U.S. Department of Transportation
Federal Highway Administration

SPECIFICATION FOR THE NATIONAL BRIDGE INVENTORY BRIDGE ELEMENTS

01-21-2014

Woodrow Wilson Bridge. Courtesy of the Virginia Department of Transportation and Maryland State Highway Administration - Woodrow Wilson Bridge Project.

Contents

Introduction

The proper assessment of element level bridge conditions and the ability to use the condition data to efficiently and effectively manage bridge inventories are cornerstones to providing a safe and efficient highway transportation system. The introduction of element level bridge inspection techniques in the early 1990s represents a significant advancement in bridge inspection and management practice and has been adopted by the majority of State Transportation Departments in the United States. The FHWA and bridge owners nationwide have recognized the benefits of more detailed element level bridge inspection condition data to better show the severity and extent of bridge condition deficiencies. The collection and use of element level bridge inspection data by the FHWA is expected to improve the performance management of the nation's highway bridges through enhanced national level analysis, forecasting, and reporting of bridge conditions and needs (preservation, improvement, and replacement) using risk-based, data driven methods.

The goals of this document are to:

- Set the framework for the inventory and assessment of common bridge elements that can be used to better describe the condition of highway bridges in the National Bridge Inventory, and
- Provide consistency for element identification, quantity measurement, and condition state assessment.

Framework

This specification provides the framework needed to support the collection and reporting of element level bridge condition data to the FHWA. Refer to the AASHTO Manual for Bridge Element Inspection, First Edition (AASHTO Manual) for element descriptions, quantity calculations and condition state definitions.

Elements

Refer to Table 1 for a listing of elements for which data will be collected by the FHWA. Data items to be collected for each element inventoried for a bridge are specified in the Element Data Items section. Specific material defects as shown in the AASHTO Manual will not be collected.

Element Condition

All elements have four defined condition states. The severity of multiple distress paths or deficiencies is defined in the AASHTO Manual for each condition state with the general intent of the condition states as follows: Condition State 1 – Good, Condition State 2 – Fair, Condition State 3 – Poor, and Condition State 4 – Severe.

For primary load carrying elements, quantities reported to the FHWA in Condition State 4 indicate that a structural review, defined in the AASHTO Manual, has been completed and observed defects impact strength or serviceability. Once actions have been taken to address severe defects, those quantities may be reassigned to another applicable condition state.

Table 1. Bridge Elements.

Element	Units	Element Number					
		Steel	Prestressed Concrete	Reinforced Concrete	Timber	Masonry	Other
Deck/Slab							
Deck	SF		13	12	31		60
Open Grid Deck	SF	28					
Concrete Filled Grid Deck	SF	29					
Corrugated or Orthotropic Deck	SF	30					
Slab	SF			38	54		65
Top Flange	SF		15	16			
Superstructure							
Closed Web/Box Girder	LF	102	104	105			106
Girder/Beam	LF	107	109	110	111		112
Stringer	LF	113	115	116	117		118
Truss	LF	120			135		136
Arch	LF	141	143	144	146	145	142
Main Cable	LF	147					
Secondary Cable	EA	148					149
Floor Beam	LF	152	154	155	156		157
Pin, Pin and Hanger Assembly	EA	161					
Gusset Plate	EA	162					
Substructure							
Column	EA	202	204	205	206		203
Column Tower (Trestle)	LF	207			208		
Pier Wall	LF			210	212	213	211
Abutment	LF	219		215	216	217	218
Pile Cap/Footing	LF			220			
Pile	EA	225	226	227	228		229
Pier Cap	LF	231	233	234	235		236
Culvert							
Culvert	LF	240	245	241	242	244	243
Bridge Rail							
Bridge Rail	LF	330*		331	332	334	333
Joint							
Strip Seal	LF	300					
Pourable	LF	301					
Compression	LF	302					
Assembly with Seal (Modular)	LF	303					
Open	LF	304					
Assembly without Seal	LF	305					
Other	LF	306					
Bearing							
Elastomeric	EA	310					
Movable (roller, sliding, etc.)	EA	311					
Enclosed/Concealed	EA	312					
Fixed	EA	313					
Pot	EA	314					
Disk	EA	315					
Other	EA	316					
Wearing Surfaces and Protective Coatings							
Wearing Surfaces	SF	510					
Steel Protective Coating	SF	515					
Concrete Protective Coating	SF	521					

*Element 330-Metal Bridge Rail may include steel or aluminum rails.

Specification Format

These specifications provide information in a format modeled in part after the AASHTO design specifications, with the specifications separated and presented parallel to the commentary. The format used to present *new data items* is as shown in the following table.

Data Item Name			
Format	Frequency	Record Type	Item Number or Element Number
Specification		Commentary	
Specifications and any codes and information required.		Commentary on the specifications.	
Specification Continued, Commentary Continued or Examples			
Additional Space			

The fields shown in the table above are further described as follows.

Field Name	Field Name Description
Data Item Name	Name of the data item.
Format	Designates the format of the data. Alphanumeric (ANX) – X is the length of the field Numeric (X,Y) – X is the length of the field and Y is the number of decimal places This information is provided to assist owners when establishing databases. Examples: AN4 – Alphanumeric data, field length 4 N (8,3) – Numeric data, field length 8, decimal places 3
Frequency	Initial (I) – data recorded initially or updated when a change is made. Each Inspection (EI) – data verified or updated during each inspection. Calculated (C) – data is automatically calculated and stored by the FHWA. It is not recorded during inspections.
Record Type	Specifies whether the data must be coded for a bridge “On” record, a bridge “Under” record or both.

Field Name	Field Name Description
Item Number or Element Number	Item Number - Identifies the data item number as traditionally used in the *1995 Coding Guide.* In this version of the Specifications, item numbers are not prescribed. To assist in review and to provide a relationship to the 1995 Coding Guide, the old data item numbers are provided for reference purposes. Element Number – Identifies the applicable bridge elements that are consistent with those elements defined by AASHTO.
Specification	Presents the coding required.
Commentary	Expanded guidance for the specification, but not intended to be a requirement of the specification.
Additional Space	Area for continuation of specification or commentary. Also may include examples with figures or photos to further clarify the specification.

Element Data Items

The data items in this section identify the elements inventoried on the bridge, the total quantity for each element, and the element quantity that exists in each of four condition states. Elements that are entirely below ground and not accessible for inspection such as piles and pile caps are not intended to be recorded. The State Code (NBI Item 1) and Structure Number (NBI Item 8) items will be reported together with each element item as an interim identifier for the element data and link to the NBI data. See Appendix A for an example data set.

Table 2. Data items to be collected and reported.

Data Items
State Code
Structure Number
Element Number
Element Parent Number
Element Total Quantity
Element Quantity Condition State One
Element Quantity Condition State Two
Element Quantity Condition State Three
Element Quantity Condition State Four

State Code

Format	Frequency	Record Type	Item Number
N (2,0)	I	On	1

Specification	Commentary
Record the State code where the bridge is located using one of the codes in the table below.	State codes are derived from the FIPS, Standard Codes For States (FIPS PUB 5-2).

Specification Continued

Code	Description	Code	Description	Code	Description
1	Alabama	22	Louisiana	40	Oklahoma
2	Alaska	23	Maine	41	Oregon
4	Arizona	24	Maryland	42	Pennsylvania
5	Arkansas	25	Massachusetts	44	Rhode Island
6	California	26	Michigan	45	South Carolina
8	Colorado	27	Minnesota	46	South Dakota
9	Connecticut	28	Mississippi	47	Tennessee
10	Delaware	29	Missouri	48	Texas
11	District of Columbia	30	Montana	49	Utah
12	Florida	31	Nebraska	50	Vermont
13	Georgia	32	Nevada	51	Virginia
15	Hawaii	33	New Hampshire	53	Washington
16	Idaho	34	New Jersey	54	West Virginia
17	Illinois	35	New Mexico	55	Wisconsin
18	Indiana	36	New York	56	Wyoming
19	Iowa	37	North Carolina	72	Puerto Rico
20	Kansas	38	North Dakota		
21	Kentucky	39	Ohio		

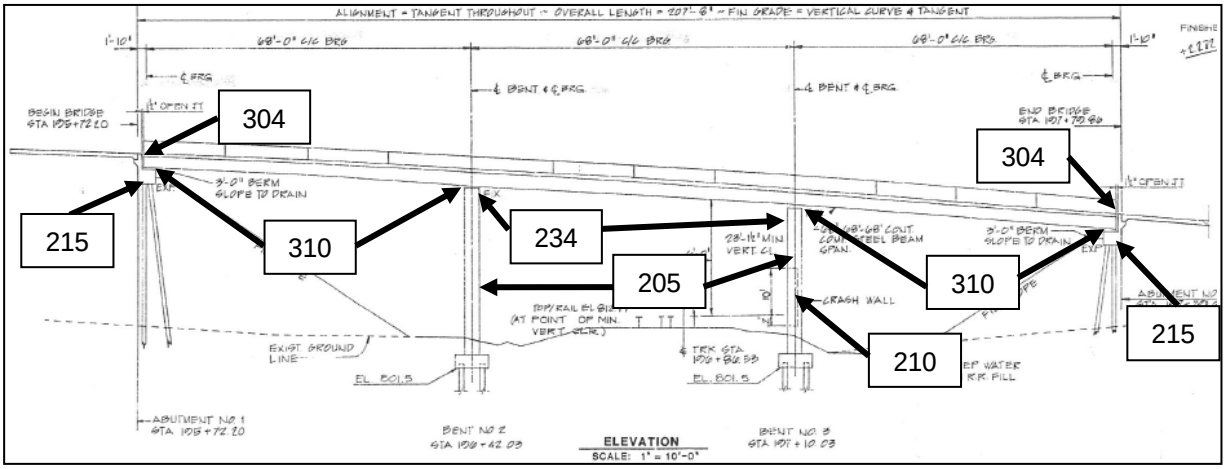
Structure Number			
Format AN15	Frequency I	Record Type On	Item Number 8
Specification		Commentary	
Record the same exact number as recorded for NBI item 8 – Structure Number. Do not change the structure number once it has been assigned and recorded.		There are no national policies established for assigning unique structure numbers. Therefore, each State Transportation Department or Federal agency develops policy for assigning unique structure numbers.	

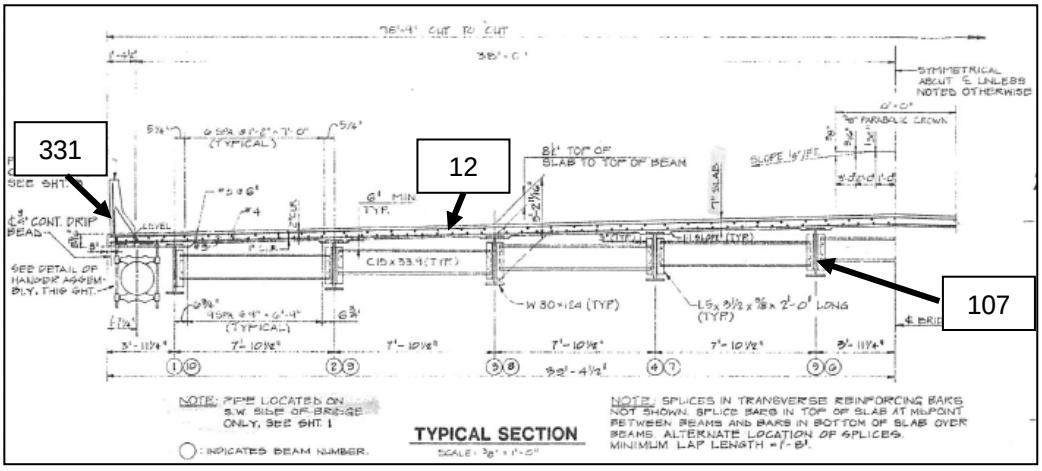
Format	Frequency	Record Type	Element Number
N (4,0)	EI	On	All
Record the applicable element number (EN) for each element inventoried for the bridge.		Refer to the element listing in the Bridge Elements section for applicable elements.	

Values shown in the shaded cells are the data for the elements in this example and continued for other related data items.

Element	EN
Reinforced Concrete Deck	
Wearing Surface	
Open Joint	
Reinforced Concrete Bridge Railing	
Steel Beam/Girder	
Steel Protective Coating	

Element	EN
Elastomeric Bearings	
Reinforced Concrete Columns	
Reinforced Concrete Pier Wall	
Reinforced Concrete Abutment	
Reinforced Concrete Pier Cap	





Element Parent Number

Format	Frequency	Record Type	Element Number
N (4,0)	EI	On	All

Specification	Commentary
Record the element number for the protected element for each protective system element inventoried on the bridge. Leave blank for elements that do not have a protective system.	Refer to the element listing in the Bridge Elements section for applicable protective system elements.

Example

Values shown in the shaded cells are the element parent number (EPN) data for the *Element Numbers* in this example and continued for other related data items. The wearing surface element is a protective system for the deck element and the steel protective coating element is a protective system for the steel beam/girder element.

Element	EN	EPN
Reinforced Concrete Deck	12	
Wearing Surface	510	12
Open Joint	304	
Reinforced Concrete Bridge Railing	331	
Steel Beam/Girder	107	
Steel Protective Coating	515	107
Elastomeric Bearings	310	
Reinforced Concrete Columns	205	
Reinforced Concrete Pier Wall	210	
Reinforced Concrete Abutment	215	
Reinforced Concrete Pier Cap	234	

Element Total Quantity

Format	Frequency	Record Type	Element Number
N (8,0)	EI	On	All

Specification	Commentary
Record the total element quantity to the nearest whole unit of measure for each applicable element inventoried for the bridge.	Refer to the AASHTO Manual for details on the calculation of total element quantities for applicable elements.

Exampl

Quantities shown in the shaded cells are the data for the *Element Numbers* in this example and continued for other related data items.

Element	EN	EPN	Total QTY
Reinforced Concrete Deck (SF)	12		16217
Wearing Surface (SF)	510	12	15783
Open Joint (LF)	304		
Reinforced Concrete Bridge Railing (LF)	331		
Steel Beam/Girder (LF)	107		
Steel Protective Coating (SF)	515	107	
Elastomeric Bearings (EA)	310		40
Reinforced Concrete Columns (EA)	205		8
Reinforced Concrete Pier Wall (LF)	210		
Reinforced Concrete Abutment (LF)	215		
Reinforced Concrete Pier Cap (LF)	234		

Element Quantity Condition State One

Format	Frequency	Record Type	Element Number
N (8,0)	EI	On	All

Specification	Commentary
Record the element quantity assigned to condition state one to the nearest whole unit of measure for each applicable element inventoried for the bridge.	Refer to the AASHTO Manual for element descriptions, quantity calculations and condition state definitions.

Example

Quantities shown in the shaded cells are the data for the *Element Numbers* in this example and continued for other related data items.

Element	EN	EPN	Total QTY	CS-1 QTY
Reinforced Concrete Deck (SF)	12		16217	0
Wearing Surface (SF)	510	12	15783	15083
Open Joint (LF)	304		158	100
Reinforced Concrete Bridge Railing (LF)	331		412	360
Steel Beam/Girder (LF)	107		2054	1044
Steel Protective Coating (SF)	515	107	15728	0
Elastomeric Bearings (EA)	310		40	30
Reinforced Concrete Columns (EA)	205		8	4
Reinforced Concrete Pier Wall (LF)	210		54	44
Reinforced Concrete Abutment (LF)	215		182	140
Reinforced Concrete Pier Cap (LF)	234		150	105

Element Quantity Condition State Two

Format	Frequency	Record Type	Element Number
N (8,0)	EI	On	All

Specification	Commentary
Record the element quantity assigned to condition state two to the nearest whole unit of measure for each applicable element inventoried for the bridge.	Refer to the AASHTO Manual for element descriptions, quantity calculations and condition state definitions.

Example

Quantities shown in the shaded cells are the data for the *Element Numbers* in this example and continued for other related data items.

Element	EN	EPN	Total QTY	CS-1 QTY	CS-2 QTY
Reinforced Concrete Deck (SF)	12		16217	0	16000
Wearing Surface (SF)	510	12	15783	15083	500
Open Joint (LF)	304		158	100	58
Reinforced Concrete Bridge Railing (LF)	331		412	360	40
Steel Beam/Girder (LF)	107		2054	1044	1000
Steel Protective Coating (SF)	515	107	15728	0	5628
Elastomeric Bearings (EA)	310		40	30	5
Reinforced Concrete Columns (EA)	205		8	4	4
Reinforced Concrete Pier Wall (LF)	210		54	44	5
Reinforced Concrete Abutment (LF)	215		182	140	30
Reinforced Concrete Pier Cap (LF)	234		150	105	30

Element Quantity Condition State Three

Format	Frequency	Record Type	Element Number
N (8,0)	EI	On	All

Specification	Commentary
Record the element quantity assigned to condition state three to the nearest whole unit of measure for each applicable element inventoried for the bridge.	Refer to the AASHTO Manual for element descriptions, quantity calculations and condition state definitions.

Example

Quantities shown in the shaded cells are the data for the *Element Numbers* in this example and continued for other related data items.

Element	EN	EPN	Total QTY	CS-1 QTY	CS-2 QTY	CS-3 QTY
Reinforced Concrete Deck (SF)	12		16217	0	16000	217
Wearing Surface (SF)	510	12	15783	15083	500	0
Open Joint (LF)	304		158	100	58	0
Reinforced Concrete Bridge Railing (LF)	331		412	360	40	12
Steel Beam/Girder (LF)	107		2054	1044	1000	10
Steel Protective Coating (SF)	515	107	15728	0	5628	10000
Elastomeric Bearings (EA)	310		40	30	5	5
Reinforced Concrete Columns (EA)	205		8	4	4	0
Reinforced Concrete Pier Wall (LF)	210		54	44	5	5
Reinforced Concrete Abutment (LF)	215		182	140	30	12
Reinforced Concrete Pier Cap (LF)	234		150	105	30	15

Element Quantity Condition State Four

Format	Frequency	Record Type	Element Number
N (8,0)	EI	On	All

Specification	Commentary
Record the element quantity assigned to condition state four to the nearest whole unit of measure for each applicable element inventoried for the bridge.	Refer to the AASHTO Manual for element descriptions, quantity calculations and condition state definitions.

Example

Quantities shown in the shaded cells are the data for the *Element Numbers* in this example.

Element	EN	EPN	Total QTY	CS-1 QTY	CS-2 QTY	CS-3 QTY	CS-4 QTY
Reinforced Concrete Deck (SF)	12		16217	0	16000	217	0
Wearing Surface (SF)	510	12	15783	15083	500	0	200
Open Joint (LF)	304		158	100	58	0	0
Reinforced Concrete Bridge Railing (LF)	331		412	360	40	12	0
Steel Beam/Girder (LF)	107		2054	1044	1000	10	0
Steel Protective Coating (SF)	515	107	15728	0	5628	10000	100
Elastomeric Bearings (EA)	310		40	30	5	5	0
Reinforced Concrete Columns (EA)	205		8	4	4	0	0
Reinforced Concrete Pier Wall (LF)	210		54	44	5	5	0
Reinforced Concrete Abutment (LF)	215		182	140	30	12	0
Reinforced Concrete Pier Cap (LF)	234		150	105	30	15	0

APPENDIX A – EXAMPLE DATA SET

This example shows the progression of data sets taking into account all inspections performed since the last submittal of data to the FHWA and ending with the data set (Table A-3) that would be submitted to the FHWA.

Table A-1: Data set for a complete routine inspection performed since the last submittal of data to the FHWA.

State Code	Structure Number	EN	EPN	Total QTY	CS-1 QTY	CS-2 QTY	CS-3 QTY	CS-4 QTY
1	14277	12		16217	0	16000	217	0
1	14277	510	12	15783	15083	500	0	200
1	14277	107		2054	1044	1000	10	0
1	14277	515	107	15728	0	5628	10000	100
1	14277	205		8	4	4	0	0
1	14277	210		54	44	5	5	0
1	14277	215		182	140	30	12	0
1	14277	234		150	105	30	15	0
1	14277	304		158	100	58	0	0
1	14277	310		40	30	5	5	0
1	14277	331		412	360	40	12	0

Preservation work was completed on the reinforced concrete deck (12) and steel open girder/beam (107). A special inspection was performed prior to submittal of data to the FHWA to update the condition of the following elements: steel protective coating (515), steel open girder/beam (107 - with section loss), reinforced concrete deck (12), new wearing surface (510) and new pourable joints (301). The data for this inspection is shown in Table A-2.

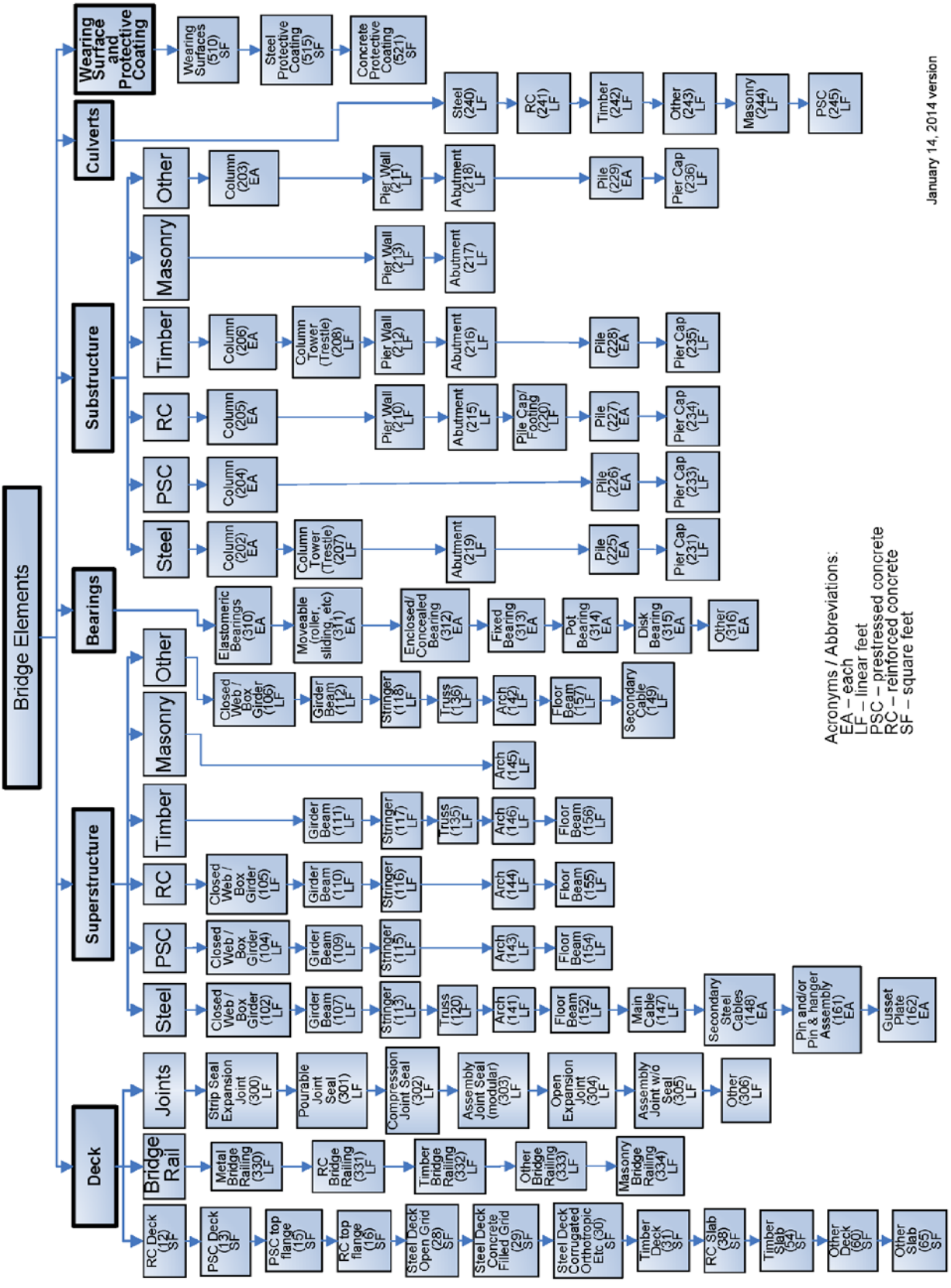
Table A-2: Data collected for special inspection to account for preservation work that occurred after inspection data shown in Table A-1 and prior to submittal of data to the FHWA. Cells shaded to show changes in data from Table A-1.

State Code	Structure Number	EN	EPN	Total QTY	CS-1 QTY	CS-2 QTY	CS-3 QTY	CS-4 QTY
1	14277	12		16217	0	16217	0	0
1	14277	510	12	15783	15783	0	0	0
1	14277	107		2054	2044	0	10	0
1	14277	515	107	15728	15728	0	0	0
1	14277	301		158	158	0	0	0

Table A-3: Data set submitted to the FHWA reflecting all inspections performed since the last data submittal to the FHWA. Cells shaded to show changes in data from Table A-1.

State Code	Structure Number	EN	EPN	Total QTY	CS-1 QTY	CS-2 QTY	CS-3 QTY	CS-4 QTY
1	14277	12		16217	0	16217	0	0
1	14277	510	12	15783	15783	0	0	0
1	14277	107		2054	2044	0	10	0
1	14277	515	107	15728	15728	0	0	0
1	14277	301		158	158	0	0	0
1	14277	205		8	4	4	0	0
1	14277	210		54	44	5	5	0
1	14277	215		182	140	30	12	0
1	14277	234		150	105	30	15	0
1	14277	310		40	30	5	5	0
1	14277	331		412	360	40	12	0

APPENDIX B – BRIDGE ELEMENTS



APPENDIX C – BRIDGE ELEMENT DATA FORMAT

SNBI Bridge Element Data Items	Format
State Code	N (2,0)
Structure Number	AN15
Element Number	N (4,0)
Element Parent Number	N (4,0)
Element Total Quantity	N (8,0)
Element Quantity Condition State 1	N (8,0)
Element Quantity Condition State 2	N (8,0)
Element Quantity Condition State 3	N (8,0)
Element Quantity Condition State 4	N (8,0)