Instrumentation Summary

For the Vernon Avenue over the Ware River
Powder Mill Bridge
in Barre, MA
Bridge #B-02-012

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09/15/2012

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Overview

In January 2008, the National Science Foundation selected a team of researchers from Tufts University, the University of New Hampshire, Fay Spofford & Thorndike, and Geocomp, to participate in a project, "Whatever Happened to Long Term Bridge Design". The goals of the project include evaluation of bridge design procedures to facilitate long term monitoring and development of structural health monitoring systems. To help achieve these goals, the research team, working in cooperation with highway departments in New England, proposed to develop a "baseline" analytical model of a highway bridge. This model would be as close as possible to a "perfect" analytical representation of the bridge structure, in contrast to the typical AASHTO analysis model with its appropriately conservative assumptions and elemental design approach. The baseline model could be compared to instrumentation data to better evaluate the performance of the bridge structure over its design life. The research will assist in developing procedures for regular structural health monitoring of bridges, leading to better and more cost effective bridge maintenance and management.

In support of the NSF project, the Massachusetts Highway Department has granted the research team access to Bridge #B-02-012, Vernon Avenue over the Ware River in Barre, Massachusetts. The research team will develop a baseline model of the bridge and an instrumentation and monitoring program. This document details the instrumentation of the Vernon Avenue Bridge completed by members of the Research team, consisting of engineers, academicians and students from the University of New Hampshire (UNH), Tufts University (Tufts), Geocomp Corporation (Geocomp) and Fay, Spofford, & Thorndike Inc. (FST). See Appendix A for contact information. The purpose of this document is to provide a reference for installation procedure and final location of all instruments. See Appendix B for annotated bridge plans. See Appendix C for summary of chips in iSite boxes. See Appendix D for final locations of strain gauges. See Appendix E for system architecture diagram.

Instrumentation

Introduction

Instrumentation of the Powder Mill Bridge began in June 2009 and was completed in September of 2009. The types of sensors and quantities installed can be found in Table 1. Due to the confined staging area at the Vernon Avenue construction site, as well as the limited time between girder arrival and girder erection, it was necessary for research team members to travel to the fabrication facility of High Steel Structures in Lancaster, PA to install all strain gauges and girder temperature sensors prior to delivery. The installation of the deck temperature sensors, accelerometers, tiltmeters, and ambient temperature sensors was completed at the bridge construction site. All installation completed on site was coordinated with Mass Highway as well as ET & L in order to prevent any interference with the construction of the bridge. Table 2 summarizes the phase of construction during which each instrument type was installed.

Table 1: Instrumentation Summary

Quantity	Instrument Type
100	Strain Gauges
36	Girder Temperature Sensors
36	Concrete Temperature Sensors
16	Accelerometers
16	Tiltmeters
4	Ambient Temperature Sensors

Table 2: Summary of Installation Time Schedule

Instrumentation Type	Place of Installation	Time of Installation
Strain Gauges	Steel Fabrication Facility	Prior to Delivery
Girder Temperature Sensors	Steel Fabrication Facility	Prior to Delivery
iSite Data Acquisition Boxes	On Site	After girder erection, prior to placement of reinforcement cage
Concrete Temperature Sensors	On Site	After placement of reinforcement cage, prior to deck pour
Accelerometers and Tiltmeters	On Site	After deck cure, prior to load test
Ambient Temperature Sensors	On Site	After commissioning, when it was determined they would provide useful information

Installation Procedures

Strain Gauge Installation:

The strain gauges were installed on the girders at fabrication yard of High Steel, Inc. in Lancaster, PA prior to the delivery of the girders to the site. All strain gauge locations were measured, marked, and labeled using washable chalk as shown in Figure 1. Since the steel used was weathering steel, an area approximately 3"x 3" was then grinded down to bare steel. In order to ensure a smooth surface, the bare steel was sanded using medium grit sand paper. The area was then cleaned using acetone and a clean cloth. Once the surface was prepared, the strain gauge was attached using a small drop of Loctite glue. After the glue had set, measurements were again taken and recorded for the final location of the gauge (see Appendix D). In order to protect the gauge from weathering, silicone caulking was applied. The lead wire of the gauge was then secured using moldable epoxy. After the silicone and epoxy was applied, the entire area was then secured using all-weather aluminum tape as shown in Figure 2.

Figure 1. Strain Gauge markings prior to grinding

Figure 2. Installed Strain Gauge

Girder Temperature Sensor Installation:

Girder temperature sensors were also installed on the girders at High Steel prior to the delivery of the girders to the site. The sensors were installed using a small piece of moldable epoxy as close to the strain gauge location as possible as seen in Figure 3. The temperature sensor, excluding the tip, was then covered with aluminum tape for weather protection as shown in Figure 4.

Figure 3. Installed Girder Temperature Sensor

Figure 4. Strain Gauge/Temperature Sensor with Weather Protection

iSite Box Installation:

The iSite data loggers boxes were installed on the girders on site, after the erection of the girders but prior to the placement of the reinforcement cage. The installation consisted of attaching prefabricated iSite boxes to 8”x4”x1/2” painted steel angles. The angles were then attached to the south ends of the girders using removable c-clamps as shown in Figure 5. Three V3 iSite boxes were installed for the temperature sensors on girder 1. These boxes connect to the onboard PC via a serial cable.

Figure 5. Mounted iSite Boxes

Concrete Temperature Sensor Installation:

The concrete temperature sensors were installed on site after placement of the reinforcement cage, prior to the deck pour. The sensors were installed within the deck rebar cage. At each location, one sensor is tied to the underside to the top rebar layer, while the second sensor is tied to the underside of the bottom rebar layer as shown from above in Figure 6 and from the side in Figure 7. All sensor wires were tied to rebar and then placed through the small gap between the stay in place pans and the steel flange which can be seen in the top of Figure 6.

Figures 6 & 7. Installed Concrete Temperature Sensors

Tiltmeter Installation:

Tiltmeters were installed on site once the concrete deck was poured but prior to paving. The tiltmeters were installed in the middle of the web and wired to the appropriate iSite boxes. To install the tiltmeters, the location was measured out and marked, an area of about 3”x3” was ground down to bare steel and the sensor was attached to the girder using moldable epoxy, as

shown in Figure 8. The sensor was then covered with silicon and covered with aluminum tape to provide environmental protection for the final installed configuration as shown in Figure 9.

Figures 8 & 9. Installed Tiltmeters

Tiltmeters were also installed on abutments and pier caps to capture any rotation at those locations. A similar process was used for installation however there was no grinding, just cleaning of the surface before epoxying the sensor.

Accelerometer Installation:

The accelerometers were installed in a similar fashion to the tiltmeters, grinding down the steel and attaching the sensors using moldable epoxy. Figure 10 shows the installed accelerometers. The environmental protection for the accelerometers was the same as the tiltmeters, silicon and aluminum tape. Since these sensors had to be installed in the correct orientation, the moldable epoxy was formed around them to create a secure connection to the girder.

Figure 10. Installed Accelerometer

Pressure Plate Installation:

Pressure plates were installed at the site just before the south approach. The pressure plates (2) were installed in the sub base layer before asphalt as shown in Figure 11.

Figure 11. Pressure Plate Before Asphalt

Final System Installation

Once the bridge was opened, the final system installations took place. The systems were power, internet, and networking. Since these items were not part of the original contract for the bridge the research team performed these installations after the bridge was opened and turned over to the Town of Barre. Permanent power was installed onsite with help from Tattan Electric. As shown in Figure 12 a circuit breaker and meter were installed on the abutment wall. The power for this was run underground from the pump station down the road, comes up at the telephone pole right next to the bridge, and then goes underground again to the south abutment where it connects to the meter and then the circuit breaker. Also during power installation 2 3' long copper rods were installed in the ground right outside of girder 1 for grounding of the system

Figure 12. Circuit breaker and power meter

Along with this installation, permanent conduit was installed to carry both power and networking cables to the system as shown in Figure 13. The permanent system installation also took place at this time which included a central box to house all of the networking components as well as the onsite PC for data collection and system maintenance. The IP phone was installed on a box on south abutment, inside of girder 1 and the antenna was installed on the wing wall of the south abutment.

Figure 13. Final System Setup

Other upgrades to the site include the installation of a UPS unit, as seen in Figure 14, which was installed to troubleshoot power issues at the site. The UPS is installed after the power

goes through the meter and the circuit breaker but before it reaches any system electronics. With the UPS, researchers can remotely restart the system if needed. Due to concerns about the seasons temperature differences and the effect it could have on the UPS, the box was outfitted with cooling fans as well as a heater place that is controlled with a thermostat inside the UPS unit.

Figure 14. Installed UPS Unit

Most recently a new onsite laptop was installed for high speed data collection. This laptop was installed in a new fiberglass box next to the existing central box. This computer is fully connected to the network and can be reached remotely. The new laptop was setup to control the UPS for remote restarts.

Location of Instrumentation

The instrumentation of the structure occurs at 13 stations along the length of the bridge as follows. A summary of this information is found in Table 3 and Table 4. See Appendix B for annotated drawings of instrumentation locations.

Girder Instrumentation:

The six girders were instrumented at stations 1 through 11. Strain gauges were installed at stations 2, 4, 6, 8, and 10. The six girders were instrumented with four gauges at each station—two on the top side of the bottom flange, one on either side of the web, and two on the bottom side of the top flange, one on either side of the web. The two exterior girders did not have strain gauges installed on the exterior face to maintain the appearance of the bridge. Each strain gauge is located 3” in from the outer edge of the flange on which it is attached.

Temperature sensors were installed at stations 2, 6, and 10. All girders were instrumented with two temperature sensors at each station; one sensor was installed on the top

side of the bottom flange and one on the bottom side of the top flange. On Girders 1 through 6 the sensors are located on the interior side of the web.

Accelerometers were installed on Girders 1, 2, 3 and 6 at stations 1, 5, 7, and 11, with one accelerometer per station. The accelerometers are installed at mid-height on the web at these locations.

Tiltmeters were installed at stations 0, 3, 9 and 12 on Girders 2 and 5 and at stations 3 and 9 on Girders 1 and 6. All girders are instrumented with one tiltmeter at each designated station. The tiltmeters were installed at the mid-height of the web, on the interior side of the web.

Concrete Deck Instrumentation:

The concrete deck was instrumented with temperature sensors at stations 2, 6, and 10. There are two sensors above all six girders at these designated stations.

Substructure Instrumentation:

Each pier and each abutment was instrumented with one tiltmeter: stations 0, 3, 9, and 12. Each tiltmeter was installed along the centerline of the abutment or pier, just below the bearing.

Table 3. Instrumentation Schedule for Stations 0-6

Vernon Ave. Bridge Instrumentation Schedule - Station 0 through 6													
		Station 0	**Station 1**	**Station 2**	**Station 3**	**Station 4**	**Station 5**	**Station 6**
Girder 1	*Deck*			2 Concrete Thermister				2 Concrete Thermister
	Top Flange			1 Strain		1 Strain		1 Strain
				1 Thermister				1 Thermister
	Web		1 Accel		1 Titlmeter		1 Accel	
	Bottom Flange			1 Strain		1 Strain		1 Strain
				1 Thermister				1 Thermister
Girder 2	*Deck*			2 Concrete Thermister				2 Concrete Thermister
	Top Flange			2 Strain		2 Strain		2 Strain
				1 Thermister				1 Thermister
	Web	1 Titlmeter	1 Accel		1 Titlmeter		1 Accel	
	Bottom Flange			2 Strain		2 Strain		2 Strain
				1 Thermister				1 Thermister
Girder 3	*Deck*			2 Concrete Thermister				2 Concrete Thermister
	Top Flange			2 Strain		2 Strain		2 Strain
				1 Thermister				1 Thermister
	Web		1 Accel				1 Accel	
	Bottom Flange			2 Strain		2 Strain		2 Strain
				1 Thermister				1 Thermister
Girder 4	*Deck*			2 Concrete Thermister				2 Concrete Thermister
	Top Flange			2 Strain		2 Strain		2 Strain
				1 Thermister				1 Thermister
	Web							
	Bottom Flange			2 Strain		2 Strain		2 Strain
				1 Thermister				1 Thermister
Girder 5	*Deck*			2 Concrete Thermister				2 Concrete Thermister
	Top Flange			2 Strain		2 Strain		2 Strain
				1 Thermister				1 Thermister
	Web	1 Titlmeter			1 Titlmeter			
	Bottom Flange			2 Strain		2 Strain		2 Strain
				1 Thermister				1 Thermister
Girder 6	*Deck*			2 Concrete Thermister				2 Concrete Thermister
	Top Flange			1 Strain		1 Strain		1 Strain
				1 Thermister				1 Thermister
	Web		1 Accel		1 Titlmeter		1 Accel	
	Bottom Flange			1 Strain		1 Strain		1 Strain
				1 Thermister				1 Thermister
Abutment		1 Tiltmeter						
Pier Cap					1 Tiltmeter			

Table 4. Instrumentation Schedule for Stations 7-12, and Total Instruments per Girder

Vernon Ave. Bridge Instrumentation Schedule - Station 7 through 12													
		Station 7	**Station 8**	**Station 9**	**Station 10**	**Station 11**	**Station 12**	**Totals**
Girder 1	*Deck*				2 Concrete Thermister			6 Concrete Thermister
	Top Flange		1 Strain		1 Strain			4 Strain
					1 Thermister			3 Thermister
	Web	1 Accel		1 Tiltmeter		1 Accel		4 Accel, 2 Tiltmeter
	Bottom Flange		1 Strain		1 Strain			4 Strain
					1 Thermister			3 Thermister
Girder 2	*Deck*				2 Concrete Thermister			6 Concrete Thermister
	Top Flange		2 Strain		2 Strain			8 Strain
					1 Thermister			3 Thermister
	Web	1 Accel		1 Tiltmeter		1 Accel	1 Titlmeter	4 Accel, 4 Tiltmeter
	Bottom Flange		2 Strain		2 Strain			8 Strain
					1 Thermister			3 Thermister
Girder 3	*Deck*				2 Concrete Thermister			6 Concrete Thermister
	Top Flange		2 Strain		2 Strain			8 Strain
					1 Thermister			3 Thermister
	Web	1 Accel				1 Accel		3 Accel
	Bottom Flange		2 Strain		2 Strain			8 Strain
					1 Thermister			3 Thermister
Girder 4	*Deck*				2 Concrete Thermister			6 Concrete Thermister
	Top Flange		2 Strain		2 Strain			8 Strain
					1 Thermister			3 Thermister
	Web							
	Bottom Flange		2 Strain		2 Strain			8 Strain
					1 Thermister			3 Thermister
Girder 5	*Deck*				2 Concrete Thermister			6 Concrete Thermister
	Top Flange		2 Strain		2 Strain			8 Strain
					1 Thermister			3 Thermister
	Web			1 Titlmeter			1 Titlmeter	4 Titlmeter
	Bottom Flange		2 Strain		2 Strain			8 Strain
					1 Thermister			3 Thermister
Girder 6	*Deck*				2 Concrete Thermister			6 Concrete Thermister
	Top Flange		1 Strain		1 Strain			4 Strain
					1 Thermister			3 Thermister
	Web	1 Accel		1 Tiltmeter		1 Accel		4 Accel, 2 Tiltmeter
	Bottom Flange		1 Strain		1 Strain			4 Strain
					1 Thermister			3 Thermister
Abutment							1 Tiltmeter	2 Tiltmeter
Pier Cap				1 Tiltmeter				2 Tiltmeter

Method of Installation

All attachment of instrumentation to girders was done via mechanical or adhesive-type fasters. No welding, drilling, or bolting was performed on any part of the bridge as a part of the research work.

- Strain gauges, temperature sensors, and accelerometers were attached by epoxy or glue. The steel surface was prepared by locally grinding surface rust.
- Wires extending from sensors to the data acquisition boxes were secured with a marine epoxy.
- Split wire loom was installed between stations to protect wiring. The conduit was attached with mechanical fasteners.
- Remote DAQ were installed using mechanical fasteners.

Sensor Specifications and iSite Box Wiring

The information contained in this section details the specifications for the different types of instrumentation as well as how they are wired to the iSite box.

Sensor Specifications

Table 5 below show the various manufacturers and corresponding model numbers for the sensors installed on the bridge. Data sheets for the calibration factors for the accelerometers can be found at the personnel at Tufts University. Details about the pressure plates can be found at the personnel at the University of New Hampshire.

Table 5: Instrumentation Manufacturing Information

Instrument	Manufacturer	Model
Accelerometer	Dytran	7521A1
Thermistor	YSI	44000
Strain Gage	Omega	KFG-5-120-C1-11L3M3R
Tilt	VTI	D07
Pressure plate	GeoKon	3500

iSite Box Wiring

Table 6 shows the standard wiring for the sensors into the iSite boxes. This wiring is typical, however if replacing a box the wiring should always be noted and kept consistently since there were changes made during troubleshooting on a case-by-case basis.

Table 6: iSite Box Wire Connectivity

Strain

	Strain Gauge Wire	*CAT5 Cable*	*iSite Box Connection*
Top Flange - Lower #	Wire w/red	Green	V-
	Not specified	Blue	S+
	Not specified	Blue White	S-
Bottom Flange - Higher #	Wire w/red	Brown	V-
	Not specified	Orange	S+
	Not specified	Orange White	S-
		Shield	Shield

Thermistor

Thermistor Wire	*CAT5 Cable*	*iSite Box Connection*
Not specified	Blue/Blue White	Not specified
Not specified	Orange/Orange White	Not specified

Tiltmeters

	Tiltmeter Wire	*CAT5 Cable*	*iSite Box Connection*
Y-Axis Channel	Red	Brown White	V+
	Blue	Brown	V-
	Green	Green White/Green	S+
X-Axis Channel	Yellow	Orange White/Orange	S+

Accelerometer

Accelerometer Wires	*CAT5 Cable*	*iSite Box Connection*
Red	Brown White	V+
Black	Brown	V-
Green	Green White and Green	S+
Shield	Shield	Shield
Yellow	Cut flush	
Blue	Cut flush	
White	No connection, do not cut	

iSite Box Number, IP Address, and DB Number

Table 7 below is a key for the different addresses for the iSite loggers. The IP address and DB number can be used to connect to boxes using the ICC program, however IP address is preferred.

Table 7: iSite Box Information

iSite Box Number	IP Address	DB Number	Notes
HS 101	192.168.1.180	DB0088	
HS 102	192.168.1.181	DB0089	
HS 103	192.168.1.182	DB0055	was DB0090 until 9/7/12
HS 104	192.168.1.183	DB0091	
HS 105	192.168.1.184	DB0092	
HS 106	192.168.1.185	DB0093	
HS 107	192.168.1.186	DB0094	
HS 108	192.168.1.187	DB0095	
HS 109	192.168.1.188	DB0096	
HS 110	192.168.1.189	DB0097	
HS 111	192.168.1.190	DB0098	
HS 112	192.168.1.191	DB0099	
HS 113	192.168.1.192	DB0001	
HS 114	192.168.1.193	DB0002	
HS 115	192.168.1.194	DB0003	
HS 116	192.168.1.195	DB0004	
HS 117	192.168.1.196	DB0005	
HS 118	192.168.1.197	DB0006	
HS 119	192.168.1.198	DB0071	was DB0007 until 9/7/12
HS 120	192.168.1.199	DB0008	
V3 Temperature	localhost	-	

Appendix A: Contact Information

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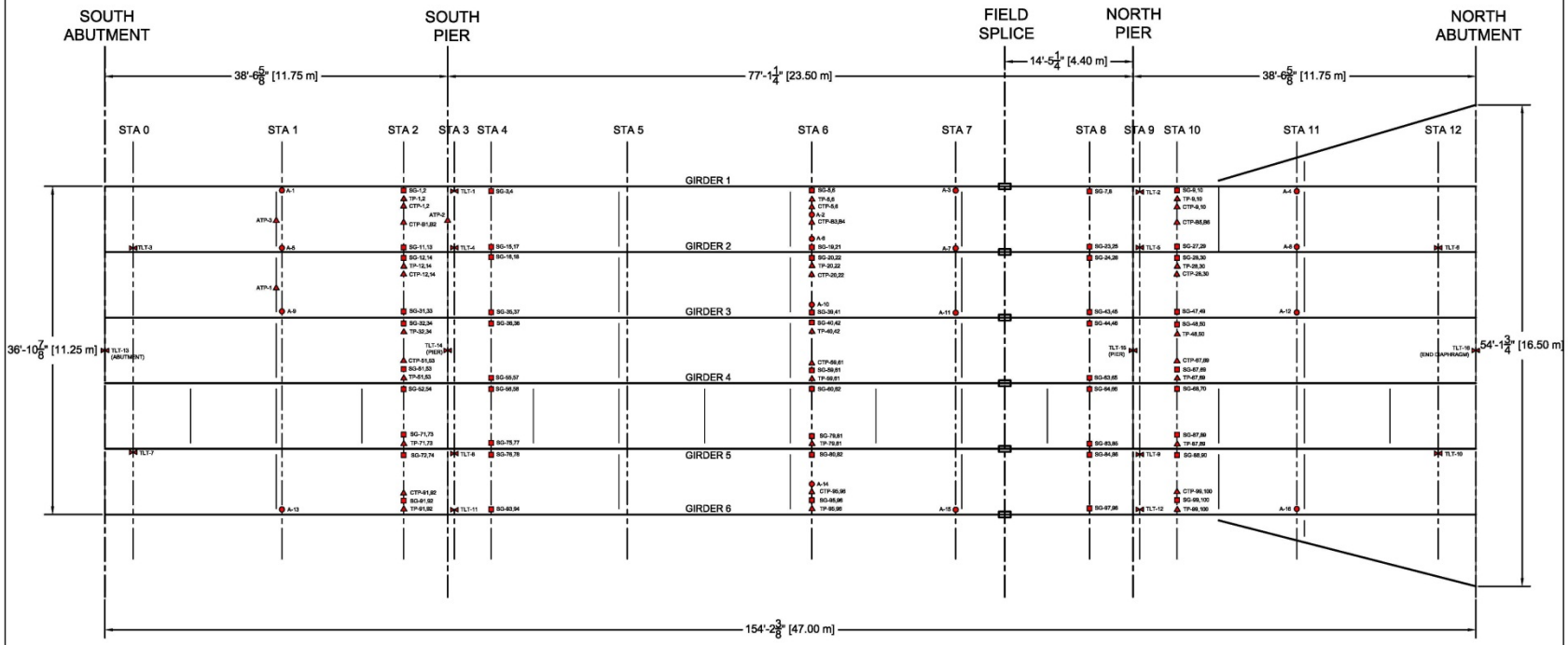
Appendix B: Annotated Bridge Plans



SENSOR KEY
- STRAIN GAUGE
- TEMPERATURE SENSOR
- TILTMETER
- ACCELEROMETER

INSTRUMENTATION PLAN VIEW

No.	DATE	REVISIONS / ISSUE	INIT

DESIGNED BY: JDS	FILE / PROJECT NUMBER: 20197
DRAWN BY: JDS	
CHECKED BY: ESB	DATE: JUNE 18, 2009

Tufts University School of Engineering
200 College Ave
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Boxborough, MA 01719

VERNON AVE BRIDGE
INSTRUMENTATION PLAN

Scale	Contract No.	Drawing No.	Sheet No.
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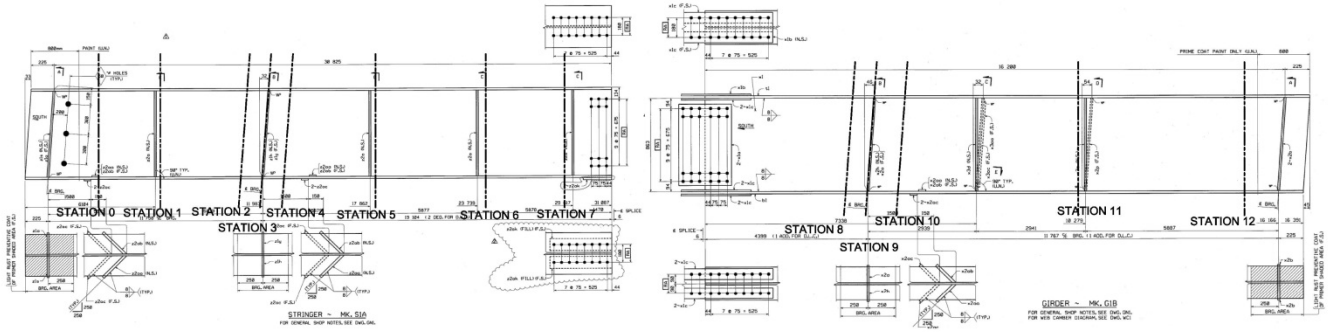

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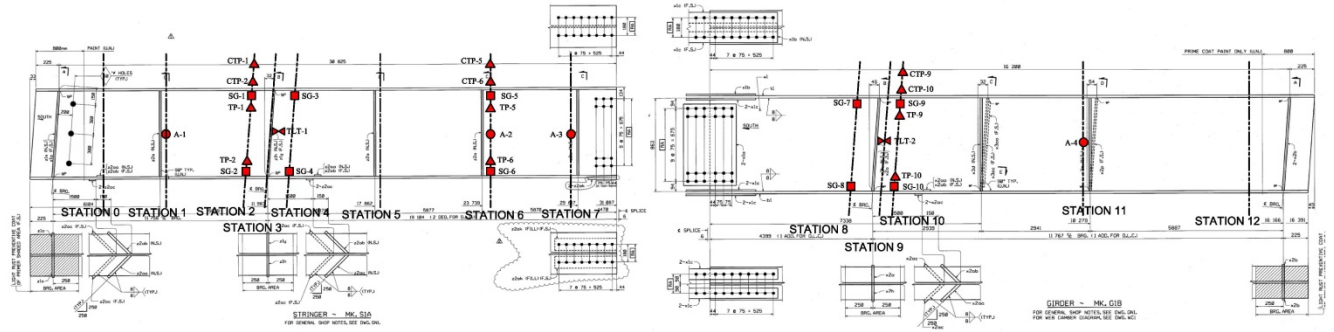

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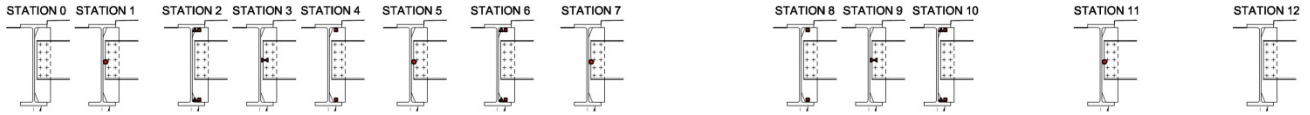

SECTIONS

FOR EXACT SENSOR LOCATION SEE SHEET 7

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VERNON AVE BRIDGE
GIRDER 1 INSTRUMENTATION ELEV

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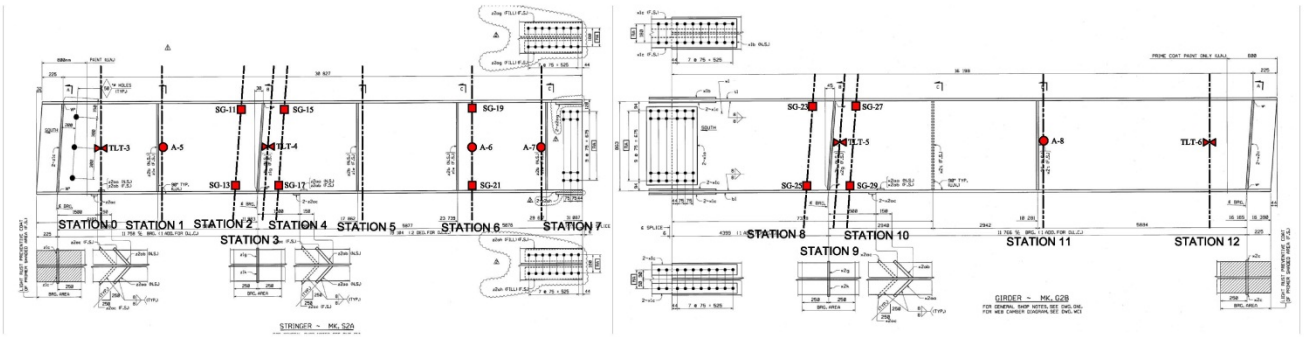

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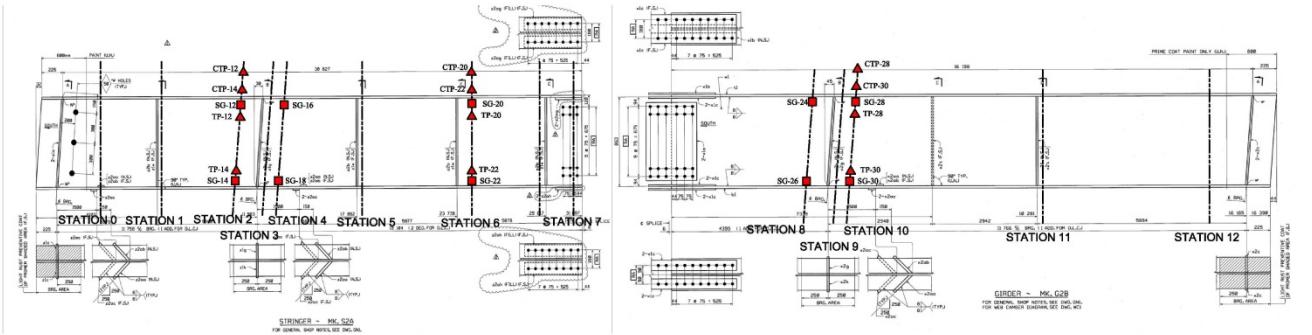

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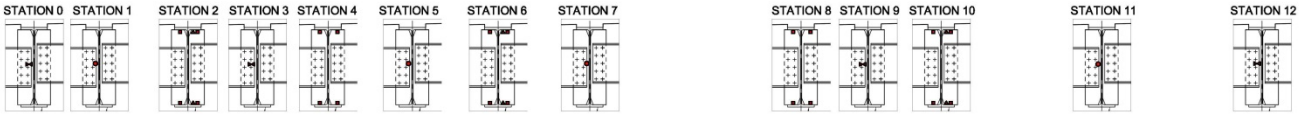

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VERNON AVE BRIDGE
GIRDER 2 INSTRUMENTATION ELEV

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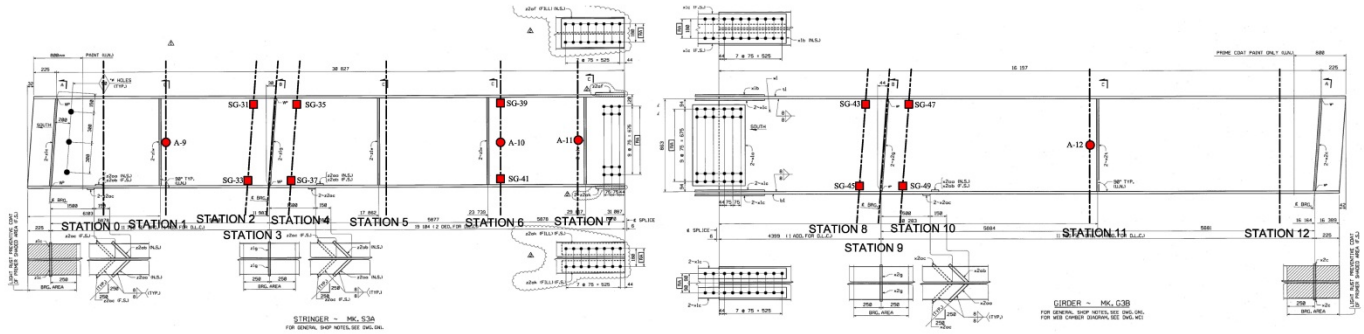

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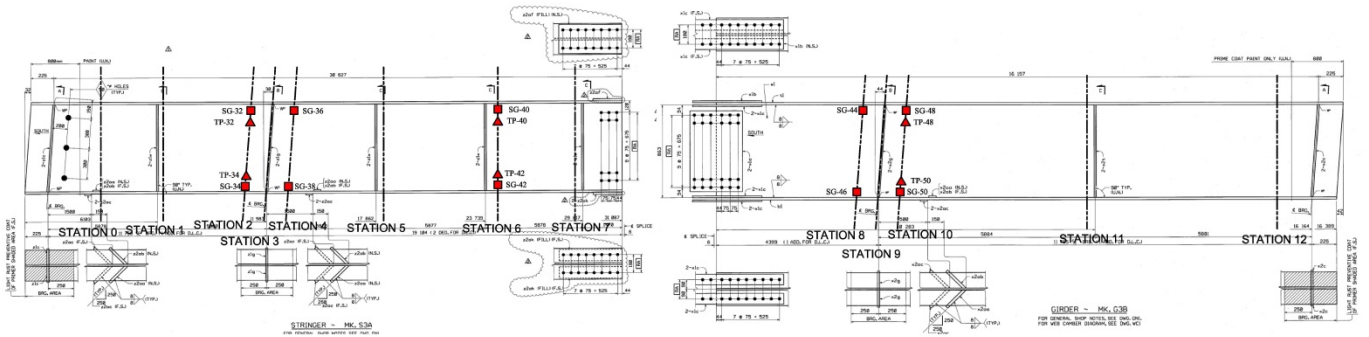

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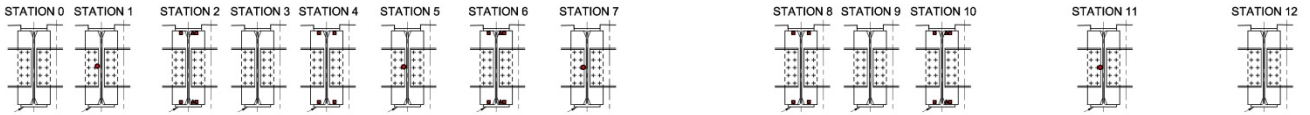

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VERNON AVE BRIDGE
GIRDER 3 INSTRUMENTATION ELEV

Scale	Contract No.	Drawing No.	Sheet No.
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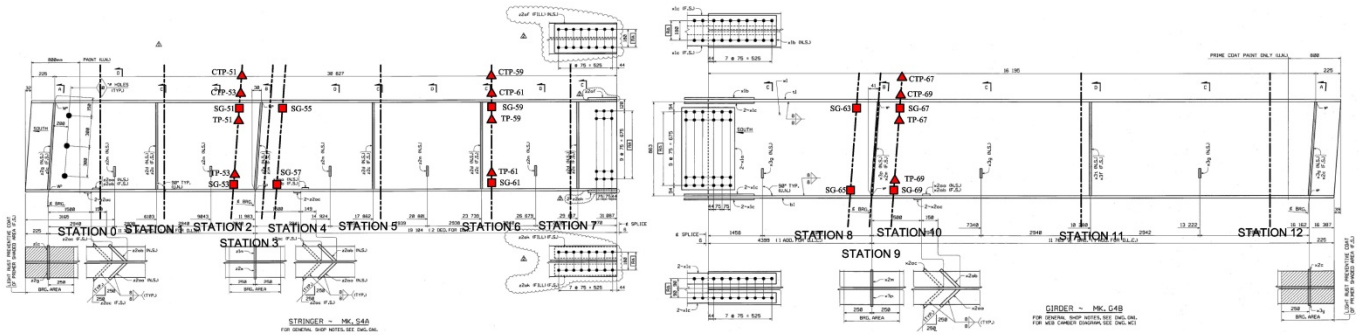

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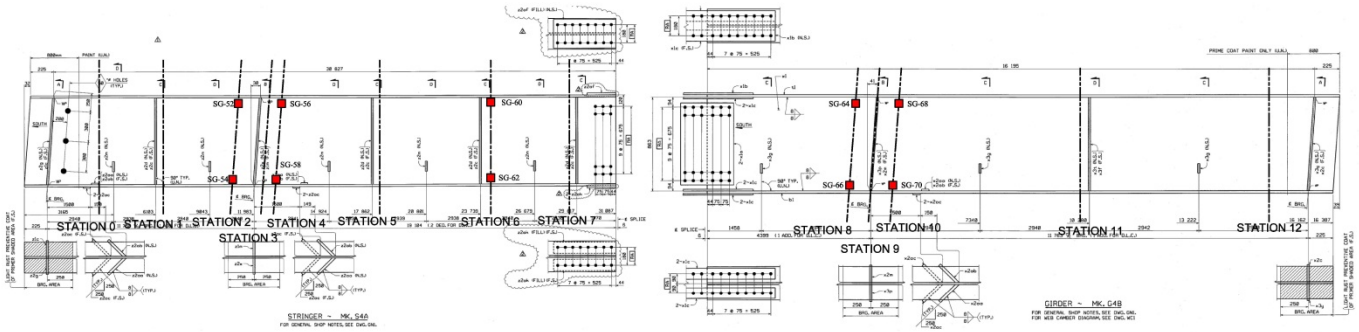

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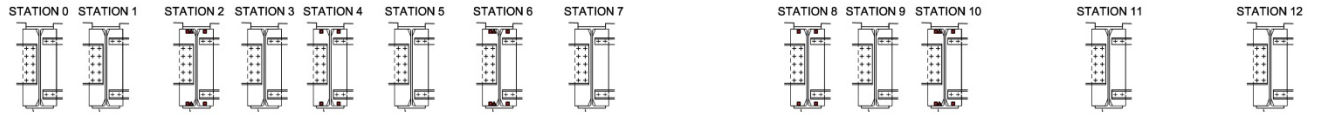

SECTIONS

FOR EXACT SENSOR LOCATION SEE SHEET 7

No.	DATE	REVISIONS / ISSUE	INIT

DESIGNED BY: JDS	FILE / PROJECT NUMBER: 20197
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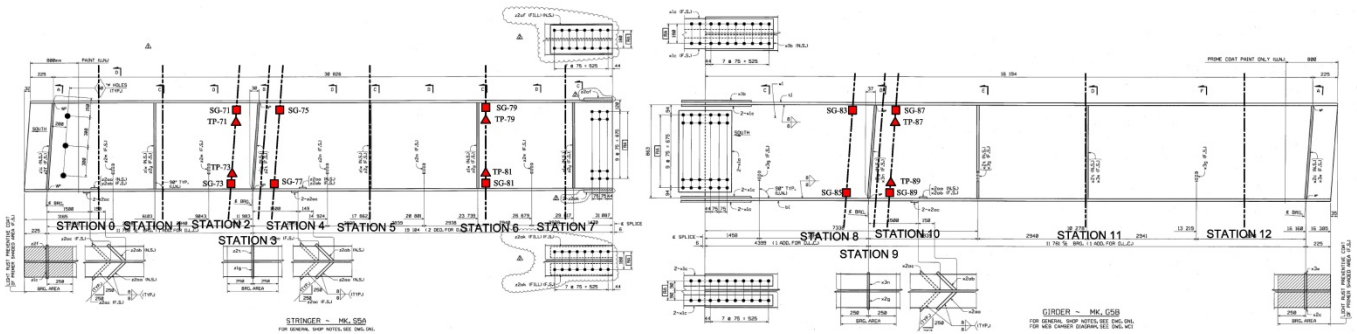
VERNON AVE BRIDGE
GIRDER 4 INSTRUMENTATION ELEV

Scale	Contract No.	Drawing No.	Sheet No.
NTS	N/A	GCC-1	4 OF 7



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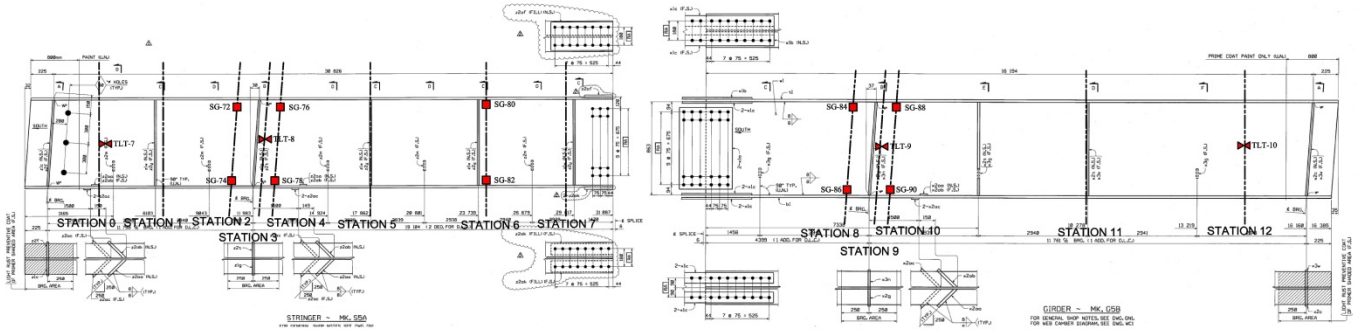

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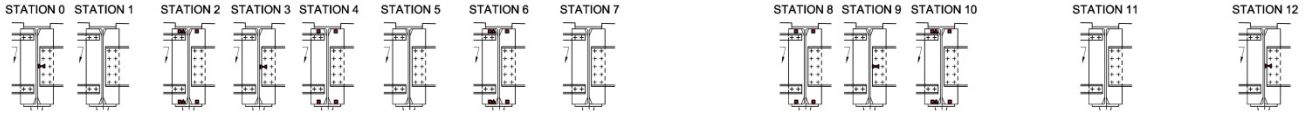

SECTIONS

FOR EXACT SENSOR LOCATION SEE SHEET 7

No.	DATE	REVISIONS / ISSUE	INIT

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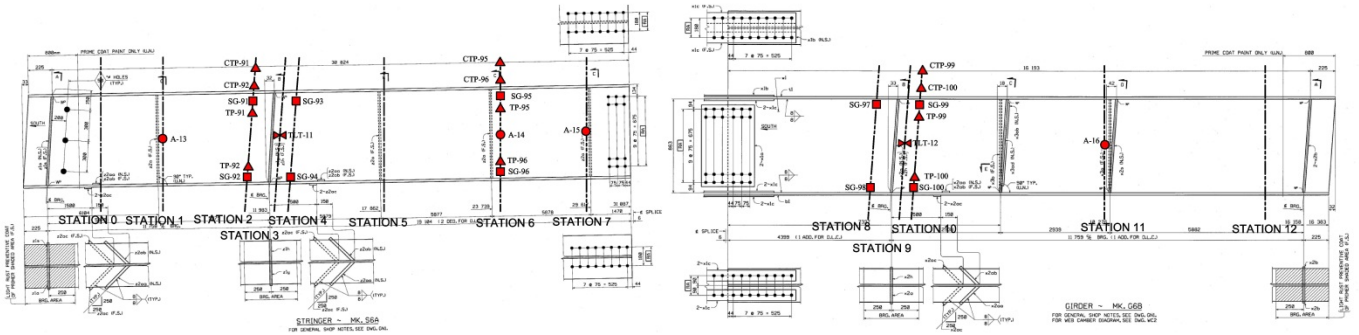
VERNON AVE BRIDGE
GIRDER 5 INSTRUMENTATION ELEV

Scale	Contract No.	Drawing No.	Sheet No.
NTS	N/A	GCC-1	5 OF 7



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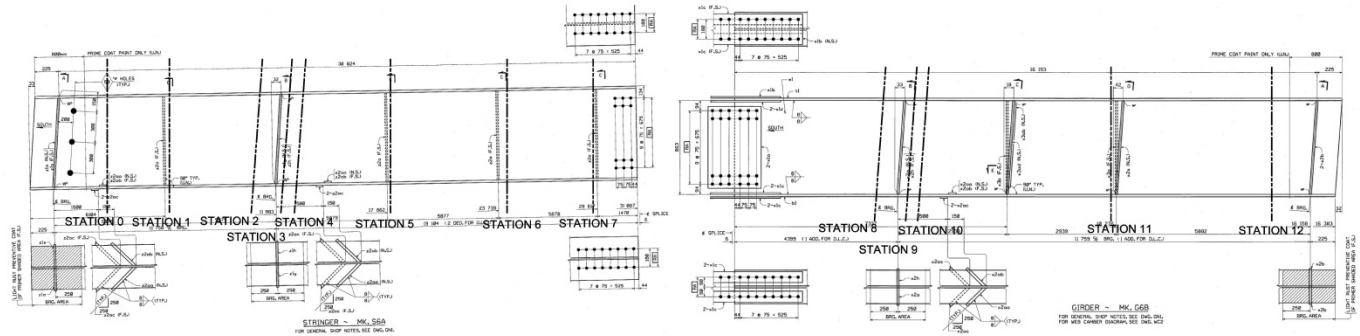

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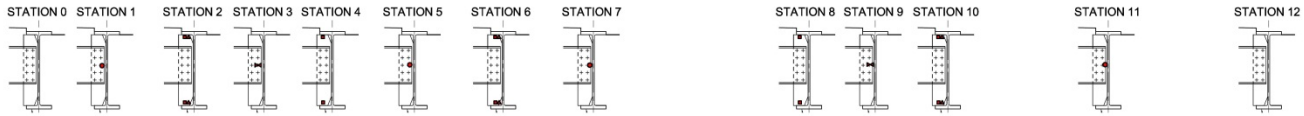

SECTIONS

FOR EXACT SENSOR LOCATION SEE SHEET 7

No.	DATE	REVISIONS / ISSUE	INIT

DESIGNED BY: JDS	FILE / PROJECT NUMBER: 20197
DRAWN BY: JDS	
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GIRDER 6 INSTRUMENTATION ELEV

Scale	Contract No.	Drawing No.	Sheet No.
NTS	N/A	GCC-1	6 OF 7

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Appendix C: Chip Inventory

iSite-HS 113 Address: DB0001 192.168.1.192					
Channel	Gauge ID	Working?	Notes	Chip	Output Range (mV)
1	SG-1	Yes		3501	(0.03177643) to (0.04436493)
2	SG-2	Yes		3501	(-0.06274224) to (0.08008004)
3	SG-3	Yes		3501	(2.351332) to (2.372341)
4	SG-4	Yes		3501	(2.876597) to (2.996397)
5	SG-5	Yes		3501	(0.7727433) to (0.7901955)
6	SG-6	Yes		3501	(0.4500199) to (0.6554413)
7	SG-7	Yes		3501	(1.903601) to (1.957417)
8	SG-8	Yes		3501	(0.747223) to (0.8481026)
iSite-HS 112 Address: DB0099 192.168.1.191					
Channel	Gauge ID	Working?	Notes	Chip	Output Range (mV)
1	SG-9	Yes - 25.7Hz Noise		3501	(2.544689) to (2.568093)
2	SG-10	Yes - 25.7Hz Noise		3501	(2.799549) to (2.960558)
3	SG-11	Yes - 25.7Hz Noise		3501	(1.070967) to (1.092692)
4	SG-13	Yes - 25.7Hz Noise		3501	(0.8471966) to (1.062813)
5	SG-19	Yes - 25.7Hz Noise	Was originally marked as SG-15	3501	(0.05100251) to (0.08261681)
6	SG-21	Yes - 25.7Hz Noise	Was originally marked as SG-17	3501	(-0.6104756) to (-0.3388977)
7	SG-15	Yes - 25.7Hz Noise	Was originally marked as SG-19	3501	(4.108668) to (4.144717)
8	SG-17	Yes - 25.7Hz Noise	Was originally marked as SG-21	3501	(1.996327) to (2.141972)

iSite-HS 111 Address: DB0098 192.168.1.190					
Channel	**Gauge ID**	**Working?**	**Notes**	**Chip**	**Output Range (mV)**
1	SG-12	Yes		3501	(-2.240677) to (-2.221327)
2	SG-14	Yes		3501	(-3.242169) to (-3.032446)
3	SG-16	Yes		3501	(1.537104) to (1.553459)
4	SG-18	Yes		3501	(-1.336689) to (-1.178942)
5	SG-20	Yes		3501	(8.146497) to (8.167411)
6	SG-22	Yes		3501	(-1.164122) to (-0.8812714)
7	SG-23	Yes	Minor 60Hz Noise	3501	(0.7375718) to (0.7555771)
8	SG-25	Yes		3501	(1.269102) to (1.416359)
iSite-HS 110 Address: DB0097 192.168.1.189					
Channel	**Gauge ID**	**Working?**	**Notes**	**Chip**	**Output Range (mV)**
1	SG-24	Yes - 19.25Hz Noise		3501	(1.65165) to (1.672611)
2	SG-26	Yes - 19.25Hz Noise		3501	(0.2541352) to (0.4043579)
3	SG-27	Yes - 19.25Hz Noise	Minor 60Hz Noise	3501	(1.019726) to (1.053162)
4	SG-28	Yes - 19.25Hz Noise		3501	(4.142027) to (4.159213)
5	SG-29	Yes - 19.25Hz Noise		3501	(-0.7000256) to (-0.4972077)
6	SG-30	Yes - 19.25Hz Noise		3501	(2.160149) to (2.350168)
7	SG-31	Yes - 19.25Hz Noise		3501	(0.3630638) to (0.3883267)
8	SG-33	Yes - 19.25Hz Noise		3501	(0.2937317) to (0.3900624)

iSite-HS 109 Address: DB0096 192.168.1.188					
Channel	**Gauge ID**	**Working?**	**Notes**	**Chip**	**Output Range (mV)**
1	SG-32	Yes		3501	(-3.575058) to (-3.548813)
2	SG-34	Yes		3501	(-0.6420899) to (-0.5553532)
3	SG-35	Yes		3501	(-1.100283) to (-1.069212)
4	SG-36	Yes		3501	(4.655972) to (4.675436)
5	SG-37	Yes		3501	(-1.810532) to (-1.718922)
6	SG-38	Yes		3501	(-1.13575) to (-1.036148)
7	SG-39	Yes		3501	(-0.5203152) to (-0.5090142)
8	SG-41	Yes		3501	(1.811657) to (1.984968)
iSite-HS 108 Address: DB0095 192.168.1.187					
Channel	**Gauge ID**	**Working?**	**Notes**	**Chip**	**Output Range (mV)**
1	SG-40	Yes		3501	(-0.1779843) to (-0.1676369)
2	SG-42	Yes		3501	(-1.710901) to (-1.533489)
3	SG-43	Yes	MInor 60Hz Noise	3501	(4.973336) to (4.991303)
4	SG-44	Yes		3501	(1.663199) to (1.682253)
5	SG-45	Yes		3501	(-0.5209923) to (-0.4405117)
6	SG-46	Yes		3501	(2.999287) to (3.083306)
7	SG-49	Yes	Was originally marked as SG-47 - Minor 60Hz Noise - **Special Wiring - Incorrect Sign**	3501	(2.634926) to (2.658167)
8	SG-47	Yes	Was originally marked as SG-49 - Minor 60Hz Noise - **Special Wiring - Incorrect Sign**	3501	(0.3868199) to (0.5065632)

iSite-HS 107 Address: DB0094 192.168.1.186					
Channel	Gauge ID	Working?	Notes	Chip	Output Range (mV)
1	SG-48	Yes		3501	(4.128695) to (4.152537)
2	SG-50	Yes		3501	(0.960951) to (1.079283)
3	SG-51	Yes		3501	(-1.228991) to (-1.215201)
4	SG-52	Yes		3501	(1.358824) to (1.371632)
5	SG-53	Yes		3501	(-1.983805) to (-1.918698)
6	SG-54	Yes		3501	(-0.0787449) to (-0.0104332)
7	SG-55	Yes		3501	(1.558704) to (1.567745)
8	SG-57	Yes		3501	(0.2142811) to (0.2640915)
iSite-HS 106 Address: DB0093 192.168.1.185					
Channel	Gauge ID	Working?	Notes	Chip	Output Range (mV)
1	SG-56	Yes		3501	(5.020762) to (5.027981)
2	SG-58	Yes		3501	(2.268324) to (2.315264)
3	SG-59	Yes		3501	(-1.022406) to (-1.011381)
4	SG-60	Yes		3501	(3.120051) to (3.13016)
5	SG-61	Yes		3501	(-0.2214432) to (-0.1356125)
6	SG-62	Yes		3501	(3.70512) to (3.799153)
7	SG-63	Yes		3501	(-0.6919194) to (-0.677023)
8	SG-65	Yes		3501	(1.529226) to (1.56951)

iSite-HS 105 Address: DB0092 192.168.1.184					
Channel	Gauge ID	Working?	Notes	Chip	Output Range (mV)
1	SG-64	Yes		3501	(2.435875) to (2.445774)
2	SG-66	Yes		3501	(0.509224) to (0.554123)
3	SG-67	Yes		3501	(2.599735) to (2.616825)
4	SG-68	Yes		3501	(2.678328) to (2.694254)
5	SG-69	Yes		3501	(-1.700926) to (-1.639519)
6	SG-70	Yes		3501	(-0.9271432) to (-0.8637906)
7	SG-71	Yes		3501	(1.21728) to (1.222925)
8	SG-73	Yes		3501	(-1.541853) to (-1.517363)
iSite-HS 104 Address: DB0091 192.168.1.183					
Channel	Gauge ID	Working?	Notes	Chip	Output Range (mV)
1	SG-72	Yes		3501	(1.55859) to (1.564255)
2	SG-74	Yes		3501	(1.030769) to (1.059456)
3	SG-75	Yes		3501	(0.9528829) to (0.9580995)
4	SG-76	Yes		3501	(2.66408) to (2.669449)
5	SG-77	No	Resistance reading of 350 across 1 set, but 415 across another set	3501	(-80.00001) to (-80.00001)
6	SG-78	Yes		3501	(4.263554) to (4.286061)
7	SG-79	Yes		3501	(1.740017) to (1.745215)
8	SG-81	Yes		3501	(2.067118) to (2.101441)

iSite-HS 103 Address: DB0055 (as of 9/7/12) 192.168.1.182					
Channel	Gauge ID	Working?	Notes	Chip	Output Range (mV)
1	SG-80	Yes - Noisy		3501	(2.073241) to (2.079993)
2	SG-82	Yes - Noisy		3501	(1.254606) to (1.289435)
3	SG-83	Yes - Noisy		3501	(0.05975724) to (0.06907464)
4	SG-84	Yes - Noisy		3501	(-0.4498387) to (-0.4407502)
5	SG-85	Yes - Noisy		3501	(-1.456795) to (-1.443005)
6	SG-86	Yes - Noisy		3501	(-3.54353) to (-3.525782)
7	SG-87	Yes - Noisy		3501	(1.931706) to (1.939621)
8	SG-89	Yes - Noisy		3501	(-2.919836) to (-2.894602)
iSite-HS 102 Address: DB0089 192.168.1.181					
Channel	Gauge ID	Working?	Notes	Chip	Output Range (mV)
1	SG-88	Yes		3501	(1.427002) to (1.435013)
2	SG-90	Yes		3501	(1.414595) to (1.439772)
3	SG-91	Yes		3501	(-3.162842) to (-3.156996)
4	SG-92	Yes		3501	(-2.988253) to (-2.981844)
5	SG-93	Yes		3501	(0.2666474) to (0.2720452)
6	SG-94	Yes		3501	(-4.231587) to (-4.226428)
7	SG-95	Yes		3501	(-4.794178) to (-4.783726)
8	SG-96	Yes		3501	(-1.319943) to (-1.31382)

iSite-HS 101 Address: DB0088 192.168.1.180					
Channel	Gauge ID	Working?	Notes	Chip	Output Range (mV)
1	SG-97	Yes		3501	(-1.705475) to (-1.699391)
2	SG-98	Yes		3501	(-2.766905) to (-2.761717)
3	SG-99	Yes		3501	(2.760105) to (2.766295)
4	SG-100	NO	Very high resistance readings	3501	(-80.00001) to (-80.00001)
5				3501	
6				3501	
7	DG-1	Yes		3501	
8	DG-2	Yes		3501	

iSite-HS 114 Address: DB0002 192.168.1.193					
Channel	**Gauge ID**	**Working?**	**Notes**	**Chip**	
1	A-1	Yes		ACCELL	
2	A-2	Yes		ACCELL	
3	A-3	Yes	Minor 60Hz Noise	ACCELL	
4	A-4	Yes - 60 Hz Noise		ACCELL	
5	TLT-1-1	Yes		TILT	
6	TLT-1-2	Yes		TILT	
7	TLT-2-1	Yes		TILT	
8	TLT-2-2	Yes		TILT	
iSite-HS 115 Address: DB0003 192.168.1.194					
Channel	**Gauge ID**	**Working?**	**Notes**	**Chip**	
1	A-5	Yes		ACCELL	
2	A-6	Yes		ACCELL	
3	A-7	Yes		ACCELL	
4	A-8	Yes	Originally this had TLT-5 wired into this location, wires were moved so after 11/11/2009 A-8 is correctly in this location	ACCELL	
5	SWP	Yes		DIFF	
6	SWP	Yes		DIFF	
7	SWP	Yes		SP2	
8				SP2	

iSite-HS 116 Address: DB0004 192.168.1.195					
Channel	**Gauge ID**	**Working?**	**Notes**	**Chip**	
1	TLT-3-1	Yes		TILT	
2	TLT-3-2	Yes		TILT	
3	TLT-4-1	Yes		TILT	
4	TLT-4-2	Yes		TILT	
5	TLT-5-1	Yes - 60 Hz Noise	Originally this had A-8 wired into this location, wires were moved so after 11/11/2009 TLT-5 is correctly in this location	TILT	
6	TLT-5-2	Yes - 60 Hz Noise	Originally this had A-8 wired into this location, wires were moved so after 11/11/2009 TLT-5 is correctly in this location	TILT	
7	TLT-6-1	Yes		TILT	
8	TLT-6-2	Yes		TILT	
iSite-HS 117 Address: DB0005 192.168.1.196					
Channel	**Gauge ID**	**Working?**	**Notes**	**Chip**	
1	A-9	Yes	Minor 60Hz Noise	ACCELL	
2	A-10	Yes		ACCELL	
3	A-11	Yes		ACCELL	
4	A-12	Yes - 60 Hz Noise		ACCELL	
5	TLT-7-1	Yes		TILT	
6	TLT-7-2	Yes		TILT	
7	TLT-8-1	Yes		TILT	
8	TLT-8-2	Yes		TILT	

iSite-HS 118 Address: DB0006 192.168.1.197					
Channel	**Gauge ID**	**Working?**	**Notes**	**Chip**	
1	TLT-13-1	Yes	South Abut	TILT	
2	TLT-13-2	Yes		TILT	
3	TLT-14-1	Yes	South Pier	TILT	
4	TLT-14-2	Yes		TILT	
5	TLT-15-1	Yes - Drift	North Pier	TILT	
6	TLT-15-2	Yes		TILT	
7	TLT-16-1	Yes - Drift	North Abut	TILT	
8	TLT-16-2	Yes		TILT	
iSite-HS 119 Address: DB0071 (as of 9/7/12) 192.168.1.198					
Channel	**Gauge ID**	**Working?**	**Notes**	**Chip**	
1	TLT-9-1	Yes		TILT	
2	TLT-9-2	Yes		TILT	
3	TLT-10-1	Yes		TILT	
4	TLT-10-2	Yes		TILT	
5	Pressure Plate			G-3500	
6	Pressure Plate			TEMP	
7	Pressure Plate			G-3500	
8	Pressure Plate			TEMP	

iSite-HS 120 Address: DB0008 192.168.1.199					
Channel	Gauge ID	Working?	Notes	Chip	
1	A-13	Yes		ACCELL	
2	A-14	Yes		ACCELL	
3	A-15	Yes - Drift		ACCELL	
4	A-16	Yes		ACCELL	
5	TLT-11-1	Yes		TILT	
6	TLT-11-2	Yes		TILT	
7	TLT-12-1	Yes		TILT	
8	TLT-12-2	Yes		TILT	

iSite-V3 1 Device 2						
Channel	Gauge ID	Working?		2ND GAUGE ID	Chip	
1	TP-1	YES	YES	CTP-5	SC2T2S	
2	TP-2	YES	YES	CTP-6	SC2T2S	
3	TP-5	YES	YES	CTP-B3	SC2T2S	
4	TP-6	YES	YES	CTP-B4	SC2T2S	
5	TP-9	YES	YES	CTP-9	SC2T2S	
6	TP-10	YES	YES	CTP-10	SC2T2S	
7	TP-12	YES	YES	CTP-B5	SC2T2S	
8	TP-14	YES	YES	CTP-B6	SC2T2S	
9	TP-20	YES	YES	CTP-20	SC2T2S	
10	TP-22	YES	YES	CTP-22	SC2T2S	
11	TP-28	YES	YES	CTP-28	SC2T2S	
12	TP-30	YES	YES	CTP-30	SC2T2S	
13	TP-32	YES	YES	CTP-59	SC2T2S	
14	TP-34	YES	YES	CTP-61	SC2T2S	
15	TP-40	YES	YES	CTP-67	SC2T2S	
16	TP-42	**NO**	YES	CTP-69	SC2T2S	

iSite-V3 2 Device 3						
Channel	Gauge ID	Working?		2ND GAUGE ID	Chip	
1	TP-48	YES	YES	CTP-95	SC2T2S	
2	TP-50	YES	YES	CTP-96	SC2T2S	
3	TP-51	YES	YES	CTP-99	SC2T2S	
4	TP-53	YES	YES	CTP-100	SC2T2S	
5	TP-59	YES			SC2T2S	
6	TP-61	YES			SC2T2S	
7	TP-67	YES			SC2T2S	
8	TP-69	YES			SC2T2S	
9	TP-71	YES			SC2T2S	
10	TP-73	YES			SC2T2S	
11	TP-79	YES			SC2T2S	
12	TP-81	YES			SC2T2S	
13	TP-87	YES			SC2T2S	
14	TP-89	YES			SC2T2S	
15	TP-91	YES			SC2T2S	
16	TP-92	YES			SC2T2S	

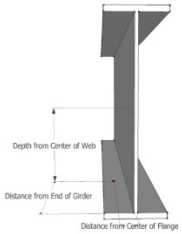
iSite-V3 3 Device 4					
Channel	**Gauge ID**	**Working?**	**2ND GAUGE ID**	**Chip**	
1	TP-95	YES		SC2T2S	
2	TP-96	YES		SC2T2S	
3	TP-99	YES		SC2T2S	
4	TP-100	YES		SC2T2S	
5	CTP-B1	YES		SC2T2S	
6	CTP-B2	YES		SC2T2S	
7	CTP-1	YES		SC2T2S	
8	CTP-2	YES		SC2T2S	
9	CTP-12	YES		SC2T2S	
10	CTP-14	YES		SC2T2S	
11	CTP-51	YES		SC2T2S	
12	CTP-53	YES		SC2T2S	
13	CTP-91	YES		SC2T2S	
14	CTP-92	YES		SC2T2S	
15				SC2T2S	
16				SC2T2S	

Appendix D: Final Location of Strain Gauges

Gauge ID	Girder Number	Girder Section	Installer	Temperature Gauge ID#	Location		Actual Location						Station #	Distance from End of Girder (in)	Distance from Center of Flange (in)	Depth from Center of Web (in)
					Face	Flange	Offset from Stiffener			Distance in from edge of						
SG-1	1	Main	PL	TP-1	Right	Top	4	ft	11 3/16	inches	3 1/16	inches	2	412.334	5.186	16.972
SG-2	1	Main	PL	TP-2	Right	Bottom	4	ft	11 1/8	inches	3 1/8	inches	2	412.397	5.123	-16.972
SG-3	1	Main	JP		Right	Top	4	ft	1	inches	3 1/8	inches	4	521.022	5.123	16.972
SG-4	1	Main	JP		Right	Bottom	4	ft	3/8	inches	3	inches	4	520.397	5.248	-16.972
SG-5	1	Main	PL	TP-5	Right	Top	2	ft	4 7/8	inches	3	inches	6	963.731	5.248	16.972
SG-6	1	Main	PL	TP-6	Right	Bottom	2	ft	4 3/4	inches	3 3/16	inches	6	963.606	5.061	-16.972
SG-7	1	Splice	JP		Right	Top	4	ft	10 1/2	inches	3	inches	8	1338.337	3.063	16.972
SG-8	1	Splice	JP		Right	Bottom	4	ft	10 3/4	inches	3	inches	8	1338.087	3.063	-16.972
SG-9	1	Splice	JKT	TP-9	Right	Top	4	ft	1 1/4	inches	2 15/16	inches	10	1446.587	3.125	16.972
SG-10	1	Splice	JKT	TP-10	Right	Bottom	4	ft	1 1/4	inches	3	inches	10	1446.587	3.063	-16.972
SG-11	2	Main	JKT		Left	Bottom	4	ft	11	inches	3	inches	2	412.522	-3.004	16.972
SG-12	2	Main	DH	TP-12	Right	Top	4	ft	11 1/8	inches	3 1/8	inches	2	412.397	2.879	16.972
SG-13	2	Main	JKT		Left	Bottom	4	ft	11	inches	3	inches	2	412.522	-3.004	-16.972
SG-14	2	Main	DH	TP-14	Right	Bottom	4	ft	11 1/8	inches	3	inches	2	412.397	3.004	-16.972
SG-15	2	Main	DH		Left	Top	4	ft	5/8	inches	3	inches	4	520.647	-3.004	16.972
SG-16	2	Main	DH		Right	Top	4	ft	5/8	inches	2 7/8	inches	4	520.647	3.129	16.972
SG-17	2	Main	DH		Left	Bottom	4	ft	5/8	inches	3 1/8	inches	4	520.647	-2.879	-16.972
SG-18	2	Main	DH		Right	Bottom	4	ft	5/8	inches	3 1/8	inches	4	520.647	2.879	-16.972
SG-19	2	Main	JKT		Left	Top	2	ft	4 3/4	inches	3	inches	6	963.606	-3.004	16.972
SG-20	2	Main	JP	TP-20			2	ft	4 3/4	inches	3	inches	6	963.606	3.004	16.972
SG-21	2	Main	JKT		Left	Bottom	2	ft	4 3/4	inches	3 1/16	inches	6	963.606	-2.941	-16.972
SG-22	2	Main	JP	TP-22	Right	Bottom	2	ft	4 5/8	inches	3	inches	6	963.481	3.004	-16.972
SG-23	2	Splice	JP		Left	Top	4	ft	10 3/8	inches	3	inches	8	1338.462	-3.004	16.972
SG-24	2	Splice	DH		Right	Top	4	ft	10 1/2	inches	3	inches	8	1338.337	3.004	16.972
SG-25	2	Splice	JP		Left	Bottom	4	ft	10 1/2	inches	3	inches	8	1338.337	-3.004	-16.972
SG-26	2	Splice	DH		Right	Bottom	4	ft	10 1/2	inches	3	inches	8	1338.337	3.004	-16.972
SG-27	2	Splice	JKT		Left	Bottom	4	ft	1 1/4	inches	2 15/16	inches	10	1446.587	-3.066	16.972
SG-28	2	Splice	DH	TP-28	Right	Top	4	ft	1 1/4	inches	3	inches	10	1446.587	3.004	16.972
SG-29	2	Splice	JKT		Left	Top	4	ft	1 1/8	inches	3 1/16	inches	10	1446.462	-2.941	-16.972
SG-30	2	Splice	DH	TP-30	Right	Bottom	4	ft	1 1/4	inches	2 7/8	inches	10	1446.587	3.129	-16.972
SG-31	3	Main	JP		Left	Top	4	ft	10 7/8	inches	3 1/16	inches	2	412.647	-2.941	16.972
SG-32	3	Main	JKT	TP-32	Right	Top	4	ft	11 1/4	inches	3 1/8	inches	2	412.272	2.879	16.972
SG-33	3	Main	JP		Left	Bottom	4	ft	11 1/8	inches	3	inches	2	412.397	-3.004	-16.972
SG-34	3	Main	JKT	TP-34	Right	Bottom	4	ft	11 3/16	inches	3 3/16	inches	2	412.334	2.836	-16.972
SG-35	3	Main	JP		Left	Top	4	ft	0	inches	3	inches	4	520.022	-3.004	16.972
SG-36	3	Main	DH		Right	Top	4	ft	1/2	inches	3	inches	4	520.522	3.004	16.972
SG-37	3	Main	JP		Left	Bottom	4	ft	0	inches	3	inches	4	520.022	-3.004	-16.972
SG-38	3	Main	DH		Right	Bottom	4	ft	5/8	inches	3 1/8	inches	4	520.647	2.879	-16.972
SG-39	3	Main	JP		Left	Top	2	ft	4 3/4	inches	2 7/8	inches	6	963.606	-3.129	16.972
SG-40	3	Main	JKT	TP-40	Right	Top	2	ft	5 1/16	inches	3 1/4	inches	6	963.919	2.754	16.972
SG-41	3	Main	JP		Left	Bottom	2	ft	4 7/8	inches	3	inches	6	963.731	-3.004	-16.972
SG-42	3	Main	JKT	TP-42	Right	Bottom	2	ft	4 3/4	inches	3	inches	6	963.606	3.004	-16.972
SG-43	3	Splice	PL		Left	Top	4	ft	10 7/16	inches	3	inches	8	1338.399	-3.004	16.972
SG-44	3	Splice	JKT		Right	Top	4	ft	10 1/2	inches	3	inches	8	1338.337	3.004	16.972
SG-45	3	Splice	PL		Left	Bottom	4	ft	10 7/16	inches	2 3/4	inches	8	1338.399	-3.254	-16.972
SG-46	3	Splice	JKT		Right	Bottom	4	ft	10 1/2	inches	3	inches	8	1338.337	3.004	-16.972
SG-47	3	Splice	PL		Left	Top	4	ft	1 1/4	inches	2 7/8	inches	10	1446.587	-3.129	16.972
SG-48	3	Splice	JDS	TP-48	Right	Top	4	ft	1 1/8	inches	2 15/16	inches	10	1446.462	3.066	16.972
SG-49	3	Splice	PL		Left	Bottom	4	ft	1 1/4	inches	3	inches	10	1446.587	-3.004	-16.972

Gauge ID	Girder Number	Girder Section	Installer	Temperature Gauge ID#	Location		Actual Location						Station #	Distance from End of Girder (in)	Distance from Center of Flange (in)	Depth from Center of Web (in)
					Face	Flange	Offset from Stiffener			Distance in from edge of						
SG-50	3	Splice	JDS	TP-50	Right	Bottom	4	ft	1 1/8	inches	2 15/16	inches	10	1446.462	3.066	-16.972
SG-51	4	Main	PL	TP-51	Left	Top	4	ft	11 3/8	inches	3 1/8	inches	2	412.147	-2.879	16.972
SG-52	4	Main			Right	Bottom	4	ft	11 1/8	inches	2 5/8	inches	2	412.397	3.379	16.972
SG-53	4	Main	PL	TP-53	Left	Bottom	4	ft	11	inches	3 1/16	inches	2	412.522	-2.941	-16.972
SG-54	4	Main	DH		Right	Bottom	4	ft	11 1/8	inches	3 1/8	inches	2	412.397	2.879	-16.972
SG-55	4	Main	JP		Left	Top	4	ft	3/8	inches	3 1/8	inches	4	520.397	-2.879	16.972
SG-56	4	Main	JKT		Right	Top	4	ft	5/8	inches	3 1/4	inches	4	520.647	2.754	16.972
SG-57	4	Main	JP		Left	Bottom	4	ft	5/8	inches	3	inches	4	520.647	-3.004	-16.972
SG-58	4	Main	JKT		Right	Bottom	4	ft	9/16	inches	3 1/8	inches	4	520.584	2.879	-16.972
SG-59	4	Main		TP-59	Left	Bottom	2	ft	4 3/4	inches	3 3/16	inches	6	963.606	-2.816	16.972
SG-60	4	Main	JP		Right	Top	4	ft	3/4	inches	2 7/8	inches	6	983.606	3.129	16.972
SG-61	4	Main		TP-61	Left	Bottom	2	ft	4 3/4	inches	3 3/16	inches	6	963.606	-2.816	-16.972
SG-62	4	Main	JP		Right	Bottom	2	ft	5	inches	3	inches	6	963.856	3.004	-16.972
SG-63	4	Splice	PL		Left	Top	4	ft	10 5/8	inches	3 1/16	inches	8	1338.212	-2.941	16.972
SG-64	4	Splice	JP		Right		4	ft	10 1/2	inches	3	inches	8	1338.337	3.004	16.972
SG-65	4	Splice	PL		Left	Bottom	4	ft	10 3/8	inches	2 7/8	inches	8	1338.462	-3.129	-16.972
SG-66	4	Splice	JP		Right	Bottom	4	ft	10 5/8	inches	2 7/8	inches	8	1338.212	3.129	-16.972
SG-67	4	Splice	DH	TP-67	Left	Top	4	ft	1 3/8	inches	3 1/8	inches	10	1446.712	-2.879	16.972
SG-68	4	Splice	JKT				4	ft	1 1/2	inches	3	inches	10	1446.837	3.004	16.972
SG-69	4	Splice	DH	TP-69	Left	Bottom	4	ft	1 3/8	inches	3	inches	10	1446.712	-3.004	-16.972
SG-70	4	Splice	JKT		Right	Bottom	4	ft	1 1/2	inches	3	inches	10	1446.837	3.004	-16.972
SG-71	5	Main	DH	TP-71	Left	Top	4	ft	11 1/4	inches	3	inches	2	412.272	-3.004	16.972
SG-72	5	Main	DH		Right	Top	4	ft	11 1/4	inches	3	inches	2	412.272	3.004	16.972
SG-73	5	Main	DH	TP-73	Left	Bottom	4	ft	11 1/4	inches	3	inches	2	412.272	-3.004	-16.972
SG-74	5	Main	DH		Right	Bottom	4	ft	11 1/8	inches	3 1/8	inches	2	412.397	2.879	-16.972
SG-75	5	Main	DH		Left	Top	4	ft	1/2	inches	2 7/8	inches	4	520.522	-3.129	16.972
SG-76	5	Main	JKT		Right	Top	4	ft	3/4	inches	3 1/8	inches	4	520.772	2.879	16.972
SG-77	5	Main	DH		Left	Bottom	4	ft	1/2	inches	3	inches	4	520.522	-3.004	-16.972
SG-78	5	Main	JKT		Right	Bottom	4	ft	3/4	inches	3 1/8	inches	4	520.772	2.879	-16.972
SG-79	5	Main	JKT	TP-79	Left	Top	2	ft	4 5/8	inches	2 15/16	inches	6	963.481	-3.066	16.972
SG-80	5	Main			Right	Top	4	ft	4 3/4	inches	3	inches	6	987.606	3.004	16.972
SG-81	5	Main	JKT	TP-81	Left	Bottom	2	ft	4 15/16	inches	3	inches	6	963.794	-3.004	-16.972
SG-82	5	Main	DH		Right	Bottom	4	ft	4 3/4	inches	3	inches	6	987.606	3.004	-16.972
SG-83	5	Splice	JKT		Left	Top	4	ft	11 3/4	inches	3	inches	8	1337.087	-3.004	16.972
SG-84	5	Splice	PL		Right	Top	4	ft	10 9/16	inches	3	inches	8	1338.274	3.004	16.972
SG-85	5	Splice	JKT		Left	Bottom	4	ft	11 3/4	inches	3	inches	8	1337.087	-3.004	-16.972
SG-86	5	Splice	PL		Right	Bottom	4	ft	10 5/8	inches	2 15/16	inches	8	1338.212	3.066	-16.972
SG-87	5	Splice	JP	TP-87	Left	Top	4	ft	1 1/4	inches	3 1/16	inches	10	1446.587	-2.941	16.972
SG-88	5	Splice	JKT		Right	Top	4	ft	1 1/4	inches	3	inches	10	1446.587	3.004	16.972
SG-89	5	Splice	JP	TP-89	Left	Bottom	4	ft	1 1/16	inches	3	inches	10	1446.649	-3.004	-16.972
SG-90	5	Splice	JKT		Right	Bottom	4	ft	1 1/4	inches	3	inches	10	1446.587	3.004	-16.972
SG-91	6	Main	DH	TP-91	Left	Top	4	ft	11 1/4	inches	2 13/16	inches	2	412.272	5.436	16.972
SG-92	6	Main	PL	TP-92	Left	Bottom	4	ft	11 1/8	inches	3	inches	2	412.397	5.248	-16.972
SG-93	6	Main	PL		Left	Top	4	ft	7/16	inches	3 1/16	inches	4	520.459	5.186	16.972
SG-94	6	Main	PL		Left	Bottom	4	ft	1/2	inches	2 7/8	inches	4	520.522	5.373	-16.972
SG-95	6	Main	PL	TP-95	Left	Top	2	ft	4 1/2	inches	2 5/8	inches	6	963.356	5.623	16.972
SG-96	6	Main	PL	TP-96	Left	Bottom	2	ft	4 7/8	inches	3 1/8	inches	6	963.731	5.123	-16.972
SG-97	6	Splice	PL		Left	Top	4	ft	10 1/2	inches	2 7/8	inches	8	1338.337	3.188	16.972
SG-98	6	Splice	PL		Left	Bottom	4	ft	10 7/16	inches	3 1/16	inches	8	1338.399	3.000	-16.972
SG-99	6	Splice	JKT	TP-99	Left	Top	4	ft	1 1/4	inches	3	inches	10	1446.587	3.063	16.972
SG-100	6	Splice	JKT	TP-100	Left	Bottom	4	ft	1 1/4	inches	3	inches	10	1446.587	3.063	-16.972

INSTALLED SENSOR LOCATION TABLE



LOCATION K EY

No.	DATE	REVISIONS / ISSUE	INIT

DESIGNED BY: JDS
DRAWN BY: JDS
CHECKED BY: ESB/JP

FILE / PROJECT NUMBER: 20197
DATE: JUNE 18, 2009

Tufts University School of Engineering
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Medford, MA 02155

Geocomp Corporation
1145 Massachusetts Ave
Boxborough, MA 01719

VERNON AVE BRIDGE
SENSOR LOCATIONS

Scale	Contract No.	Drawing No.	Sheet No.
NTS	N/A	GCC-1	7 OF 7

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Appendix E: System Architecture

Appendix E: System Schematic