

# Chapter 1 — Introduction and Definitions

## 1.1—INTRODUCTION

The author of the Bridge Design Manual (BDM) is the Bridge Policy and Quality Assurance Section of the Bridge Division of Nebraska Department of Transportation (NDOT).

Any mention of “Bridge Division” in the text refers to NDOT Bridge Division.

## 1.2—FORMAT

The BDM is written in a 2-column format, where the left column represents the policy, and the right column represents commentary.

The terms “shall”, “must”, or “will” denote requirements for compliance with the policy. The term “should” indicates a strong preference for the criterion. The term “may” indicates a criterion that could be modified or adapted if local condition warrant different conditions.

In the few locations where the BDM is written in a 1-column format, all the text represents policy and there is no commentary

The commentary may include background information or any supplemental information that may be useful to the designer..

## 1.3—PUBLICATION AND MAINTENANCE

Following the first publication, the BDM will be updated on a yearly basis, with only the changes from the previous release being highlighted with change bars in the margins.

Interim revisions or policy changes will be issued through Bridge Policy Letters.

All documents posted online can be found on the Bridge Division’s website. A contact for the BDM is also provided for any questions or comments.

The appendices to this document are up-to-date at the time of publication. For the most up-to-date base sheets and special provisions, see “NDOT Production” ProjectWise Datasource. It is the designers’ responsibility to incorporate the most up-to-date base sheets and special provisions in their design.

Bridge Division documents are available on the website at: <https://dot.nebraska.gov/business-center/bridge/>.

Base sheets are located on the “NDOT Production” ProjectWise Datasource in the current workspace configuration standards folder. Special Provisions are located on the “NDOT Production” ProjectWise Datasource in the Standard Plans/Bridge folder.

## 1.4—PURPOSE AND AUDIENCE

The BDM establishes the policies and defines preferred practices for the Bridge Division for the structural design, analysis, and detailing of new and existing bridges and bridge sized culverts.

The BDM is intended to provide preferred practices based on local expertise and experience, while allowing designers to adapt the practices to individual site and design conditions. Contents are provided to promote consistency in design analysis, contract documents, and constructibility considerations.

Policies for bridge inspection and load rating can be found in NDOT Bridge Inspection Program Manual (BIP). Policies for hydraulic analysis can be found in NDOT Hydraulic Analysis Guidelines.

All bridge designs are the responsibility of the Engineer of Record; Bridge Division does not accept responsibility for any errors or oversights in the use of this manual.

Deviations from the policies herein shall be discussed with the Bridge Division and approved in writing during the design phase of the project.

It is important for the Bridge Division to be made aware of deviations from the policy so the intent of the modification can be understood, any implications related to maintenance and construction can be evaluated, and for on-going policy evaluation.

## 1.5—COORDINATION WITH OTHER DOCUMENTS

NDOT bridge design shall be in conformance with the following publications, listed in descending order of precedence in the case of discrepancy:

- A. NDOT Bridge Policy Letters
- B. NDOT Bridge Design Manual
- C. NDOT base sheets, standard details, and standard cells, as can be found on "NDOT Production" ProjectWise Datasource
- D. NDOT Hydraulic Analysis Guidelines 2015, NDOT Roadway Design Manual 10/2023, NDOT Standard/Special Plans Manual for Designers & Consultants 10/2024
- E. NDOT Supplemental Specifications current at the time of contract
- F. NDOT Standard Specifications for Highway Construction 2017
- G. NDOT Construction Manual 2023
- H. AASHTO LRFD Bridge Design Specifications and subsequent interims and AASHTO LRFD Bridge Construction Specifications and subsequent interims.

All NDOT Manuals and Standard Specifications are available on the NDOT website.

See §1.6 for current AASHTO Specifications.

For construction methods not clearly defined in the documents listed above, the plans and project special provisions must show enough details (description and instructions) to ensure clarity for construction and for contract administration.

During construction, the hierarchy of the contract documents in case of discrepancy is listed in the Standard Specifications (§105.04.1.b). Designers should note that special provisions will govern over plans.

## 1.6—CURRENT AASHTO SPECIFICATIONS

At the time of publication, the current edition of AASHTO Load and Resistance Factor Design Bridge Design Specifications is the 9<sup>th</sup> edition (AASHTO, 2020), with subsequent interims.

At the time of publication, the current edition of AASHTO Load and Resistance Factor Design Bridge Construction Specifications is the 4<sup>th</sup> edition (AASHTO, 2017), with subsequent interims.

## 1.7—DEFINITIONS

The definitions in this section are meant to clarify local practices. Refer to LRFD BDS for definitions of common bridge terms.

- Approach Section — Part of the Approach Slab. It spans from the bridge deck to the grade beam.
- Approach Slab — A reinforced concrete slab which spans the distance between the bridge deck and roadway pavement
- Bent — Bridge supports between abutments that are supported on a single row of piles without a footing. Open pile bents were used on many short span structures but are not common anymore. Concrete encased pile bents are still common.

- Berm Elevation – The horizontal portion of the graded channel profile immediately adjacent to the abutment. Given to the top of the unarmored soil (bottom of riprap) or top of concrete slope protection.
- Bridge – A structure, including supports, erected over a depression or any obstruction, with a passageway for carrying traffic or other moving loads and has a length measured along the centerline of roadway of more than 20 feet.
- Bridge Determination – Planning document listing the description of the work to be completed on the structure. Developed by the Bridge Management Section of Bridge Division.
- Critical Berm – The soil line in front of the abutment, after considering the  $Q_{100}$  scour and channel behavior.
- Crown – high point of the roadway when the cross-section slopes to both shoulders. A superelevated cross-section does not have a crown
- Design Standard – Minimum standard of design, construction, and maintenance for the project, generally determined by Roadway Division. See Nebraska Administrative Code Title 428 “Rules and Regulations of the Board of Public Roads Classifications and Standards” for additional information.
- End of Floor – End of the bridge deck at grade
- Freeboard – The clear distance between low superstructure elevation and design high water elevation.
- Grade Beam – The concrete element supported on piling which supports the approach slab away from the end of floor
- Haunch – any thickening of a concrete section at a support OR, when discussion girders, the distance between the bottom of the deck and the girder. For NU girders and rolled steel girders, it is the distance to the top of the top flange. For welded steel plate girder, it is the distance to the top of the web (includes the top flange). Haunch is the nomenclature for this dimension during the design phase, while shim is used in the field for the same dimension.
- Integral Abutment – Abutments type that is placed on vertical piles with sufficient flexibility so that the superstructure can contract and expand with changes in temperature. Girder ends are cast into the abutment during construction. Allows the expansion joint to be moved to the grade beam.
- Maintenance – A planned strategy of cost-effective treatments to an existing roadway system and its appurtenances that preserves the system, slows future deterioration, and maintains or improves the functional condition of the system without increasing the structural capacity. (Nebraska Department of Transportation, 2022)
- Minimum Bridge Grade – The lowest point of grade line elevation at the PGL between CL abutments used by the Hydraulic Section for the hydraulic study. Actual grade line profiles for the Bridge Design should use the minimum grade or higher in order to avoid decreasing the freeboard.
- New Structure – A new bridge on a new alignment.
- NU girder – I-shaped precast/prestressed concrete girder with wide bottom and top flanges.
- Ordinary High Water – The point at which natural vegetation shifts from predominately water dependent species to terrestrial species.
- OnBase – The states enterprise content management system, used for document management, business process automation and records management.
- Paving Section – Part of the Approach Slab. It spans from the grade beam to the roadway pavement
- Pier – Bridge supports between abutments that do not qualify as Bents.
- Preservation – The application of treatments at the proper time to prevent or correct the deterioration of an asset in order to extend its service life. (Nebraska Department of Transportation, 2022)
- Reconstructed Structure – A new bridge on an existing alignment
- Redeck – Replacement of the existing deck to the same clear roadway width. Girders can be made composite, continuous, or converted from pin and hanger. May also include partial superstructure replacement.
- Rehabilitated Structure – Replacement of an existing deck and all of the superstructure. This can include repairs to the existing substructure.
- Semi-integral Abutment – Abutment type that uses a concrete turndown at the girder ends and allows longitudinal movement (for expansion ends). Allows the expansion joint to be moved to the grade beam.
- Shims – See Haunch definition
- Substructure – All portions of the bridge below the girder bearing devices or below the slab and its haunches in the case of slab bridges.
- Sufficiency Rating – A rating factor between 1 and 100 that indicates the overall condition of the bridge structure.
- Superstructure – All portions of the bridge above and including the girder bearing devices or above the bottom of the slab in the case of slab bridges.
- Turndown – Concrete diaphragms encasing girder ends at the abutments. Used for the semi-integral abutment type
- Widen – Addition of a section of bridge that increases the bridge clear roadway width. This may include widening the existing substructure, adding a line of girders, or both.

## 1.8—QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) PROCESS

Reserved for future use

## 1.9—OPERATIONAL IMPORTANCE OF BRIDGES

Bridges that meet critical or essential bridges criteria shall be indicated on the BDS and shall use the operational importance factor for design listed in LRFDBDS Article 1.3.5.

Critical or essential structures shall include, at a minimum, Missouri River crossings and other structures as determined by Bridge Division.

## 1.10—ABBREVIATIONS

- AASHTO – American Association of State Highway and Transportation Officials
- AC – Asphaltic Concrete
- AC+M – Asphaltic Concrete with a Waterproof Membrane
- AADT – Annual Average Daily Traffic
- ADTT – Average Daily Truck Traffic
- APL – NDOT Approved Products List
- ASTM – American Society for Testing and Material
- AWS – American Welding Society
- BDS – Bridge Data Sheet
- BDM – Bridge Design Manual
- BIP – Bridge Inspection Program
- CADD – Computer-Aided Design and Drafting
- CDP – Cotton Duck Pad
- CL – Centerline
- CIP – Cast-in-Place
- CIT – Concrete Inverted Tee
- CSB – Concrete Slab Bridge
- CPG – Concrete Prestressed Girder
- CY – Cubic Yard
- EJ – Expansion Joint
- EPO – Epoxy Polymer Overlay
- EOF – End of floor (end of bridge deck at grade)
- FHWA – Federal Highway Administration
- FRP – Fiber Reinforced Polymer
- GPR – Ground-penetrating Radar
- HDPE – High-Density Polyethylene
- HLMR – High Load Multi-Rotational
- HMA – Hot Mix Asphalt
- HPS – High Performance Steel
- LB – Pound
- LF – Lineal Feet
- LRFDBDS – Load and Resistance Factor Design Bridge Design Specifications. This refers to the current edition of the AASHTO LRFD Bridge Design Specifications. References to specific AASHTO LRFD sections will include the article number (e.g. LRFDBDS 11.10.5)
- MASH – Manual for Assessing Safety Hardware
- MGS – Midwest Guardrail System

Article numbers refer to the current specification at the time of publication.

- MTV – Material Transport Vehicle
- NBI – National Bridge Inventory
- NCHRP – National Cooperative Highway Research Program
- NDOT – Nebraska Department of Transportation
- npUHPC – Non-proprietary Ultra-High Performance Concrete
- NSBA – National Steel Bridge Alliance
- OCR – Open Concrete Rail
- OHW – Ordinary High Water
- P&H – Pin and Hanger
- PCAN – Precaster Association of Nebraska
- PCC – Portland Cement Concrete
- PCI – Precast/Prestressed Concrete Institute
- PGL – Profile Grade Line
- PPC – Polyester Polymer Concrete
- PPF – Precompressed Polyurethane Foam
- QA/QC – Quality Assurance/Quality Control
- RDM – Roadway Design Manual
- SCC – Self-Consolidating Concrete
- SF – Square Feet
- SHPO – State Historic Preservation Office
- SN – Surface Friction Number
- SPG – Steel Plate Girder
- SRB – Steel Rolled Beam
- SSCR – Single Slope Closed Rail
- SWWR – Steel Welded Wire Reinforcement
- Standard Specifications – NDOT Standard Specifications for Highway Construction

All references to Standard Specifications in the text refer to the current NDOT Standard Specifications. The current Standard Specifications at the time of publications are from 2017. Any references to sections refer to that edition.

- SY – Square Yard
- TM – Temperature Movement
- TS&L – The preliminary plan showing Type, Size, and Location of the structure
- TYP – Typical
- UHPC – Ultra-High Performance Concrete
- UNO – Unless Noted Otherwise
- VPD – Vehicles Per Day
- WPG – Welded Plate Girder
- WPS – Welding Procedure Specification
- WWR – Welded Wire Reinforcement
- 3R – Resurfacing, Restoration and Rehabilitation

### 1.11—REFERENCES

AASHTO. (2017). LRFD Bridge Construction Specifications (4th ed.). American Association of State Highway and Transportation Officials. LRFDCONS-4

AASHTO. (2020). LRFD Bridge Design Specifications (9th ed.). American Association of State Highway and Transportation Officials. LRFDBDS-9

Nebraska Department of Transportation. (2022). *Transportation Asset Management Plan*. <https://dot.nebraska.gov/projects/publications/tamp/>

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