

**GENERAL PROJECT INFORMATION**

PLAN CHECK NO. \_\_\_\_\_ DISTRICT NO \_\_\_\_\_  
 JOB ADDRESS \_\_\_\_\_ CITY \_\_\_\_\_ ZIP \_\_\_\_\_

REFERENCES & ABBREVIATIONS: AISC Seismic Provisions for Structural Steel Buildings AISC 341-22 (SPSSB), AISC Specification for Structural Steel Buildings AISC 360-22, AISC Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications AISC 358-22, Minimum Design Loads for Buildings and Other Structures ASCE7-22, Building Code Requirements for Structural Concrete ACI318-25, Special Moment Resisting Frame (SMF), Intermediate Moment resisting Frame (IMF), and Ordinary Moment Resisting Frame (OMF), Table (T).

**INSTRUCTIONS**

- Corrections with circled item numbers apply to this plan check.
- In the left-hand margin of the circled corrections, please indicate the sheet number and detail or note number on the plans where the corrections are made. Resubmit marked original plans and two corrected sets of plans, calculations and this plan review list.
- Incomplete, unclear, or faded drawings or calculations will not be accepted.
- Incorporate all comments as marked on checked set of plans and calculations and these correction sheets.

**GENERAL REQUIREMENTS**

**GENERAL**

1. Identify on the plans the type of Lateral Force Resisting System the structure is designed for. I.e. SMF, IMF or OMF.
2. "I" columns connected at weak axis (y-y) to beam is not permitted, unless qualified by cyclic testing in accordance with AISC SPSSB, Section K2.
3. Clearly identify on the plan the location and length of the expected plastic hinging zone (protected zone). No welded, screwed, bolted, or shot-in attachment, except decking arc spot-weld is permitted within the protected zone. (AISC SPSSB Section I2.1)
4. Beams and columns shall meet the width-to-thickness ratio limitations of AISC SPSSB T-D1.1 for SMF & IMF. Width-to-thickness ratios of compression elements shall not exceed  $\lambda_{hd}$  &  $\lambda_{md}$  of the table.
5. Column web splices shall be either bolted or welded or welded to one column and bolted to the other. In moment frames using bolted splices, plates or channels shall be used on both sides of the column web. (AISC SPSSB Section D2.5d)
6. Column splices made with fillet welds or partial penetration groove welds shall not be located within 4-ft. nor one-half the column clear height of beam-column connections, whichever is less. Detail on the plan. (AISC SPSSB Section D2.5a)
7. Provide a beveled transition detail in accordance with AWS D1.8/1.8M clause 4.2 where changes in thickness and width of flanges and webs occur in complete joint penetration groove welds and when tension stress in the smaller flange exceeds  $0.3 F_y(LRFD)$  in column splice. (AISC SPSSB Section D2.5b)
8. Groove welds for column splices in SMF and IMF frames shall be demand critical welds in compliance with AISC SPSSB Section A3.4a & A3.4b.
9. Column splices where the column is not part of the seismic load resisting system (SLRS) shall be detailed in accordance with AISC SPSSB Section D2.5a.
10. Doubler plate connection shall be detailed on the plans as follows: (AISC SPSSB Section E3.6e.3)
  - a. When doubler plates are welded to the column flanges, welds shall be either a complete-joint-penetration groove welded or fillet-welded joint.
  - b. When doubler plates are placed against the column web, they shall be welded across the top and bottom flanges.
  - c. When doubler plates are placed away from the column web, they shall be placed symmetrically in pairs and welded to the continuity plates.
  - d. When continuity plates are not used doubler plates shall be extended a minimum of 6" above and below the top and bottom of deeper moment frame beam.

11. Continuity plates connection shall be detailed on the plans as follows: (AISC SPSSB Section D2.4, I2.4, E1.6b.c.4, E2.6f, E3.6f)
  - a. Corners of continuity plates placed in the webs of rolled shapes shall be clipped.
  - b. At the end of the weld adjacent to the column web/flange juncture, weld tabs for continuity plates shall not be used.
  - c. For one-sided connections, continuity plate thickness shall be at least one half of the thickness of the beam flange.
  - d. For two-sided connections, continuity plate thickness shall be at least equal in thickness to the thicker of the beam flanges.
12. Weld access hole shall be detailed on the plan per AISC SPSSB, Section E1.6b.c.3 and subclause 6.11.2 of AWS D1.8/1.8M.
13. When the calculated column-to-beam moment ratio is less than or equal to 2, using Equation (E3-1) the following requirements shall apply: (AISC SPSSB Section E3.4c)
  - a. Column flanges shall be laterally supported at the levels of both top and bottom beam flanges
  - b. Column flanges shall be laterally supported by means of the column web or by the flanges of perpendicular beams.
14. Lateral bracing of beam flanges per AISC SPSSB D1.2a, D1.2b, D1.2c, E2.4a & E3.4b shall be provided as follows:
  - a. Both flanges of beam shall be laterally braced or the beam cross section shall be torsionally braced.
  - b. The un-braced length between lateral bracings shall not exceed  $0.086 r_y E / F_y$  for SMF and  $0.17 r_y E / F_y$  for IMF lateral load resisting frames.
  - c. Lateral bracings shall be placed near concentrated forces, changes in cross section and other locations where analysis indicates that a plastic hinge will form during inelastic deformations.
  - d. Bracings shall meet the provisions of AISC specification, Appendix 6 Equations A-6.7 & A-6.8. The required strength of lateral bracing shall be at least 2% of the expected required strength of the beam flange, and the required strength of lateral bracing adjacent to plastic hinges shall be at least 6% of the expected required strength of the beam flange.

### **SPECIAL & INTERMEDIATE MOMENT RESISTING FRAME (SMF & IMF)**

15. Pre-qualified connections for SMF & IMF (RBS, BUEEP, BSEEP, BFP, WUF-W, KBB, ConXL) shall be designed within limitations specified in AISC 358.

16. Beam-to-column connections could be qualified by cyclic testing in accordance to AISC SPSSB Section K2. The depth of the beam, column and the weight of the beam could differ from the member sizes used in the prototype in accordance to AISC SPSSB Section K2.3b.
17. Any new beam-to-column connection requiring testing shall be verified and approved by the Research Section of Building and Safety Division.
18. Where groove welds are used to make column splice, they shall be complete joint penetration groove welds. Weld tabs shall be removed upon completion of weld. Section D2.5d.
19. The individual thickness of the column webs and doubler plates, if used shall not be less than AISC SPSSB Equation (E3-7).

### **ORDINARY MOMENT RESISTING FRAME (OMF)**

20. Connections in conformance with AISC SPSSB Sections E3.6e and E3.6f or Sections E2.6e and E2.6f (SMF and IMF) shall be permitted for use in OMF.
21. Beam-to-column connections could be either fully restrained (FR) or partially restrained (PR). AISC SPSSB Section E1.6

### **FULLY RESTRAINED MOMENT CONNECTION (FR)**

22. FR moment connections shall be designed for a *required flexural strength* that is equal to the expected beam flexural strength multiplied by 1.1 (LRFD) or by 1.1/1.5 (ASD), as appropriate. The expected beam flexural strength shall be determined as  $R_y M_p$ .  
 The *required shear strength*,  $V_u$  or  $V_a$ , as appropriate, of the connection shall be based on the load combinations in the *applicable building code* that include the *amplified seismic load*. In determining the amplified seismic load the effect of horizontal forces including overstrength,  $E_{mh}$ , shall be taken as:  $E_{mh} = 2[1.1 R_y M_p] / L_{cf}$  (E1-1) where:  
 $L_{cf}$  = clear length of beam, in. (mm)  
 $M_p = F_y Z$ , kip-in. (N-mm)  
 $R_y$  = ratio of *expected yield stress* to the specified minimum yield stress,  $F_y$
23. Where steel backing is used with complete joint penetration (CJP) beam flange groove, steel backing shall be removed, except the top flange backing attached to the column by a continuous 5/16" fillet weld on the edge below the CJP groove weld need not be removed. (AISC 358 Chapter 3 (3.3))

## **CALCULATIONS**

24. Clearly identify on the plan for removal of the backing bar from the beam bottom flange upon completion of the welded joint. Following the removal of backing bar, the root pass shall be backgouged to sound weld metal and back-welded with a minimum leg size of 5/16-in. reinforcing fillet weld. (AISC 358 Chapter 3 (3.3))
25. Weld tab removal shall extend to within 1/8-in. of the base metal surface, except at continuity plates where removal to within 1/4-in. of the plate edge is acceptable. (AISC 358 Chapter 3 (3.4))
26. Single-sided partial joint penetration groove welds and single-sided fillet welds shall not be used to resist tensile forces in the connections.

### **PARTIALLY RESTRAINED MOMENT CONNECTIONS (PR)**

27. Design shall be based on AISC SPSSB Section E1.6c
28. Complete joint penetration groove welds of beam flanges, shear plates, and beam webs to columns shall be demand critical welds. E1.6a, E2.6a & E3.6a.

### **QUALITY ASSURANCE, QUALITY CONTROL (QA/QC)**

Engineer of record shall indicate on the plans the following QA/QC information in accordance with AISC SPSSB Section J & I.

29. Referenced Documents
30. Material Specifications
31. Welding Processes
32. Inspection & nondestructive testing SPSSB Section J5
33. Contractor documents that has to be reviewed by the engineer of record including but not limited to:
  - a. Shop Drawings
  - b. Erection drawings
  - c. Welding Procedure Specifications (WPS)
  - d. Manufacturer certificate of conformance for all electrodes, fluxes and shielding gases.
  - e. Manufacturer product data sheets or catalog for SMAW, FCAW and GMAW process.
34. Quality Assurance Agency Documents SPSSB Section J4.
35. Inspection Points and Frequencies
  - a. Visual Welding Inspection SPSSB Section J7.
  - b. Nondestructive Testing (NDT) of Welds SPSSB Section J5.
  - c. Inspection of Bolting SPSSB Section J8.
  - d. Other Inspections SPSSB Section J9.

### **GENERAL**

36. Clearly identify in the structural calculations what type of steel moment frame system the structure is designed for.
37. The Response Modification Coefficient (R) value used for design of the steel moment frame system shall be in accordance with ASCE7 T-12.2-1.
38. Where working design is used, the nominal strength of structural steel members shall be divided by the safety factor ( $\Omega$ ).
39. Provide calculations to comply with the requirements of AISC SPSSB section D1.4.
40. The required shear strength,  $V_u$ , of the beam-to-column connection shall be determined using the load combination of the building code considering the amplified Earthquake load shear  $E=2[1.1R_yF_yZ] / [\text{distance between plastic hinges}]$ . SPSSB Section E1.6b, E2.6d & E3.6d.
41. The maximum story drift,  $\Delta$ , of the frame shall not exceed the allowable story drift of ASCE7 T-12.12-1.
42. The connection of the frame to column base shall be designed to transmit forces to the foundation. Column base elements include anchor bolts, base plate welds, and any elements that transfer shear, moment, or tension to the foundation. SPSSB Section D2.6.
  - a. Column bases shall be designed for the member forces as those required for the members and connections framing into them. If the connections of the system are required to be designed for the amplified seismic loads or loads based on member strengths, the connection to the column base must be designed for those loads.
  - b. Design of concrete elements at the column base, including anchor rod embedment and reinforcement steel, shall be in accordance with ACI 318-11 Appendix D.
  - c. Grade beams shall be provided with ductile detailing per ACI 318 11 Chapter 21.

### **SPECIAL MOMENT FRAME (SM F)**

43. Members shall be sized to provide strong column/weak beam ratio more than 1 in accordance with Equation (E3-1) of AISC SPSSB Section E3.4a.
44. Column splices shall comply with AISC SPSSB E3.6g.& D2.5.
45. Provide calculations to show that the required shear strength of the panel zone,  $R_u$ , is less than the design shear strength  $\phi_v R_n$  (LRFD) of the panel zone. (AISC SPSSB E3.6e)

46. The individual thickness,  $t$ , of the column web and doubler plates, if used, shall be  $t \geq (d_z + w_z)/90$  (E3-6). (AISC SPSSB Section E3.6e)

#### **INTERMEDIATE MOMENT RESISTING FRAME (IMF)**

47. The R value used in determining the base shear shall be limited to 4.5.
48. In seismic category D, intermediate moment frames are permitted to a height of 35-ft. For exceptions see footnote k of Table 12.2-1 and ASCE 7 Section 12.2.5.7.1.
49. In seismic category E, intermediate moment frames are permitted to a height of 35-ft. provided neither the roof nor the floor dead load supported by and tributary to the moment frame exceeds 35-psf. The dead load of the exterior walls tributary to the moment frame shall not exceed 20-psf. ASCE 7 Section 12.2.5.7.2b. See 12.2.5.7.2a for other limitations.
50. In seismic category F, intermediate moment frames are permitted in light-frame construction and with weight limitations of category E. ASCE 7 Section 12.2.5.7.3b.
51. Single story intermediate moment resisting frame in seismic category D or E is permitted up to a height of 65-ft. where the dead load of the roof and exterior wall tributary to the moment frame and more than 35-ft. above the base does not exceed 20-psf. For exceptions see ASCE 7 Section 12.2.5.7.1 & 12.2.5.7.2.
52. Single story intermediate moment resisting frame in seismic category F is permitted up to a height of 65-ft. where the dead load of the roof and exterior wall tributary to the moment frame does not exceed 20-psf. ASCE 7 Section 12.2.5.7.3a.
53. The required shear strength of the beam-to-column connection need not exceed the shear resulting from the application of appropriate load combinations using the amplified seismic load per AISC SPSSB Eq. (E2-1) and load combinations with over strength factor (ASCE7 12.4.3.1 & 12.4.3.2.)
54. For panel zone, continuity plates, column splices and lateral bracing requirements of the AISC SPSSB Section E2.6e shall be satisfied.

#### **ORDINARY MOMENT RESISTING FRAME (OMF)**

55. The R value used in determining the base shear shall be limited to 3.5.
56. Within light-frame construction ordinary moment frame in Seismic Design Category D or E is permitted when the height is limited to 35-ft.

provided neither the roof nor the floor dead loads supported by and tributary to the moment frame exceeds 35-psf. The dead load of exterior walls tributary to the moment frame shall not exceed 20-psf. AISC 7 Section 12.2.5.6.1b.

57. Single story ordinary moment resisting frame in seismic category D or E is permitted up to a height of 65-ft. where the dead load of the roof and exterior wall tributary to the moment frame and more than 35-ft. above the base does not exceed 20-psf. AISC 7 Section 12.2.5.6.1a.
58. Single story ordinary moment resisting frame in seismic category F is permitted up to a height of 65-ft. where the dead load of the roof and exterior wall tributary to the moment frame does not exceed 20-psf. AISC 7 Section 12.2.5.6.2.

#### **BEAM-TO-COLUMN CONNECTION FOR STEEL MOMENT FRAMES**

59. Pre-qualified connections for Special and Intermediate Steel Moment Frames (SMF) & (IMF) for seismic applications shall be within limitations and specifications of AISC 358 and one of the following types:
- Reduced Beam Section (RBS)
  - Bolted Unstiffened Extended End Plate (BUEEP)
  - Bolted Stiffened Extended End Plate (BSEEP)
  - Welded Unreinforced Flange-Welded Web (WUF-W)
  - Kaiser Bolted Bracket (KBB)-Proprietary Connection
  - ConXtech ConXL- Proprietary Connection
60. Non-qualified connections for Special and Intermediate Steel moment frames (SMF) & (IMF) shall be tested in accordance with the AISC SPSSB, Section K2. The Research Section of Building and Safety Division shall approve the report of the test. Variations in weight and size of the frame members within the limitations of AISC SPSSB Section K2 will be permitted.
61. Proprietary connections shall be presented and approved by the Research Section of Building and Safety Division.
62. Connections for Ordinary Moment Frame (OMF) are prescriptive and are based on strength calculations and prescriptive details. No testing is required.
- Beam-to-column connections shall be made with welds and/or high-strength bolts. Connections are permitted to be fully restrained (FR) or partially restrained (PR) moment connections.

