Post-Task 1 Report

To the
New England Transportation Consortium (NETC)

Project 20211012000000000359

In-Service Performance Evaluation of New England Transportation Consortium (NETC) Steel Bridge Railings

Task 1: Develop an Inventory of NETC Steel Bridge Railings

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Introduction

The objective of task 1 was to coordinate with member states to obtain available data to develop an inventory of NETC steel bridge railings and the transitions to the bridge railing. Identifying quantitative data elements which can be readily assembled from available records was one focus of this task.

Thoughtful consideration of the specifics for the inventoried elements was essential to minimize the collection of irrelevant data elements and maximize the usefulness of the inventory. The research team collaborated with each member state to develop the list of data elements that would be the most effective for this ISPE. It was important for the inventory to distinguish between each type of NETC steel bridge railing and each style of transition; therefore, standard names with supporting documentation were developed for each state by the research team. Some of the inventory data fields were collected from the data assembled and maintained at the state level for the National Bridge Inventory (NBI) while inspection reports, inspection photos, and publicly available roadway photologs were consulted for the remainder of the inventory fields.

Methodology for Identifying Bridges with NETC style Bridge Rails

MaineDOT

An inventory of the bridges in Maine that have NETC style bridge rails and/or approach guardrail transitions (AGTs) has been compiled. The inventory was generated by reviewing the file *NETC Steel Bridge Rail Updated.xlsx* (*ME List*), provided by MaineDOT on May 20, 2021. The *ME List* file contains a list of all bridges in the State suspected to have NETC bridge rails. The *ME List* contained 295 bridges, the full list of bridges was reduced to only bridges with NETC bridge rails or AGTs on at least one side of the bridge in the steps outlined in Figure 1.

The first and only data reduction step was to review the inspection photos and inspection reports available on the AssetWise web portal along with Google Earth Street View imagery when available. Using these data sources, the analyst was able to categorize and identify each bridge rail and AGT type. Most of the bridges contained in the original ME List file do have NETC type bridge rails and/or AGTs, however, some rails were other steel or concrete and steel combination railings. Bridges with these non-NETC type bridge rails and/or AGTs were removed from the dataset.

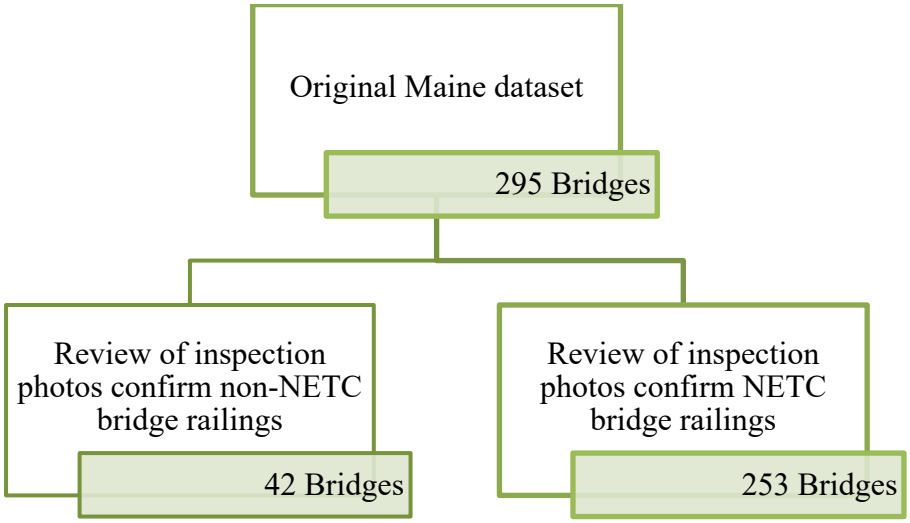


Figure 1: Bridge Inventory Data Reduction

The 253 bridges that were identified as having NETC type bridge railing have been compiled into a single dataset. The fields discussed later in this report were populated for each bridge in the NETC bridge railings inventory dataset. Bridge rails and AGTs have been categorized and identified by the analyst through a visual review of available photographs and Google Earth Street View images. A detailed as-built drawing review of the structural elements and rail components used for each bridge was not performed. Therefore, the diameter of baseplate bolts or top rail height for bridge rails and post embedment depth of the AGT sections and other specific design elements could not be verified by reviewing images.

NHDOT

An inventory of the bridges in New Hampshire that have NETC style bridge rails and/or approach guardrail transitions (AGTs) has been compiled. The inventory was generated by reviewing the file *qryChelseaAllRail.xlsx* (*NH List*), provided by NHDOT on June 18, 2021. The *NH List* contains a list of all bridges in the State with bridge railings. A large database of bridge photos was provided to the research team. The original intention was to identify bridge railings using the provided photos, but the photos lacked sufficient quality and quantity to make positive bridge rail identifications, therefore Google Earth Street View imagery was used when required. The original *NH List* contained 3,091 bridges, the full list of bridges was reduced to only bridges with NETC bridge rails or AGTs on at least one side of the bridge in the steps outlined in Figure 2.

The first step was to remove bridges with non-metal railing installed. This was accomplished by retaining only bridges with the code 330 entered in the ELEM_KEY field of the *NH List*. The *NH List* ELEM_KEY codes are equivalent to the Manual for Bridge Element Inspection (MBEI) bridge railing element codes as shown in Table 1. (AASHTO 2019) Removing non-metal bridge railings resulted in 2,588 bridges remaining in the dataset.

Table 1: MBEI Railings Element Codes (equivalent to NH LIST ELEM_KEY field) (AASHTO 2019)

Element	Code
Metal Bridge Railing	330
Reinforced Concrete Bridge Railing	331
Timber Bridge Railing	332
Other Bridge Railing	333
Masonry Bridge Railing	334

The second step was to remove bridges that were not NETC type bridge rails based on the *NH List* ELEM_NOTES field. This field is a text field that contains inspection observations and sometimes the bridge rail type. Bridges that had ELEM_NOTES indicating aluminum bridge rails, steel balusters, w-beams, T 100, steel channel rail, etc. were removed from the dataset. This resulted in retention of 868 bridges which either indicated NETC type bridge rails or inconclusive design.

The final data reduction step was to “visit” each of the remaining 868 bridges on Google Earth Street View and categorize each bridge rail. Bridge rails that were not NETC type were removed from the dataset and the bridge rails on the remaining 497 bridges were categorized according to their apparent design.

The 497 bridges that were identified as having NETC bridge railing have been compiled into a single dataset. The fields discussed later in this report were populated for each bridge in the NETC bridge railings inventory dataset. Bridge rails and AGTs have been identified and

categorized by the analyst through a visual review of available photographs and Google Earth Street View. A detailed as-built drawing review of the structural elements or rail components used for each bridge was not undertaken. Therefore, the diameter of baseplate bolts or top rail height for bridge rails and post embedment depth of the AGT sections and other specific design elements could not be determined by simply reviewing images.

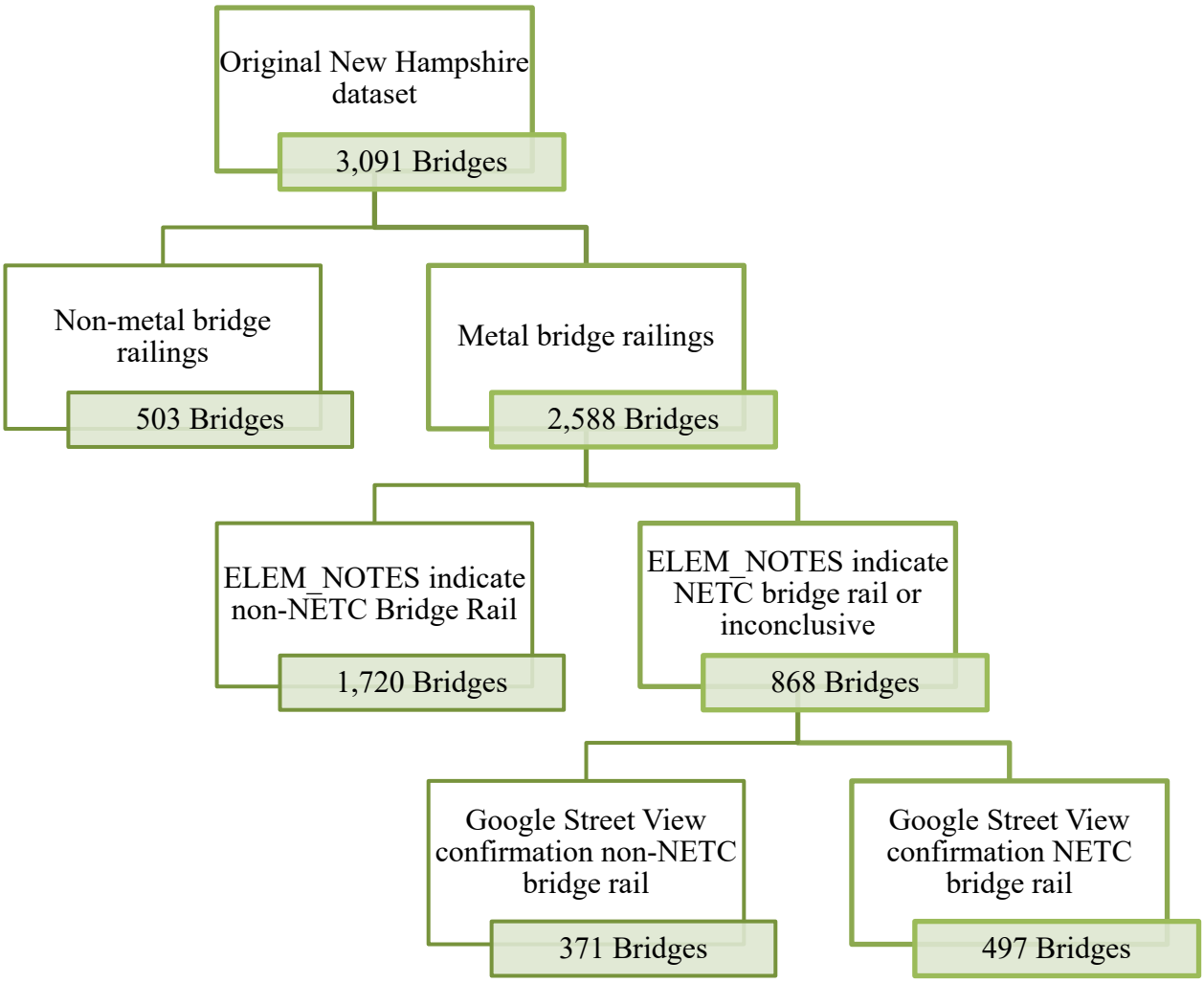


Figure 2: Bridge Inventory Data Reduction

RIDOT

An inventory of the bridges in Rhode Island that have NETC style bridge rails and/or approach guardrail transitions (AGTs) has been compiled. The inventory was generated by reviewing the file *Element 330 Bridge Query.xlsx* (*RI List*), provided by RIDOT on March 24, 2021. This file is a list of all bridges in the State coded with MBEI Element 330 (metal bridge railing). The *RI List* contained 315 bridges, the full list of bridges was reduced to only bridges with NETC bridge rails or AGTs on at least one side of the bridge in the steps outlined in Figure 3.

The first and only data reduction step was to review the inspection photos and inspection reports available on the RIDOT BrM web portal along with Google Earth Street View imagery

when available. Using these data sources, the analyst was able to categorize and identify each bridge rail and AGT type. This resulted in the identification of 52 bridges that have NETC type bridge rails and/or AGTs, however, some rails in the list were other steel or concrete and steel combination railings. Bridges with these non-NETC type bridge rails and/or AGTs were removed from the dataset.

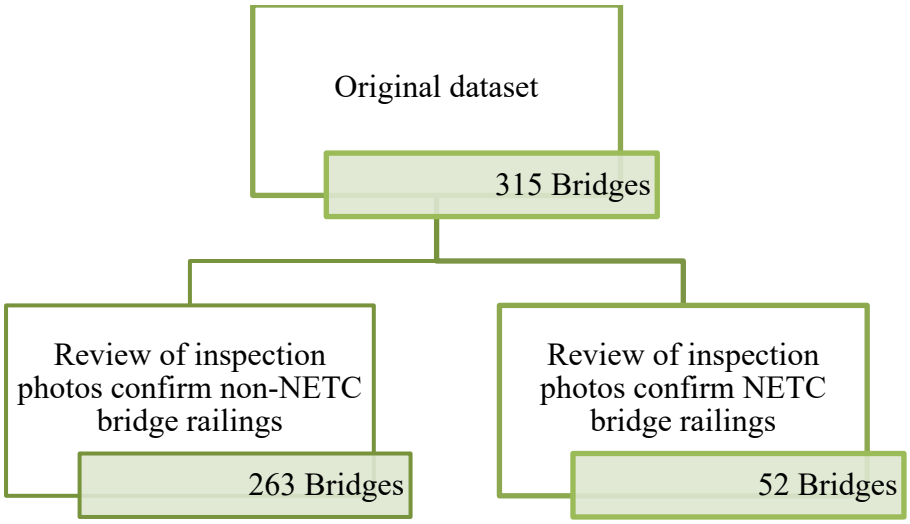


Figure 3: Bridge Inventory Data Reduction

The 52 bridges that were identified as having NETC bridge railing were exported from the RIDOT BrM web portal into a spreadsheet using the "RIDOT Lat Lon" BrM web portal layout. The applicable data was then cross-linked to and compiled into a single dataset. The fields discussed later in this report were populated for each bridge in the NETC bridge railings inventory dataset. Bridge rails and AGTs have been identified and categorized by the analyst through a visual review of available photographs and Google Earth Street View. A detailed as-built drawing review of the structural elements or rail components used for each bridge was not undertaken. Therefore, the diameter of baseplate bolts or top rail height for bridge rails and post embedment depth of the AGT sections and other specific design elements could not be determined by simply reviewing images.

VTrans

An inventory of the bridges in Vermont that have NETC style bridge rails and/or approach guardrail transitions (AGTs) has been compiled. The inventory was generated by reviewing the file *Railing.xlsx* (*VT List*), provided by VTDOT on July 01, 2021. This file is a list of all bridges in the State with bridge railings. The *VT List* contained 4,042 bridges (2,682 long structures and 1,360 short structures), the full list of bridges was reduced to only bridges with NETC bridge rails or AGTs on at least one side of the bridge in the steps outlined in Figure 4.

The first step was to remove bridges with non-NETC bridge rail material/designs. This was accomplished by retaining only bridges with the NETC applicable codes entered in the 221C field of the *VT List*. The *VT List* 221C codes are shown in Table 2. Removing non-NETC bridge railing materials/designs resulted in retaining 409 long structures and 9 short structures in the dataset.

Table 2: Material/Design of Rail Codes (221C) Retained in Dataset

221C Codes	Material/Design of Rail
06	Box Beam (Double)
08	2-Rail Clear View Box Beam
09	3-Rail Clear View Box Beam
12	Miscellaneous Steel Shapes (Angle Irons, Channels, or Other Structural Shapes)
28	Other

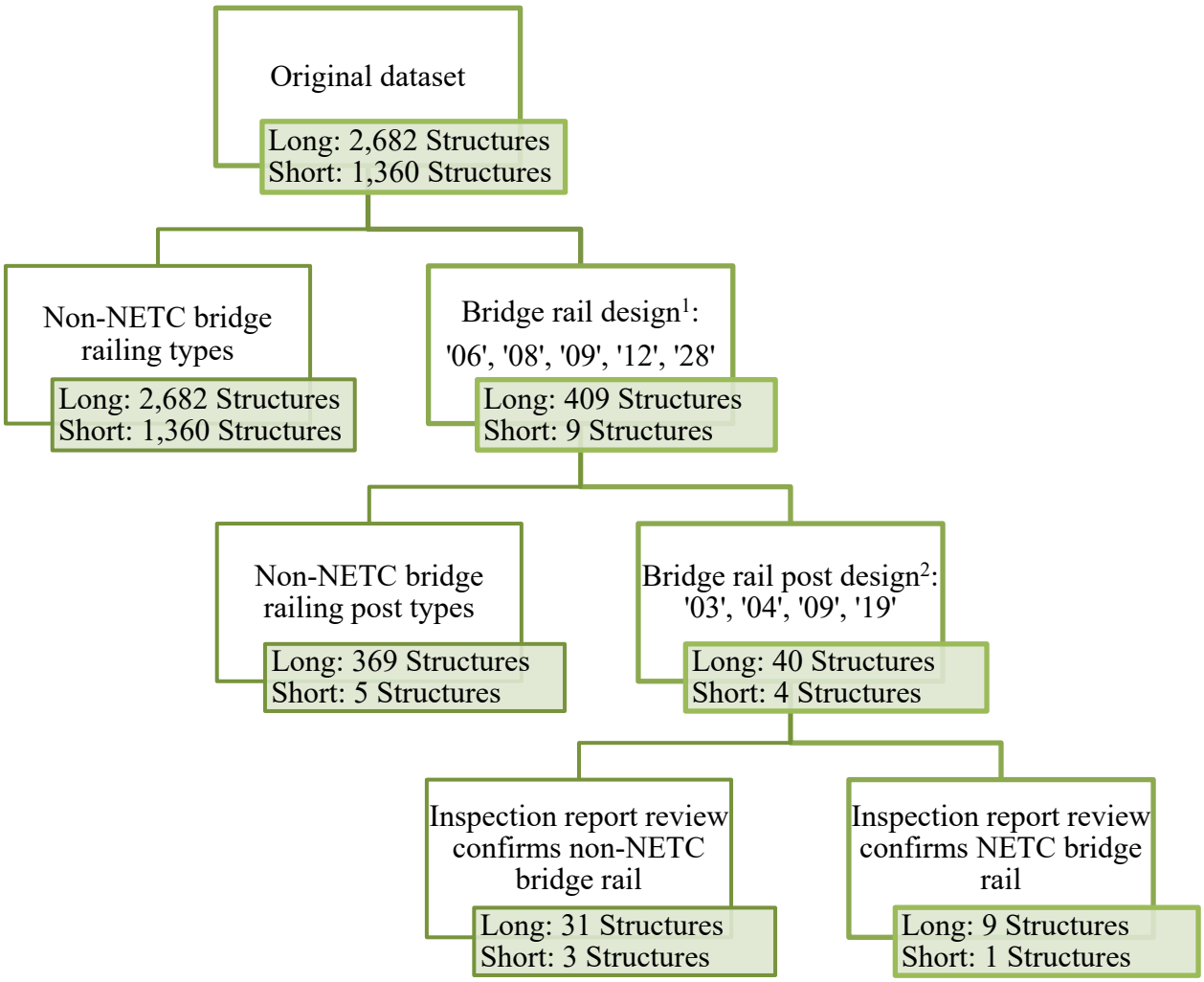
The second step was to remove bridges with non-NETC bridge rail post material/designs. This was accomplished by retaining only bridges with the NETC applicable codes entered in the 221A field of the *VT List*. The *VT List* 221A codes are shown in Table 3. Removing non-NETC bridge railing post materials/designs resulted in retaining 40 long structures and 4 short structures in the dataset.

Table 3: Material/Design of Posts Codes (221A) Retained in Dataset

221A Codes	Material/Design of Posts
03	Steel WF (Pedestal Mounted/Driven - No Offset Blocks)
04	Steel WF (Pedestal Mounted/Driven - w/Offset Blocks)
09	Miscellaneous Steel Shapes (Angle Irons, Channels, or Other Structural Shapes)
19	Other

The final data reduction step was to review the inspection reports and photos on VTransparency for each of the remaining 44 bridges as well as "visiting" the sites on Google Earth Street View to categorize each bridge rail. Bridge rails that were not NETC type were removed from the dataset and the bridge rails on the remaining 10 bridges were categorized according to their apparent design.

The 10 bridges that were identified as having NETC bridge railing have been compiled into a single dataset. The fields discussed later in this report were populated for each bridge in the NETC bridge railings inventory dataset. Bridge rails and AGTs have been identified and categorized by the analyst through a visual review of available photographs and Google Earth Street View. A detailed as-built drawing review of the structural elements or rail components used for each bridge was not undertaken. Therefore, the diameter of baseplate bolts or top rail height for bridge rails and post embedment depth of the AGT sections and other specific design elements could not be determined by simply reviewing images.



[1] '06' = Box Beam (Double), '08' = 2-Rail Clear View Box Beam, '09' = 3-Rail Clear View Box Beam, '12' = Miscellaneous Steel Shapes, '28' = Other

[2] '03' = Steel WF (Pedestal Mounted… No block), '04' = 2- Steel WF (Pedestal Mounted… w/ Block), '09' = Miscellaneous Steel Shapes, '19' = Other

Figure 4: Bridge Inventory Data Reduction

ConnDOT

Through email discussions with the ConnDOT point of contact, David Kilpatrick, it was determined that Connecticut never adopted the NETC bridge rail designs but used modified versions. ConnDOT provided the research team with a list of nine bridges with beam-type steel bridge railings. The research team reviewed these railings and determined that the designs were not tested NETC designs, therefore, ConnDOT does not have any rails within the scope of this research project. It is recommended that ConnDOT be removed from further data gathering and assessment tasks.

MassDOT

Like ConnDOT, MassDOT has not adopted the NETC bridge rail designs but uses modified versions. The research team performed a literature search of the MassDOT published

Standard details for railing/traffic barrier systems and confirmed that the steel tube railing designs used by MassDOT differ in multiple ways from the NETC designs (e.g., tube size, baseplate design, etc.). It is recommended that MassDOT be removed from further data gathering and assessment tasks.

Data Fields for Bridge Rail Inventory

The layout for each state's bridge rail inventory has been standardized into the fields shown in Table 4. Definitions and the formats for the inputs are also shown in Table 4. Additional discussion for each field, as populated for each specific state can be found in the specific state's data dictionary, included as appendices to this report.

Table 4: Bridge Rail Inventory Fields, Definitions and Formats.

Column	Field Name	Definitions	Format
A	BRIDGE_NO	Identification of the bridge (linkable to NBI)	Unique number
B	CROSSING	Identification of the feature being crossed by the bridge	Text input
C	TOWN	Town the bridge where the bridge is located	Text input
D	ROUTE	Route that the bridge carries	Text input
E	LAT	Latitude of the bridge	Varies between States
F	LONG	Longitude of the bridge	Varies between States
G	AADT	Average Annual Daily Traffic on the route	Numerical input
H	OWNER	Owner of the bridge	Numerical code input
I	NHS	Is the bridge on the National Highway System	0 or 1
J	FC	Functional classification of the route	1, 2, 6, 7, 8, 9, 11, 12, 14, 16, 17, or 19
K	N_E_MOUNT	Identification of what the bridge rail on the N or E side of the bridge is mounted to	1, 2, 3, 4, 99, or N/A
L	N_E_BRIDGE_ RAIL_TYPE	Identification of the type of NETC bridge rail on the N or E side of the bridge	a, b, c, j, k, m, n, o, 99, or N/A
M	N_E_AGT_TYPE	Identification of the type of NETC ATG on the N or E side of the bridge	d, e, f, g, h, i, l, q, r, s, t, u, v, w, 99, or N/A
N	N_E_TYP_ INSTALL	Determination of whether the installation of the bridge rail/AGT on the N or E side of the bridge is typical	0, 1, 99, or N/A
O	S_W_MOUNT	Identification of what the bridge rail on the S or W side of the bridge is mounted to	1, 2, 3, 4, 99, or N/A

P	S_W BRIDGE_ RAIL_TYPE	Identification of the type of NETC bridge rail on the S or W side of the bridge	a, b, c, j, k, m, n, o, 99, or N/A
Q	S_W_AGT_TYPE	Identification of the type of NETC ATG on the S or W side of the bridge	d, e, f, g, h, i, l, q, r, s, t, u, v, w, 99, or N/A
R	S_W_TYP_ INSTALL	Determination of whether the installation of the bridge rail/AGT on the S or W side of the bridge is typical	0, 1, 99, or N/A
S	INSTALL_YR	Earliest inspection report reviewed with NETC bridge rail installed	pre-****, ****, or ****-****
T	ADDITIONAL_ NOTES	Additional information that may be of interest	Text input, no restrictions or validation

NBI Elements

The first 10 fields identified in Table 4 (Column A-J) have been imported directly either from the publicly available NBI or from the bridge rail list provided by each of the states. These data fields include data for identifying and locating the bridges, as well as classifications of the roadways that the bridges carry.

Bridge Rail and AGT Fields

The second 10 fields identified in Table 4 (Column K-T) have been populated by review of inspection reports and photos and/or "visiting" each bridge on Google Earth Street View. The code descriptions and example photos for the mount, bridge rail, AGT and typical installation fields are provided in Tables 5 through 8.

Mount

Table 5: Code, Descriptions, and Examples of MOUNT Coding

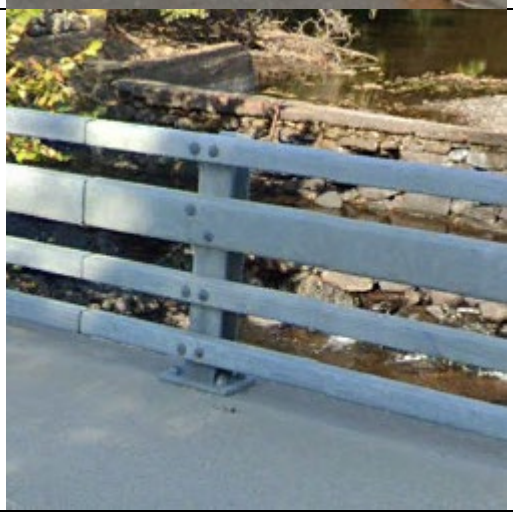
Code	Description	Example
1	Curb	

Code	Description	Example
2	Sidewalk (back)	
3	Sidewalk (front)	
4	Deck	

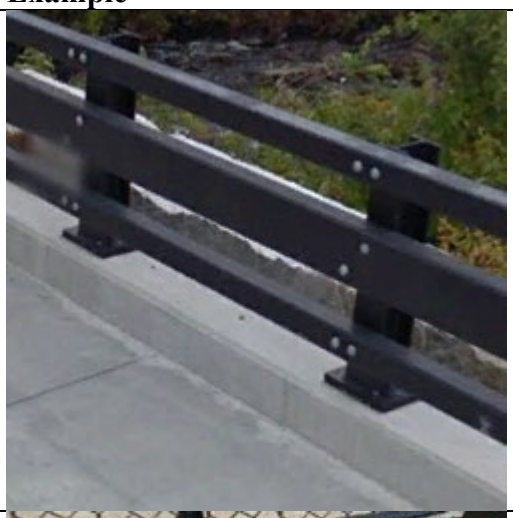
Code	Description	Example
5	Facia	

Bridge Rail

Table 6: Code, Descriptions, and Examples of BRIDGE_RAIL_TYPE Coding

Code	Description	Example
a	NETC 2-bar steel bridge rail *NETC T2 Steel Bridge Rail* *NHDOT T2 Steel Bridge Rail* *MaineDOT DWG 507(04)* *RIDOT DWG 10.30* *VTrans DWG S-360A-B*	
b	NETC 3-bar steel bridge rail *NETC T3 Steel Bridge Rail* *NHDOT T3 Steel Bridge Rail* *MaineDOT DWG 507(05)*	
c	NETC 4-bar steel bridge rail *NETC T4 Steel Bridge Rail* *NHDOT T4 Steel Bridge Rail* *MaineDOT DWG 507(07)*	

Code	Description	Example
j	RIDOT 4-bar steel bridge rail *RIDOT DWG 10.22*	
k	MaineDOT 4-bar steel traffic/Bicycle bridge rail *MaineDOT DWG 507(06)*	
m	2-bar bridge rail, non-NETC	

Code	Description	Example
n	3-bar bridge rail, non-NETC	
p	4-bar bridge rail, non-NETC	

AGTs

Table 7: Code, Descriptions, and Examples of AGT_TYPE Coding

Code	Description	Example
d	NETC 2-bar AGT *NETC T2 Steel Bridge Approach Rail* *NHDOT T2 Steel Bridge Approach Rail* *VTrans DWG S-360B*	
e	NETC 3-bar AGT *NETC T3 Steel Bridge Approach Rail* *NHDOT T3 Steel Bridge Approach Rail* *MaineDOT DWG 507(20-26)*	
f	NETC 4-bar AGT *NETC T3 Steel Bridge Approach Rail* *NHDOT T3 Steel Bridge Approach Rail*	

g	MaineDOT 2-bar concrete transition barrier *MaineDOT DWG 526(25-27)*	
h	MaineDOT 3-bar concrete transition barrier *MaineDOT DWG 526(28-30)*	
i	MaineDOT 4-bar concrete transition barrier *MaineDOT DWG 526(34-36)*	

l	MaineDOT 4-bar traffic/bicycle concrete transition barrier *MaineDOT DWG 526(31-33)*	
q	2-bar steel AGT, non-NETC *RIDOT DWG 10.32*	
r	3-bar steel AGT, non-NETC	No examples available
s	4-bar steel AGT, non-NETC	No examples available
t	2-bar concrete transition barrier, non-NETC	

u	3-bar concrete transition barrier, non-NETC	
v	4-bar concrete transition barrier, non-NETC	
w	MaineDOT 2-bar AGT *MaineDOT DWG 507(16-19)*	

Typical Install

Table 8: Code, Descriptions and Examples of TYP_INSTALL Coding

Code	Description	
0	Bridge Railing is a non-typical installation	   
1	Bridge Railing is a typical installation	
99	Bridge Railing installation status unknown	

References

(AASHTO 2019) AASHTO, "Manual for Bridge Element Inspection," 2019.