

## **Data Management Plan**

**Name of Contractor: BridgeTech, Inc.**

**Name of the Project: Assessment and Evaluations of I-80 Truck Loads and Their Load Effects: Phase 2: Service**

**Project Duration: Start Date: 3/26/2018                      End Date: 5/31/2020**

**DMP Version: 1**

**Date Amended, if any:**

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**WYDOT Project Number: RS07218**

- **Name of all peer reviewed publications, which have been generated using data from this project to include: N/A**
  
- **Any Digital Object Identifier (DOI), assigned to any peer reviewed publication or data generated by this project: N/A**
  
- **URLs for all peer reviewed publications which have been generated using data from this project: N/A**
  
- **Dataset URL, if available: N/A**

### **1. Introduction**

The research objective is to assess the performance (in terms of AASHTO design expectations for serviceability) of bridges along the Interstate 80 (I-80) corridor for Wyoming's truck traffic. Wyoming's I-80 corridor carries a large volume of cross-continental and large energy industry trucks compared to many states. Moreover, frequent weather closures position trucks side-by-side and end-to-end for miles. These vehicles then travel as a convoy once the road opens. Wyoming's unique truck traffic and traffic patterns potentially create larger demands on bridges than those considered in the development of the AASHTO LRFD *Bridge Design Specifications*. These characteristics may also be true for other states that contain unique traffic features.

A previous study was performed to assess the bridge safety (in terms of AASHTO Strength I design expectations) along the I-80 corridor. Rational single- and multi-presence load cases were developed to model the traffic pattern characteristics thought to exist on I-80 across Wyoming. The 75-year design life live load model was applied for reliability studies. Reliability indices were computed using Monte Carlo simulation. The results indicated Wyoming's truck traffic and traffic patterns create larger demands than that considered in the AASHTO LRFD Specifications. Shorter, multi-span bridges are especially critical, leading to lower reliability indices. This led to recommendations for increasing the Strength I live load factor.

Similar reliability studies and live load factor calibration were performed in this study using a database of in-service Wyoming bridges. This database, consisting of 112 steel bridges and 60 prestressed concrete bridges, was used to determine modified Service II and Service III live load factors to maintain adequate reliability against exceeding serviceability limit states. The results confirmed that the current live load factor of  $\gamma_L = 1.30$  did not meet the serviceability expectations in the AASHTO Service II limit state (structural steel yielding) for Wyoming traffic on I-80. The results also confirmed that the current live load factor of  $\gamma_L = 0.80$  did not meet the serviceability expectations in the AASHTO Service III limit state (prestressed concrete cracking) for Wyoming traffic on I-80.

The study also shows that there are many steel bridges along the I-80 corridor that currently do not meet the Service II limit state. These are older bridges that were designed between the late 1950's and mid-1970's according to earlier specifications. However, it is expected that these in-service bridges may experience yielding and permanent set in excess of that allowed in the AASHTO LRFD Specifications. This would also be true if the prestressed concrete bridges used in the study were located on the I-80 corridor.

Based on the I-80 weigh-in-motion (WIM) vehicle load characteristics that create load effects for Service II and Service III limit states, the reliability indices do not meet the target reliability in the AASHTO LRFD Specifications. Raising the design live load factors,  $\gamma_L$ , directly and fairly uniformly increases reliability indices. An increase in  $\gamma_L$  for Service II to 1.45 (from 1.30) and an increase in  $\gamma_L$  for Service III to 1.00 (from 0.80) increases all of the reliability indices to more closely match the reliability indices expected with the AASHTO LRFD Specifications.

## 2. Definitions

- a. Code or scripts include code used in the collection, manipulation, processing, analysis or visualization of data, but may also include software developed for other purposes.
- b. Copyright is a set of legal rights extended to copyright owners that govern such activities as reproducing, distributing, adapting, or exhibiting original works fixed in tangible forms.
- c. Data means the recorded factual material commonly accepted in the scientific community as necessary to validate research findings, but not any of the following: preliminary analyses, drafts of scientific papers, plans for future research, peer reviews, communications with colleagues. Recorded material excludes physical objects (e.g. laboratory samples). Research data also does not include trade secrets, commercial information, materials necessary to be held confidential; and personnel and medical information and similar information the disclosure of which would constitute a clearly unwarranted invasion of personal privacy.
- d. Data Archive is a site where machine-readable materials are stored, preserved or possibly redistributed to individuals interested in the materials.
- e. Data Management Plan is a document that specifies your plans for managing your data and files for a research project.
- f. Dataset means collection of data.
- g. Metadata refers to structured data about data that helps define administrative, technical, or structural characteristics of the digital content.
- h. WIM trucks means weigh-in-motion trucks.
- i. BRASS-GIRDER™ is software designed to assist the bridge engineer in the design review or rating of highway bridge girders for a variety of bridge types.

## 3. Data Types and Storage

The types of data and/or datasets generated and/or used in this project include:

- Bridge definitions stored as Wyoming Department of Transportation's BRASS-GIRDER™ data files
- WIM trucks and design vehicle definitions consisting of axle weights and spacings stored as BRASS™ Vehicle Library text files
- Live load moment results from BRASS-GIRDER™ stored as .csv files

The data were collected by analyzing the bridges using the Wyoming Department of Transportation's BRASS-GIRDER™ software, which generates a .csv results file. The .csv file is filtered using Microsoft Excel to extract only the live load moments. Multiple vehicle library

files were developed to define the various trucks with a fixed longitudinal spacing between the trucks, e.g., 10 feet and 50 feet, which were used to determine live load moments on one-span bridges. For the two-span bridges, a variable spacing was used from 10 feet to 50 feet.

Any of the bridge definitions and vehicle definitions can be reproduced and the live load moments can be regenerated. These data are stored on the BridgeTech FTP server, which is backed up weekly.

#### **4. Data Organization, Documentation, and Metadata**

The plan for organizing, documenting, and using descriptive metadata to assure quality control and reproducibility of these data include using BRASS-GIRDER™ data files, which are self-documented XML-based files, BRASS™ Vehicle Library files, which are documented in the corresponding help system, and a .xlsm results file, which is self-documented.

These existing files are expected to be readable by future versions of the programs.

#### **5. Data and/or Database Access and Intellectual Property**

No access and ownership concerns exist with the parametric bridge definitions developed for this study because they could be reproduced using other methods. However, for the Wyoming bridge definitions used in this study, there are access and ownership concerns. Note that the BRASS-GIRDER™ software used to analyze the bridges and define the vehicles for analysis is owned by the Wyoming Department of Transportation.

#### **6. Data Sharing and Reuse**

The data will be released for sharing upon request.

#### **7. Data Preservation and Archiving**

The data will be preserved and archived in the following ways. BRASS-GIRDER™ bridge data files, BRASS™ Vehicle library files, and live load moment spreadsheets will be stored on the BridgeTech FTP server, which is backed up weekly. The data will be self-disseminated.

The keywords listed in the Assessment and Evaluations of I-80 Truck Loads and Their Load Effects: Phase 2: Service report ensure discoverability of the pertinent information regarding this study.

The configuration of vehicles changes over time, so this data is likely relevant for another five to ten years at which time new WIM data can be obtained.

**NOTE: This DMP is created as a derivative from the DMP belonging to the University of Minnesota and can be found at <https://www.lib.umn.edu/datamanagement/DMP>**

## Metadata Schema

Elements	Example of what is expected for each element
<b>Title<sup>1</sup></b>	Parametric BRASS-GIRDER™ Data Files
<b>Creator/contact point</b>	BridgeTech, Inc. Brian L. Goodrich, P.E. goodrich@bridgetech-laramie.com
<b>Publication Date(s)</b>	N/A
<b>Description/Abstract</b>	BRASS-GIRDER™ data file containing parametric bridge geometry, materials, load factors, and live loads.
<b>Subject and Keywords</b>	BRASS-GIRDER™ data files  Bridge design, bridge analysis, bridge geometry, truck load, live load, live load factor, load and resistance design, LRFD, Wyoming, BRASS
<b>Identifier<sup>2</sup> and/or source</b>	ArchetypeBridges\*.girder  ftp://bridgetech.pairserver.com/ Contact BridgeTech for username and password.
<b>Collection and Related Documents</b>	N/A
<b>Edition</b>	BRASS-GIRDER™ Version 8.4 data file April 20, 2020
<b>Related Documents</b>	BRASS-GIRDER™ help system
<b>Coverage</b>	N/A
<b>Language</b>	English
<b>Publisher/Distributor</b>	BridgeTech, Inc. and Wyoming Department of Transportation

<sup>1</sup> To include alternate title; conference title; and journal title, if they are different.

<sup>2</sup> To include record numbers; report numbers; NTIS number; TRIS Accession Number; OCLC Number; ISBN; ISSN; contract number; and DOI if available.

<b>Elements</b>	<b>Example of what is expected for each element</b>
<b>Funding agency</b>	Wyoming Department of Transportation
<b>Access Restrictions</b>	Restricted public
<b>Intellectual Property and Other Rights</b>	All rights reserved, State of Wyoming, Wyoming Department of Transportation, and BridgeTech, Inc. Access depends on State of Wyoming policy on making Wyoming's bridge geometry and materials public knowledge.
<b>License</b>	This dataset has not been published and is available upon request.
<b>Code and software needs</b>	BRASS-GIRDER™ Version 8.4
<b>Format</b>	BRASS-GIRDER™ Version 8.4 data file (human- and machine-readable file); Size: 2-3 MB (varies by bridge)
<b>Choice of Repository</b>	BridgeTech FTP Server

**NOTE:** This Metadata Schema is created as a derivative from the Common Core required fields which can be found at <https://project-open-data.cio.gov/schema/>.

## Metadata Schema

Elements	Example of what is expected for each element
<b>Title<sup>3</sup></b>	Wyoming BRASS-GIRDER™ Data Files
<b>Creator/contact point</b>	BridgeTech, Inc. Brian L. Goodrich, P.E. goodrich@bridgetech-laramie.com
<b>Publication Date(s)</b>	N/A
<b>Description/Abstract</b>	BRASS-GIRDER™ data file containing Wyoming bridge geometry, materials, load factors, and live loads.
<b>Subject and Keywords</b>	BRASS-GIRDER™ data files  Bridge design, bridge analysis, bridge geometry, truck load, live load, live load factor, load and resistance design, LRFD, Wyoming, BRASS
<b>Identifier<sup>4</sup> and/or source</b>	SteelBridges\*.girder PSConcreteBridges\*.girder  ftp://bridgetech.pairserver.com/ Contact BridgeTech for username and password.
<b>Collection and Related Documents</b>	N/A
<b>Edition</b>	BRASS-GIRDER™ Version 8.4 data file April 20, 2020
<b>Related Documents</b>	BRASS-GIRDER™ help system
<b>Coverage</b>	N/A
<b>Language</b>	English
<b>Publisher/Distributor</b>	BridgeTech, Inc. and Wyoming Department of Transportation

<sup>3</sup> To include alternate title; conference title; and journal title, if they are different.

<sup>4</sup> To include record numbers; report numbers; NTIS number; TRIS Accession Number; OCLC Number; ISBN; ISSN; contract number; and DOI if available.



<b>Elements</b>	<b>Example of what is expected for each element</b>
<b>Funding agency</b>	Wyoming Department of Transportation
<b>Access Restrictions</b>	Restricted
<b>Intellectual Property and Other Rights</b>	All rights reserved, State of Wyoming, Wyoming Department of Transportation, and BridgeTech, Inc. Access depends on State of Wyoming policy on making Wyoming's bridge geometry and materials public knowledge.
<b>License</b>	This dataset has not been published and is available upon request.
<b>Code and software needs</b>	BRASS-GIRDER™ Version 8.4
<b>Format</b>	BRASS-GIRDER™ Version 8.4 data file (human- and machine-readable file); Size: 2-3 MB (varies by bridge)
<b>Choice of Repository</b>	BridgeTech FTP Server

**NOTE:** This Metadata Schema is created as a derivative from the Common Core required fields which can be found at <https://project-open-data.cio.gov/schema/>.

## Metadata Schema

Elements	Example of what is expected for each element
<b>Title<sup>5</sup></b>	BRASS™ vehicle libraries containing LRFD design vehicles and 5000 trucks from Wyoming WIM data along I-80
<b>Creator/contact point</b>	BridgeTech, Inc. Brian L. Goodrich, P.E. goodrich@bridgetech-laramie.com
<b>Publication Date(s)</b>	N/A
<b>Description/Abstract</b>	BRASS™ vehicle libraries containing LRFD design vehicles and 5000 trucks from Wyoming WIM data along I-80. The 5000 trucks those deemed most critical from the WIM data at two different sites along I-80. The library file ending with “Design” suffix contains the Wyoming design vehicles. The library file with no suffix contains entries for the individual WIM vehicles. The library file ending with “Train10” suffix contains entries with two identical vehicle WIM vehicles separated by a fixed headway spacing of 10 ft. The library file ending with “Train50” suffix contains entries with two identical vehicle WIM vehicles separated by a fixed headway spacing of 50 ft.
<b>Subject and Keywords</b>	BRASS™ vehicle library  Bridge design, weigh in motion, WIM data, bridge analysis, truck load, live load, load and resistance design, LRFD, interstate vehicle loads, Wyoming, BRASS
<b>Identifier<sup>6</sup> and/or source</b>	VehicleLibraries\I-80-Vehicles-Design.blv VehicleLibraries\I-80-Vehicles.blv VehicleLibraries\I-80-Vehicles-Train10.blv VehicleLibraries\I-80-Vehicles-Train50.blv  ftp://bridgetech.pairserver.com/ Contact BridgeTech for username and password.

<sup>5</sup> To include alternate title; conference title; and journal title, if they are different.

<sup>6</sup> To include record numbers; report numbers; NTIS number; TRIS Accession Number; OCLC Number; ISBN; ISSN; contract number; and DOI if available.

<b>Elements</b>	<b>Example of what is expected for each element</b>
<b>Collection and Related Documents</b>	N/A
<b>Edition</b>	BRASS™ Vehicle Library Version 2.6 April 20, 2020
<b>Related Documents</b>	BRASS™ Library Utility help system
<b>Coverage</b>	Wyoming
<b>Language</b>	English
<b>Publisher/Distributor</b>	BridgeTech, Inc. and Wyoming Department of Transportation
<b>Funding agency</b>	Wyoming Department of Transportation
<b>Access Restrictions</b>	Restricted public
<b>Intellectual Property and Other Rights</b>	All rights reserved, State of Wyoming, Wyoming Department of Transportation, and BridgeTech, Inc.
<b>License</b>	This library has not been published and is available upon request.
<b>Code and software needs</b>	BRASS™ Library Utility Version 2.6
<b>Format</b>	BRASS™ Vehicle Library (.blv) (human- and machine-readable file); Size: 2.1 MB
<b>Choice of Repository</b>	BridgeTech FTP Server

**NOTE:** This Metadata Schema is created as a derivative from the Common Core required fields which can be found at <https://project-open-data.cio.gov/schema/>.

## Metadata Schema

<b>Elements</b>	<b>Example of what is expected for each element</b>
<b>Title<sup>7</sup></b>	Live Load Moments from LRFD design vehicles and 5000 trucks from Wyoming WIM data along I-80
<b>Creator/contact point</b>	BridgeTech, Inc. Brian L. Goodrich, P.E. goodrich@bridgetech-laramie.com
<b>Publication Date(s)</b>	N/A
<b>Description/Abstract</b>	Spreadsheet containing live load moment results from analysis of parametric bridges to which LRFD design vehicles and 5000 trucks from Wyoming WIM data along I-80 were applied.
<b>Subject and Keywords</b>	Live Load Moments  Bridge design, bridge analysis, bridge geometry, weigh in motion, WIM data, truck load, live load, live load factor, load and resistance design, LRFD, interstate vehicle loads, Wyoming, BRASS
<b>Identifier<sup>8</sup> and/or source</b>	LiveLoadMoments\I-80-CompiledResults.xlsx  ftp://bridgetech.pairserver.com/ Contact BridgeTech for username and password.
<b>Collection and Related Documents</b>	N/A
<b>Edition</b>	April 20, 2020
<b>Related Documents</b>	N/A
<b>Coverage</b>	Wyoming
<b>Language</b>	English

<sup>7</sup> To include alternate title; conference title; and journal title, if they are different.

<sup>8</sup> To include record numbers; report numbers; NTIS number; TRIS Accession Number; OCLC Number; ISBN; ISSN; contract number; and DOI if available.

<b>Elements</b>	<b>Example of what is expected for each element</b>
<b>Publisher/Distributor</b>	BridgeTech, Inc. and Wyoming Department of Transportation
<b>Funding agency</b>	Wyoming Department of Transportation
<b>Access Restrictions</b>	Restricted public
<b>Intellectual Property and Other Rights</b>	All rights reserved, State of Wyoming, Wyoming Department of Transportation, and BridgeTech, Inc.
<b>License</b>	This dataset has not been published and is available upon request.
<b>Code and software needs</b>	Excel 2019
<b>Format</b>	Excel spreadsheet; Size: 4.5 MB
<b>Choice of Repository</b>	BridgeTech FTP Server

**NOTE:** This Metadata Schema is created as a derivative from the Common Core required fields which can be found at <https://project-open-data.cio.gov/schema/>.