March 30, 2011

Memorandum to: Members ACI/CIRSI Committee 315 - Details of Concrete Reinforcement

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Richard D. Thomas

From: Anthony L. Felder
Secretary

Subject: Meeting Notice and Agenda
April 3, 2011
Westin Harbour Island
Tampa, Florida

Our next meeting will be held on Sunday, April 3, 2011 from 2:00 p.m. to 5:00 p.m. in the Garrisons Room of the Westin Harbour Island.

A proposed agenda is attached.

Copy to: David J. Bird, TAC Contact
Daniel W. Falconer, ACI Technical Director
AGENDA
ACI/CRSI COMMITTEE 315 - DETAILS OF CONCRETE REINFORCEMENT

April 3, 2011

1. 2:00 p.m. - call meeting to order

2. Approval of minutes of last meeting, October 24, 2010, distributed January 20, 2011

3. Committee membership changes since last meeting. See Exhibit 1, current roster.

4. ACI Detailing Manual (SP-66)
   b. Conference call with ACI Staff concerning SP-66. See Exhibit 3.
   c. Continued discussion on development of “Guide to Details and Detailing of Concrete Reinforcement” - Hall. See Exhibit 4.
   d. Report from Task Group (Hawkinson, Hall, Hunter and Hetherington) on stream-lining the Standard


   Secretary's Note: Subcommittee B is scheduled to meet on Sunday, April 3, 2011 from 8:30 a.m. to 11:30 a.m. in the Salon 1 Room of the Marriott Tampa Waterside.

6. Nuclear Verbatim Compliance
   a. Continue discussion of new hook dimensions. See Exhibit 5.

7. New Business
ACI/CRSI COMMITTEE 315 ROSTER
April 2011

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DRAFT OUTLINE
BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE (ACI 318-14)

CHAPTER 1—GENERAL

1.1 Scope of the code
1.2 General
1.3 Non-conforming systems and approaches

CHAPTER 2—NOTATION AND TERMINOLOGY

2.1 Notation
2.2 Terminology

CHAPTER 3—REFERENCED STANDARDS

3.1 Scope
3.2 ACI standards
3.3 ASTM standards
3.4 Other standards

CHAPTER 4—BUILDING SYSTEMS

4.1 Scope
4.2 General
4.3 Structural concept
4.4 Structural integrity
4.5 Strength
4.6 Serviceability
4.7 Seismic-force-resisting systems
4.8 Prestressed
4.9 Precast
4.10 Concrete-structural steel composite
4.11 Structural plain
4.12 Alternate systems

CHAPTER 5—MATERIAL PROPERTIES FOR DESIGN AND DURABILITY

5.1 Scope
5.2 General
5.3 Concrete properties and cover
5.4 Steel reinforcement properties
CHAPTER 6—LOADS

6.1 Scope
6.2 General
6.3 Load factors and combinations
6.4 Load patterns
6.5 Induced forces

CHAPTER 7—STRUCTURAL ANALYSIS

7.1 Scope
7.2 General
7.3 Modeling assumptions
7.4 Equilibrium-compatibility elasticity methods
7.5 Equilibrium plasticity methods
7.6 Empirical methods

CHAPTER 8—DESIGN METHODS

8.1 Scope
8.2 General
8.3 Sectional strength — axial and flexure
8.4 Sectional strength — flexure
8.5 Sectional strength — one-way shear
8.6 Sectional strength — two-way shear
8.7 Sectional strength — torsion and torsion interaction
8.8 Sectional stress limits — prestressed members
8.9 Member strength — truss analogy
8.10 Empirical methods

CHAPTER 9—ONE-WAY SLABS

9.1 Scope
9.2 General
9.3 Design limits
9.4 Required strength
9.5 Nominal strength
9.6 Minimum reinforcement
9.7 Detailing
9.8 Construction
CHAPTER 10—TWO-WAY SLABS

10.1 Scope
10.2 General
10.3 Design limits
10.4 Required strength
10.5 Nominal strength
10.6 Minimum reinforcement
10.7 Detailing
10.8 Construction

CHAPTER 11—BEAMS

11.1 Scope
11.2 General
11.3 Design limits
11.4 Required strength
11.5 Nominal strength
11.6 Minimum reinforcement
11.7 Detailing
11.8 Construction

CHAPTER 12—COLUMNS

12.1 Scope
12.2 General
12.3 Design limits
12.4 Required strength
12.5 Nominal strength
12.6 Minimum and maximum reinforcement
12.7 Detailing
12.8 Construction

CHAPTER 13—WALLS

13.1 Scope
13.2 General
13.3 Design limits
13.4 Required strength
13.5 Nominal strength
13.6 Minimum and maximum reinforcement
13.7 Detailing
13.8 Construction
# Draft Table of Contents

## CHAPTER 14—FOUNDATIONS

14.1 Scope  
14.2 General  
14.3 One-way shallow foundations  
14.4 Two-way shallow foundations  
14.5 Deep foundations  
14.6 Construction

## CHAPTER 15—OTHER MEMBERS

15.1 Scope  
15.2 General  
15.3 Slab diaphragms  
15.4 Structural trusses  
15.5 Deep beams  
15.6 Coupling beams  
15.7 Tension-dominant members  
15.8 Shear-dominant walls  
15.9 Shear-dominant columns and pedestals  
15.10 Pile caps  
15.11 Shells and folded plate members

## CHAPTER 16—JOINTS AND CONNECTIONS

16.1 Scope  
16.2 Cast-in-place joints  
16.3 Bearing  
16.4 Force transfer across a plane  
16.5 Horizontal shear – composite construction  
16.6 Force transfer between structural steel and concrete in composite columns  
16.7 Precast connections  
16.8 Anchorage to concrete

## CHAPTER 17—EARTHQUAKE-RESISTANT STRUCTURES

17.1 Scope  
17.2 General  
17.3 Ordinary moment frames  
17.4 Intermediate moment frames  
17.5 Intermediate precast structural walls  
17.6 Flexural members of special moment frames  
17.7 Special moment frame members subjected to bending and axial load  
17.8 Joints of special moment frames  
17.9 Special moment frames constructed using precast concrete  
17.10 Special structural walls and coupling beams
17.11 Special structural walls constructed using precast concrete
17.12 Structural diaphragms and trusses
17.13 Foundations
17.14 Members not designated as part of the seismic-force-resisting system

CHAPTER 18—REINFORCEMENT DETAILS

18.1 Scope
18.2 General
18.3 Development
18.4 Splices
18.5 Detailing – one-way slabs
18.6 Detailing – two-way slabs
18.7 Detailing – beams
18.8 Detailing – columns
18.9 Detailing – walls
18.10 Field limits

CHAPTER 19—CONCRETE MATERIALS AND QUALITY ASSURANCE

19.1 Scope
19.2 General
19.3 Materials for concrete
19.4 Proportioning of concrete mixtures
19.5 Evaluation and acceptance of concrete
19.6 Grout for bonded tendons

CHAPTER 20—SPECIFIER REQUIREMENTS

20.1 Scope
20.2 General
20.3 Drawings and specifications
20.4 Testing and inspection
20.5 Formwork
20.6 Reinforcement and embedments
20.7 Concrete mixtures
20.8 Concrete handling, placing, and curing
20.9 Post-tensioned
20.10 Tilt-up
20.11 Precast
20.12 Architectural
20.13 Alternate systems
CHAPTER 21—STRENGTH EVALUATION OF EXISTING STRUCTURES

21.1 Scope
21.2 General
21.3 Determination of required dimensions and material properties
21.4 Load test procedure
21.5 Loading criteria
21.6 Acceptance criteria
21.7 Provision for lower load rating
21.8 Safety
21.9 Strength evaluation of precast construction
Draft plan to revise SP-66 (for discussion purposes only)

1) **Overall assumptions**
   a) Details and Detailing of Concrete Reinforcement to be consistent with the ACI 318-14 Code.
   b) Details and Detailing of Concrete Reinforcement will be a Guide for individuals who create design drawings, and for those who check related shop drawings.
   c) The ACI Detailing Manual will cover cast-in-place concrete building detailing only.
   d) CRSI Bar Detailing Guide will be with a guide for individuals who create shop drawings.

2) **What is in the revised manual?**
   a) Part 1 - Discussion and guidance on detailing
      i) Rules of thumb for cost savings regarding installation, simplicity, and repetitiveness.
      ii) Guidance on how to avoid problems, such as interference at joints and connections.
      iii) Reasoning behind why certain details are best in certain conditions. This should help us cover "other" structural elements that many engineers ask questions about – stairs, wall corners, etc.
   b) Part 2 – Show by example
      i) Develop/choose a standard column grid that can be constructed by several frame types.
      ii) A 20 x 30 foot column grid layout may be best.
      iii) Assumed design information for detailing members
         (1) Moment, shear, and torsion envelopes, along with related $A_v$ and $A_s/s$ along the member
         (2) Material and geometry, such as $f_y$, $f_c$, $b_w$, $h$, $c_o$, and end conditions
         (3) For PT beams and slabs, required PT force and limits of profile
      iv) Building framing types (1) through (6) will be presented:
         (1) Joist – conventional reinforcement only
         (2) Pan-joist – conventional reinforcement only
         (3) Flat-slab – conventional reinforcement only
         (4) Flat-plate – PT reinforcement only
         (5) Beam and girder – both conventional and PT
         (6) Bearing wall – both conventional and PT slab systems
   v) Building lateral force resisting systems (1) and (2) will be presented:
      (1) Moment frames
         (a) Ordinary
         (b) Intermediate
         (c) Special
      (2) Shear walls
         (a) Ordinary
         (b) Intermediate
         (c) Special
   vi) Common members (1) through (4) will be presented:
      (1) Foundations (shallow only)
      (2) Columns
      (3) Walls
      (4) Transfer girders
   vii) Typical details and schedules
Good Evening Everyone,

I wanted to take an opportunity to follow up on the status of Part B and C of the manual re-write. Part A, which will remain an ACI standard document (with mandatory language), is being coordinated by Dennis Hunter.

Based on the last few meetings, I have the following volunteer / chapter assignments noted:

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<th>Volunteer(s)</th>
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<td>7 - Supports for Reinforcing Bars</td>
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<td>8 - Mechanical Splices (Couplers) for Reinforcing Bars</td>
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<td>9 - Welded Wire Reinforcement</td>
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<td>10 – Foundations</td>
<td>Dick Birley and Condor</td>
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<td>11 – Walls</td>
<td>Todd Hawkinson</td>
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<td>12 – Columns</td>
<td>Robbie Hall / Chris Perry</td>
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<td>13 – Beams</td>
<td>Robbie Hall / Chris Perry</td>
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<tr>
<td>14 – One Way Slabs</td>
<td>Todd Hawkinson</td>
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<tr>
<td>15 – Two Way Slabs</td>
<td>James Lai – Draft provided</td>
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<td>19 – Earthquake Resistant Structures</td>
<td>James Lai – Draft provided</td>
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<td>20 – Structures with Post Tensioning Applications</td>
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<td>21 – Bridges and Highway Structures</td>
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I know we don’t have a whole lot of time before our next meeting, but I was hoping we could each do our best to establish a rough outline (similar to the column example provided) for our assigned chapter(s) for our discussions in Tampa. Once we agree on the outlines, we can continue working on content, references, details, etc. If you see a chapter that isn’t assigned, but catches your interest, please let me know.

I have attached the lastest version of the re-write outline and the chapter format documents for your reference.
Thanks in advance. I hope to see you in a few weeks.

**Robbie Hall**  
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**CMC Rebar**  
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Details and Detailing of Concrete Reinforcement  
(ACI 315-xx)  

Reported by ACI Committee 315  

Introduction  

PART A – ACI 315 Standard  

1. General  
   a. Scope  
   b. Purpose  
   c. Relationship other ACI committees  

2. Notation and Terminology  
   a. Scope  
   b. Notation  
   c. Terminology  

3. Responsibilities  
   a. Designer (Architect / Engineer)  
      i. General  
      ii. Scope  
      iii. Procedure  
      iv. Drawing requirements and standards  
      v. Recommendations  
      vi. How to avoid ambiguity and misunderstanding  
   b. Reinforcing Bar Detailer  
      i. General  
      ii. Scope  
      iii. Procedure  
      iv. Drawing requirements and standards  
      v. Recommendations  
      vi. How to avoid ambiguity and misunderstanding  
   c. Reinforcing Bar Fabrication Shop  

4. Standards of Practice  
   a. General  
   b. Tolerances  
   c. Concrete cover  
   d. Bar lengths  
   e. Hooks and bends  
   f. Development and splices of reinforcing steel  
   g. Corrosion resistant coatings for reinforcing steel  
   h. Fabrication standards  

5. References  
   a. Referenced standards (ACI, ASTM)  
   b. Cited references  
   c. Referenced recommendations (CRSI)  
   d. Cited recommendations
PART B – Guide to Details and Detailing of Concrete Reinforcement

6. CAD, 3D Modeling and BIM
   a. CAD Detailing
   b. 3D Modeling
   c. BIM

7. Supports for Reinforcing Bars
   a. General information
   b. Types
   c. Application
   d. Detailing
   e. Placing

8. Mechanical Splices (Couplers) for Reinforcing Bars
   a. General information
   b. Types
   c. Application
   d. Detailing
   e. Placing

9. Welded Wire Reinforcement
   a. General information
   b. Types
   c. Laps
   d. Detailing
   e. Application
   f. Placing

10. Foundations (to be separated and organized into individual members at a later date)
    a. Design
       i. ACI 318 requirements related to reinforcing
       ii. Recommendations (including design drawing minimum requirements)
       iii. Typical details
    b. Detailing
       i. Recommendations (including placing drawing minimum requirements)
       ii. Application of ACI 318 requirements
       iii. Typical details

11. Walls
    a. Design
       i. ACI 318 requirements related to reinforcing
       ii. Recommendations (including design drawing minimum requirements)
       iii. Typical details
    b. Detailing
       i. Recommendations (including placing drawing minimum requirements)
       ii. Application of ACI 318 requirements
       iii. Typical details
12. Columns
   a. Design
      i. ACI 318 requirements related to reinforcing
      ii. Recommendations (including design drawing minimum requirements)
      iii. Typical details
   b. Detailing
      i. Recommendations (including placing drawing minimum requirements)
      ii. Application of ACI 318 requirements
      iii. Typical details

13. Beams
   a. Design
      i. ACI 318 requirements related to reinforcing
      ii. Recommendations (including design drawing minimum requirements)
      iii. Typical details
   b. Detailing
      i. Recommendations (including placing drawing minimum requirements)
      ii. Application of ACI 318 requirements
      iii. Typical details

14. One Way Slabs
   a. Design
      i. ACI 318 requirements related to reinforcing
      ii. Recommendations (including design drawing minimum requirements)
      iii. Typical details
   b. Detailing
      i. Recommendations (including placing drawing minimum requirements)
      ii. Application of ACI 318 requirements
      iii. Typical details

15. Two Way Slabs
   a. Design
      i. ACI 318 requirements related to reinforcing
      ii. Recommendations (including design drawing minimum requirements)
      iii. Typical details
   b. Detailing
      i. Recommendations (including placing drawing minimum requirements)
      ii. Application of ACI 318 requirements
      iii. Typical details

16. Other Members
   a. Deep Beams
   b. Corbels
   c. Pedestals
PART C – Guide to Details and Detailing of Special Structures

17. Water Treatment and Waste Water Treatment Plants
   a. Design
   b. Detailing

18. Nuclear Structures
   a. Design
   b. Detailing

19. Earthquake Resistant Structures
   a. Design
   b. Detailing

20. Structures with Post-Tensioning Applications
   a. Design
   b. Detailing

21. Bridges and Highway Structures
   a. Design
   b. Detailing

PART D – Supporting Information

22. Glossary

23. Notations and Abbreviations

24. Appendix
   a. Design reference information
      i. Figures and Tables
   b. Detailing reference information
      i. Figures and Tables
CHAPTER X – ELEMENT DESCRIPTION

X.1 – Structural Drawing Recommendations
X.2 – Placing Drawing Recommendations
X.3 – Details and Detailing of Reinforcement
  X.3.1 –
    X.3.1.1 –
    Etc.
  X.3.2 –
    X.3.2.1 –
    Etc.
  X.3.3 –
    X.3.3.1 –
    Etc.
Example 2:

CHAPTER 11 – COLUMNS

11.1 – Structural Drawing Recommendations
11.2 – Placing Drawing Recommendations
11.3 – Details and Detailing of Reinforcement
   11.3.1 – Longitudinal (vertical) bars
      11.3.1.1 – General
      11.3.1.2 – Offset Bars
      11.3.1.3 - Splicing
      11.3.1.4 – Minimum reinforcement
      11.3.1.5 – Maximum reinforcement
      11.3.1.6 – Offset between column faces
      11.3.1.7 – Changing bar arrangements between floors
   11.3.2 – Ties
      11.3.2.1 – General
      11.3.2.2 – Bar size
      11.3.2.3 – Spacing
      11.3.2.4 – Arrangements
      11.3.2.5 – Location
      11.3.2.6 – Ties at anchor bolts
   11.3.3 – Spirals
      11.3.3.1 – General
      11.3.3.2 – Turns top and bottom
      11.3.3.3 – Splicing
      11.3.3.4 – Pitch
      11.3.3.5 – Spacers
      11.3.3.6 – Location
      11.3.3.7 – Limitations
### ACI 318

<table>
<thead>
<tr>
<th>BAR SIZE</th>
<th>NOMINAL DIAMETER (in.)</th>
<th>FINISHED BEND DIAMETER (in.)</th>
<th>90° STD</th>
<th>180° STD</th>
<th>FINISHED BEND DIAMETER STIRRUP (in.)</th>
<th>90° STIRRUP</th>
<th>135° STIRRUP HOOKS</th>
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<tr>
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<td></td>
<td></td>
<td>A or G</td>
<td>A or G</td>
<td>D°</td>
<td>A or G</td>
<td>H (in.) (Approx.)</td>
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<td>0-2 1/2</td>
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<td>0-5 1/4</td>
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<td>0-7 1/2</td>
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<td>0-8</td>
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<td>3-0</td>
<td>1-11 1/4</td>
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</table>

**NOTE:** 1. OTHER SEISMIC HOOKS ARE THE SAME AS 135° STIRRUP HOOKS
2. hook° = 4db° + D/2 + db (4db° = min 2.5°)
3. hook°° = 6db°° + D°/2 + db (only for seismic 6db°° = min 3°)
Mission

- Prepare new and update existing CRSI and ACI documentation in response to Nuclear Verbatim Compliance
- Continue our involvement with ACI 315
Goals

**Actions**
- Update the way we describe fabrication tolerances
- Standardize and clearly illustrate bend shape measuring points
- Review and finalize ACI 315’s recommendations for bend shape guidelines

**Results**
- Produce a CRSI Tech Note
- Coordinate revisions and additions to CRSI and ACI publications
ACI 315 Recommendations for Bend Shape Guidelines

- Address Typical Bends vs. Special Bends
- Define guidelines for:
  - Naming convention for bend shapes
  - Naming convention for bend shape legs
  - Rules for bend shapes
  - General “housekeeping” for bend shapes in current publications
    - Additions, modifications, etc.
    - Address inconsistencies
<table>
<thead>
<tr>
<th>Size</th>
<th>Diameter</th>
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<tr>
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<td>+/- 1/2&quot;</td>
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<td>+/- 1/2&quot;</td>
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<td>#5</td>
<td>+/- 1/2&quot;</td>
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<td>+/- 1/2&quot;</td>
</tr>
<tr>
<td>#8</td>
<td>+/- 1/2&quot;</td>
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- Not Recommended
- Not Available
<table>
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<tr>
<th>Condition</th>
<th>Illustrations</th>
<th>#3 thru #11</th>
<th>#14</th>
<th>#18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight bar</td>
<td></td>
<td>+/- 1&quot;</td>
<td>+/- 2&quot;</td>
<td>+/- 2&quot;</td>
</tr>
<tr>
<td>Bent leg</td>
<td></td>
<td>+/- 1&quot;</td>
<td>+/- 2½&quot;</td>
<td>+/- 3½&quot;</td>
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<tr>
<td>Rise/Run of a Bounded Sloping Leg</td>
<td></td>
<td>+0, -1/2&quot;</td>
<td>+/- 2½&quot;</td>
<td>+/- 3½&quot;</td>
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<tr>
<td>Rise/Run of a Free Sloping Leg</td>
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<td>+/- 1&quot;</td>
<td>+/- 2½&quot;</td>
<td>+/- 3½&quot;</td>
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<tr>
<td>Out to out of multiple legs and/or Rise/Runs</td>
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<td>+/- 1&quot;</td>
<td>+/- 2½&quot;</td>
<td>+/- 3½&quot;</td>
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<tr>
<td>Bounded Radius</td>
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<td>+/- 1&quot;</td>
<td>+/- 2½&quot;</td>
<td>+/- 3½&quot;</td>
</tr>
<tr>
<td>Radius</td>
<td></td>
<td>+/- 1&quot;</td>
<td>+/- 2½&quot;</td>
<td>+/- 3½&quot;</td>
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</table>

<table>
<thead>
<tr>
<th>Condition</th>
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<th>#14</th>
<th>#18</th>
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</thead>
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<td>+/- 2½&quot;</td>
<td>+/- 3½&quot;</td>
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<tr>
<td>Chord</td>
<td></td>
<td>+ 1.5% x O,</td>
<td>+/- 2 1/2&quot; min</td>
<td>+/- 2.0% x O,</td>
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<tr>
<td></td>
<td></td>
<td>+/- 2 1/2&quot; min</td>
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<td>+/- 3 1/2&quot; min</td>
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<tr>
<td>180° Hook Depth 1</td>
<td></td>
<td>+/- 1/2&quot;</td>
<td>+/- 1½&quot;</td>
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<td>90° Hook Length A or G</td>
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<td>+/- 2½&quot;</td>
<td>+/- 3½&quot;</td>
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<td></td>
<td>See Stirrup and Tie</td>
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</table>

Truss Bar Overall Length                        |               | +/- 1"      | Not Applicable |
| Truss Bar Height                               |               | +0, -1/2"   | Not Applicable |

---

Proposed Tolerance

ACI 117  Tolerance for Concrete Construction - Section 2.1
<table>
<thead>
<tr>
<th>Condition</th>
<th>Illustrations</th>
<th>#3 thru #5</th>
<th>#6 thru #8</th>
</tr>
</thead>
<tbody>
<tr>
<td>90° Bent leg (Bounded or Unbounded)</td>
<td></td>
<td>+/- 1/2&quot;</td>
<td>+/- 1&quot;</td>
</tr>
<tr>
<td>Rise/Run of a Sloping Leg (Bounded or Unbounded)</td>
<td></td>
<td>+/- 1/2&quot;</td>
<td>+/- 1&quot;</td>
</tr>
<tr>
<td>Hoop Diameter</td>
<td></td>
<td>+/- 1/2&quot;</td>
<td>+/- 1/2&quot;</td>
</tr>
<tr>
<td>135° Hook Depth</td>
<td></td>
<td>+/- 1/2&quot;</td>
<td>+/- 1/2&quot;</td>
</tr>
<tr>
<td>90° Hook Length</td>
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<td>+/- 1/2&quot;</td>
<td>+/- 1/2&quot;</td>
</tr>
<tr>
<td>Standee Height</td>
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<td>+/- 1/2&quot;</td>
<td>+/- 1&quot;</td>
</tr>
<tr>
<td>Lap Length</td>
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</tbody>
</table>

*Proposed Tolerance*

*ACI 117 Tolerance for Concrete Construction - Section 2.1*
Measuring Points

- Measuring point

Vertical or Horizontal

Square
180 Hook Measuring Points

- Measuring point

Vertical or Horizontal
90 Hook Measuring Points

- Measuring point

**Extension(s):**
- 12 db Standard Bends
- 12 db Stirrup Bends #6 thru #8
- 6 db Stirrup Bends #3 thru #5

_Vertical or Horizontal_
135 Hook Measuring Points

- Measuring point

Vertical / Horizontal
Measuring Points

- Measuring point

**Sloping**

- \( H \) Rise
- \( K \) Run
- Leg Name
Measuring Points

Acute Sloping

Obtuse Sloping

K Run

Leg Name

H Rise

Measuring point
90 Hook Measuring Points

- Measuring point

**Extension(s):**
- 12 db Standard Bends
- 12 db Stirrup Bends #6 thru #8
- 6 db Stirrup Bends #3 thru #5

**Obtuse Sloping**
180 Hook Measuring Points

- Measuring point

Obtuse Sloping
135 Hook Measuring Points

- Measuring point

- Hook

- 6db or 3” Min.

- Leg Name

- H1 Rise

- K Run
Radial Measuring Points

- K Chord
- Leg name
- Partial Circle
- Chord Height
- Full Circle
- Diameter
- Measuring point