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Course Description

Drawing and Specification Requirements for Seismic Design

July 21, 2016

Design drawings and specifications are integral parts of structural steel contracts. They must accurately convey the work to be performed in order to ensure accurate bids and safe projects. Both the AISC *Code of Standard Practice* and the AISC *Seismic Provisions* contain requirements related to the information that must be provided to the contractor by the engineer of record.

This presentation will provide an overview of the relevant AISC documents and their requirements pertaining to seismic design. The presenters will discuss the effect incomplete information can have on the bidding process and some common issues they have seen in practice. Examples of how to properly include the requisite information will be provided.

Learning Objectives

- Gain an understanding of the required information that must be provided in the contract documents by the engineer of record to the contractor.
- Become familiar with the AISC *Code of Standard Practice* and the AISC *Seismic Provisions* and their requirements pertaining to seismic design.
- Understand some of the common issues related to drawing and specification requirements for seismic design including incomplete bid documents, excessively applying requirements through misinterpretation, and undefined connection configurations.
- Become familiar with how to present the required information contract documents through the review of real-world examples of drawings, details, notes and specifications.

There's always a solution in steel.

Drawing and Specification Requirements for Seismic Design

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structural STEEL

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OVERVIEW

- Why is this presentation necessary?
- Why do we need to provide this information?
- What standards apply?
- What information needs to be shown?
- What problems are we seeing?
- Preparation of Design Drawings

10

Why is this presentation necessary?

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Eight Years Ago

A presentation was given on this topic about 8 years ago. At that time:

- Many engineers and fabricators were still unfamiliar with the *Seismic Provisions*.
- Prequalified moment connections were relatively new.
- The length of the *Seismic Provisions* had nearly doubled and the number of projects subject to its requirements increased significantly.

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Eight Years Ago

- Engineer's drawings and specifications often lacked basic information.
- The final cost of some projects were multiples of the bid price.
- Many engineers did not understand capacity-based design.
  - Connections were often required to resist forces greatly in excess of those that could be resisted by the members.

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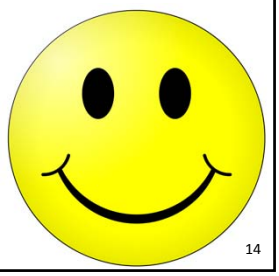
Today

- Engineers and fabricators are more knowledgeable about seismic design
- The *Seismic Provisions* have stabilized.



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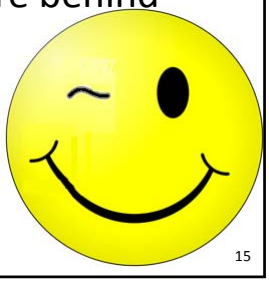
Today

- Engineers and fabricators are more knowledgeable about seismic design
- The *Seismic Provisions* have stabilized.
- It is a new day and our problems are behind us.



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Why do we need to provide all this information?

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Why? SAFETY

Structural engineers provide information related to the design and construction of buildings.

If you want the building to perform the way you intend, then the information you provide must be clear and accurate.

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Why? MONEY

- Meeting the *Seismic Provisions* increases the cost of projects.
- Fabricators bid what they see.
- When the $cope of work change$ from that e$tabli$hed in the Contract Document$, a modification of the contract price $hall be made. (paraphrased from the CO$P)

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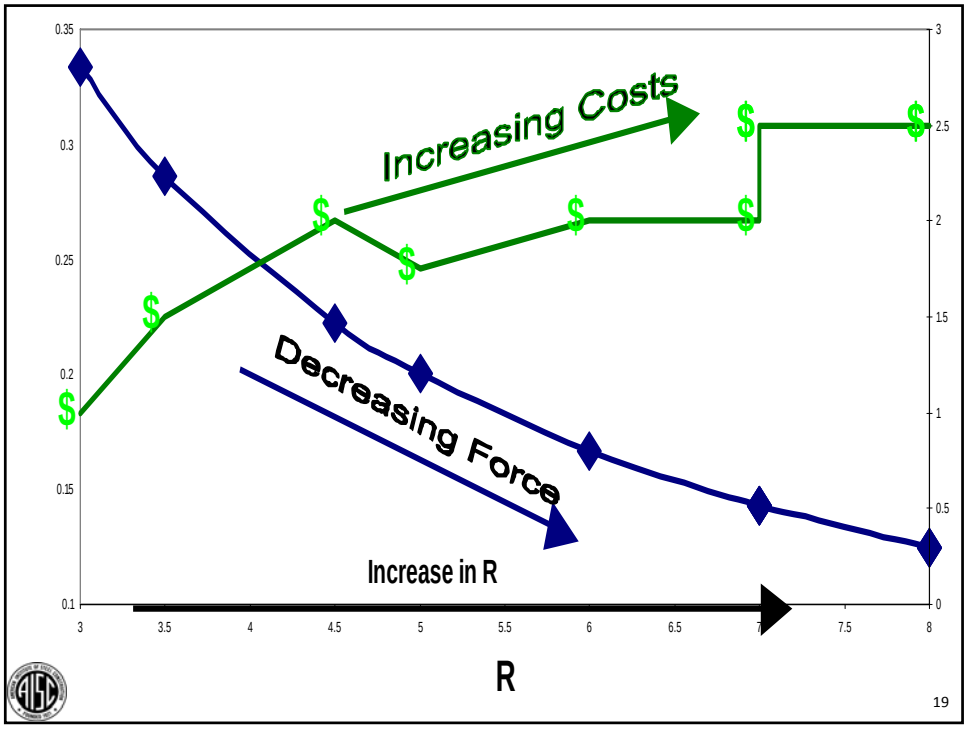

The Contractors' Dilemma

Bid what I see and fight for extras later.

Bid what I think the engineer wants and lose the project to a lower bidder.

What standards apply?

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The Specs, Codes and Standards

AISC 360 *Specification for Structural Steel Buildings*

AISC 341 *Seismic Provisions for Structural Steel Buildings*

AISC 303 *Code of Standard Practice for Steel Buildings and Bridges*

AISC 358 *Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications*

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The Specs, Codes and Standards

AWS D1.1 *Structural Weld Code – Steel*

AWS D1.8 *Structural Weld Code – Seismic Supplement*

RCSC *Specification for Structural Joints Using High-Strength Bolts*

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What information needs to be shown?

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Code of Standard Practice

Three connection design options

1. The complete connection design shown in the structural design drawings
2. The connection designated to be selected or completed by an experienced steel detailer
3. The connection designated to be designed by a licensed professional engineer working for the fabricator

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Code of Standard Practice

For all connection design options:

a) Permanent bracing, reinforcement, openings and other special details
b) Approvals

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Code of Standard Practice

Detailer selects connections OR Delegated connection design:

a) Any restrictions on the types of connections
b) Forces
c) Forces given at the service or the factored-load level
d) Whether LRFD or ASD is to be used
e) What substantiating connection information to be provided to the engineer of record.

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A4. Structural Design Drawings & Specs

Section A4 of the AISC *Seismic Provisions* contains a list of requirements… More on this later.

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AWS D1.8 & A4. Structural Design Drawings & Specs

1) Identification of the members and connections that are part of the SFRS
2) Locations and dimensions of *protected zones*
3) Configuration of the connections
4) Connection material specifications and sizes
5) Locations of *demand critical welds*
6) *Lowest anticipated service temperature* (LAST) of the steel structure, if the structure is not enclosed and maintained at a temperature of 50 °F (10 °C) or higher
7) Locations where weld backing is required to be removed
8) Locations where fillet welds are required when weld backing is permitted to remain

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AWS D1.8 & A4. Structural Design Drawings & Specs

9) Locations where fillet welds are required to reinforce groove welds or to improve connection geometry
10) Locations where weld tabs are req'd to be removed
11) Splice locations where tapered transitions are req'd
12) The shape of weld access holes, if a shape other than those provided for in the *Specification* is req'd
13) Joints or groups of joints in which a specific assembly order, welding sequence, welding technique or other special precautions where such items are designated to be submitted to the EoR

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AWS D1.8

1. Quality Assurance Plan for the Project
2. Any additional project-specific provisions not governed by AWS D1.1 or D1.8.

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AWS D1.8

1.2.1 Engineer's Responsibilities. In addition to the items listed in AWS D1.1/D1.1M, the Engineer shall provide the following information in the Contract Documents:

(1) Connection configuration, material specifications, and part sizes required to provide the needed seismic performance (see 1.3)

(2) Identification of members that comprise the Seismic Force Resisting System (SFRS) and that are subject to the provisions of this code (see 3.1)

(3) The location of the Protected Zone for members of the SFRS (see 3.3)

(4) Welds designated as "Demand Critical" and subject to specific provisions of this code (see 3.2)

(5) Locations where the removal of backing is required (see 6.7)

(6) Locations where fillet welds are required when backing is permitted to remain (see 6.9)

AWS D1.8 is a useful resource as it provides reference to the requirements in the list of items to be shown in the contract documents.

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What problems are we seeing?

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Some Common Issues

Incomplete bid documents

This is not a problem specific to seismic design, but can be a bigger problem with seismic projects.

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Some Common Issues

- Imagined Requirements:
  - All steel must be A992 **– FALSE**
  - All welds are Demand Critical **- FALSE**
  - All backing must be removed **– FALSE**
- Connection configuration desired but not defined.
- Prequalified Connections

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Some Common Issues
– Demand Critical Welds –

GENERALLY Demand Critical Welds are required for:

1. Groove welds at Column Splices & Bases in higher ductility systems (IMF, SMF, STMF, SCCS, SCBF, EBF, BRBF, SPSW)
2. Groove welds at Beam-to-Column connections in higher ductility systems (IMF, SMF and SCBF, EBF, BRBF – where moment connections are used)

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Some Common Issues
– Demand Critical Welds –

GENERALLY Demand Critical Welds are NOT required for lower ductility (ordinary) systems.

The exception:

Groove welds at Beam-to-Column connections for OMF

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Simplified Conflict Resolution
– Demand Critical Welds –

Steps

1. Open a pdf of the *Seismic Provisions*
2. Press ctrl + F.
3. Type: demand critical
4. Hit Enter.

If Demand Critical welds are required, it is clearly stated in the *Provisions*.

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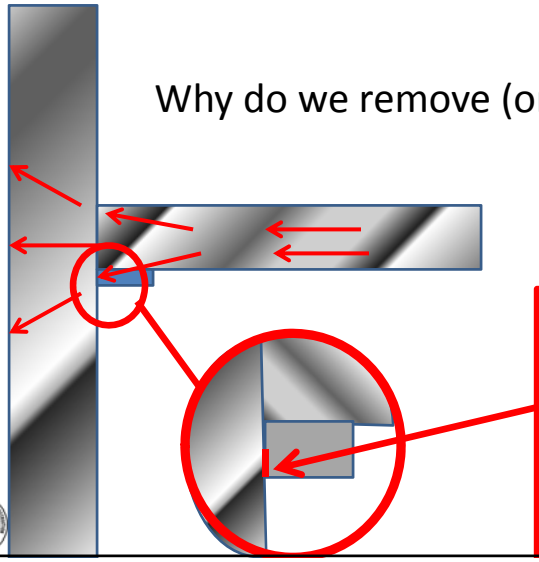
Some Common Issues
– Removal of Backing –

Why do we remove (or reinforce) backing?

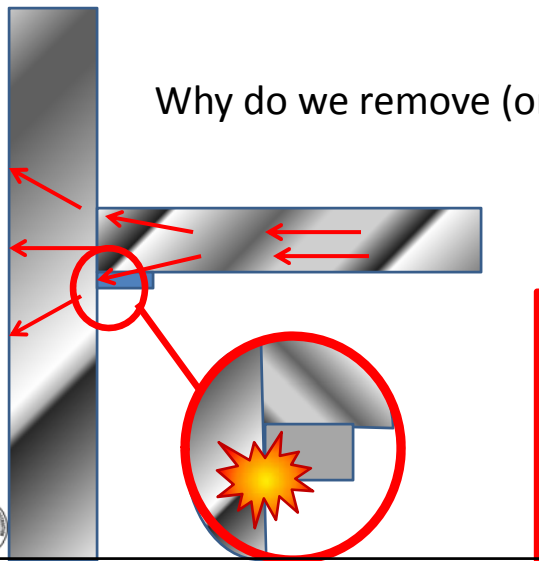


Lack of fusion under the backing bar away from the CJP weld causes a stress riser.

39

Some Common Issues
– Removal of Backing –

Why do we remove (or reinforce) backing?

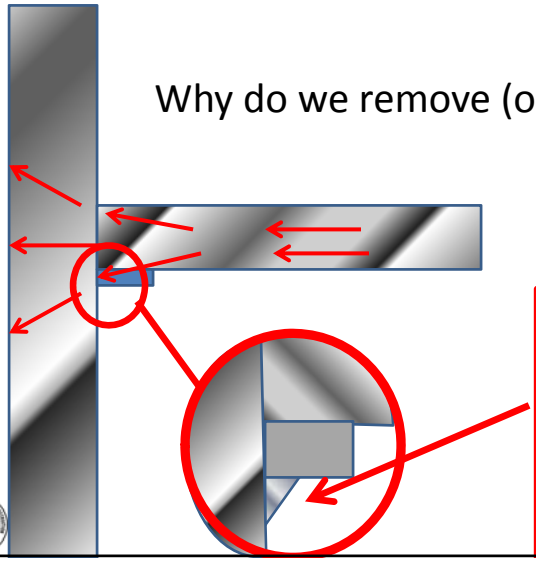


Lack of fusion under the backing bar away from the CJP weld causes a stress riser.

40

Some Common Issues
– Removal of Backing –

Why do we remove (or reinforce) backing?

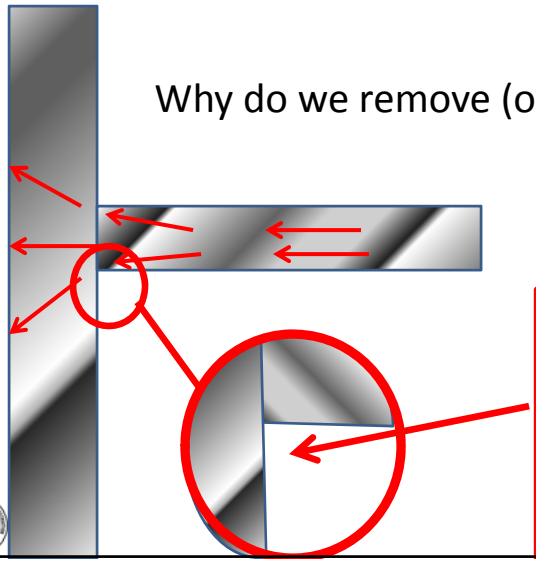


A contouring fillet weld helps to bridge the gap and provides a better stress path.

41

Some Common Issues
– Removal of Backing –

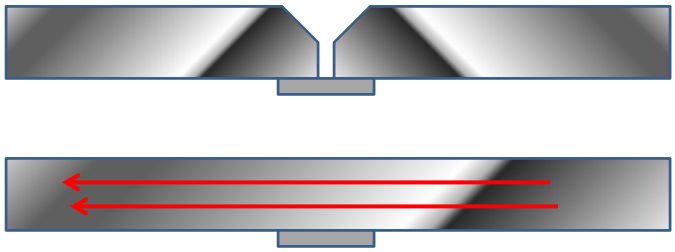
Why do we remove (or reinforce) backing?



Removal of backing and back-gouging also provide needed fusion and smooth transition.

42

Some Common Issues – Removal of Backing –



The same problems do not exist with a CJP butt joint so removal of backing or reinforcing fillets generally should not be required for butt joints.

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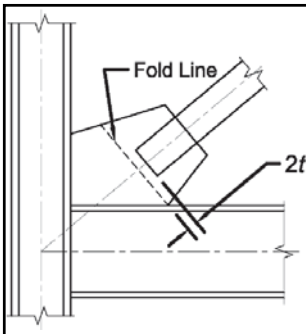
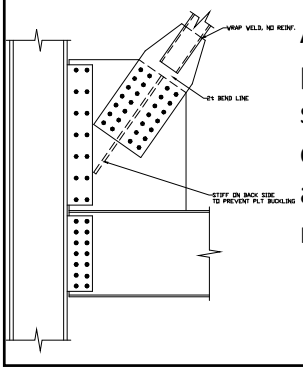
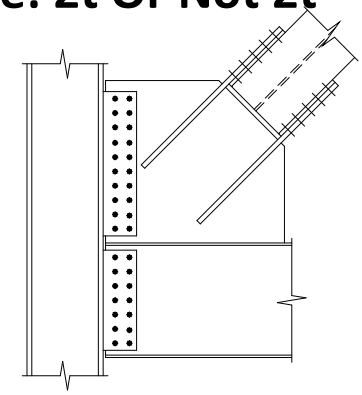
Joint Configuration Example: 2t Or Not 2t



2t is an option but not the only option



A hinge in the splice plate provides sufficient rotation capacity to accommodate rotation.



Designed to withstand 1.1 times the expected flexural strength of the brace.

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WANTED
PUBLIC ENEMY #1

The most common problems we see related to seismic design involve the use of prequalified moment connections.

Before the design progresses too far, ensure that there exists a prequalified connection that will work with your structure.

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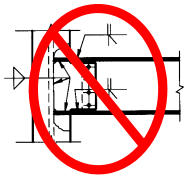
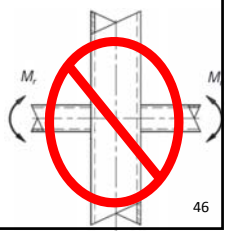
WANTED
THE USUAL SUSPECTS

- There are no prequalified connections to the weak-axis of a column.
- HSS
  - There is only one prequalified option for HSS columns (concrete filled).
  - There is only one prequalified option for HSS beams.
  - There are no prequalified options for HSS columns & beams at the same joint.





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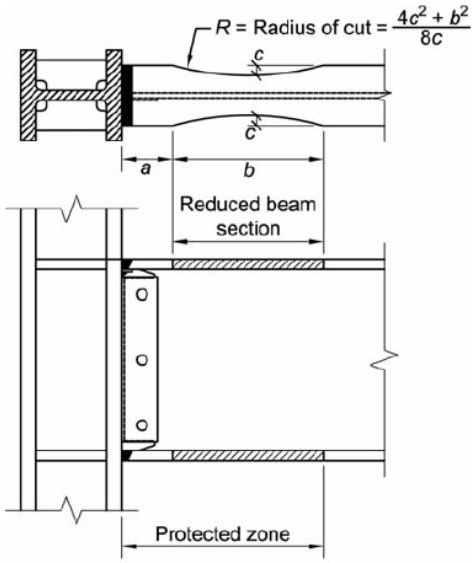
KNOW YOUR LIMITS
REDUCED BEAM SECTIONS



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KNOW YOUR LIMITS
REDUCED BEAM SECTIONS

Beam Limitations

1) Rolled wide-flange or built-up I-shaped members
2) d ≤ W36
3) Weight ≤ 300 lb/ft
4) t_f ≤ 1 ¾ in.
5) Span-to-depth ratios
6) Width-to-thickness ratios for flanges and web
7) Lateral bracing
8) Protected zones

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KNOW YOUR LIMITS
REDUCED BEAM SECTIONS

Column Limitations

1) Rolled shapes or built-up sections
2) d ≤ W36 (W920) – other restrictions for built-up
3) Width-to-thickness ratios for the flanges and web
4) Lateral bracing

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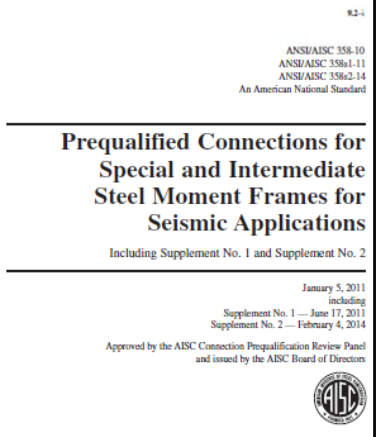
KNOW YOUR LIMITS
AISC 358

Each prequalified configuration has its own limitations.

The start of construction is not the time to realize there is no prequalified connection for your project.



ANSI/AISC 358-10
ANSI/AISC 358s1-11
ANSI/AISC 358s2-14
An American National Standard

Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications

Including Supplement No. 1 and Supplement No. 2

January 5, 2011
including
Supplement No. 1 — June 17, 2011
Supplement No. 2 — February 4, 2014

Approved by the AISC Connection Prequalification Review Panel and issued by the AISC Board of Directors

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There's always a solution in steel.

Drawing and Specification Requirements for Seismic Design

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Preparation of Design Drawings

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Required Information on Drawings

- Required information on the drawings is defined in the building code (e.g., IBC) and AISC standards (e.g., AISC 341)
- Building code: the focus is on seismic design parameters and quantities, special inspection and structural observation
- AISC Standards: the focus is on system identification, detailing and material requirements

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Building Code Requirements

2015 IBC Section 1603.1.5 requires the following information, even if seismic does not govern the design:

- Risk category
- Seismic importance factor, I_e
- Mapped spectral response parameters, S_S and S_1
- Design spectral response parameters, S_{DS} and S_{D1}
- Site class
- Seismic design category

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Building Code Requirements

IBC Section 1603.1.5 requires the following information, even if seismic does not govern the design (continued):

- Basic seismic force resisting system (SFRS)
- Design base shear(s)
- Seismic response coefficient(s), C_s
- Response modification coefficient(s), R
- Analysis procedure used

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Information Required by IBC Section 1603.1.5

GENERAL

1. Perform construction and workmanship in compliance with contract documents and 2013 California Building Code (CBC). Building Risk Category for CBC Table 1604.5 of CBC is III.

3. Design Criteria:
Earthquake Design Data
Seismic Importance Factor = 1.25
Mapped Spectral Acceleration
Ss = 2.256g
S1 = 0.822g
Site Class = D
Spectral Response Coefficients
S_DS = 1.504g
S_D1 = 0.822g
Seismic Design Category = E
Superstructure
Basic Seismic-force Resisting System = Special Steel Moment Frames
Design Base Shear = 600 kips
Seismic response coefficient, Cs = 0.15g
Response modification factor, R = 8
Redundancy factor = 1.0
Analysis Procedure used = Modal Response Spectrum Analysis
Max. Drift Ratio per Floor = 0.015

Risk category

Seismic Importance Factor, I_e

Mapped Spectral Response Factors S_S and S_1

Site Class

Design spectral response factors S_{DS} and S_{D1}

Seismic design category

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Information Required by IBC Section 1603.1.5

GENERAL

1. Perform construction and workmanship in compliance with contract documents and 2013 California Building Code (CBC). Building Risk Category for CBC Table 1604.5 of CBC is III.

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Seismic response coefficient, Cs = 0.15g
Response modification factor, R = 8
Redundancy factor = 1.0
Analysis Procedure used = Modal Response Spectrum Analysis
Max. Drift Ratio per Floor = 0.015

Response modification coefficient(s), *R*

Analysis procedure used

Basic seismic force-resisting system(s)

Design base shear(s)

Seismic response coefficients, C_s

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Building Code Requirements

IBC Section 1704.3 addresses the Statement of Special Inspections based on Section 1705

- IBC defers to AISC 360 (Chapter N) and AISC 341 (Chapter J) for inspection requirements

IBC Section 1704.5 addresses Structural Observation

- S.O. is not inspection
- S.O. is to confirm that the Contractor understands the design intent shown on the structural drawings.

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Information Required by IBC Section 1704.3

Project:			
Location: Los Angeles, California			
ITEM	TESTING, INSPECTION & VERIFICATION TASKS	FREQUENCY	
		CONTINUOUS	PERIODIC
	STRUCTURAL STEEL INSPECTIONS & VERIFICATION (Table 1705.2.1)		
1.	Material verification of high-strength bolts, nuts and washers:		
	a. Identification markings to conform to ASTM standards specified in the approved construction documents. **(See drawings, ASTM Standards, ANSI/AISC 360 Section A3.3)**		X
	b. Manufacturer's certificate of compliance required.		X
2.	Inspection of high-strength bolting:		
	a. Bearing-type connections. **(ANSI/AISC 360 Section M2.5)**		X
	b. Slip-critical connections. **(ANSI/AISC 360 Section M2.5)**	X	
3.	Material verification of structural steel:		
	a. Identification markings to conform to ASTM standards specified in the approved construction documents.		X
	b. Manufacturers' certified mill test reports.		X
4.	Material verification of weld filler materials:		
	a. Identification markings to conform to AWS specification in the approved construction documents. **(ANSI/AISC 360 Section A3.5)**		X
	b. Manufacturer's certificate of compliance required.		X

This is a partial listing

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Information Required by IBC Section 1704.3

Project:			
Location: Los Angeles, California			
ITEM	TESTING, INSPECTION & VERIFICATION TASKS	FREQUENCY	
		CONTINUOUS	PERIODIC
5.	Inspection of welding:		
	a. Structural steel: **(AWS D1.1)**		
	1) Complete and partial penetration groove welds.	X	
	2) Multi-pass fillet welds.	X	
	3) Single-pass fillet welds > 5/16"	X	
	4) Single-pass fillet welds ≤ 5/16"		X
	5) Floor and roof deck welds. **(AWS D1.3)**		X
	6) Shear connectors. **(ANSI/AISC 360 Section A3.6)**		X
	SPECIAL PROVISIONS FOR SEISMIC RESISTANCE		
7.	The testing shall be as required by AISC 341.	---	---
8.	Base metal thicker than 1.5 inches (38 mm), where subject to through-thickness weld shrinkage strains, shall be ultrasonically tested for discontinuities behind and adjacent to such welds after joint completion.	---	---
9.	The acceptance criteria for nondestructive testing shall be as required in AWS D1.1. Any material discontinuities shall be accepted or rejected on the basis of ASTM A 435 or ASTM A 898 (Level 1 criteria).		
10.	Continuous special inspection is required for structural welding in accordance with AISC 341		

IBC Section 1704.3.2 specifically requires designation of special inspection requirements for seismic systems

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Information Required by IBC Section 1704.5

Note the emphasis on "first," which distinguishes S.O. from inspection

STRUCTURAL OBSERVATION

CONSTRUCTION STAGES	ELEMENTS/CONNECTIONS TO BE OBSERVED
A. Foundations	First wall and spread footing reinforcing steel placement. First anchor rod placements at SMF base plate.
B. Structural Steel	First SMF connections, steel gravity connection at floor and roof.
C. Floor and Roof Metal Deck	Slab and chord reinforcing metal Deck shear studs and deck welding for first concrete pour.

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AISC 341 Requirements (Section A4)

Section A4 outlines general requirements and specific requirements for structural steel and composite construction.

1. General

1) Designation of the SFRS
2) Identification of the members and connections that are part of the SFRS
3) Locations and dimensions of *protected zones*
4) Connection details between concrete floor diaphragms and the structural steel elements of the SFRS
5) Shop drawing and erection drawing requirements not addressed in Section I1

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AISC 341 Requirements (Section A4)

2. Steel Construction

1) Configuration of the connections
2) Connection material specifications and sizes
3) Locations of *demand critical welds*
4) Locations where gusset plates are to be detailed to accommodate inelastic rotation
5) Locations of connection plates requiring Charpy V-notch toughness in accordance with Section A3.3(b)

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AISC 341 Requirements (Section A4)

2. Steel Construction (continued)

6) Lowest anticipated service temperature (LAST) of the steel structure, if the structure is not enclosed and maintained at a temperature of 50 °F (10 °C) or higher

7) Locations where weld backing is required to be removed
8) Locations where fillet welds are required when weld backing is permitted to remain
9) Locations where fillet welds are required to reinforce groove welds or to improve connection geometry

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AISC 341 Requirements (Section A4)

2. **Steel Construction** (continued)
   10) Locations where weld tabs are required to be removed
   11) Splice locations where tapered transitions are required
   12) The shape of weld access holes, if a shape other than those provided for in the *Specification* is required
   13) Joints or groups of joints in which a specific assembly order, welding sequence, welding technique or other special precautions where such items are designated to be submitted to the *engineer of record*

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AISC 341 Requirements (Section A4)

3. **Composite Construction**
   1) Bar placement, cutoffs, lap and mechanical splices, hooks and mechanical anchorage, placement of ties and other transverse reinforcement
   2) Requirements for dimensional changes resulting from temperature changes, creep and shrinkage
   3) Location, magnitude and sequencing of any prestressing or post-tensioning present
   4) Location of steel headed stud anchors and welded reinforcing bar anchors

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Information Required by AISC 341 Section A4

Basic Strategies for Developing Structural Drawings

1) Group seismic information on separate "SFRS" sheets – define SFRS in General Notes
2) Use typical details to present repetitive information and avoid inconsistencies; don't forget to modify them for specific project requirements
3) Identify the different conditions that require specific details

Note: Example drawings in this webinar illustrate how required information may be shown rather than showing detailing appropriate for a specific project

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Information Required by AISC 341 Section A4

GENERAL

1. Perform construction and workmanship in compliance with contract documents and 2013 California Building Code (CBC). Building Risk Category for CBC Table 1604.5 of CBC is III.

3. Design Criteria:
   Earthquake Design Data
   Seismic Importance Factor = 1.25
   Mapped Spectral Acceleration
   Ss = 2.256g
   S1 = 0.822g
   Site Class = D
   Spectral Response Coefficients
   S_DS = 1.504g
   S_D1 = 0.822g
   Seismic Design Category = E
   Superstructure
   Basic Seismic-force Resisting System = Special Steel Moment Frames
   Design Base Shear = 600 kips
   Seismic response coefficient, Cs = 0.15g
   Response modification factor, R = 8
   Redundancy factor = 1.0
   Analysis Procedure used = Modal Response Spectrum Analysis
   Max. Drift Ratio per Floor = 0.015

Designation of seismic force-resisting system(s)

68

Information Required by AISC 341 Section A4

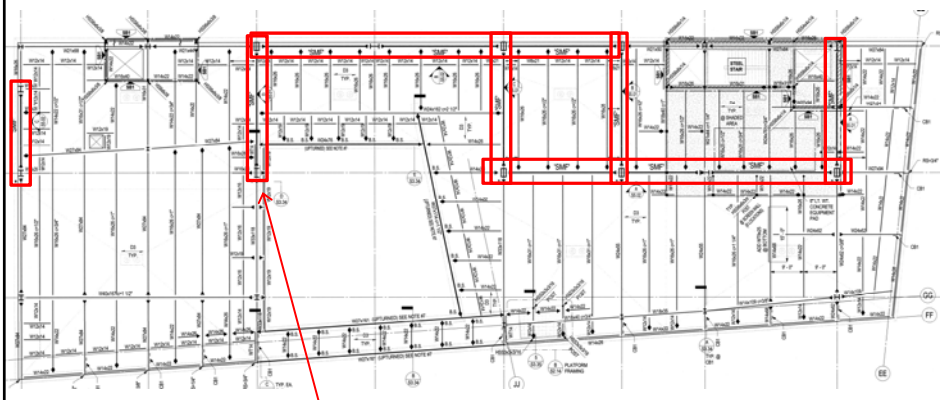
STRUCTURAL STEEL

1. STRUCTURAL STEEL: Material, Fabrication, and Erection
   A. Materials
      1. Provide structural steel complying with the following ASTM Standard Specifications, unless noted otherwise:
         - Wide Flanges
           - ASTM A992
         - Plates, channels, angles
           - ASTM A36
           - ASTM A572 Grade 42 or Grade 50
         - Pipes
           - ASTM A53, Grade B (35 ksi)
         - Hollow structural section
           - ASTM A500, Grade B (46 ksi - Rectangular Section, 42 ksi - Round Section).
         - Anchor rods
           - ASTM F1554, Grade 55
           - ASTM F1554. Grade 105 at SFRS

SFRS (and other) material specifications

69

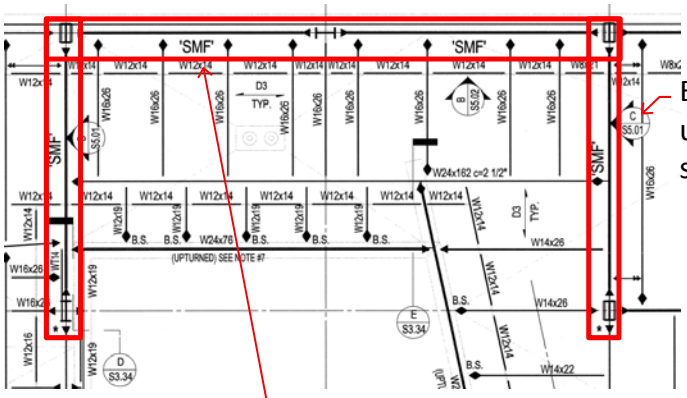
Information Required by AISC 341 Section A4



Identification of SFRS members and connections (it's pretty straightforward to identify basic SFRS members such as frames)

70

Information Required by AISC 341 Section A4

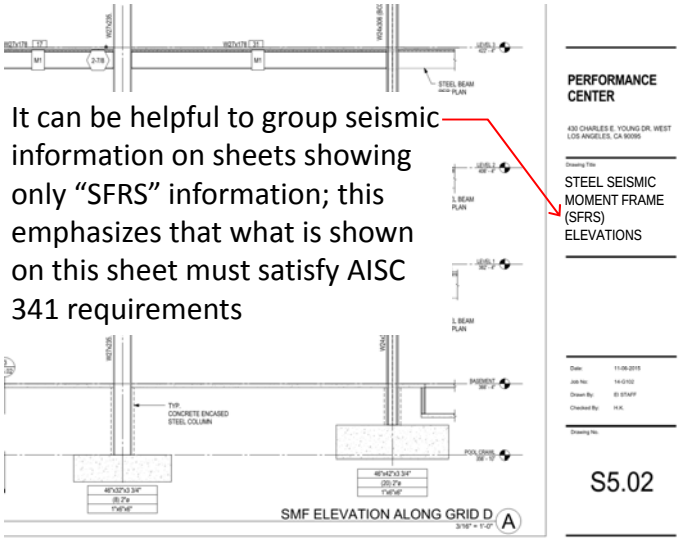


Elevations direct user to "seismic" sheets

Identification of SFRS members and connections (it's pretty straightforward to identify basic SFRS members such as frames)

71

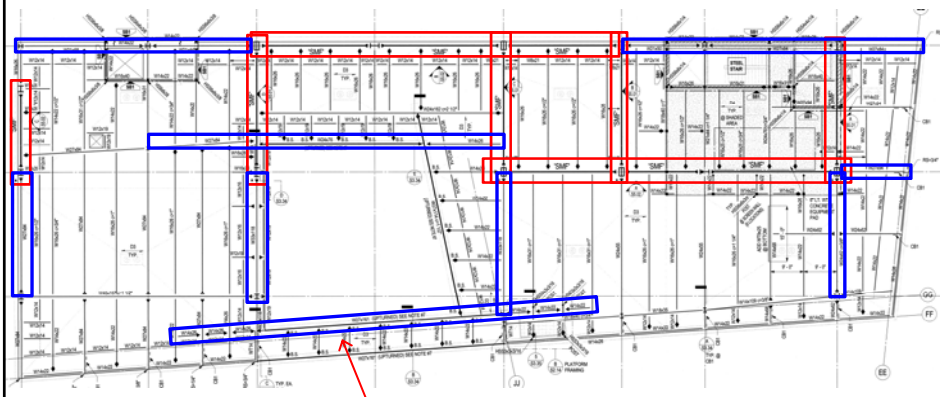
Information Required by AISC 341 Section A4



It can be helpful to group seismic information on sheets showing only "SFRS" information; this emphasizes that what is shown on this sheet must satisfy AISC 341 requirements

72

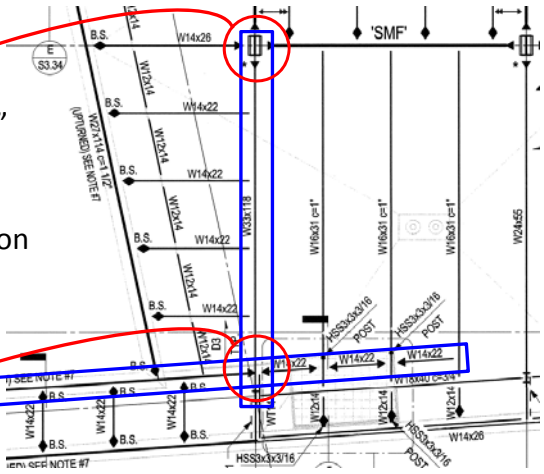
Information Required by AISC 341 Section A4



Identification of SFRS members (it's more of a challenge to identify "secondary" members and connections such as chords and collectors)

73

Information Required by AISC 341 Section A4



Specifies a "gravity-type" moment connection but with CVN filler metal satisfying AISC 341 Section A3.4a (still part of SFRS)

Specifies specific SFRS drag connection

This project used different methods to develop collector loads; designated using the framing plan legend

74

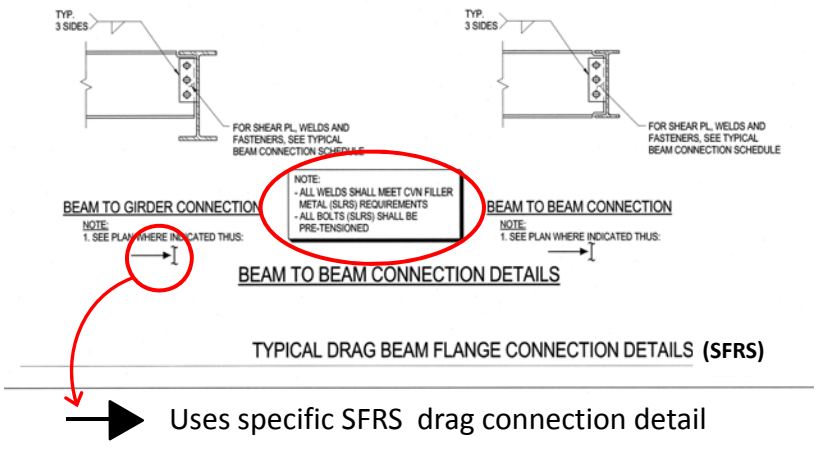
Information Required by AISC 341 Section A4

SYMBOL	DESCRIPTION
FRAME	INDICATES SEISMIC MOMENT FRAME (SLRS) COLUMN, SEE SMF FRAME ELEVATIONS ON S5.0 SERIES SHEETS.
	INDICATES MOMENT CONNECTION, SEE DETAILS 6/S1.11 AND 7/S1.11, UNLESS NOTED OTHERWISE. CANTILEVER END TO MATCH BACKSPAN, U.N.O.
	INDICATES BEAM STIFFENER, SEE DETAIL 2/S1.11
	INDICATES ANGLE BRACE, SEE DETAIL 10/S1.12
	INDICATES DRAG CONNECTION SEE DETAIL 3/S1.11
	INDICATES MOMENT CONNECTION WELD TO MEET CVN FILLER METAL(SFRS)REQUIREMENT.

Framing plan legend can be used to help to identify elements of the SFRS

75

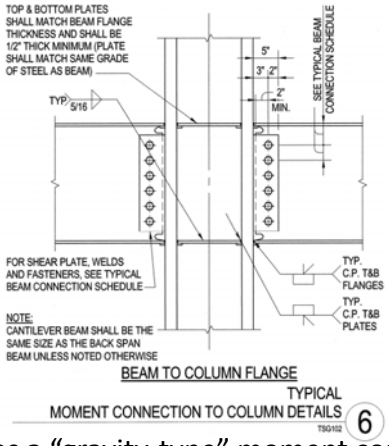
Information Required by AISC 341 Section A4



Uses specific SFRS drag connection detail

76

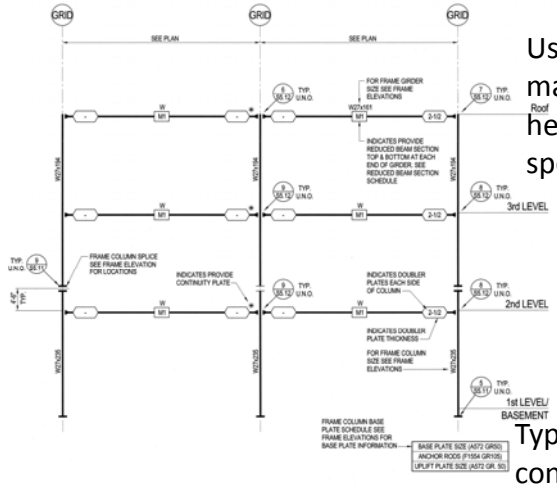
Information Required by AISC 341 Section A4



* Uses a "gravity-type" moment connection but with CVN filler metal satisfying AISC 341 Section A3.4a – this makes it part of the SFRS

77

Information Required by AISC 341 Section A4

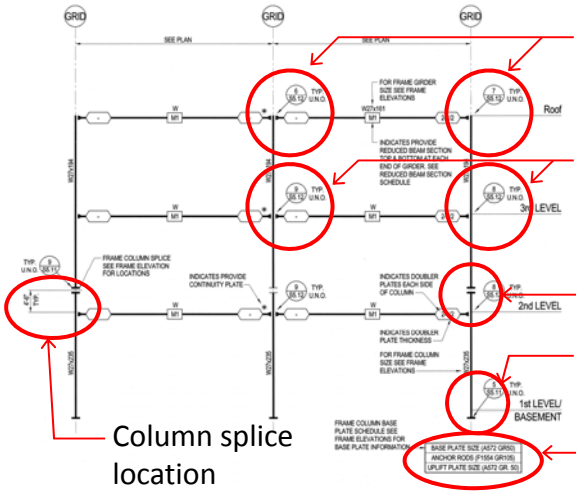


Use of typical details – maintains consistency and helps unclutter project specific drawings

Typical frame elevation contains legend and call-outs for other typical details

78

Information Required by AISC 341 Section A4



Interior and exterior roof-level SMF connections

Interior and exterior intermediate -level SMF connections

Column splice detail

Column base detail

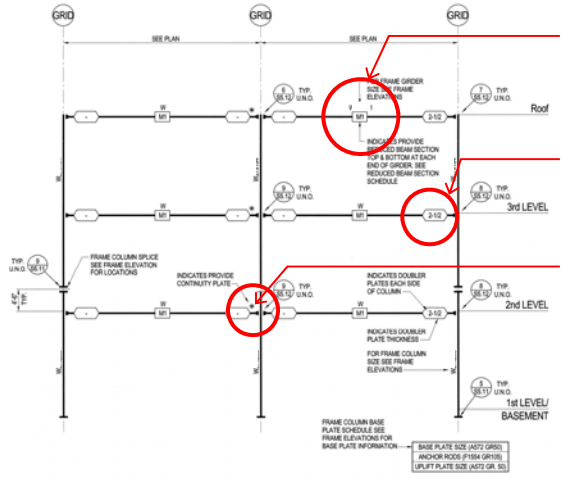
Column splice location

Column base schedule

TYPICAL 'SMF' FRAME ELEVATION LEGEND 1

79

Information Required by AISC 341 Section A4



RBS dimension call-out (see frame elevation and schedule)

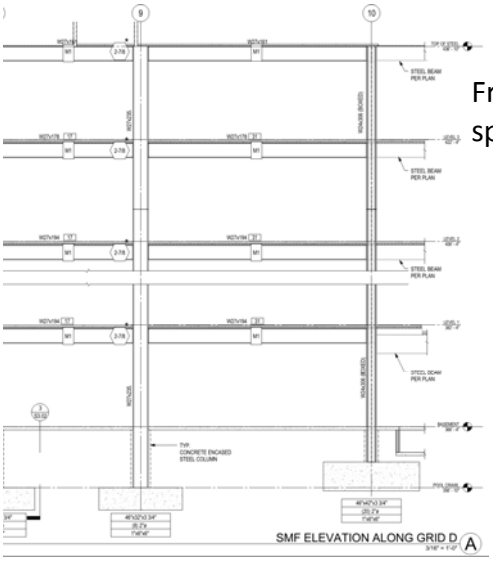
Doubler plate call-out (see frame elevation)

Continuity plate call-out (see typical detail)

TYPICAL 'SMF' FRAME ELEVATION LEGEND 1

80

Information Required by AISC 341 Section A4

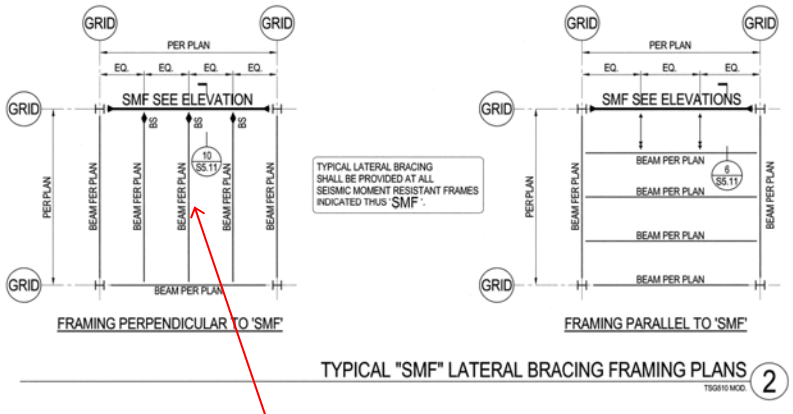


Frame elevations show project-specific requirements:

- Member sizes
- Connection requirements
- Doubler plate call-outs
- Stiffener call-outs
- Column splice locations
- Base plate and anchor rods

81

Information Required by AISC 341 Section A4

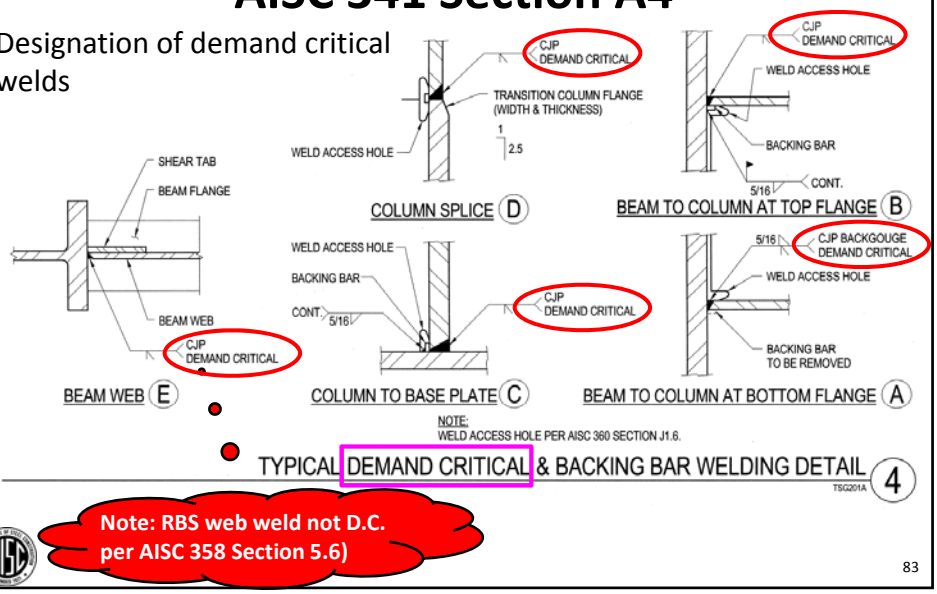


Typical detail showing frame beam LTB bracing requirements (confirm that L_b or L_p requirement are satisfied)

82

Information Required by AISC 341 Section A4

Designation of demand critical welds

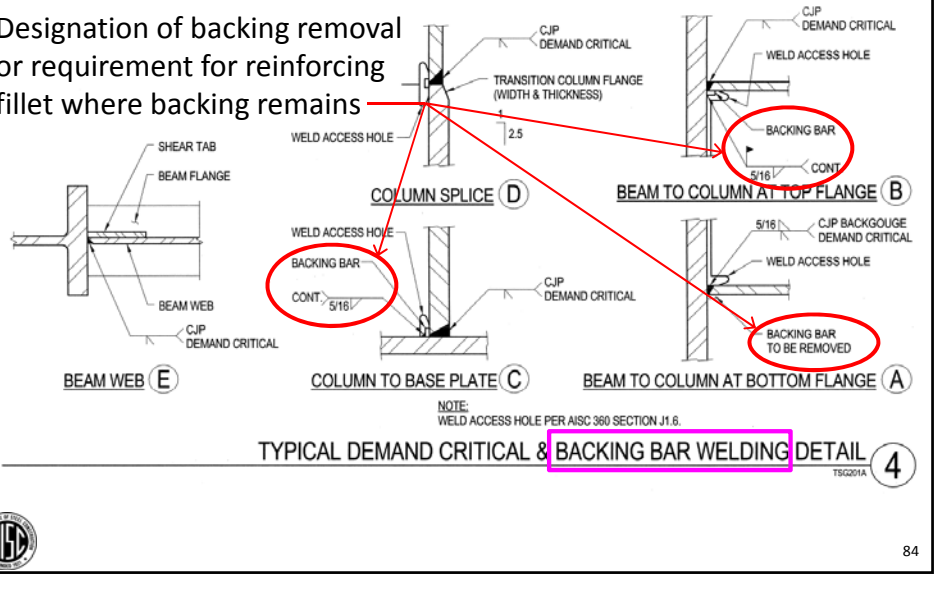


Note: RBS web weld not D.C. per AISC 358 Section 5.6)

83

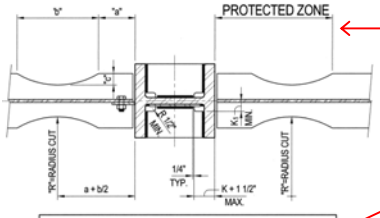
Information Required by AISC 341 Section A4

Designation of backing removal or requirement for reinforcing fillet where backing remains



84

Information Required by AISC 341 Section A4



REDUCED BEAM SECTION (RBS)
TOP & BOTTOM FLANGE SCHEDULE

MARK	TOP & BOTTOM FLANGE			
	"a"	"b"	"c"	"R"
M1	8.0	20.0	2.75	19.56
M2	6.0	20.0	2.25	23.35	

NOTES:
1. WELDERS PERFORMANCE TEST REQUIRED FOR ALL WELDERS COMPLETING BEAM/COLUMN CONNECTION.
2. REMOVE ALL WELD TABS AND GRIND SMOOTH FOR BEAM/COLUMN CONNECTION.
3. NO ATTACHMENTS ALLOWED IN THE PROTECTED ZONE EXCEPT FOR PLUG WELD FOR DECK ATTACHMENT

TYPICAL 'SMF' REDUCED BEAM SECTION (RBS) CONNECTION DETAIL 2
TSG504-MOD

- Location of protected zone (see also connection elevation)
- Configuration of RBS connection via a schedule
- Dimensions would vary from project to project
- It may be possible to group similar sized beams into a single set of dimensions to simplify fabrication

85

Information Required by AISC 341 Section A4

Reminder: AWS D1.8 Annex C: Supplemental Welder Qualification for Restricted Access Welding

Reminder: weld tabs are to be removed

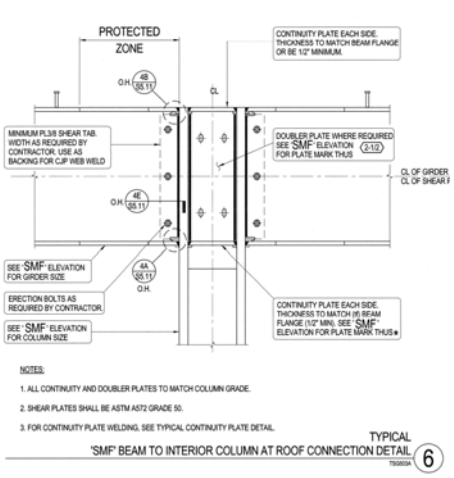
Reminder: no attachments in the protected zone.

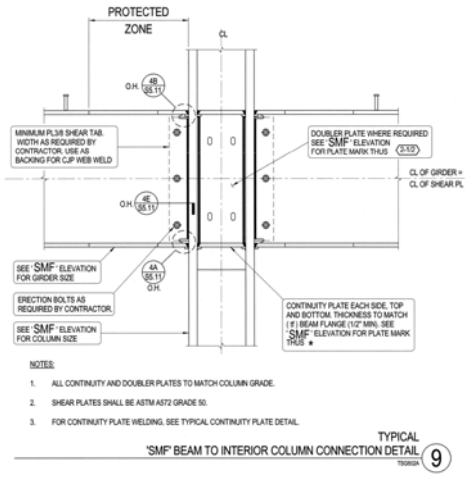
NOTES:
1. WELDER QUALIFICATION REQUIRED FOR BEAM BOTTOM FLANGE WELDING THROUGH A WELD ACCESS HOLE.
2. REMOVE ALL WELD TABS AND GRIND SMOOTH AT BEAM/COLUMN CONNECTION.
3. NO ATTACHMENTS ALLOWED IN THE PROTECTED ZONE EXCEPT FOR PUDDLE WELD FOR DECK ATTACHMENT.

TYPICAL 'SMF' REDUCED BEAM SECTION (RBS) CONNECTION DETAIL 2
TSG504-MOD

86

Information Required by AISC 341 Section A4

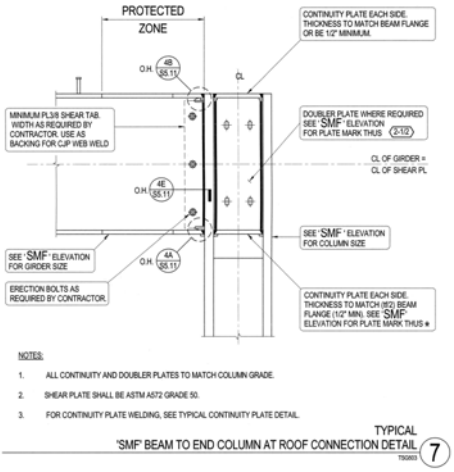


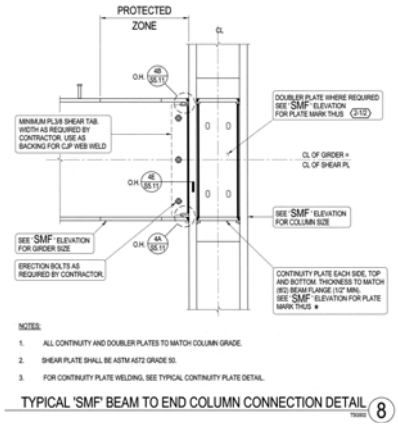


Examples of connection configurations

87

Information Required by AISC 341 Section A4

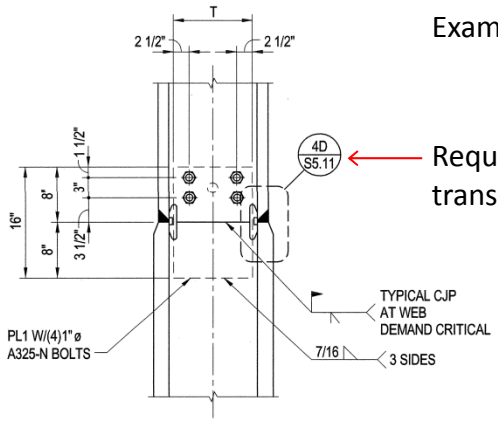




Examples of connection configurations

88

Information Required by AISC 341 Section A4



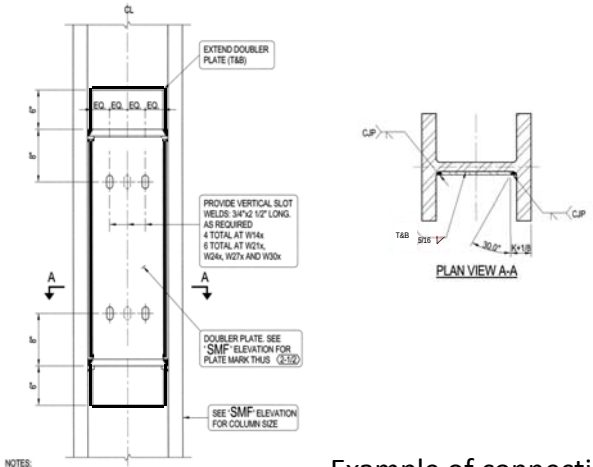
Example of connection geometry

Requirement for tapered transition at splice location

TYPICAL
SEISMIC FRAME COLUMN SPLICE DETAIL 9
TSG201

89

Information Required by AISC 341 Section A4

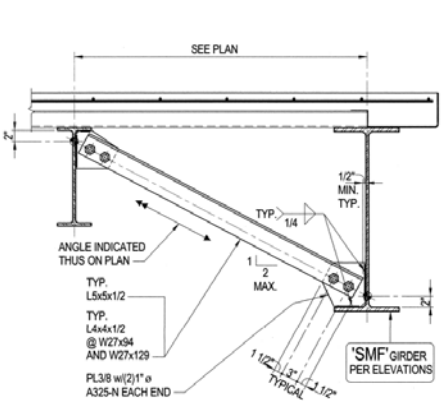


Example of connection configuration

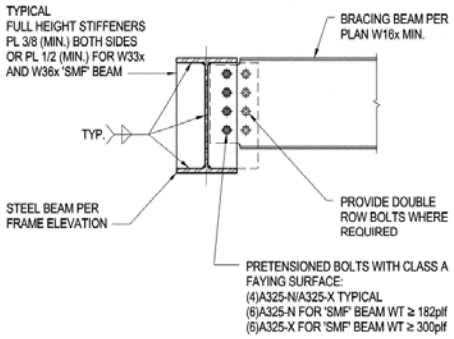
TYPICAL
'SMF' DOUBLER PLATE DETAIL 1

90

Information Required by AISC 341 Section A4



TYPICAL 'SMF' BEAM BRACE DETAIL 6
TSG611 MOD.

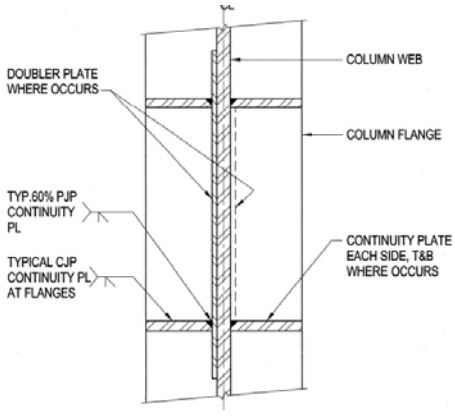


TYPICAL 'SMF' LATERAL BEAM BRACING DETAIL 10
TSG614

Examples of connection configurations

91

Information Required by AISC 341 Section A4



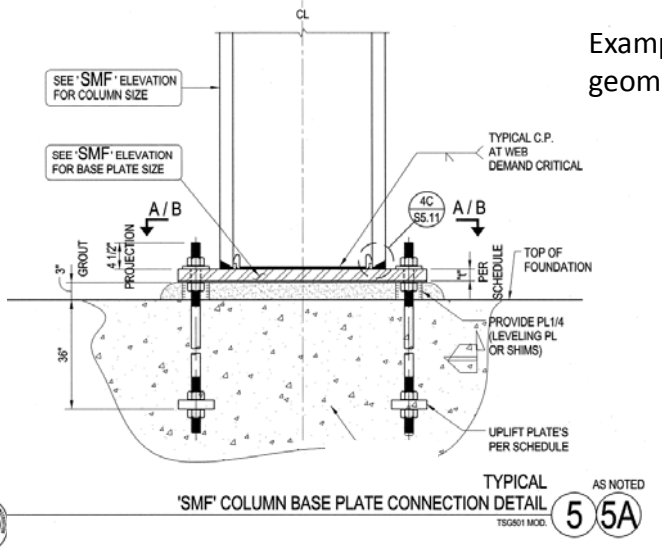
Example of connection geometry

NOTE:
REMOVE ALL WELD TABS AND GRIND SMOOTH.

TYPICAL CONTINUITY PLATE DETAIL 8
TSG506

92

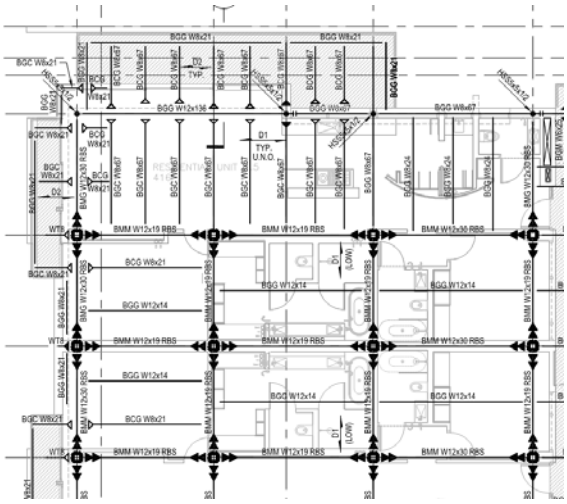
Information Required by AISC 341 Section A4



Example of connection geometry

93

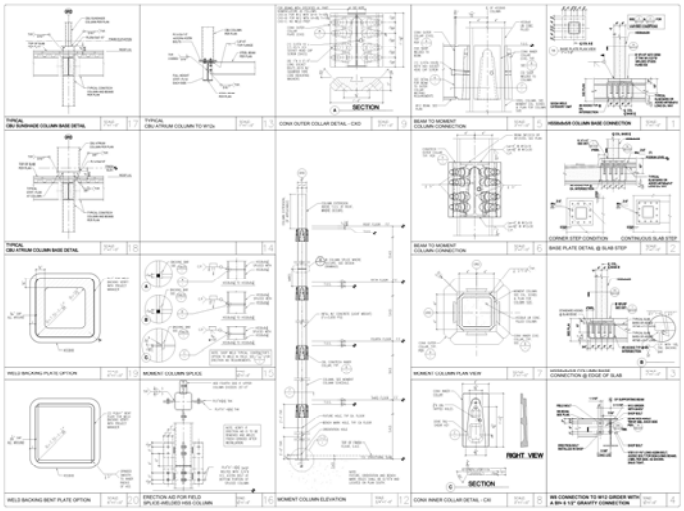
Information Required by AISC 341 Section A4



- Some SMF beam-to-column connections are proprietary.
- Engineer-of-record typically shows frame configuration and member sizes and delegates connection design.

94

Information Required by AISC 341 Section A4

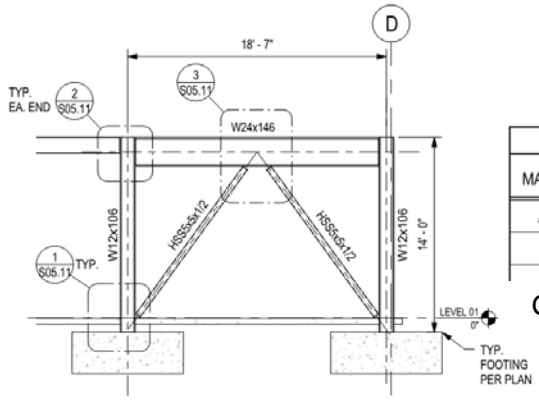


- Some SMF beam-to-column connections are proprietary.
- Owner of connection license typically provides details.

Detail sheet provided by proprietary connection designer

95

Information Required by AISC 341 Section A4



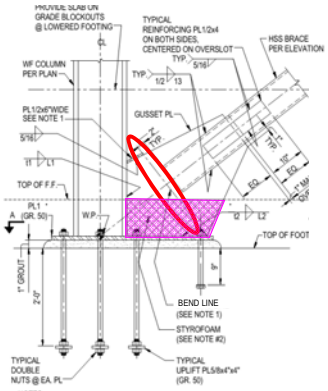
GUSSET PLATE SCHEDULE					
MARK	t1 (IN)	L1 (IN)	t2 (IN)	L2 (IN)	REMARKS
A	1/2	13	1/2	28	-
-	-	-	-	-	-

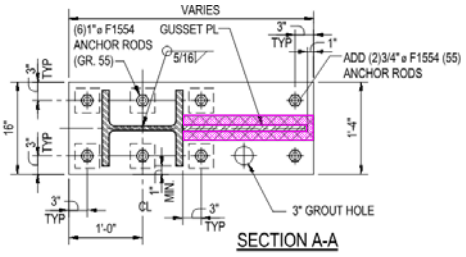
Gusset plate schedule

Brace frame configuration

96

Information Required by AISC 341 Section A4

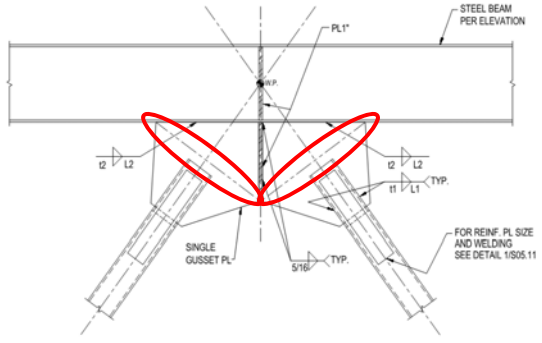




SCBF connection configuration showing gusset plate detailing to accommodate inelastic rotation

97

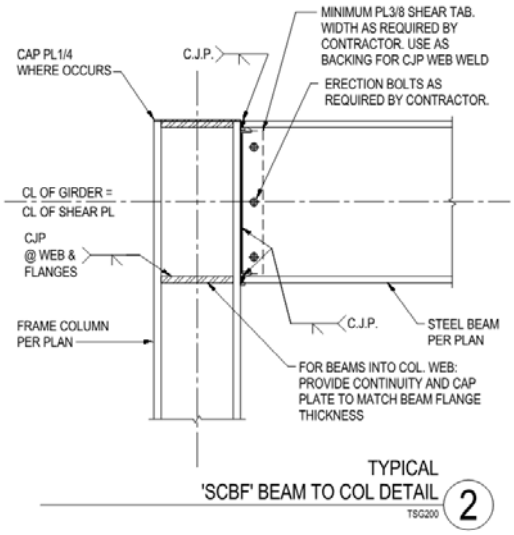
Information Required by AISC 341 Section A4



SCBF connection configuration showing gusset plate detailing to accommodate inelastic rotation

98

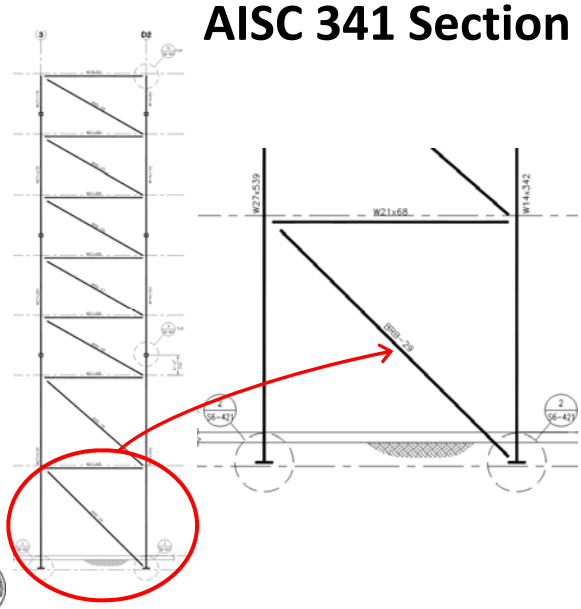
Information Required by AISC 341 Section A4



SCBF beam-column connection configuration

99

Information Required by AISC 341 Section A4



- BRBFs are proprietary.
- Engineer-of-record must show frame configuration and basic brace properties.
- EOR delegates brace and connection design.

100

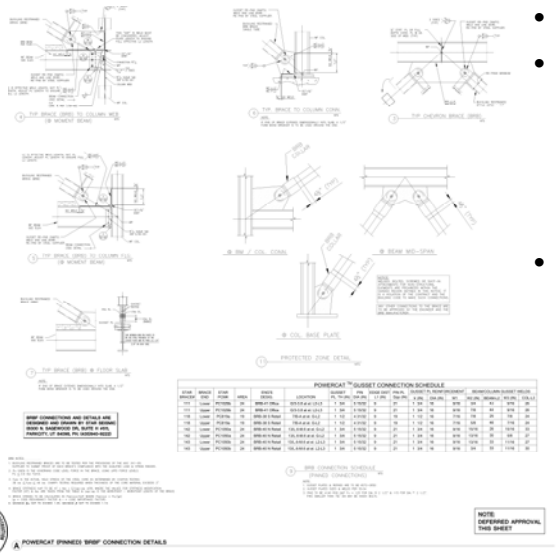
Information Required by AISC 341 Section A4

BUCKLING RESTRAINED FRAME SCHEDULE				
MARK	PU (KIPS)	ASC (in2)	STIFF MODIFIED FACTOR (SMF)	REMARKS
BRB–01	30	1.00	1.30	
BRB–02	275	8.50	1.33	
BBR–03	72.79	5.00	1.31	
BRB–04	407	12.00	1.35	
BRB–05	268	8.50	1.35	

- BRBFs are proprietary.
- Engineer-of-record must show frame configuration and basic brace properties.
- For bidding, usually only geometry and required strength, P_u, are required.
- The area of the core, A_{SC}, and the stiffness modifier, *SMF*, were needed for modeling purposes to obtain a building permit and would be confirmed by the BRBF manufacturer.

101

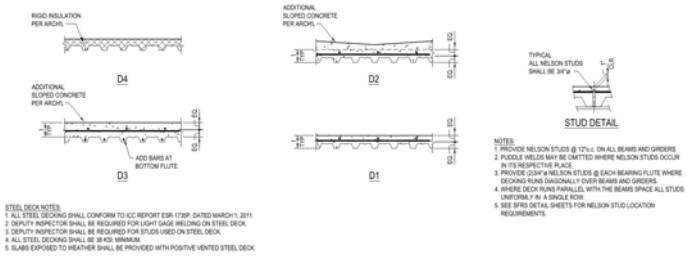
Information Required by AISC 341 Section A4



- BRBF are proprietary.
- Brace manufacturer provides detailed brace design and typically provides connection details.
- These may have to be incorporated into the drawings to obtain a building permit or treated as a deferred approval.

102

Information Required by AISC 341 Section A4



STEEL DECK NOTES:
1. ALL STEEL DECKING SHALL CONFORM TO ICC REPORT ESR-1739P, DATED MARCH 1, 2011.
2. DEPUTY INSPECTOR SHALL BE REQUIRED FOR LIGHT GAGE WELDING ON STEEL DECK.
3. DEPUTY INSPECTOR SHALL BE REQUIRED FOR STUDS USED ON STEEL DECK.
4. ALL STEEL DECKING SHALL BE 38 KSI MINIMUM.
5. SLABS EXPOSED TO WEATHER SHALL BE PROVIDED WITH POSITIVE VENTED STEEL DECK.

NOTES:
1. PROVIDE NELSON STUDS @ 12"o.c. ON ALL BEAMS AND GIRDERS.
2. PUDDLE WELDS MAY BE OMITTED WHERE NELSON STUDS OCCUR IN IT'S RESPECTIVE PLACE.
3. PROVIDE (2)3/4" ø NELSON STUDS @ EACH BEARING FLUTE WHERE DECKING RUNS DIAGONALLY OVER BEAMS AND GIRDERS.
4. WHERE DECK RUNS PARALLEL WITH THE BEAMS SPACE ALL STUDS UNIFORMLY IN A SINGLE ROW.
5. SEE SFRS DETAIL SHEETS FOR NELSON STUD LOCATION REQUIREMENTS.

MARK	STEEL DECK TYPE	GAGE	TOTAL SLAB "t"	SLAB DESCRIPTION	STEEL DECK ATTACHMENT PATTERN				MAXIMUM UNSHORED SPAN			REMARKS
					PERPENDICULAR TO SUPPORT		PARALLEL TO SUPPORT	SEAMS	SINGLE	DOUBLE	TRIPLE	
					ENDS	INTERMEDIATE						
D1	VERCO B FORMLOK	18	4"	2 1/2" LT. WT. CONCRETE w/ #4@12 E.W.	(7)HILTI X-ENP19 FASTENERS	(4)HILTI X-ENP19 FASTENERS	HILTI X-ENP19 @ 12"o.c.	BUTTON PUNCH 36"o.c.	7'-6"	8'-6"	9'-6"	TYP. FLOOR
D2	VERCO B FORMLOK	16	4"	2 1/2" LT. WT. CONCRETE w/ #4@12 E.W.	(7)HILTI X-ENP19 FASTENERS	(4)HILTI X-ENP19 FASTENERS	HILTI X-ENP19 @ 12"o.c.	BUTTON PUNCH 36"o.c.	8'-6"	9'-6"	10'-6"	TYP. EXTERIOR WALKWAYS, BALCONIES & GREEN ROOFS
D3	VERCO B FORMLOK	16	6"	4 1/2" LT. WT. CONCRETE w/ #4@12 E.W. & #4@6 BOTTOM FLUTE	(7)HILTI X-ENP19 FASTENERS	(4)HILTI X-ENP19 FASTENERS	HILTI X-ENP19 @ 12"o.c.	BUTTON PUNCH 36"o.c.	5'-0"	5'-0"	5'-0"	TYP. AT POOL DECK AREA
D4	VERCO HSB 36	18	-	RIGID INSULATION (NO CONCRETE FILL)	(7)HILTI X-ENP19 FASTENERS	(4)HILTI X-ENP19 FASTENERS	HILTI X-ENP19 @ 12"o.c.	BUTTON PUNCH 36"o.c.	-	-	-	SHAFT ROOFS

TYPICAL SLAB AND STEEL DECK SCHEDULE 1
TSD101 MOD.

Connection between concrete floor diaphragm and steel SFRS elements (number of studs shown on framing plan)

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Drawing and Specification Requirements for Seismic Design

Questions?

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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!

PDH Certificates

Within 2 business days…

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

There's always a solution in steel.

Thank You

Please give us your feedback!
Survey at conclusion of webinar.