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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.
How do you specify and ensure a quality steel project? The answer is in Chapter N. Chapter N has been a part of the AISC Specification for Structural Steel Buildings (ANSI/AISC 360) since 2010. Why was this added to the AISC Specification? Are these new quality requirements for fabrication and erection? What is the difference between Quality Control (QC) and Quality Assurance (QA)? How does this relate to the International Building Code (IBC)? This session will try to address these burning questions that you may have. In addition, do statistics show how a quality program is functioning while increasing productivity? The answers may surprise you.

### Session Description

- **18.8 Quality Control and Quality Assurance**
- **December 10, 2018**

How do you specify and ensure a quality steel project? The answer is in Chapter N. Chapter N has been a part of the AISC Specification for Structural Steel Buildings (ANSI/AISC 360) since 2010. Why was this added to the AISC Specification? Are these new quality requirements for fabrication and erection? What is the difference between Quality Control (QC) and Quality Assurance (QA)? How does this relate to the International Building Code (IBC)? This session will try to address these burning questions that you may have. In addition, do statistics show how a quality program is functioning while increasing productivity? The answers may surprise you.

### Learning Objectives

- Describe the links between construction quality and building safety, serviceability and value pertaining to structural steel buildings.
- Describe how Chapter N supports effective methods in order to achieve greater uniformity in quality of structural steel construction.
- Describe the scope of the Chapter N provisions and their relationship to requirements in related codes and standards.
- Describe how a quality program can achieve building safety and increase productivity.
Night School 18

18.1 Introduction to the Steel Construction Process
18.2 The Manufacturing of Structural Steel Shapes
18.3 A Virtual, Detailed Tour of the Steel Fabrication Process
18.4 Connection Design as the Fabricator’s Representative
18.5 It Doesn’t Get Built Without the Erector
18.6 Erection Engineering – Stability During Construction
18.7 Field Fixes and Solutions
18.8 Quality Control and Quality Assurance

AISC Specification For Steel Buildings
AISC 360

- Chapter A – General Provisions
- Chapter B – Design Requirements
- Chapter C – Design for Stability
- Chapter D – Design of Members for Tension
- Chapter E – Design of Members for Compression
- Chapter F – Design of Members for Flexure
- Chapter G – Design of Members for Shear
- Chapter H – Design of Members for Combined Forces and Torsion
- Chapter I – Design of Composite Members
- Chapter J – Design of Connections
- Chapter K – Additional Requirements for HSS and Box Section Connections
- Chapter L – Design for Serviceability
- Chapter M – Fabrication and Erection
- Chapter N – Quality Control and Quality Assurance

The Plan for Today:

Part One:
Demystifying Chapter N and the Building Code

Part Two:
Applying Chapter N and Statistical Improvement
Demystifying Chapter N and the Building Code

Part 1

Chapter N
- Why was this added to the AISC Specification?
- What is the source of these quality requirements for fabrication and erection?
- What is the difference between Quality Control (QC) and Quality Assurance (QA)?
- What does Perform (P) and Observe (O) mean?
- How does this relate to the International Building Code (IBC)?

Typical Inspection Process

Chapter N
- Why was this added to the AISC Specification?
Why was this added to the AISC Specification?
- Provide guidance of items to be listed as special inspection items
- Assure consistent quality of structural steel
  - Fabrication
  - Erection
- Require documented quality program from all Fabricators & Erectors

Why was this added to the AISC Specification?

Background

Building Code Requirements

- 2009 IBC Special Inspection requirements (Chapter 17) - 20 pages with significant references to outside documents

Typical Special Inspection List

<table>
<thead>
<tr>
<th>Verification and Inspection</th>
<th>Continuous</th>
<th>Periodic</th>
<th>Reference</th>
<th>AISC Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material fabrication</td>
<td>X</td>
<td></td>
<td></td>
<td>AISC 360, Section 6.9.13</td>
</tr>
<tr>
<td>Member fabrication</td>
<td></td>
<td></td>
<td>AISC 360, Section 6.9.13</td>
<td></td>
</tr>
<tr>
<td>Structural steel (10 ft above base)</td>
<td>X</td>
<td></td>
<td></td>
<td>AISC 360, Section 6.9.13</td>
</tr>
<tr>
<td>Structural steel (10 ft above base)</td>
<td></td>
<td></td>
<td>AISC 360, Section 6.9.13</td>
<td></td>
</tr>
<tr>
<td>Structural steel (10 ft above base)</td>
<td>X</td>
<td></td>
<td></td>
<td>AISC 360, Section 6.9.13</td>
</tr>
<tr>
<td>Structural steel (10 ft above base)</td>
<td></td>
<td></td>
<td>AISC 360, Section 6.9.13</td>
<td></td>
</tr>
</tbody>
</table>
| Typical Special Inspection List

<table>
<thead>
<tr>
<th>Item</th>
<th>Verification</th>
<th>AISC Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td>AISC 360, Section 6.9.13</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>AISC 360, Section 6.9.13</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>AISC 360, Section 6.9.13</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>AISC 360, Section 6.9.13</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>AISC 360, Section 6.9.13</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>AISC 360, Section 6.9.13</td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td>AISC 360, Section 6.9.13</td>
</tr>
<tr>
<td>8.</td>
<td></td>
<td>AISC 360, Section 6.9.13</td>
</tr>
<tr>
<td>9.</td>
<td></td>
<td>AISC 360, Section 6.9.13</td>
</tr>
<tr>
<td>10.</td>
<td></td>
<td>AISC 360, Section 6.9.13</td>
</tr>
</tbody>
</table>

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### Typical Special Inspection List

#### Special Inspection Requirements - Steel Construction

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
<th>Frequency</th>
<th>Responsible Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Building Material</td>
<td>X</td>
<td>AISC</td>
</tr>
<tr>
<td>2.</td>
<td>Structural Connection</td>
<td>X</td>
<td>AISC</td>
</tr>
<tr>
<td>3.</td>
<td>Welding Inspection</td>
<td>X</td>
<td>AISC</td>
</tr>
<tr>
<td>4.</td>
<td>Fabrication</td>
<td>X</td>
<td>AISC</td>
</tr>
<tr>
<td>5.</td>
<td>Installation</td>
<td>X</td>
<td>AISC</td>
</tr>
<tr>
<td>6.</td>
<td>Inspection</td>
<td>X</td>
<td>AISC</td>
</tr>
</tbody>
</table>

**SCOPE OF SERVICE**
- AISC: American Institute of Steel Construction

**REFERENCES**
- AISC 360-16

---

### Typical Special Inspection List

#### SCHEDULE OF SPECIAL INSPECTORS PER REQUIREMENT OF CHAPTER 17: STRUCTURAL TESTS AND SPECIAL INSPECTIONS; ASCE 2016

**MATERIALS**
- AISC: American Institute of Steel Construction

**REFERENCES**
- ASCE 2016

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Typical Special Inspection List

Many References Required

Why was this added to the AISC Specification?
- Provide guidance of items to be listed as special inspection items
- Assure consistent quality of structural steel
  - Fabrication
  - Erection
- Require documented quality program from all Fabricators & Erectors
Why was this added to the AISC Specification?

- Provide guidance of items to be listed as special inspection items
- Assure consistent quality of structural steel
  - Fabrication
  - Erection
- Require documented quality program from all Fabricators & Erectors

Chapter N

What is the source of these quality requirements for fabrication and erection?
What is the source of these quality requirements for fabrication and erection?

TABLE N5.4-1
Inspection Tasks Prior to Welding

<table>
<thead>
<tr>
<th>Inspection Tasks Prior to Welding</th>
<th>QC</th>
<th>GA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welder qualification records and continuity records</td>
<td>P</td>
<td>O</td>
</tr>
<tr>
<td>WPS available</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Manufacturer certifications for welding consumables available</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Material identification (type/grade)</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Welder identification system(\text{E})</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Fit-up of groove welds (including joint geometry)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Joint preparations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Dimensions (alignment, root opening, root face, bevel)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Cleanliness (condition of steel surfaces)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Tack weld quality and location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Backing type and fit (if applicable)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What is the source of these quality requirements for fabrication and erection?

TABLE N5.4-2
Inspection Tasks During Welding

<table>
<thead>
<tr>
<th>Inspection Tasks During Welding</th>
<th>QC</th>
<th>GA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control and handling of welding consumables</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>• Packaging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Exposure control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No welding over cracked task welds</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Environmental conditions</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>• Wind speed within limits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Precipitation and temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WPS followed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Settings on welding equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Travel speed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Selected welding materials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Shielding gas type/flow rate</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What is the source of these quality requirements for fabrication and erection?

TABLE N5.4-3
Inspection Tasks After Welding

<table>
<thead>
<tr>
<th>Inspection Tasks After Welding</th>
<th>QC</th>
<th>GA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welds cleaned</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Size, length and location of welds</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Welds meet visual acceptance criteria</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Crack prohibition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Weld/base metal fusion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Crater across section</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Weld profiles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Weld size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Undercut</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Porosity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc strikes</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>a-area(\text{E})</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What is the source of these quality requirements for fabrication and erection?

TABLE C-N5.4-1
Reference to AWS D1.1/D1.1M (AWS, 2015) Clauses for Inspection Tasks Prior to Welding

<table>
<thead>
<tr>
<th>Inspection Tasks Prior to Welding</th>
<th>Clauses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welding procedure specifications (WPS) available</td>
<td>6.3</td>
</tr>
<tr>
<td>Manufacturer certifications for welding consumables available</td>
<td>6.2</td>
</tr>
<tr>
<td>Material identification (type/grade)</td>
<td>6.2</td>
</tr>
<tr>
<td>Welder identification system</td>
<td>6.4</td>
</tr>
<tr>
<td>(identification system not required by AWS D1.1/D1.1M)</td>
<td></td>
</tr>
</tbody>
</table>
What is the source of these quality requirements for fabrication and erection?

TABLE C-N5.4-2
Reference to AWS D1.1/D1.1M (AWS, 2015) Clauses for Inspection Tasks During Welding

<table>
<thead>
<tr>
<th>Inspection Tasks During Welding</th>
<th>Clauses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of qualified welders</td>
<td>6.4</td>
</tr>
<tr>
<td>Control and handling of welding consumables</td>
<td>6.2</td>
</tr>
<tr>
<td>• Precautions</td>
<td>5.3.1</td>
</tr>
<tr>
<td>• Exposure control</td>
<td>5.3.2 (for SMAW), 5.3.3 (for SAW)</td>
</tr>
<tr>
<td>No welding over cracked tack welds</td>
<td>5.17</td>
</tr>
<tr>
<td>Environmental conditions</td>
<td>5.11.1</td>
</tr>
<tr>
<td>• Wind speed within limits</td>
<td>5.11.2</td>
</tr>
<tr>
<td>• Precipitation and temperature</td>
<td></td>
</tr>
<tr>
<td>WPS followed</td>
<td>6.3.3, 6.5.2, 5.5, 5.20</td>
</tr>
<tr>
<td>• Settings on welding equipment</td>
<td></td>
</tr>
<tr>
<td>• Travel speed</td>
<td></td>
</tr>
<tr>
<td>• Selected welding materials</td>
<td></td>
</tr>
<tr>
<td>• Shielding gas type/flow rate</td>
<td></td>
</tr>
</tbody>
</table>

What is the source of these quality requirements for fabrication and erection?

TABLE N5.6-1
Inspection Tasks Prior to Bolting

<table>
<thead>
<tr>
<th>Inspection Tasks Prior to Bolting</th>
<th>QC</th>
<th>QA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer's certifications available for fastener materials</td>
<td>O</td>
<td>P</td>
</tr>
<tr>
<td>Fasteners marked in accordance with ASTM requirements</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Correct fasteners selected for the joint detail (grade, type, bolt length if threads are to be excluded from shear plane)</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Correct bolting procedure selected for joint detail</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Connecting elements, including the appropriate faying surface condition and hole preparation, if specified, meet applicable requirements</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

What is the source of these quality requirements for fabrication and erection?

TABLE C-N5.6-1
Reference to RCSC Specification (RCSC, 2014) Sections for Inspection Tasks Prior to Bolting

<table>
<thead>
<tr>
<th>Inspection Tasks Prior to Bolting</th>
<th>Sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer's certifications available for fastener materials</td>
<td>2.1, 9.1</td>
</tr>
<tr>
<td>Fasteners marked in accordance with ASTM requirements</td>
<td>Pages 2.3.1, 9.1 (also see ASTM standards)</td>
</tr>
<tr>
<td>Correct fasteners selected for the joint detail (grade, type, bolt length if threads are to be excluded from shear plane)</td>
<td>2.3.2, 2.7.2, 9.1</td>
</tr>
<tr>
<td>Correct bolting procedure selected for joint detail</td>
<td>4, 8</td>
</tr>
<tr>
<td>Connecting elements, including the appropriate faying surface condition and hole preparation, if specified, meet applicable requirements</td>
<td>3, 9.1, 9.3</td>
</tr>
<tr>
<td>Pre-installation verification testing by installation</td>
<td></td>
</tr>
</tbody>
</table>

How are these Inspection Tasks Performed?

TABLE N5.4-1
Inspection Tasks Prior to Welding

<table>
<thead>
<tr>
<th>Inspection Tasks Prior to Welding</th>
<th>QC</th>
<th>QA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welder qualification records and continuity records</td>
<td>P</td>
<td>D</td>
</tr>
<tr>
<td>WPS available</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Manufacturer certifications available for welding consumables</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Material identification (type/grade)</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Welder identification system</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Pin-up of groove welds (including joint geometry)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Joint preparations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Dimensions (alignment, root opening, root face, bevel)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Cleanliness (condition of steel surfaces)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Tackling tack weld quality and location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Backing type and fit (if applicable)</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>
Fit-up of Groove Welds

How are these Inspection Tasks Performed?

### TABLE N5.4-2
Inspection Tasks During Welding

<table>
<thead>
<tr>
<th>Inspection Tasks During Welding</th>
<th>QC</th>
<th>QA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control and handling of welding consumables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Packaging</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>• Exposure control</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>No welding over cracked task welds</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Environmental conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Wind speed within limits</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>• Precipitation and temperature</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>WPS followed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Settings on welding equipment</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>• Travel speed</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>• Selected welding materials</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>• Shielding gas type/flow rate</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

Welding Procedure Specification

Settings on Welding Equipment
How are these Inspection Tasks Performed?

<table>
<thead>
<tr>
<th>Inspection Tasks After Welding</th>
<th>QC</th>
<th>QA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welds cleaned</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Size, length and location of welds</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Welds meet visual acceptance criteria</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Crack penetration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weld/base-metal fusion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coater cross section</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weld profile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weld size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undercut</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Porosity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arc strikes</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>A-grade™</td>
<td>P</td>
<td>P</td>
</tr>
</tbody>
</table>

Weld Size

How are these Inspection Tasks Performed?

<table>
<thead>
<tr>
<th>Inspection Tasks Prior to Bolting</th>
<th>QC</th>
<th>QA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer's certifications available for fastener materials</td>
<td>O</td>
<td>P</td>
</tr>
<tr>
<td>Fasteners marked in accordance with ASTM requirements</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Correct fasteners selected for the joint detail (grade, type, bolt length if threads are to be excluded from shear plane)</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Correct bolting procedure selected for joint detail</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Connecting elements, including the appropriate facing surface condition and hole preparation, if specified, meet applicable requirements</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

Weld Length
Marked with ASTM Requirements

Proper Bolting Procedures

Pre-installation Verification

Pre-installation Verification
SECTION 7. PRE-INSTALLATION VERIFICATION

7.1. Tension Calibrator
A tension calibrator shall be used where bolts are to be installed in pretensioned joints and slip-critical joints to:

(1) Confirm the suitability of the complete fastener assembly, including lubrication, for pretensioned installation; and,

(2) Confirm the procedure and proper use by the bolting crew of the pretensioning method to be used.

Commentary:
Direct tension indicators (DTIs) may be used as tension calibrators, except in the case of turn-of-nut installation. This method is especially useful for, but not restricted to, bolts that are too short to fit into a hydraulic tension calibrator.
Pre-installation Verification

Chapter N

What does Perform and Observe mean?

What does Observe and Perform Mean?

CONTINUOUS - PERIODIC:

IBC 2000, 2003, 2006, SECTION 1702 DEFINITIONS

SPECIAL INSPECTION, CONTINUOUS. The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.

SPECIAL INSPECTION, PERIODIC. The part-time or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work has been or is being performed and at the completion of the work.

What does Observe and Perform Mean?

2009 IBC Section 1702
(Terms different in 2012 & 2015)

- Continuous Inspection
  Special inspection by the special inspector who is present when and where the work to be inspected is being performed.

- Periodic Inspection
  Special inspection by the special inspector who is intermittently present where the work to be inspected has been or is being performed.
What does Observe and Perform Mean?

2012 & 2015 IBC Section 202

- **Continuous Special Inspection**
  Special inspection by the *special inspector* who is present when and where the work to be inspected is being performed.

- **Periodic Special Inspection**
  Special inspection by the *special inspector* who is intermittently present where the work to be inspected has been or is being performed.

What does Observe and Perform Mean?

2012 & 2015 IBC Section 202

- **Continuous**
  - “On-Site”
  - References codes (AWS D1.1)
  - Not every task on every weld.

What does Observe and Perform Mean?

AWS D1.1

6.5.2 Scope of Examinations. The Inspector shall at suitable intervals, observe joint preparation, assembly practice, the welding techniques, and performance of each welder, welding operator, and tack welder to ensure that the applicable requirements of this code are met.

Chapter N labels these Observe.

What does Observe and Perform Mean?

AWS D1.1

6.5.3 Extent of Examination. The Inspector shall examine the work to ensure that it meets the requirements of this code. …Size and contour of welds shall be measured with suitable gages…

Chapter N labels these Perform.
What does Observe and Perform Mean?

N5. Min. Requirements for Inspection of Structural Steel Buildings

- Items necessary for the final acceptance of a weld.
- Based on AWS D1.1 phrase, “shall examine the work” and “size and contour of welds shall be measured”

RCSC

Section 9. Inspection

When inspection is required in the contract documents, the inspector shall ensure while the work is in progress that the requirements in this specification are met.

Chapter N

What is the difference between Quality Control (QC) and Quality Assurance (QA)?


Minimum requirements for quality control, quality assurance and non-destructive testing for structural steel.
What is the difference between QC & QA?

• Quality Control (QC)
  Provided by fabricator and erector.

What is the difference between QC & QA?

• Quality Control (QC)
• Quality Assurance (QA)
  Provided by Others as required by:
  • Authority Having Jurisdiction (AHJ)
  • Applicable Building Code (ABC)
  • Engineer of Record (EOR)
  • Owner

What is the difference between QC & QA?
N2. Fabricator and Erector QC Program

• Procedures and Inspections
  Perform work in accordance with the AISC Specification and the construction documents.
  Inspections must be documented, including non-conformances and corrections implemented.
What is the difference between QC & QA?

N2. Fabricator and Erector QC Program

- Procedures and Inspections
- Material Identification

To comply with *Code of Standard Practice, Section 6.1.*, and monitored by the fabricator’s quality control inspector (QCI).

What is the difference between QC & QA?

N2. Fabricator and Erector QC Program

- Procedures and Inspections
- Material Identification
- Fabricator Quality Control Procedures
  - Shop welding, high-strength bolting and details.
  - Shop cut and finish surfaces.
  - Shop heating for straightening, cambering and curving.
  - Tolerances for shop fabrication.

What is the difference between QC & QA?

N5.1 Quality Control

- Tasks listed in tables.
- Work is performed in accordance with the *construction documents*.
  - Shop Drawings.
  - Erection Drawings.
  - Applicable referenced specifications, codes and standards.

Field inspections similar to shop inspections.
What is the difference between QC & QA?

N5.2 Quality Assurance

- Tasks listed in same tables as QC.
- Work is performed in accordance with the construction documents.
- Design drawings and specifications.

N5.3 Coordinated Inspection

Where same task is to be performed by QC and QA:

- Inspection may be performed by 1 party only, either QCI or QAI.
- If inspection by QCI only, then:
  - Approval by EOR, and
  - Approval by AHJ.

Chapter N

How does this relate to the International Building Code (IBC)?

- QA by Third Party, except NDT, may be waived.
- NDT of welds may be performed by the approved fabricator. NDT can’t be done by an approved erector.
- AISC Certification program or similar program.
- Certificate of compliance required.
How does this relate to IBC?

The 2018 International Building Code (IBC) (ICC, 2018) requirements for special inspection of structural steel states in Section 1705.2.1 that the requirements for Special Inspection are to be performed in accordance with Chapter N of AISC 360.

The 2018 IBC Section 1704.2.5.1 (ICC, 2018) states that:
Special inspections during fabrication are not required where the work is done on the premises of a fabricator approved to perform work without special inspection. Approval shall be based on the review of the fabricator’s written fabrication procedures and quality control manuals that provide a basis for control of materials and workmanship.

Coordinated Inspection Process

[Diagram showing the coordinated inspection process involving Owner, Construction Manager/General Contractor, EOR, Erector (QC/QA), Fabricator (QC/QA), and Inspection Report.]
Chapter N

What is the source of these quality requirements for fabrication and erection?

One new item was added

<table>
<thead>
<tr>
<th>What is the source of these quality requirements for fabrication and erection?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

**TABLE N5.4-1**

<table>
<thead>
<tr>
<th>Inspection Tasks Prior to Welding</th>
<th>QC</th>
<th>QA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welder qualification records and continuity records</td>
<td>F</td>
<td>O</td>
</tr>
<tr>
<td>WPS available</td>
<td>F</td>
<td>P</td>
</tr>
<tr>
<td>Manufacturer certifications for welding consumables available</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>Material identification (type/grade)</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Welder identification system&lt;sup&gt;TM&lt;/sup&gt;</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Follow-up of groove welds (including joint geometry)</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>• Joint preparations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Dimensions (alignment, root opening, root face, bevel)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Cleanliness (condition of steel surfaces)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Tackling (tack weld quality and location)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Backing type and fit (if applicable)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Bolter Identification System

Bolter Identification System

Bolter Identification System

Bolter Identification System
Field Final Inspection

Chapter N - Summation

- Why was this added to the AISC Specification?
  - Provide minimum quality standards for steel construction
  - Assure consistently high quality steel construction

Chapter N - Summation

- What is the source of these quality requirements for fabrication and erection?
  - It is only listing in one location the requirements of other codes such as AWS and RCSC
  - Only the welder identification system was added

Chapter N - Summation

- What is the difference between Quality Control (QC) and Quality Assurance (QA)?
  - QC is provided by the fabricator or erector
  - QA is provided by a third party
  - Coordinated QC & QA is permitted
Chapter N - Summation

- What does Perform (P) and Observe (O) mean?
  - Perform (P) inspections must be done on each joint
  - Observe (O) inspections must be done on a random basis

Chapter N - Summation

- How does this relate to the International Building Code (IBC)?
  - IBC 2018 has referenced AISC Specification (AISC 360) Chapter N as the requirements for Special Inspections for Structural Steel Construction.

Applying Chapter N and Statistical Improvement

Part 2

Quality Management System

Specific procedures written
- Engineering
  - Contract review
  - Document control
  - Drawing preparation
- Sub-con detailing procedures
- RFI procedures
- Drawing issuing
- Drawing changes
- Non-conformance reporting
Quality Management System

Specific procedures written
  • Fabrication
  • Purchasing
  • Subcontracting
  • Material Identification
  • Operation procedures
  • Welding & Bolting procedures
  • Surface preparation & painting procedures
  • In process inspections
  • Final inspections
  • Non-conformance reporting

Quality Management System

Specific procedures written
  • Erection
    • Bolting procedures
    • Welding procedures
    • Site Specific Safety Plan
    • Site Specific Erection Plan
    • Non-conformance reporting

Non-conformance Reporting

Specific procedures written
  • Compiled by engineering
  • Shared with everyone at weekly production meeting
  • Evaluated to determine the root cause
  • Determine if the quality procedure needed to be changed

DOUGLAS STEEL FABRICATING CORPORATION
NONCONFORMANCE REPORT

RECEIVING
JOB NUMBER: 6881
DESCRIPTION OF NONCONFORMANCE: Right end has a 3/4" hole in front hole. Should have been 3" to match the gender
PLACED ON HOLD BY: R&B
PLACED ON HOLD BY: R&B
DATE: 11/4/2012
DATE: 11/4/2012

FABRICATION
JOB NUMBER: 6881
DESCRIPTION OF NONCONFORMANCE: Field weld clips to beams at correct location
PLACED ON HOLD BY: R&B
PLACED ON HOLD BY: R&B
DATE: 11/4/2012
DATE: 11/4/2012

POST DELIVERY
JOB NUMBER: 6881
DESCRIPTION OF NONCONFORMANCE: Field weld clips to beams at correct location
PLACED ON HOLD BY: R&B
PLACED ON HOLD BY: R&B
DATE: 11/4/2012
DATE: 11/4/2012

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American Institute of Steel Construction
DOUGLAS STEEL FABRICATING CORPORATION

NONCONFORMANCE REPORT

RECEIVING
JOB NUMBER: 6001
PO NUMBER: 5705
PLACED ON HOLD BY: RAAS
DATE: 11/12/12
DESCRIPTION OF NONCONFORMANCE: Clip angles at left end of beam were missing (shop)

RESOLUTION: Send clip angles to field
RESOLVED BY: RAAS
DATE: 11/12/12

FABRICATION
JOB NUMBER: 6001
PERC MARK: 80041
PLACED ON HOLD BY: RAAS
DATE: 11/12/12
DESCRIPTION OF NONCONFORMANCE:

RESOLUTION: None
RESOLVED BY: RAAS
DATE: 11/12/12

POST DELIVERY
JOB NUMBER: 6001
PERC MARK: 80041
PLACED ON HOLD BY: RAAS
DATE: 11/12/12
DESCRIPTION OF NONCONFORMANCE: Field Cut frame down, should not have. (elevation)

RESOLUTION: Send new frame to field
RESOLVED BY: RAAS
DATE: 11/12/12

DOUGLAS STEEL FABRICATING CORPORATION

NONCONFORMANCE REPORT

RECEIVING
JOB NUMBER: 6001
PO NUMBER: 5705
PLACED ON HOLD BY: RAAS
DATE: 11/12/12
DESCRIPTION OF NONCONFORMANCE:

RESOLUTION: None
RESOLVED BY: RAAS
DATE: 11/12/12

FABRICATION
JOB NUMBER: 6001
PERC MARK: 80041
PLACED ON HOLD BY: RAAS
DATE: 11/12/12
DESCRIPTION OF NONCONFORMANCE: Beam was detailed with temporary bolted connection for field welding.

RESOLUTION: None
RESOLVED BY: RAAS
DATE: 11/12/12

POST DELIVERY
JOB NUMBER: 6001
PERC MARK: 80041
PLACED ON HOLD BY: RAAS
DATE: 11/12/12
DESCRIPTION OF NONCONFORMANCE: Field weld detail not shown on E- sheet (elevation)

RESOLUTION: Beam field welded after notice because of both parties.

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### Corrective Action Request

**#008**

**Douglas Steel Fabricating Corporation**

**Part #1: Problem**

7 - Detailing, Checking and Shop Drawing. Nonconformance from the month of February. Drawings not prepared in accordance with the project requirements.

**Part #2: Evidence**

- Beam was detailed with temporary bolted connection, and was intended to be field welded to complete the connection. The field weld detail was never cut out on the erection drawings, therefore the beam was never fully welded.

**Originator Signature:**

**Date:** 2/9/11

**Recipient Signature:**

**Date:**

**Notes:** Temporary bolted connection failed when load was induced. EOR was included in discussion on the project.

**Part #3: Correction Action**

- Verifying completion - Made through review of next month's plans.
- Review of drawings and discussions documented in the action.
- Clerk reports completion - Field details completed - Action documented in #3 above.

**Verification by:**

**Date:** 2/9/11

**Comments:**

<table>
<thead>
<tr>
<th>CAR #</th>
<th>Response Due Date</th>
<th>Response Received</th>
<th>Evidence due by</th>
</tr>
</thead>
<tbody>
<tr>
<td>008</td>
<td>2/9/11</td>
<td></td>
<td>2/9/11</td>
</tr>
</tbody>
</table>

---

**Douglas Steel Fabricating Corporation**

**Fabricating Corporation**

**Engineering Standards**

---

**Engineering Standards**

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Location</th>
<th>Controlled Copy</th>
</tr>
</thead>
<tbody>
<tr>
<td>L. Kraft, PE</td>
<td>VP of Engineering, Technology &amp; Safety</td>
<td>Office</td>
<td>CC 1</td>
</tr>
<tr>
<td>S. Heath, PE</td>
<td>Project Manager</td>
<td>Office</td>
<td>CC 2</td>
</tr>
<tr>
<td>M. Reh, PE</td>
<td>Estimator</td>
<td>Office</td>
<td>CC 3</td>
</tr>
<tr>
<td>C. Henn, PE</td>
<td>Checker</td>
<td>Office</td>
<td>CC 4</td>
</tr>
<tr>
<td>D. Ingleson, Detailer</td>
<td>Office</td>
<td>CC 5</td>
<td></td>
</tr>
<tr>
<td>J. Johnson, Detailer</td>
<td>Office</td>
<td>CC 6</td>
<td></td>
</tr>
<tr>
<td>R. Smith, Detailer</td>
<td>Office</td>
<td>CC 7</td>
<td></td>
</tr>
<tr>
<td>T. Black, Detailer</td>
<td>Office</td>
<td>CC 8</td>
<td></td>
</tr>
<tr>
<td>C. Covert, Engineer</td>
<td>Office</td>
<td>CC 9</td>
<td></td>
</tr>
<tr>
<td>Sheet Copy</td>
<td>Engineering</td>
<td>CC 10</td>
<td></td>
</tr>
</tbody>
</table>

The Engineering Standards are approved by:

L. Kraft, PE, VP of Engineering, Technology & Safety
30. When perimeter cable is required at an HSS column or a column with a flange designation greater than 2", provide tabs with holes shop welded to the column to pick up the perimeter cable.

31. Perimeter cable is required at the perimeter of the building along sequence lines, and around any opening not to be dished over.

32. When detailing a member that requires field welding place a section bubble on the section view where the welded joint occurs, noting both the groove details and whether a field weld section is required.

33. OMITTED

34. The largest diameter F1932 or F2250 bolt that is available is 1 1/8" diameter. Holes with diameters greater than 1 1/8" must be A325 or A490.

35. Bolts longer than 5" increase in length by 1/8" increments.
Part #2

Corrective Action Request

#22

Douglas Steel Fabricating Corporation

Part #1

Reference:

#22 - DSF improper fabrication

Description of Defect:

Large holes were found. Original CNC file was reviewed with no holes, and hole gauge did not accept any of the sample. This hole gauge was checked. Holes are over 0.250".

Correction:

Modify program to add holes.

Date:

7/19/14

Part #2

Calculation

Cost

Response Due Date

55

7/19/14

Payment Received

7/19/14

Statistics

Breakdown of Nonconformities by Department

<table>
<thead>
<tr>
<th>Department</th>
<th>Description</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>Threading error 10.25&quot;</td>
<td>3</td>
</tr>
<tr>
<td>Engineering</td>
<td>Pedestal error 8.5&quot;</td>
<td>1</td>
</tr>
</tbody>
</table>

This was a major cost item for a job that we did not detail, or erect. Although the CNC was not correct initially, the engine should have been measured in the fit-up process, and during final inspection.
Statistics

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Non-Conformances</th>
<th>Cost as Percent of Yearly Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>81</td>
<td>0.22%</td>
</tr>
<tr>
<td>2006</td>
<td>121</td>
<td>0.15%</td>
</tr>
<tr>
<td>2007</td>
<td>134</td>
<td>0.21%</td>
</tr>
<tr>
<td>2008</td>
<td>134</td>
<td>0.21%</td>
</tr>
<tr>
<td>2009</td>
<td>106</td>
<td>0.28%</td>
</tr>
<tr>
<td>2010</td>
<td>97</td>
<td>0.35%</td>
</tr>
<tr>
<td>2011</td>
<td>81</td>
<td>0.19%</td>
</tr>
<tr>
<td>2012</td>
<td>141</td>
<td>0.22%</td>
</tr>
<tr>
<td>2013</td>
<td>111</td>
<td>0.21%</td>
</tr>
<tr>
<td>2014</td>
<td>84</td>
<td>0.20%</td>
</tr>
</tbody>
</table>

Individual Webinar Registrants

CEU/PDH Certificates
Within 2 business days...

- You will receive an email on how to report attendance from: registration@aisc.org.
- Be on the lookout: Check your spam filter! Check your junk folder!
- Completely fill out online form. Don’t forget to check the boxes next to each attendee’s name!

AISC | Questions?
Individual Webinar Registrants

CEU/PDH Certificates
Within 2 business days...

- New reporting site (URL will be provided in the forthcoming email).
- Username: Same as AISC website username.
- Password: Same as AISC website password.

8-Session Registrants

CEU/PDH Certificates
One certificate will be issued at the conclusion of all 8 sessions.

Certificates will be issued January 3-4, 2019.
8-Session Registrants

Access to the quiz: Information for accessing the quiz will be emailed to you by Wednesday. It will contain a link to access the quiz. EMAIL COMES FROM NIGHTSCHOOL@AISC.ORG

Quiz and Attendance records: Posted Tuesday mornings. www.aisc.org/nightschool - click on Current Course Details.

Reasons for quiz:

• EEU – must take all quizzes and final to receive EEU
• CEUs/PDHS – If you watch a recorded session you must take quiz for CEUs/PDHs.
• REINFORCEMENT – Reinforce what you learned tonight. Get more out of the course.

NOTE: If you attend the live presentation, you do not have to take the quizzes to receive CEUs/PDHS.

Night School Resources for 8-session package Registrants

Find all your handouts, quizzes and quiz scores, recording access, and attendance information all in one place!

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