
CHAPTER 15

STEEL STRUCTURES¹

FOREWORD

Part 1 through Part 4, Part 6, and Part 7 formulate specific and detailed recommendations for the design, fabrication, erection, maintenance, inspection, and rating of steel railway bridges for:

- Spans up to 400 feet,
- Standard gage track,
- Normal North American passenger and freight equipment, and
- Speeds of freight trains up to 80 mph and passenger trains up to 90 mph.

The requirements, however, apply to spans of any length, but special provisions for spans longer than 400 feet should be added by the company as may be required. Part 5, *Bearing Design and Construction*, formulates specific and detailed recommendations for the design and construction of bearings for nonmovable railway bridges. Part 6 provides recommendations for the design and construction of movable bridges, including requirements for special movable bridge bearings not covered within Part 5. Part 8 covers miscellaneous items. Part 9 is a commentary, including references, for explanation of various articles in the other parts.

This chapter is presented as a consensus document by a committee composed of railroad engineers, engineers in private practice, engineers involved in research and teaching, and other industry professionals having substantial and broad-based experience designing, evaluating, and investigating steel structures used by railroads. The recommendations contained herein are based upon past successful usage, advances in the state of knowledge, and changes in design and maintenance practices. These recommendations have been developed and are intended for routine use and may not provide sufficient criteria for infrequently encountered conditions. Therefore, professional judgment must be exercised when applying the recommendations of this chapter as part of an overall solution to any particular issue.

In general, this chapter is revised and published anew on an annual basis. The latest published edition of the chapter should be used, regardless of the age of an existing structure. For purposes of determining historical recommendations under which an existing structure may have been built and maintained, it can prove useful to examine previously published editions of the chapter. However, when historical recommendations differ from the recommendations contained in the latest published edition of the chapter, the recommendations of the latest published edition of the chapter shall govern.

¹ The material in this and other chapters in the AREMA *Manual for Railway Engineering* is published as recommended practice to railroads and others concerned with the engineering, design and construction of railroad fixed properties (except signals and communications), and allied services and facilities (Reference 19). For the purpose of this Manual, RECOMMENDED PRACTICE is defined as a material, device, design, plan, specification, principle or practice recommended to the railways for use as required, either exactly as presented or with such modifications as may be necessary or desirable to meet the needs of individual railways, but in either event, with a view to promoting efficiency and economy in the location, construction, operation or maintenance of railways. It is not intended to imply that other practices may not be equally acceptable.

Grateful acknowledgment is hereby made to the American Association of State Highway and Transportation Officials and the American Welding Society for having made available their Bridge Welding Code (AWS D1.5) for use by reference in these recommended practices. In applying AWS D1.5, the term “allowable stresses” is to be construed as those allowed herein. Certain other modifications and exceptions to the Code are also recommended.

Grateful acknowledgement is also made to the Society of Protective Coating (SSPC) for use of their publications by reference in the recommendations cited in [Part 8, Section 8.7](#), regarding the cleaning and painting of existing steel railway bridges.

Part 2, Design – High Strength Steels was combined with [Part 1, Design](#) in 1993.

Part 5, Special Types of Construction was combined with [Part 1, Design](#) in 2008.

Part 10, Bearing Design, and Part 11, Bearing Construction, were combined into a new [Part 5, Bearing Design and Construction](#) in 2013.

TABLE OF CONTENTS

Part/Section	Description	Page
Special Index		15-vi
1 Design		15-1-1
1.1	Proposals and Drawings	15-1-5
1.2	General Requirements	15-1-7
1.3	Loads, Forces and Stresses	15-1-14
1.4	Basic Allowable Stresses	15-1-40
1.5	General Rules	15-1-46
1.6	Members Stressed Primarily in Axial Tension or Compression	15-1-50
1.7	Members Stressed Primarily in Bending	15-1-56
1.8	Floor Members and Floorbeam Hangers	15-1-67
1.9	Construction with Fasteners	15-1-68
1.10	Welded Construction	15-1-69
1.11	Bracing	15-1-71
1.12	Pins and Pin-Connected Members	15-1-72
1.13	Continuous and Cantilever Steel Structures	15-1-73
1.14	Fracture-Critical Members	15-1-76
1.15	Live Load Moments, Shears and Reactions	15-1-77
3 Fabrication		15-3-1
3.1	General	15-3-3
3.2	Bolted Construction	15-3-9
3.3	Welded Construction	15-3-18
3.4	Shop Painting	15-3-19
3.5	Inspection	15-3-19
3.6	Shipment and Pay Weight	15-3-21
4 Erection		15-4-1
4.1	General (1992) R(2015)	15-4-2
4.2	Definitions of Terms (2015)	15-4-2
4.3	Work to be Done (2002) R(2015)	15-4-3
4.4	Drawings or Special Provisions to Govern (1992) R(2015)	15-4-3
4.5	Plant (1992) R(2015)	15-4-3
4.6	Plans (2017)	15-4-3
4.7	Delivery of Materials (1992) R(2015)	15-4-4
4.8	Handling and Storing Materials (1992) R(2015)	15-4-4
4.9	Establishment of Lines and Elevations	15-4-4
4.10	Bearings and Anchorage (2002) R(2015)	15-4-4
4.11	Erection Procedure, Shoring and Falsework (2018)	15-4-4
4.12	Alteration of Members (2016)	15-4-5
4.13	Allowable Stresses During Erection (1991) R(2015)	15-4-6
4.14	Drift or Traffic Pins (1991) R(2016)	15-4-6
4.15	Field Assembly of Members (2017)	15-4-6
4.16	Fit-up of Field Connections (2017)	15-4-7
4.17	High-Strength Bolted Field Connections (1991) R(2015)	15-4-7
4.18	Field Welding (1991) R(2015)	15-4-7
4.19	Field Connections Using Pins (1991) R(2015)	15-4-7
4.20	Field Inspection (1991) R(2015)	15-4-7

TABLE OF CONTENTS (CONT)

Part/Section	Description	Page
4.21	Misfits (1991) R(2015)	15-4-8
4.22	Field Cleaning and Coating (2016)	15-4-8
4.23	Deck (1991) R(2015)	15-4-8
4.24	Removal of Old Structure and Falsework, and Cleanup (2018)	15-4-9
4.25	Interference with Traffic (1983) R(2015)	15-4-9
4.26	Company Equipment (1983) R(2015)	15-4-9
4.27	Work Train Service (1983) R(2015)	15-4-10
4.28	Risk (1983) R(2015)	15-4-10
4.29	Laws and Permits (1983) R(2015)	15-4-10
4.30	Patents (1983) R(2015)	15-4-10
5	Bearing Design and Construction	15-5-1
5.1	Bearing Design	15-5-4
5.2	Basic Allowable Stresses	15-5-11
5.3	Steel Bearing Component Design	15-5-12
5.4	Bronze or Copper-Alloy Sliding Expansion Bearing Design	15-5-18
5.5	PTFE Sliding Bearing Surface Design	15-5-19
5.6	Elastomeric Bearing Design	15-5-23
5.7	Multi-Rotational Bearing Design	15-5-34
5.8	Bearing Construction	15-5-39
5.9	Steel Bearing Component Construction	15-5-40
5.10	Bronze or Copper-Alloy Sliding Expansion Bearing Construction	15-5-44
5.11	PTFE Sliding Bearing Surface Construction	15-5-45
5.12	Elastomeric Bearing Construction	15-5-48
5.13	Multi-Rotational Bearing Construction	15-5-52
6	Movable Bridges	15-6-1
6.1	Proposals and General Requirements	15-6-5
6.2	General Features of Design	15-6-13
6.3	Loads, Forces and Stresses	15-6-17
6.4	Basic Allowable Stresses and Hydraulic Pressures	15-6-27
6.5	General Details	15-6-33
6.6	Wire Ropes and Sockets	15-6-68
6.7	Power Equipment	15-6-72
6.8	Workmanship	15-6-95
6.9	Erection	15-6-100
7	Existing Bridges	15-7-1
7.1	General	15-7-2
7.2	Inspection	15-7-4
7.3	Rating	15-7-13
7.4	Repair, Strengthening and Retrofitting	15-7-25
7.5	Maintenance	15-7-32
8	Miscellaneous	15-8-1
8.1	Turntables	15-8-3
8.2	Methods of Shortening Eyebars to Equalize the Stress	15-8-11
8.3	Anchorage of Decks and Rails on Steel Bridges	15-8-16
8.4	Unloading Pits	15-8-20
8.5	Walkways, Handrails, and Fixed Ladders on Bridges	15-8-28
8.6	Guidelines for Evaluating Fire Damaged Steel Railway Bridges	15-8-31

TABLE OF CONTENTS (CONT)

Part/Section	Description	Page
8.7	Guide to the Preparation of a Specification for the Cleaning and Coating of Existing Steel Railway Bridges	15-8-33
9	Commentary	15-9-1
	Part 1 Design	15-9-7
	Part 3 Fabrication	15-9-50
	Part 4 Erection	15-9-54
	Part 5 Bearing Design and Construction	15-9-55
	Part 6 Movable Bridges	15-9-61
	Part 7 Existing Bridges	15-9-66
	Part 8 Miscellaneous	15-9-78
Chapter 15	Glossary	15-G-1
References		15-R-1
Appendix 1 - Rivets (Legacy)		15-A-1

INTRODUCTION

The Chapters of the AREMA Manual are divided into numbered Parts, each comprised of related documents (specifications, recommended practices, plans, etc.). Individual Parts are divided into Sections by centered headings set in capital letters and identified by a Section number. These Sections are subdivided into Articles designated by numbered side headings.

Page Numbers – In the page numbering of the Manual (15-3-1, for example) the first numeral designates the Chapter number, the second denotes the Part number in the Chapter, and the third numeral designates the page number in the Part. Thus, 15-3-1 means Chapter 15, Part 3, page 1.

In the Glossary and References, the Part number is replaced by either a “G” for Glossary or “R” for References.

Document Dates – The bold type date (Document Date) at the beginning of each document (Part) applies to the document as a whole and designates the year in which revisions were last published somewhere in the document, unless an attached footnote indicates that the document was adopted, reapproved, or rewritten in that year.

Article Dates – Each Article shows the date (in parenthesis) of the last publication of revisions to that Article.

Reaffirmed Dates - Each Article is being reviewed and reaffirmed every 6 years beginning with the year 2002. If no technical changes are made, the publication date of the last reaffirmation is shown following the title of the Article and the Article Date.

Revision Marks – All current year revisions (changes and additions) which have been incorporated into the document are identified by a vertical line along the outside margin of the page, directly beside the modified information.

Proceedings Footnote – The Proceedings footnote on the first page of each document gives references to all Association action with respect to the document.

Annual Updates – New manuals, as well as revision sets, will be printed and issued yearly.