

Contents

Preface	i		
Chapter 1			
Material Specifications for Reinforcing Bars	1-1		
1.1 Introduction	1-1		
1.2 Reinforcing Bars	1-1		
1.3 ACI 318 Code—Requirements for Reinforcing Bars	1-1		
1.4 Specialty Reinforcing Bars	1-1		
1.5 Spiral Reinforcement	1-4		
1.5.1 Standard Sizes	1-4		
1.5.2 Material	1-4		
1.6 Welding of Reinforcing Bars	1-4		
1.6.1 Material Specifications and Welding Code	1-4		
1.6.2 Project Drawings and Project Specifications	1-4		
1.6.3 CRSI Recommendations	1-5		
1.7 Identification Marks—ASTM Standard Reinforcing Bars	1-5		
Chapter 2			
Welded Wire Reinforcement (WWR)	2-1		
2.1 Introduction	2-1		
2.2 ASTM Specifications	2-1		
2.3 WWR Style Identification	2-1		
2.4 Specifying Welded Wire Reinforcement	2-1		
2.5 Detailing Welded Wire Reinforcement	2-1		
2.5.1 Width	2-1		
2.5.2 Length	2-2		
2.6 ASTM Specification for Epoxy-Coated Wire and Welded Wire Reinforcement	2-2		
2.7 ASTM Specification for Zinc-Coated (Galvanized) Steel Welded Wire Reinforcement	2-2		
2.8 ASTM Specification for Stainless-Steel Welded Wire Reinforcement	2-2		
2.9 Rust	2-2		
2.10 Handling, Shipping and Unloading	2-3		
Chapter 3			
Supports for Reinforcement (Bar Supports)	3-1		
3.1 Introduction	3-1		
3.2 Side-Form Spacers	3-1		
3.3 Recommendations for Bar Supports	3-1		
3.3.1 Standard, Non-Coated	3-1		
3.3.2 Epoxy-Coated or Dual-Coated	3-1		
3.3.3 Galvanized	3-1		
3.3.4 Stainless-Steel	3-7		
3.3.5 Low-Carbon, Chromium	3-7		
3.4 Placing Bar Supports	3-7		
3.4.1 Application and Use of Bar Supports	3-7		
3.4.2 Slabs-on-Ground, Grade Beams and Foundation Mats	3-7		
3.4.3 Joist Construction	3-7		
3.4.4 Side-Form Spacers	3-7		
3.4.5 Recommended Details and Placing Sequences	3-8		
3.5 One-Way Solid Slabs	3-8		
3.6 Joists	3-9		
3.7 Beams and Girders	3-9		
3.8 Sequence of Placing Bar Supports and Reinforcing Bars in Two-Way Flat Plate	3-10		
3.9 Sequence of Placing Bar Supports and Reinforcing Bars in Two-Way Flat Slab	3-11		
3.10 Sequence of Placing Bar Supports and Reinforcing Bars in Two-Way Waffle Flat Slab	3-12		
3.11 Bar Supports for Special Conditions	3-13		
3.11.1 One-Way Slabs on Corrugated Steel Forms—Placing Sequence	3-13		
3.11.2 Foundation Mats and Slabs on Ground or on Mud-Mat	3-14		
3.12 Bar Supports for Highway Bridge Slab Reinforcement	3-15		
3.12.1 Slabs on Flat Formwork	3-15		
3.12.2 Slabs on Permanent Corrugated Steel Forms	3-16		
Chapter 4			
Notes and Recommendations to the Architect/Engineer	4-1		
4.1 Introduction	4-1		
4.2 Recommended Industry Practices	4-1		
4.2.1 General	4-1		
4.2.2 Structural Drawings, Details, and Specifications	4-1		
4.3 Sizes of Reinforcing Bars and Spirals	4-1		
4.4 Grade or Minimum Yield Strength Designation	4-2		
4.5 Standard Notation	4-2		
4.6 Project Drawings	4-2		

Contents

4.7 Length of Reinforcing Bars	4-3
4.8 Beams and Girders	4-3
4.9 Joist Construction	4-3
4.10 Flat Plates and Flat Slabs	4-3
4.11 Post-Tensioned Beams and Slabs	4-4
4.12 Falsework and Form Reuse	4-4
4.13 Columns	4-4
4.14 Structural Integrity	4-4
4.14.1 Joists	4-4
4.14.2 Beams	4-5
4.14.3 Two-Way Slabs	4-5
4.15 Splices	4-5
4.16 Designing with Specialty Reinforcing Bars	4-5
4.17 Fabrication of Reinforcing Bars	4-5
4.18 Placing Drawings	4-6
4.19 Special Services and Items	4-6
4.20 Field Cutting of Reinforcing Bars	4-6
Suggested Specifications for Reinforcing Steel	4-7

Chapter 5

Recommended Industry Practice for Estimating Reinforcing Materials and Services 5-1

5.1 Introduction	5-1
5.2 Scope	5-1
5.3 General	5-1
5.4 Fabrication	5-1
5.5 Extras	5-1
5.5.1 Bar Sizes	5-1
5.5.2 Grades	5-1
5.5.3 Bending	5-1
5.5.4 Special Services	5-2
5.5.5 Special Items	5-2
5.6 Radial Prefabrication (Bend Type 109)	5-3
5.7 Standard Hooks	5-3
5.7.1 Hooks on Main Reinforcement	5-3
5.7.2 Tie or Stirrup Hooks	5-3
5.8 Splicing of Bars	5-3
5.8.1 Lap Splices	5-3
5.8.2 Mechanical Splices, Welded Splices and Bar End Preparation	5-4
5.9 Bar Dimensions, Extensions and Cut-Offs	5-4
5.9.1 Beams, Joists and Slabs	5-4

5.9.2 Columns	5-4
5.9.3 Footings	5-4
5.9.4 Dowels	5-4
5.9.5 Column Ties	5-4
5.9.6 Beam or Girder Stirrups	5-4
5.9.7 Column Spirals	5-5
5.10 Spacers for Spiral Reinforcement	5-5
5.11 Temperature-Shrinkage Reinforcement	5-5
5.12 Slabs, Walls, Mats, or Footings Bar Spacing	5-5
5.13 Joists Adjoining Beams or Walls	5-6
5.14 Corner Bars	5-6
5.15 Bar Supports	5-6
5.16 Side-Form Spacers	5-6
5.17 Welded Plain or Deformed Wire Reinforcement	5-6
5.18 Post-Tensioned Construction	5-6
5.19 Placing Facilitation	5-6

Chapter 6

Recommended Industry Practice for Detailing Concrete Reinforcing Steel 6-1

6.1 Introduction	6-1
6.2 Technical Service by Seller	6-1
6.2.1 Types	6-1
6.2.2 Responsibility	6-1
6.2.3 Performance – Placing Drawings	6-1
6.2.3.1 Submissions	6-1
6.2.3.2 Corrections	6-1
6.2.3.3 Approved Copies	6-1
6.3 Detailer Responsibilities	6-1
6.3.1 Introduction	6-1
6.3.2 Effective Communication and Teamwork	6-2
6.3.3 Adherence to the Contract Scope	6-2
6.3.4 Adherence to the Contract Documents	6-2
6.3.5 Understanding Construction Means and Methods	6-2
6.3.6 Clarifying Missing or Contradictory Information	6-2
6.3.6.1 Asking Questions on Placing Drawings	6-3
6.3.6.2 Writing a Successful RFI	6-3
6.3.7 Planning the Submittal Sequence	6-4
6.3.8 Creating the Placing Drawing Submittal	6-4
6.3.9 Revising the Returned Placing Drawings	6-5
6.3.10 Tracking Revisions	6-5

6.3.11	Creating the Bar Lists	6-5
6.3.12	Conclusion	6-6
6.4	Placing Drawings	6-6
6.4.1	Introduction	6-6
6.4.2	Placing Drawing Content	6-6
6.4.3	Placing Drawing Sizes and Scales	6-6
6.4.4	Placing Drawing Layout	6-7
6.4.5	Placing Drawing Presentation	6-8
6.4.6	Placing Drawing Minimum Requirements	6-10
6.5	Miscellaneous Detailing Practices	6-11
6.5.1	Sharing of CAD Files	6-11
6.5.2	Correctly Using Bar Diameter when Detailing	6-11
6.5.3	Correctly Using Concrete Cover when Detailing	6-12
6.5.4	Lap Splices	6-12
6.5.5	Typical Bend Shapes, Measuring Points, Fabrication Tolerances and Standard Hooks	6-12
6.5.5.1	Typical Bend Shapes, Measuring Points and Fabrication Tolerances	6-12
6.5.5.2	Standard Hooks	6-13
6.5.6	Recommendations for Location of First and Last Bar	6-13
6.5.7	Detailing for Constructability – Confined Bars Terminating with Hook(s)	6-23
6.5.8	Temperature-Shrinkage Reinforcement	6-23
6.5.9	Precast Work	6-24
6.5.10	Post-Tensioned Work	6-24
6.5.11	Masonry Reinforcement	6-24
6.5.12	Bar Supports	6-24
6.5.13	Placing Facilitation	6-24
6.5.14	Metric Reinforcing Bar Detailing	6-25
6.6	Detailing for Specialty Reinforcing Bars	6-25
6.6.1	Uncoated Carbon Steel Reinforcing Bars	6-25
6.6.2	Epoxy-Coated Reinforcing Bars	6-25
6.6.3	Galvanized Reinforcing Bars	6-25
6.6.4	Dual-Coated Reinforcing Bars	6-26
6.6.5	Stainless-Steel Reinforcing Bars	6-26
6.6.6	Low-Carbon, Chromium Reinforcing Bars	6-26
6.7	3D Modeling and BIM	6-26
6.7.1	Introduction to Building Information Modeling	6-26
6.7.2	Level of Development (LOD)	6-26
6.7.3	Benefits of BIM	6-27
6.7.4	IFC Files and BIM File Transfers	6-27
6.7.5	State of the Technology	6-27

Chapter 7

Recommended Industry Practices for Fabrication of Concrete Reinforcing Steel 7-1

7.1	Introduction	7-1
7.2	Typical Bend Shapes	7-1
7.3	Guidelines for Typical Bend Shapes	7-9
7.3.1	Categories of Bend Shapes	7-9
7.3.2	Bend Class	7-13
7.3.3	Dimensions of Bend Shapes	7-13
7.3.4	Bend Shape Names	7-13
7.3.5	Leg Names / Dimensions for Bend Shapes	7-13
7.3.6	Complete and Partial Bend Shapes	7-14
7.3.7	Standard Hooks	7-15
7.4	Bend Diameters	7-15
7.4.1	General Information on Bend Diameters	7-15
7.4.2	Bend Diameter Requirements Comparison	7-16
7.4.3	Special Bend Diameter Requirements for Galvanized Reinforcing Bars	7-16
7.4.4	Sizing of Bending Pins	7-16
7.4.5	Inspection of Finished Bent Bars	7-16
7.5	Typical Measuring Points	7-17
7.6	Standard Fabricating Tolerances	7-20
7.7	Bend Curvature	7-22
7.8	Special Bend Shapes	7-23
7.9	Bending	7-23
7.10	Quality and Inspection	7-23
7.11	Typical Bundling and Tagging	7-23
7.11.1	Bundles	7-23
7.11.2	Lifts	7-23
7.11.3	Weights of Bundles or Lifts	7-23
7.11.4	Ties	7-23
7.11.5	Tags	7-23
7.12	Special Bundling and Tagging	7-23
7.13	Typical Fabrication	7-23
7.14	Special Fabrication	7-23
7.15	Radial Prefabrication (Bend Type 109)	7-24
7.16	Round Spirals (Bend Types 400 to 405)	7-25
7.16.1	Round Spirals (Bend Types 400 to 402)	7-25
7.16.2	Square Spirals (Bend Types 403 to 405)	7-25
7.17	Shipment Considerations	7-25
7.18	Extra Work or Materials	7-25
7.19	Special Services	7-25
7.20	Special Items	7-26

Contents

7.21 Fabrication for Specialty Reinforcing Bars	7-26
7.21.1 Uncoated Carbon Steel Reinforcing Bars	7-26
7.21.2 Epoxy-Coated Reinforcing Bars	7-26
7.21.3 Galvanized Reinforcing Bars	7-27
7.21.4 Dual-Coated Reinforcing Bars	7-27
7.21.5 Stainless-Steel Reinforcing Bars	7-28
7.21.6 Low-Carbon, Chromium Reinforcing Bar	7-29

Chapter 8

Recommended Industry Practice for Placing Reinforcing Bars 8-1

8.1 Introduction	8-1
8.2 Fusion Welding of Reinforcing Bars	8-1
8.3 Surface Condition of Reinforcing Bars	8-1
8.3.1 Epoxy-Coated, Galvanized or Dual-Coated Reinforcing Bars	8-1
8.3.2 Stainless-Steel Reinforcing Bars	8-1
8.4 Field Re-alignment of Reinforcing Bars	8-1
8.5 Spacing of Reinforcing Bars	8-2
8.6 Splices in Reinforcing Bars	8-2
8.6.1 General	8-2
8.6.2 Lap Splices	8-2
8.6.3 Mechanical Splices	8-2
8.6.3.1 Epoxy-Coated or Dual-Coated Reinforcing Bars	8-2
8.6.3.2 Galvanized Reinforcing Bars	8-2
8.6.3.3 Stainless-Steel Reinforcing Bars	8-2
8.6.3.4 Low-Carbon, Chromium Reinforcing Bars	8-2
8.6.4 Welded Splices	8-2
8.6.4.1 Epoxy-Coated Reinforcing Bars	8-2
8.6.4.2 Galvanized Reinforcing Bars	8-2
8.6.4.3 Dual-Coated Reinforcing Bars	8-3
8.6.4.4 Stainless-Steel Reinforcing Bars	8-3
8.6.4.5 Low-Carbon, Chromium Reinforcing Bars	8-3
8.7 Embedment and Extensions	8-3
8.8 Tolerances in Placement	8-3
8.9 Supports for Reinforcement (Bar Supports)	8-4
8.10 Concrete Protection for Reinforcing Bars	8-4
8.10.1 Cast-In-Place Concrete (nonprestressed)	8-4
8.10.2 Precast Concrete (manufactured under plant control conditions)	8-4
8.10.3 Cast-In-Place (prestressed)	8-5
8.10.4 Corrosive Atmosphere or Severe Exposure	8-5

8.11 Field Cutting of Reinforcing Bars	8-5
8.11.1 Epoxy-Coated or Dual-Coated Reinforcing Bars	8-5
8.11.2 Galvanized Reinforcing Bars	8-5
8.11.3 Stainless-Steel Reinforcing Bars	8-5
8.11.4 Low-Carbon, Chromium Reinforcing Bars	8-5
8.12 Handling and Storage	8-5
8.12.1 Epoxy-Coated or Dual-Coated Reinforcing Bars	8-5
8.12.2 Galvanized Reinforcing Bars	8-6
8.12.3 Stainless-Steel Reinforcing Bars	8-6
8.12.4 Low-Carbon, Chromium Reinforcing Bars	8-6
8.13 Tying	8-6
8.13.1 Epoxy-Coated or Dual-Coated Reinforcing Bars	8-6
8.13.2 Galvanized Reinforcing Bars	8-6
8.13.3 Stainless-Steel Reinforcing Bars	8-6
8.13.4 Low-Carbon, Chromium Reinforcing Bars	8-6
8.14 Field Bending	8-6
8.14.1 Epoxy-Coated or Dual-Coated Reinforcing Bars	8-6
8.14.2 Galvanized Reinforcing Bars	8-7
8.14.3 Stainless-Steel Reinforcing Bars	8-7
8.14.4 Low-Carbon, Chromium Reinforcing Bars	8-7

Chapter 9

Recommended Industry Practice for Contract Components 9-1

9.1 Preface	9-1
9.2 Material Supply Contract	9-1
9.2.1 Project and Location	9-1
9.2.2 Materials and Services	9-1
9.2.3 Price	9-1
9.2.4 Transportation	9-1
9.2.5 Extra Transportation	9-1
9.2.6 Refusal of Shipment by Buyer	9-1
9.2.7 Title Transfer	9-1
9.2.8 Over-Dimensional Material	9-1
9.2.9 Waiting Time	9-1
9.2.10 Terms of Payment	9-2
9.2.11 Delay or Impossibility to Perform	9-2
9.2.12 Testing	9-2
9.2.13 Buyer's Remedies	9-2
9.2.14 Claims	9-2

9.2.15 Taxes	9-2
9.2.16 Warranty	9-2
9.2.17 Unspecified Items	9-2
9.2.18 Acceptance of Offer	9-2
9.2.19 Representations	9-3
9.2.20 Contract Documents	9-3
9.2.21 Penalties	9-3
9.3 Material Supply and Installation Contract	9-3
9.3.1 Preface	9-3
9.3.2 Terms of Payment	9-3
9.3.3 Backcharges	9-3
9.3.4 Project Progress Schedule	9-3
9.3.5 Labor by Others	9-3
9.3.6 Overtime	9-3
9.3.7 Job-site Equipment and Conditions	9-3
9.3.8 Insurance and Bonds	9-3
9.3.9 Hold Harmless	9-4
9.3.10 Delays in Performance	9-4
9.3.11 Arbitration	9-4
9.3.12 Subcontracting	9-4
9.3.13 Acceptance	9-4
9.3.14 Miscellaneous	9-4
9.3.15 Safety Code Citations and Violations	9-4

Chapter 10

Notes on Concrete Joist and Voided Concrete Slab Construction 10-1

10.1 Concrete Joist Construction	10-1
10.1.1 Introduction	10-1
10.1.2 Design	10-1
10.1.3 Joist Forms—Standard Sizes	10-1
10.2 Voided Concrete Slab Construction	10-1
10.2.1 Introduction	10-1
10.2.2 Design	10-2
10.2.3 Voided Slabs—Standard Sizes	10-2
10.2.4 Additional Information	10-2

Chapter 11

Highways and Bridges 11-1

11.1 Introduction	11-1
11.2 Corrosion Protection of the Reinforcement	11-1
11.2.1 Bridges	11-1
11.2.2 Pavements	11-1

11.3 Bridge Decks	11-1
11.3.1 First Bar Placement	11-1
11.3.2 Slabs on Flat Formwork	11-1
11.3.3 Slabs on Corrugated Steel Forms	11-1
11.4 Location and Types of Bar Supports for Bridge Decks	11-1
11.4.1 Bridge Deck Slabs on Flat Formwork	11-1
11.4.2 Bridge Deck Slabs on Permanent Corrugated Steel Forms	11-4
11.5 Bridge Railings, Sidewalks, Barrier Walls, and Medians	11-4
11.6 Bridge Approach Slabs	11-4
11.7 Bridge Abutments	11-4
11.8 Bridge Bents	11-4
11.9 Retaining Walls	11-4
11.10 Sound Walls	11-5
11.11 Sign and Light Pole Foundations	11-5
11.12 Drainage Structures	11-5
11.13 Pavements	11-5
11.13.1 Continuously Reinforced Concrete Pavement (CRCP)	11-5
11.13.2 Jointed Reinforced Concrete Pavement (JRCP)	11-5
11.13.3 Jointed Plain Concrete Pavement (JPCP)	11-5

Chapter 12

Sustainability in Reinforced Concrete 12-1

12.1 Introduction	12-1
12.2 Definition	12-1
12.3 Keys to Reinforced Concrete Sustainability	12-1
12.4 Industry Position	12-1
12.5 Product Category Rules and Environmental Product Declaration	12-2

Appendix A – U.S. Manufacturers of Concrete Reinforcing Bars A-1**Appendix B – Legacy Bar Bends** B-1**Appendix C – Notes on Metrication** C-1**Appendix D – References** D-1**Glossary** G-1**Index** I-1