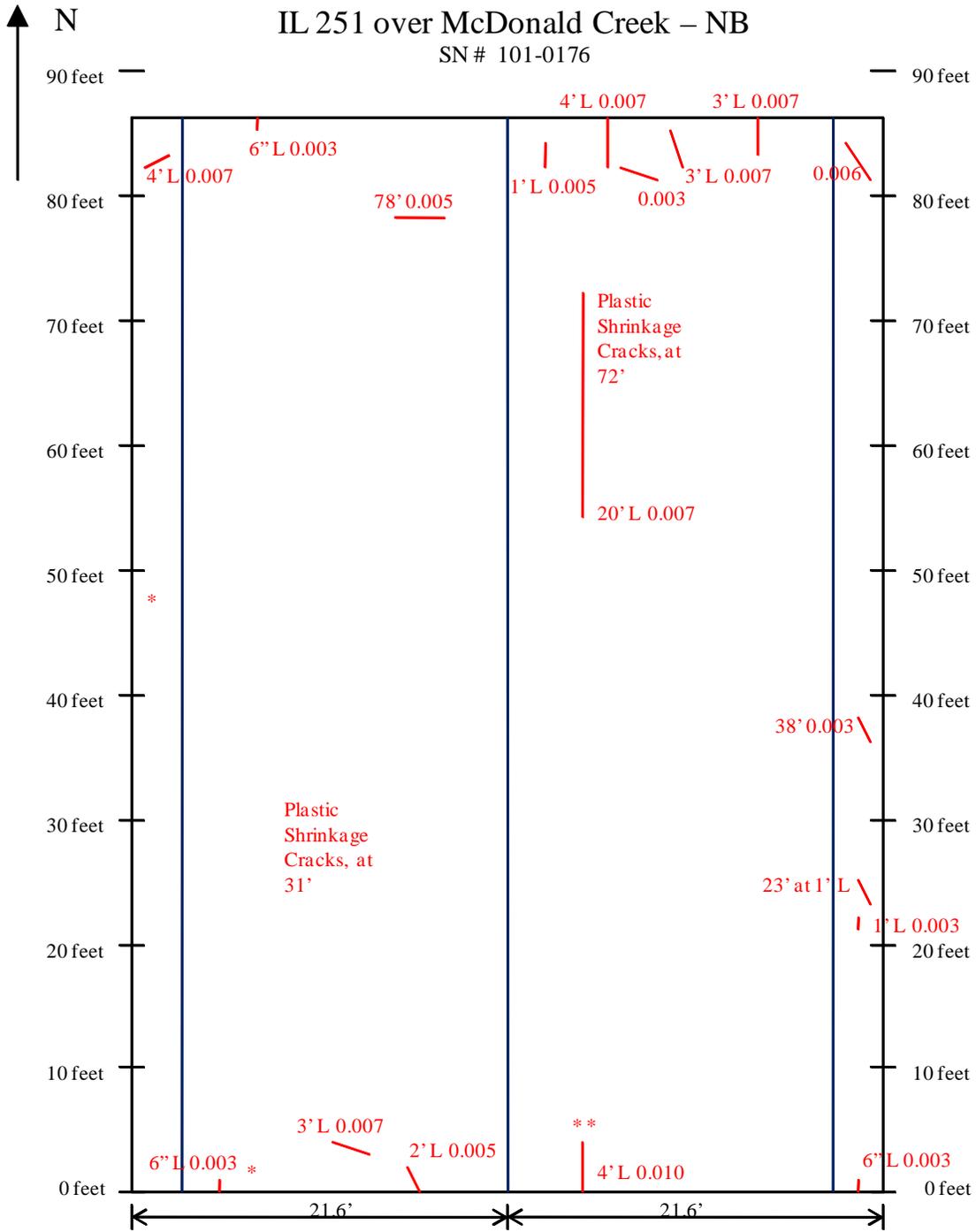
Cement Source: Lone Star Industries

HRM Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: Mineral Resource Technologies

Microsilica Source: \_\_\_\_\_



Winnebago County – SN# 101-0176 – Surveyed 9/30/2003

\* Denotes areas of plastic shrinkage cracking

\*\* Area with baseball sized popout.

Appendix B  
Bridge Survey Forms  
Expansive Cements



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 018-0007(Type K Cement)

Inspected By: DAD, DHT, JAB

Responsible District: 5

Date Inspected: 9/12/08

Number of Spans: \_\_\_\_\_

Span Lengths See below Total: 296'4½"

Deck Width: 35'2"

Beam Type:  PPC-I  Steel  Other

Beam Spacing: 5'11"

Date of Beam Erection: \_\_\_\_\_

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: \_\_\_\_\_

Stage Construction:  Y  N

Skew:  Y  N Angle: 30°

Pour Dates: Stage 1, \_\_\_\_\_ Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: \_\_\_\_\_

Longitudinal Cracking: \_\_\_\_\_

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

SN 018-0007 was built in 1991 on US 40 over Muddy Creek in Cumberland County, IL.

Virtually free of cracks.

Span Lengths: 65'8½", 82'8¾", 81'7¾", 66'3½"

**Mix Design Information: (from MISTIC)**

Mix Design Number: \_\_\_\_\_

Coarse Aggregate Source: \_\_\_\_\_  Crushed Stone  Gravel

Coarse Aggregate Source: \_\_\_\_\_  Crushed Stone  Gravel

Fine Aggregate Source: \_\_\_\_\_ Fine Aggregate Source: \_\_\_\_\_

Cement Source: Southdown, Inc. (Fairborn, OH) HRM Source: \_\_\_\_\_

Type K cement per ASTM C 845 GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: \_\_\_\_\_ Microsilica Source: \_\_\_\_\_

715 lbs of cement per cubic yard with no fly ash.



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 094-0045(Type K cement)

Inspected By: DAD, DHT, JAB, FHWA

Responsible District: 4

Date Inspected: 6/29/09

Number of Spans: 3

Span Lengths 40'0" Total: 142'6"

Deck Width: 40'0"

Beam Type:  PPC-I  Steel  Other

Beam Spacing: 7'5"

Date of Beam Erection: 1992

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: \_\_\_\_\_

Stage Construction:  Y  N

Skew:  Y  N Angle: 1°30'

Pour Dates: Stage 1, \_\_\_\_\_ Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: Almost no cracks were seen.

Longitudinal Cracking: None

Bridge Joint Cracking / Integral Abutment Cracking: Cracks were observed at distances of 3' – 4' in approach slabs near integral abutments. Minor cracking under the deck near the ends related to integral abutment cracking.

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Minimal, almost no cracking was observed on 094-0045. Some longitudinal cracking was seen on the parapet.

**Mix Design Information: (from MISTIC)**

Mix Design Number: \_\_\_\_\_

Coarse Aggregate Source: \_\_\_\_\_  Crushed Stone  Gravel

Coarse Aggregate Source: \_\_\_\_\_  Crushed Stone  Gravel

Fine Aggregate Source: \_\_\_\_\_ Fine Aggregate Source: \_\_\_\_\_

Cement Source: Southdown, Inc. (Fairborn, OH) HRM Source: \_\_\_\_\_

Type K cement per ASTM C 845 GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: \_\_\_\_\_ Microsilica Source: \_\_\_\_\_



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 094-0046(Type K cement)

Inspected By: DAD, DHT, JAB, FHWA

Responsible District: 4

Date Inspected: 6/29/09

Number of Spans: 3

Span Lengths 40'0" Total: 142'6"

Deck Width: 40'0"

Beam Type:  PPC-I  Steel  Other

Beam Spacing: 7'5"

Date of Beam Erection: 1992

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: \_\_\_\_\_

Stage Construction:  Y  N

Skew:  Y  N Angle: 1°30'

Pour Dates: Stage 1, \_\_\_\_\_ Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: Almost no cracks were seen.

Longitudinal Cracking: None

Bridge Joint Cracking / Integral Abutment Cracking: Cracks were observed at distances of 3' – 4' in approach slabs near integral abutments. Minor cracking under the deck near the ends related to integral abutment cracking.

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Minimal, almost no cracking was observed on 094-0046. Some longitudinal cracking was seen on the parapet.

**Mix Design Information: (from MISTIC)**

Mix Design Number: \_\_\_\_\_

Coarse Aggregate Source: \_\_\_\_\_  Crushed Stone  Gravel

Coarse Aggregate Source: \_\_\_\_\_  Crushed Stone  Gravel

Fine Aggregate Source: \_\_\_\_\_ Fine Aggregate Source: \_\_\_\_\_

Cement Source: Southdown, Inc. (Fairborn, OH) HRM Source: \_\_\_\_\_

Type K cement per ASTM C 845 GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: \_\_\_\_\_ Microsilica Source: \_\_\_\_\_



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 102-0046 (SCP)

Inspected By: DAD, DHT, JAB, FHWA

Responsible District: 4

Date Inspected: 6/29/09

Number of Spans: 3

Span Lengths See below Total: 225'

Deck Width: 44'0"

Beam Type:  PPC-I  Steel  Other

Beam Spacing: 6'10"

Date of Beam Erection: 1992

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: \_\_\_\_\_

Stage Construction:  Y  N

Skew:  Y  N Angle: 48°19'55"

Pour Dates: Stage 1, \_\_\_\_\_ Stage 2, \_\_\_\_\_

**Description of Cracking:**

Average Transverse Crack Distance: Only minor cracking observed in a small area with no pattern cracking.

Longitudinal Cracking: none

Bridge Joint Cracking / Integral Abutment Cracking: A small amount of cracking was seen near the ends under the deck.

Cracking over Piers: none

If staged construction, noticeable difference of crack severity between stages: \_\_\_\_\_

**Other Observations:**

Spans: 1)69'3¾"; 2)92'6"; 3)63'2½". SCP is an abbreviation for Shrinkage Compensating Powder. It is believed that approximately 85-90 lbs of Chem Comp III dry cementitious powder by CTS Cement Manufacturing Company and 605 lbs of Type I cement were in each cubic yard of concrete. Chem Comp III can be mixed with Type I cement to meet the requirements for Type K cement per ASTM C 845.

This was a slightly curved structure nearly free of cracks. Little cracking was observed on the parapets, usually around the joints. Longitudinal cracking was seen on the approach slab possibly a result from subgrade failure.

**Mix Design Information: (from MISTIC)**

Mix Design Number: \_\_\_\_\_

Coarse Aggregate Source: \_\_\_\_\_  Crushed Stone  Gravel

Coarse Aggregate Source: \_\_\_\_\_  Crushed Stone  Gravel

Fine Aggregate Source: \_\_\_\_\_ Fine Aggregate Source: \_\_\_\_\_

HRM Source: \_\_\_\_\_

Cement Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: \_\_\_\_\_

Microsilica Source: \_\_\_\_\_



# Illinois Department of Transportation

## High Performance Concrete Bridge Deck Inspection Feedback

Structure Number: 017-0006(SCP)

Responsible District: 7

Number of Spans: 3

Beam Type:  PPC-I  Steel  Other

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

ADT @ time bridge was built: light

Skew:  Y  N Angle: 46°

Inspected By: DAD, DHT, JAB

Date Inspected: 7/22/09

Span Lengths (1,3)59'10";(2)78'0" Total: 203'4"

Deck Width: 30'0"

Beam Spacing: 5'6"

Date of Beam Erection: 1992

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

Stage Construction:  Y  N

Pour Dates: ~~Stage 1~~, 1992 Stage 2, \_\_\_\_\_

### Description of Cracking:

Average Transverse Crack Distance: Some transverse cracking with distances between of 10' – 18'. The middle span has cracks, almost no cracks on spans 1 and 3. The bridge is in good shape.

Longitudinal Cracking: \_\_\_\_\_

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: N/A

### Other Observations:

SCP is an abbreviation for Shrinkage Compensating Powder. It is believed that approximately 85-90 lbs of Chem Comp III dry cementitious powder by CTS Cement Manufacturing Company and 605 lbs of Type I cement were in each cubic yard of concrete. Chem Comp III can be mixed with Type I cement to meet the requirements for Type K cement per ASTM C 845.

### Mix Design Information: (from MISTIC)

Mix Design Number: \_\_\_\_\_

Coarse Aggregate Source: \_\_\_\_\_  Crushed Stone  Gravel

Coarse Aggregate Source: \_\_\_\_\_  Crushed Stone  Gravel

Fine Aggregate Source: \_\_\_\_\_ Fine Aggregate Source: \_\_\_\_\_

HRM Source: \_\_\_\_\_

Cement Source: \_\_\_\_\_

GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: \_\_\_\_\_

Microsilica Source: \_\_\_\_\_

Appendix C  
Bridge Survey Forms  
Synthetic Fibers



**Illinois Department of Transportation**

**High Performance Concrete Bridge Deck Inspection Feedback**

Structure Number: 062-0072(Synthetic Fiber)

Inspected By: CRB, JAB

Responsible District: 4

Date Inspected: 5/17/2010

Number of Spans: 2

Span Lengths 39' 8½" Total: 79'5"

Deck Width: 34"0"

Beam Type:  PPC-I  Steel  Other

Beam Spacing: Box beams joined together

Date of Beam Erection: 2009

Abutment Type:  Pile Bent  Integral  
 Semi-Integral  Other

Bridge Joint:  Integral  Finger  
 Typical Expansion  Other

ADT @ time bridge was built: \_\_\_\_\_

Stage Construction:  Y  N

Skew:  Y  N Angle: 34°38'

Pour Dates: Stage 1, 2009 Stage 2, 2009

**Description of Cracking:**

Average Transverse Crack Distance: In the eastbound lanes, 5 transverse cracks were observed with cracks in the ends and approach. In the westbound lanes, few cracks in the ends and the approach were observed. Few transverse cracks were observed under the deck on the eastbound side. Fibers exposed on both sides.

Longitudinal Cracking: \_\_\_\_\_

Bridge Joint Cracking / Integral Abutment Cracking: \_\_\_\_\_

Cracking over Piers: \_\_\_\_\_

If staged construction, noticeable difference of crack severity between stages: More cracking in EB.

**Other Observations:**

Stage I: NW span used 4 lbs fibers/cy and NE span used 6 lbs fibers/cy.

Stage II: 4 lbs fibers/cy for the first 45 cy, then 6 lbs fibers/cy for the second 45 cy.

Stage II bridge approach: No more than 6 lbs fibers/cy.

Structure 062-0072 was formerly 062-0016.

**Mix Design Information: (from MISTIC)**

Mix Design Number: 84PCC635R

Coarse Aggregate Source: Martin Marietta (CA 11)  Crushed Stone  Gravel

Coarse Aggregate Source: Prairie Materials (CA 16)  Crushed Stone  Gravel

Fine Aggregate Source: Peoria Concrete Construction (FA 01) Fine Aggregate Source: N/A

Synthetic Fiber Source: Strux 90/40 by W. R. Grace HRM Source: \_\_\_\_\_

Cement Source: \_\_\_\_\_ GGBF Slag Source: \_\_\_\_\_

Fly Ash Source: Headwaters Resources Microsilica Source: \_\_\_\_\_