Lateral Load-Resisting Frames using Steel Joist and Joist Girders

MAY 20, 2020
Polling Questions

• New requirement to earn PDH credits
• Two questions will be asked during the duration of today’s presentation
• The question will appear within the polling section of your GoToWebinar Control Panel to respond
Disclaimer

The information presented herein is designed to be used by licensed professional engineers and architects who are competent to make a professional assessment of its accuracy, suitability and applicability. The information presented herein has been developed by the Steel Joist Institute and is produced in accordance with recognized engineering principles. The SJI and its committees have made a concerted effort to present accurate, reliable, and useful information on the design of steel joists and Joist Girders. The presentation of the material contained herein is not intended as a representation or warranty on the part of the Steel Joist Institute. Any person making use of this information does so at one’s own risk and assumes all liability arising from such use.
Description

This webinar will highlight key points when using open web steel joists and Joist Girders in lateral load resisting systems for wind and seismic loads. The webinar addresses commonly used frames, diaphragms and bracing systems as well as commonly used details and effective ways to communicate the design requirements to the joist manufacturer. SJI Technical Digest 11 is the reference for this webinar.
Learning Objectives

• Focus on the use of open web products in several different lateral load resisting systems.

• Specify how to clarify loads.

• Provide examples of commonly used connection details.

• Share tips on how to reduce costs of different systems.
New Tools for Moment Connections

Joist Girder Moment Connection Design Tools

These design tools have been developed by the Steel Joist Institute to assist the SER, the Connection Designer and the Steel Fabricator with the complex task of designing appropriate connections between Joist Girders and columns. The tools can be utilized for wide flange and HSS columns. Click on the links below to download the reference manual and design spreadsheet for each. (Note: The Design Spreadsheets are only PC compatible.)


1. Joist Girder Moment Connections to the Strong Axis of Wide Flange Columns
   Reference Manual | Design Spreadsheet

2. Joist Girder Moment Connections to the Strong Axis of Wide Flange Columns-Intermediate Levels
   Reference Manual | Design Spreadsheet

3. Joist Girder Moment Connections to the Weak Axis of Wide Flange Columns
   Reference Manual | Design Spreadsheet

4. Joist Girder Moment Connections to HSS Columns – Top Plate
   Reference Manual | Design Spreadsheet

5. Joist Girder Moment Connections to HSS Columns – Knife Plates
   Reference Manual | Design Spreadsheet

   Reference Manual | Design Spreadsheet
Systems and Selection

• Diaphragms
  – Connections

• Horizontal Bracing
  – Connections

• Braced Frames
  – Connections

• Moment or Rigid Frames
  – SJI Moment Connection Tool
Systems and Selection

Selection:

The choice of the most economical lateral load system is dependent on several parameters. These principally include:

1. The building end use
2. The building geometry
3. Expansion joint requirements
4. The type of roofing system
5. Future expansion requirements
Systems and Selection

Selection:

The systems can be mixed to provide the optimum structure. For example, diaphragms with moment frames in one direction and braced frames in the perpendicular direction.

As a rule braced frames with horizontal roof or floor diaphragms provide the most economical framing system for joist and Joist Girder buildings.

This should be the specifying professional’s first choice as a system.

The parameters listed above can cause a different framing system to be used.
Systems and Selection

Selection:

SEISMIC CONSIDERATIONS

Joists or Joist Girders are commonly used to resist seismic forces.

Joists and Joist Girders can be used as the beam in ordinary moment frame type systems, as chords/collectors of the diaphragm system and continuous ties in the wall anchorage system.
When designing a structure to resist seismic forces, the engineer must first select a Seismic Force Resisting System (SFRS). ASCE 7 Table 12.2-1
Diaphragm Methodology

Provides in-plane shear strength and stiffness (transfer in-plane forces)

Different planes:
• Roof diaphragm
• Floor diaphragm
• Wall diaphragm
• Inclined surface
Diaphragm – A Deep Girder With Deck as Web

**Diagram:**

- **Diaphragm:** Graphical representation showing the diaphragm's structure with labeled parts:
  - **Q₁**
  - **Qₜₜ**
  - **b**
  - **R**
  - **Beam Flange** (Perimeter Members)
  - **Beam Web** (Deck Diaphragm)
  - **Lateral Load Resisting Line** (Wall Diaphragm, or Vertical Braced Frame, or Others)
Typical Connections

- Side lap connections
- Support connection/Transverse welds/Perimeter connection
- Framing member parallel to deck
- Intermediate connections
  - Longitudinal welds
- Additional shear transfer elements where required
- OWSJ transverse to deck
Diaphragm Stiffness (Deflection Calculation)

\[ \Delta = \frac{5wL^4}{384EI} + \frac{qL^2}{8bG'} \]

1st part: area of the edge members determine moment of inertia

2nd part: deck type and attachment pattern determine value G’ for deck diaphragm.
Diaphragm stiffness is an issue when there are multiple vertical bracing lines with different relative stiffness between them.
Diaphragm/Support Stiffness vs. Lateral Load Distribution

Differential deflection with uniform loading
Diaphragm/Support Stiffness vs. Lateral Load Distribution

Flexible Diaphragm

[Diagram showing lateral loads and corresponding RR values]
Connection

The connections fall into three basic categories:

1. Chord Force Connections
2. Shear Wall Attachments
3. Vertical Bracing Attachments
Chord Forces

SJI Code of Standard Practice 2.3

The specifying professional shall provide the nominal loads and load combinations as stipulated by the applicable code under which the structure is designed and shall provide the design basis (ASD or LRFD).

• The specifying professional shall calculate and provide the magnitude and location of ALL JOIST and JOIST GIRDER LOADS. This includes all special loads (drift loads, mechanical units, net uplift, axial loads, moments, structural bracing loads, or other applied loads) which are to be incorporated into the joist or Joist Girder design.

• Type and magnitude of end moments and/or axial forces at the joist and Joist Girder end supports shall be shown on the structural drawings...
Chord Forces

SJI Code of Standard Practice 2.3

The IBC Building Code must be clearly noted, so that the applicable load combinations can be taken.

Any additional load cases from the standards in the IBC must be clearly defined.

Due to the factors in the equations, the loads must be defined with the factors in mind. Loads specified as:

\[ W = 20 \text{ kips}; \quad E = 15 \text{ kips} \]

are considered to be Strength Level unfactored loads consistent with their ASCE7 definitions.

Strength vs. Service/Factored vs Unfactored - define don’t assume.
Load Combinations

Basic Load Combinations from ASCE7-10 (Roof)

<table>
<thead>
<tr>
<th>ASD Load Combination</th>
<th>LRFD Load Combination</th>
</tr>
</thead>
<tbody>
<tr>
<td>D + Lr</td>
<td>1.4D</td>
</tr>
<tr>
<td>D + 0.6W</td>
<td>1.2D + 1.6Lr</td>
</tr>
<tr>
<td>D + 0.7E</td>
<td>1.2D + 1.6Lr + 0.5W</td>
</tr>
<tr>
<td>D + 0.75(Lr or S) + 0.75(0.6W)</td>
<td>1.2D + 1.0W + 0.5Lr</td>
</tr>
<tr>
<td>D + 0.75S + 0.75(0.7E)</td>
<td>1.2D + 1.0E + 0.2S</td>
</tr>
<tr>
<td>0.6D + 0.6W</td>
<td>0.9D + 1.0W</td>
</tr>
<tr>
<td>0.6D + 0.7E</td>
<td>0.9D + 1.0E</td>
</tr>
</tbody>
</table>

Seismic Load Combinations w/ Overstrength

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<tr>
<td>(1.0 + 0.14Sds)D + 0.7Em</td>
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<tr>
<td>(1.0 + 0.105Sds)D + 0.525Em + 0.75S</td>
</tr>
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<td>(0.6 - 0.14Sds)D + 0.7Em</td>
</tr>
</tbody>
</table>
Chord Forces

The Engineer of Record Must Indicate the Chord Force Requirements on the Contract Documents

Lateral (Axial) loads must be specified as:

- E or $E_m$ for earthquake loads
- W for wind loads
- Strength vs. Service level load – Define loads $W=20k$
- The applicable load combinations for each - IBC 2015 ASD $S_{ds}$ must be provided for earthquake load combinations.
Chord Forces

When specifying Earthquake or Wind loads it is recommended that they be specified using E, \( E_m \), or W. i.e., \( E = 25 \) kips, \( W = 18 \) kips

These loads can be directly input into the applicable building code and/or ASCE7 ASD or LRFD load combinations.

If you opt to specify Earthquake or Wind loads as Service level forces include the load factor used to convert the calculated Strength level load to Service. i.e., \( 0.7E = 15 \) kips, \( 0.6W = 10 \) kips.

Avoid specifying loads as “Factored”. This does not clearly define the “load factor” used to factor the load.
Chord Forces Tips

• Chord Forces are carried as additional axial loads by the top chords of joists and/or Joist Girders.

• Chord Forces may vary from one end of the joist chord to the other. The additional axial load for each joist and/or Joist Girder must be indicated.

• Connections to transfer additional axial loads from one joist to another or from joist to supporting structure must be indicated.

• Avoid transferring joist or Joist Girder axial forces or end moments through the bearing seat connection.

• The top and bottom chord connection details to the structure shall be designed by the specifying professional. The joist designer shall furnish the specifying professional with the joist information if requested.
Chord Forces Load Designation

Tables similar to this can be used to designate loads.

<table>
<thead>
<tr>
<th>Joist Mark Number</th>
<th>Designation (1)</th>
<th>Wind Top Chord Axial Load 0.6W</th>
<th>Dead Load</th>
<th>Roof Live Load Lr</th>
<th>Downward Wind load 0.6W</th>
<th>Net Wind Uplift load (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>30K7</td>
<td>20.0 kips</td>
<td>44 plf</td>
<td>63 plf</td>
<td>32 plf</td>
<td>150 plf</td>
</tr>
</tbody>
</table>

(1) Standard designation is minimum requirement. Joist Manufacturer to modify joist design as required for combined loading requirements.

(2) Joist manufacturer to use these load in the applicable code load combinations to design the joist for combined bending and axial.

(3) Net Wind Uplift is the result of the 0.6D+0.6W load combination.
Diaphragm Chord in the Basic Joist Connection
Additional Chord Bending from Axial Load Transferred Through Joist or Joist Girder Bearing Seat
Joist Chord Bending

Axial Transfer Rod Between Bearing Seat Angles
Joist Chord Bending

Axial Transfer Rod Outside of Bearing Seat Angles
Joist Tie Plate

- Used to Transfer Axial Load directly from Joist to Joist
- Tie Plate & Weld Designed by Specifying Professional
- Try to keep tie plate width to 4”
- Any weld size over 3/16” may require the top chord to be increased
Joist Tie Angles

- Increased seat depth to accommodate angle size may be required.
Shear Transfer Methods at Diaphragm Perimeter

- Deck Support Angles
- Shear Collectors
- Transfer to Shear Walls
- Across Expansion Joints
- Attachment to Vertical Bracing with Joist Girder
- Joist Seat (avoid whenever possible as this results in joist seat Rollover)
Deck Support Angle

Continuous Angle (collector)
 Loads must be transferred to the Joist girder top chord

Field Weld or Screw Deck to Angle per Roof Diaphragm Requirements

Joist Girder top chord acting as diaphragm chord
Joist Seat Rollover

EOR needs to consider seat rollover forces for the bearing seat weld connection design.
Deck Support Angle and Joist Seat Rollover
Deck Support Angle and Joist Seat Rollover

• All joist seats that are designed for rollover require reinforcing and consequently will cost more.

• Generally the maximum rollover force that can be accommodated by a stiffened seat is 3 kips.

• Joist bearing seats that require erection bolts are more difficult to accommodate the stiffeners.
Shear Collector With K-Series Joist

**Diagram: Shear Collector**

- **ROOF DECK**
- **HSS 2 1/2 X 2 1/2 X 3/16 CENTER BETWEEN JOISTS (NOT BY JOIST MANUFACTURER)**
- **JOIST GIRDER**
Shear Collector with LH-Series Joist

- ROOF DECK
- 3/16"
- 5"
- HSS 5X, L5X, 5" Bent PL, CHANNEL C5, CENTER BETWEEN JOISTS (NOT BY JOIST MANUFACTURER)
- JOIST GIRDER
CONCRETE FILLED BOND BEAM

CMU WALL

LEDGER ANGLE ANCHORED TO WALL, COMMONLY A BENT PLATE (NOT BY JOIST MANUFACTURER)

DECK ATTACHED TO LEDGER TO TRANSFER SHEAR FORCE

CAMBER OF JOIST TO BE SPECIFIED TO MATCH LEDGER

DECK
Precast Insert

SECTION A

SLOTTED INSERT

DECK NOT SHOWN FOR CLARITY

T-STRAP (NOT BY JOIST MANUFACTURER)
Expansion Joint Shear Transfer
Steel Diaphragm Summary

- Diaphragms work as deep beams the with deck as the web
- Deck fasteners and attachment patterns control strength and stiffness
- Design methods and limit states
  - Strength Level (LRFD) or Service Level (ASD)
- Diaphragm stiffness is comprised from part bending + part shear
- Tension and shear combination on fasteners. The fastening system must be designed for the combination of tension and shear loads in the horizontal diaphragm
- Concrete filled diaphragms are stronger and stiffer.
Polling Question

Open Web Steel Joist and Joist Girders can be used in the following Lateral Load Resisting Systems.

A. Diaphragm Systems
B. Horizontal Bracing
C. Braced Frames
D. Moment or Rigid Frames
E. All of the above
Horizontal Bracing
Horizontal Bracing

• Is bracing required in One or Two Directions?

• Bracing Forms

• System Assumptions
  – Bracing in combination with Joists and Joist Girders.
  – Joints are “pinned”

• Analysis Assumption Options:
  – Design each joist and/or Joist Girder for full lateral load, regardless of the number of horizontal trusses.
  – Distribute the lateral loads equally to each of the horizontal trusses (assuming the trusses have equal stiffness)
  – Design each truss for wind pressure or wind suction loads
Horizontal Bracing

Loading consists of additional Top or Bottom Chord forces to a joist or Joist Girder as part of a horizontal truss. Load types for load combinations are needed.

Load schedules could be as follows:

<table>
<thead>
<tr>
<th>Joist Mark Number</th>
<th>Joist Depth &amp; Series</th>
<th>Dead Load (plf)</th>
<th>Dead Load Collateral (plf)</th>
<th>Roof Live Load L_r (plf)</th>
<th>Snow S_min (plf)</th>
<th>Snow S_1 (plf)</th>
<th>Snow S_2 (plf)</th>
<th>Rain R (plf)</th>
<th>Downward Wind load 1.0W (plf)</th>
<th>Net Wind Uplift load (plf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>24LH</td>
<td>80</td>
<td>16</td>
<td>136</td>
<td>120</td>
<td>85</td>
<td>385</td>
<td>48</td>
<td>100</td>
<td>150</td>
</tr>
</tbody>
</table>

(1) Net Wind Uplift is the result of the 0.6D+0.6W load combination.
(2) S_min is minimum uniform snow load for low sloped roof. This load is not to be combined with drift, sliding, unbalanced, or partial loads.
(3) See Diagram below for S_1 and S_2 loads, drift condition. These loads are not combined with S_min.

<table>
<thead>
<tr>
<th>Joist Mark Number</th>
<th>Wind Load 1.0W (kips)</th>
<th>Seismic Load 1.0E (kips)</th>
<th>Dead Load (kips)</th>
<th>Roof Live Load L_r (kips)</th>
<th>Snow S (kips)</th>
<th>Rain R (kips)</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>8.5</td>
<td>26.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

(1) Top chord axial load, Tension or Compression Load.
Horizontal Bracing One Direction
Horizontal Bracing Two Directions
Horizontal Bracing Details

Diagram showing details of horizontal bracing with labels including:
- Joist Top Chord
- Column Cap
- Joist Girder Top Chord
- Gusset Plate
- Strap Brace
- 2-1/2 x 2-1/2
Braced Frames

- Braced frames can be used as the only lateral system, or they can be used in conjunction with other systems, such as moment frames or shear walls.

- Braces include:
  - Chevron configuration or Inverted chevron
  - Eccentric braces
  - Single diagonal
  - X-bracing and K configuration

- The diagonal members can be structural shapes or Buckling Restrained Braces.
Braced Frames

• The configuration, number of bays and detailing requirements will vary based on the building geometry, height and building code requirements/restrictions.

• The horizontal members of braced frames can be joists and Joist Girder, except in eccentric braced frames.

• When a joist or Joist Girder is used in a braced frame, it may only qualify as an Ordinary Braced Frame, which may limit the use. The use of joists and Joist Girders for the typical floor framing in braced frames is common and not a problem.
Braced Frames

For steel braced frame systems, there are four types applicable to steel framed structures:

- Steel Eccentrically Braced Frames (Type B1, EBF)
- Steel Special Concentrically Braced Frames (Type B2, SCBF)
- Steel Ordinary Concentrically Braced Frames (Type B3, OCBF)
- Steel Buckling-Restrained Braced Frames (Type, BRBF)
Braced Frames

The need for interior braced frame lines often occurs in large structures that are quartered by expansion joints. The bracing shown around the perimeter does not provide lateral stability for the structure. Each building segment is torsionally unstable. Using selected interior bays for bracing, usually on each side of the expansion joints is the most economical solution.
Moment or Rigid Frames

For steel moment frame systems, there are four types applicable to steel framed structures:

- Steel Special Moment Frames (Type C1, SMF)
- Steel Intermediate Moment Frames (Type C3, IMF)
- Steel Ordinary Moment Frames (Type C4, OMF)
- Steel Special Truss Moment Frames (Type C2, STMF)
Moment Frames

For Seismic Loading:

- Frames utilizing SJI Joist or Joist Girders are considered “Steel Ordinary Moment Frames”
- ASCE 7 – 16 Table12.2-1 has restrictions about how and when they can be used.
- The forces and moments need to be determined based on the appropriate factors.
Moment Frames

AISC 341-10 and ASCE 7-10 are the governing codes in most cases. (Also see the commentary for AISC 341-10 Section E1.2 for clarification for truss frames with seismic loads)

Any and all design requirements for the open web member used in a rigid must be specified.

See the footnotes for Table 12.2-1 for projects in Seismic design categories D, E, & F
Moment Frames

From SJI Code of Standard Practice 2.3

• The specifying professional shall provide the nominal loads and load combinations as stipulated by the applicable code under which the structure is designed and shall provide the design basis (ASD or LRFD).

  Example - IBC 2015 ASD design

• Type and magnitude of end moments and/or axial forces at the joist and Joist Girder end supports shall be shown on the structural drawings.

  Example – Table on slide 91
Moment Frames

From SJI Code of Standard Practice 2.3

• A note shall be provided on the structural drawings stating that all moment resisting joists shall have all dead loads applied to the joist before the bottom chord struts are welded to the supporting connection whenever the moments provided do not include dead load.
  
  – Example – Weld bottom chords of joists and joist girders to columns where noted only after dead loads have been applied.

• If accommodations are made for attachment of BC prior to all dead load are applied, note as such:
  
  – Example – Weld bottom chords of joists and joist girders to columns where noted only after 70 % of dead loads have been applied.

• The top and bottom chord moment connection details shall be designed by the specifying professional. The joist designer shall furnish the specifying professional with the joist detail information if requested.
## Moment Frames

**Basic Load Combinations from ASCE7-05 (Roof)**

<table>
<thead>
<tr>
<th>ASD Load Combination</th>
<th>LRFD Load Combination</th>
</tr>
</thead>
<tbody>
<tr>
<td>D + Lr</td>
<td>1.4D</td>
</tr>
<tr>
<td>D + 0.6W</td>
<td>1.2D + 1.6Lr</td>
</tr>
<tr>
<td>D + 0.7E</td>
<td>1.2D + 1.6Lr + 0.8W</td>
</tr>
<tr>
<td>D + 0.75Lr + 0.75(0.6W)</td>
<td>1.2D + 1.0W + 0.5(Lr or S)</td>
</tr>
<tr>
<td>D + 0.75(0.7E)</td>
<td>1.2D + 1.0E + 0.2S</td>
</tr>
<tr>
<td><strong>0.6D + W</strong></td>
<td>0.9D + 1.6W</td>
</tr>
<tr>
<td><strong>0.6D + 0.7E</strong></td>
<td>0.9D + 1.0E</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Seismic Load Combinations w/ Overstrength</th>
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</thead>
<tbody>
<tr>
<td>(1.0 + 0.14Sds)D + 0.7Em</td>
<td>(1.2 + 0.2Sds)D + Em + 0.2S</td>
</tr>
<tr>
<td>(1.0 + 0.105Sds)D + 0.525Em + 0.75(Lr or S)</td>
<td>(0.9 - 0.2Sds)D + Em</td>
</tr>
<tr>
<td>(0.6 - 0.14Sds)D + 0.7Em</td>
<td></td>
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</table>
### Rigid Frames

#### Basic Load Combinations from ASCE7-10 (Roof)

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<td>1.2D + 1.6Lr</td>
</tr>
<tr>
<td>D + 0.7E</td>
<td>1.2D + 1.6Lr + 0.5W</td>
</tr>
<tr>
<td>D + 0.75(Lr or S) + 0.75(0.6W)</td>
<td>1.2D + 1.0W + 0.5Lr</td>
</tr>
<tr>
<td>D + 0.75S + 0.75(0.7E)</td>
<td>1.2D + 1.0E + 0.2S</td>
</tr>
<tr>
<td>0.6D + 0.6W</td>
<td>0.9D + 1.0W</td>
</tr>
<tr>
<td>0.6D + 0.7E</td>
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#### Seismic Load Combinations w/ Overstrength

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</tr>
<tr>
<td>(1.0 + 0.105Sds)D + 0.525Em + 0.75S</td>
<td>(0.9 - 0.2Sds)D + Em</td>
</tr>
<tr>
<td>(0.6 - 0.14Sds)D + 0.7Em</td>
<td></td>
</tr>
</tbody>
</table>
Moment Frames

When joists or Joist Girders are used in Moment Frames the Engineer of Record must indicate the load requirements and any special load combinations, as applicable, on the Contract Documents.

<table>
<thead>
<tr>
<th>Girder Mark Number</th>
<th>Designation (Total Load/ Live Load)</th>
<th>Wind Axial Load 1.0W (kips)</th>
<th>Seismic Axial Load 1.0E (kips)</th>
<th>Add-Load (kips)</th>
<th>Min. Moment of Inertia I₀ (in⁴)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>40G 5N 13.0K/7.0K</td>
<td>-</td>
<td>-</td>
<td>4.0</td>
<td>-</td>
</tr>
<tr>
<td>G2</td>
<td>36G 5N 8.5K/3.5K</td>
<td>18.0</td>
<td>20.0</td>
<td>2.0</td>
<td>1,128</td>
</tr>
</tbody>
</table>

(1) Manufacturer to design Joist Girders using ASD. Nominal design loads shown are to be used in the applicable ASD code load combinations.
(2) Deflection Criteria: Live Load Deflection ≤ L/240.
(3) See Net Wind Uplift Diagram for uplift loads on girders.
(4) See framing plan for additional loads to be included in Joist Girder design, including mechanical loads.
(5) See framing plan for joist spacing along girder.
(6) Top chord axial load, Tension or Compression Load.
(7) Add-Load is to be treated as a Dead Load "D" for load combinations.
(8) End Moment Sign Convention, Positive moments:
Connections

Joists and Joist Girders in lateral load resisting frames must have the top and bottom chord “fixed” to the column.
Moment Connection Design

www.Steeljoist.org
Design Tools

Joist Girder Moment Connection Design Tools

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   Reference Manual | Design Spreadsheet

   Reference Manual | Design Spreadsheet
The Welded Basic Connection

Note: Weld Bottom Chord only after All Dead Loads are Applied
## The Welded Basic Connection

<table>
<thead>
<tr>
<th>Joist Girder (7.5” Seat)</th>
<th>ASD $P_a$</th>
<th>LRFD $\phi P_n$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top Chord Leg Size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5”</td>
<td>$4^K$</td>
<td>$6^K$</td>
</tr>
<tr>
<td>3.0”</td>
<td>$8^K$</td>
<td>$12^K$</td>
</tr>
<tr>
<td>3.5” and larger</td>
<td>$10^K$</td>
<td>$15^K$</td>
</tr>
</tbody>
</table>
The Welded Basic Connection: With Tie Angles

Bolts for joist connection may have to be removed to install tie angles.
Top Chord Transfer Angles
Special Reinforced Top Chords

A-A Knife Plates
B-B Extended Bearing Seat Angles
Reinforced Chords

SECTION A-A

SECTION B-B

1" X 5"
BAR
Rigid Seat Connection

$P_{\text{max}} = 50 \text{ kips (Service)}$

$75 \text{ kips (Strength)}$

Special Design Required
Moment Plate Connection

$P_{\text{max}} = 210 \text{ kips (Service)}$

$300 \text{ kips (Strength)}$

TIE PLATE

BOTH SIDES
Floor Moment Plate Connection

$P_{\text{max}} = 210 \text{ kips (Service)}$
$300 \text{ kips (Strength)}$

TIE PLATE

BOTH SIDES
The Basic Connection (at column)
The Basic Connection with Tie Plate
Stiffeners in Girder Seat

- STIFFENER PLATES
- BOTH SIDES
Joist Reinforced End Panel
Joist Reinforced End Panel
Joist Reinforced End Panel
Bottom Chord Extensions

Consider:

•Magnitude of Bottom Chord Force

•Geometrical Requirements
  –Chord Gap
  –Welding

•Column Type
Bottom Chord Attachment to Flanges
Framing to Column Web
Angle Reinforcement to Stabilizer Plates
HSS Column
Frames with Wind Connection

• Advantages:
  – Elimination of Large Continuity Moments
  – Reductions for Stiffeners, Doublers, etc.
  – Reductions in Welding Requirements

• Disadvantages:
  – Brackets on Single Story Columns
Technical Digest 11 Examples:

• Moment Frame with Joist Girders R=3.5, Charleston, SC IBC 2006

• Moment Frame with Joist Girder R=3.0, Jackson, MS, IBC 2006

• Sample Design of a Joist Girder with Moments
Check Out Our Resources

SJI offers a number of resources including:

- Design tools
- Publications
- Live webinars
  - Our next live webinar will be on June 17, 2020 3:00 p.m. EDT
    - Design of Steel Deck for Concentrated and Nonuniform Loading
- Webinars on demand
  - Our Webinars on Demand section offers 40+ pre-recorded webinars. Earn PDHs today.
Polling Question

Axial load transfer details is the design responsibility of the specifying professional.

A. True

B. False
Polling Answers

Open Web Steel Joist and Joist Girders can be used in the following Lateral Load Resisting Systems.

A. Diaphragm Systems
B. Horizontal Bracing
C. Braced Frames
D. Moment or Rigid Frames
E. All of the above

Axial load transfer details is the design responsibility of the specifying professional.

A. True
B. False

True – To make this task easier the SJI has free downloadable tools to assist with this.
Q&A SESSION
THANK YOU