



Updated Guidance for Safe Handling and Erection of Joists – Inside the New Edition of Technical Digest 9

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- Co-authored the SEAA/NISD joint publication *Detailing Guide for the Enhancement of Erection Safety*



Webinar Details

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 - Muted for the presentation.
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 - Required to be connected to the webinar for at least 1 hour and 15 minutes for PDH credits.
 - Individual connections will be logged in the report.
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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.



Webinar Description

The Steel Joist Institute's Technical Digest 9: Handling and Erection of Steel Joists and Joist Girders was recently updated. This invaluable resource for erectors, contractors and engineers presents clear and concise information on the safe installation of open web steel joists and joist girders. The webinar will provide an in-depth look at the newly updated digest and highlight the most significant changes including, added information on loading and shipping joists, erecting special configuration joists and bridging, as well as an entire new chapter on erection engineering.



Learning Objectives

- Identify different joist products.
- Describe the information provided in SJI Technical Digest 9.
- Understand considerations for handling and erection of steel joists.
- Determine where engineered erection plans are needed and how they are developed.

Technical Digest 9, Third Edition



- Handling and Erection of Steel Joists and Joist Girders
 - Products
 - Pre-erection meeting
 - Loading and shipping
 - Receiving, unloading and storing
 - Erecting joist products
 - Field inspection
 - Panelized erection
 - Bridging
 - Miscellaneous topics – common field issues
 - Summary – do's and don'ts
- Published March 2008

Technical Digest 9, Fourth Edition



- Additional information in Chapters 3, 5, 8, and 9
- Entire new Chapter 11 on Erection Engineering
- Updated Appendix A and B to include references to the latest SJI Specifications.
- Now available on the SJI website



Technical Digest 9

- Proper handling and erection procedures for open web steel joists so that
 - The products are not damaged
 - The products perform as specified
 - **The safety of the steel erectors is ensured.**
- If a joist manufacturer is asked, “How good are your products?”, the answer almost certainly would be: “only as good as their installation.” A joist manufacturer can design and build joist products with remarkable intrinsic strength, but whether these products can deliver this strength is largely dependent on how well they are handled from the time they leave the manufacturing facility until they are permanently installed in the field.

Building Component Nomenclature



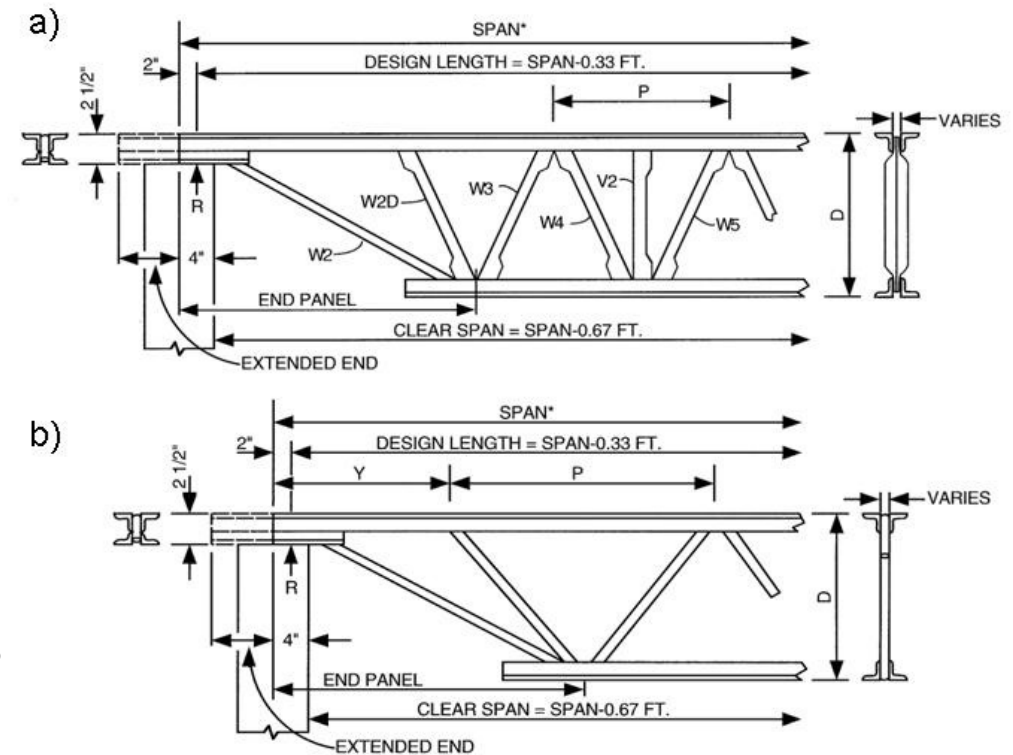


Products

- Steel joists
 - K-Series include KCS Joists and joist substitutes (bar joists or shortspans)
 - LH-Series joists (longspans)
 - DLH-Series joists (deep longspans)
- Composite joists
 - • CJ-Series composite joists
- Joist girders

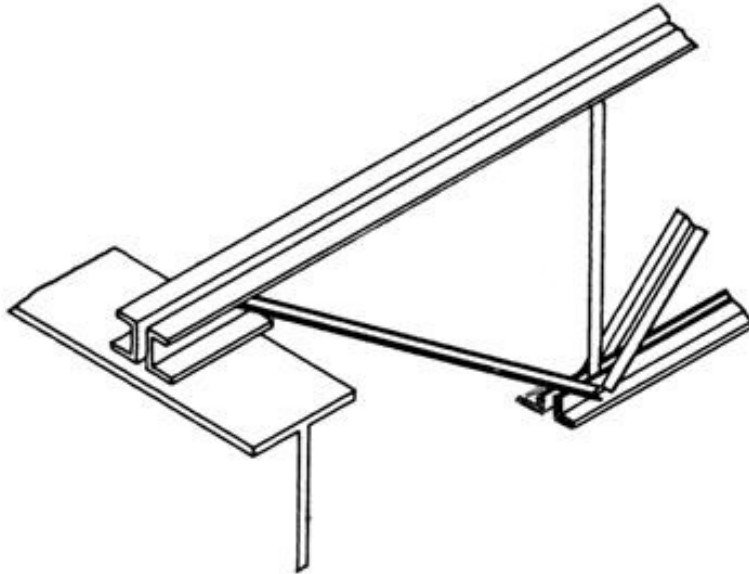
Elements of a Joist

- Top chord
 - back-to-back angles with a gap
- Bottom chord
 - back-to-back angles with a gap
- Interior diagonal and/or vertical pieces called web members
 - solid round bar, single angles, crimped angles, double angles, cold-formed channels
- End bearing seats



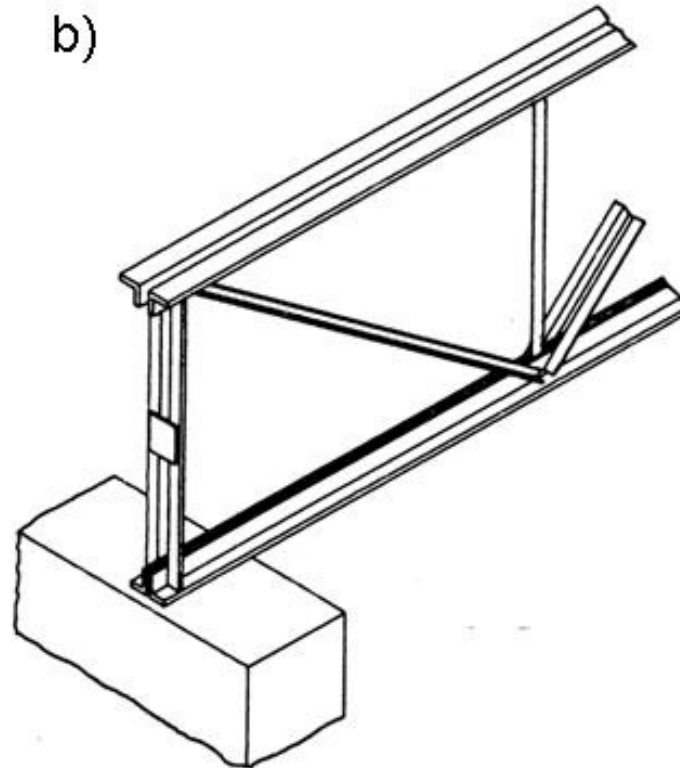
Joist Ends

a)



Underslung Joist

b)



Square End Joist

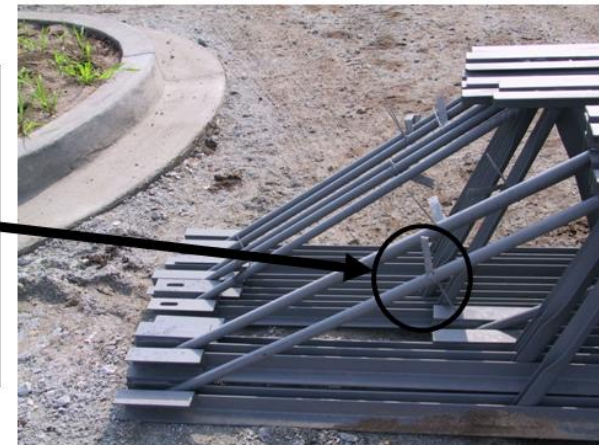
Non-Standard SJI Products

- Special Profiles
 - barrel joists, bowstring joists, gable joists, scissor joists
- Joist products over 240 feet in length and depths greater than 120 inches
- These are not “standard” Steel Joist Institute products and should be erected in accordance with the American Institute of Steel Construction *Code of Standard Practice for Steel Buildings and Bridges* and OSHA Regulations.



Joist Tags

- A metal or plastic tag is attached to one end of each joist product.
 - The joist manufacturer's name.
 - The joist manufacturer's job number.
 - The erection mark (such as J1 or T3).
- Some joists are not symmetrical, consequently it is imperative that the “Tag End” of a joist be placed as indicated on the joist placement plans.
- The tag should not be removed





Joist Handling at the Plant

- The handling of joist products begins in the joist plant immediately after the joists have been manufactured. Depending on size and length, several joists or joist girders are bundled together with metal strapping.
- They are painted, when required, and moved to a covered location where they are allowed to air dry.
 - The standard shop paint is intended to protect the steel for only a short period of exposure in ordinary atmospheric conditions.



Joist Loading

- Joist products are typically loaded onto flatbed trailers.
- Joist products are usually shipped upside down.
 - This provides greater stability to the bundles since the top chord is usually a heavier member than the bottom chord; and, in the more common underslung condition, the top chord extends the entire length of the joist or joist girder, while the bottom chord is shorter in length.
- Joist bundles are placed on the bed of the trailer, usually filling out the complete width of the bed. Spacers (normally wooden slats called dunnage) are usually placed on top of each layer of joists, perpendicular to their length.



Joist Loading

- When the loading operation is complete, the entire load is chained (or strapped) down to prevent shifting or overturning.
- Joist manufacturers take care to ensure joist products are not overtightened by chains or straps when loaded on trucks.
 - Overtightening of chains or straps can cause joist chord and web members to bend.
 - It is best to locate the straps at panel point locations since the web members of the joist are the most rigid part of the joist and are less susceptible to damage.

Joist Loading





Polling Question 1

True or false, it is okay to remove the joist tag once the joist is received at the jobsite.

- A. True
- B. False



KEY DECISION POINTS ERECTION

Joists

- 1) Determine crane placement/capacity restraints
- 2) Preferred erection/delivery sequence, schedule
- 3) Are there stability concerns?
- 4) Panelization of joists vs. singles/bundles
- 5) Determine bridging "terminus points"
- 6) Potential bridging conflicts w/sky lights, fire protection
- 7) Egress/Fall Protection
- 8) Long Span Joist Rigging Requirements



Receiving

When a truck arrives, the load should be inspected before releasing the chains or straps that are securing the load.

1. Inspection of the load for indicators of possible instability such as shifted product or broken banding.
2. Inspection of the joist products for evidence of physical damage.
3. Verification of items being delivered by comparison with the piece count and description on the delivery ticket or bill of lading.

Damage

- The joist manufacturer should be informed of any noticeable damage immediately.
- If necessary, field modifications will be provided by the joist manufacturer to assist in performing the repair.
- It may be possible to cold straighten very minor bends to outstanding legs of chords using wrenches.





Unloading

- Joist products are typically unloaded by either crane or forklift.
- Whenever possible, joist products should be unloaded in bundles.
- Bundles should never be lifted by their strapping. The banding material is not designed to carry the bundle's weight.

Unloading With a Crane



Unloading With a Fork Truck



Unloading With a Fork Truck

**Improper Joist Handling:
Load is Not Balanced on the Forks**



Unloading With a Fork Truck





Unloading Long and Slender Joists

- A standard deep longspan joist may be 240 feet long.
- Once the joists are installed and braced, they have great strength.
- However, handled singly they can be very flexible and unpredictable.
- Determination of lifting points and rigging techniques by a qualified person is critically important for such products.
- The erector must be aware of the possibility that the joist could “fold-up” under its own weight if not lifted and handled properly.



Jobsite Storage of Joist Products

- Joists and accessories should be set on proper timbers so that they are free from contact with the ground.
- When joist bundles are stacked (not preferable), timbers should be placed approximately at panel points and in line with the previously placed timbers below.
- Turning the tags in the same direction will aid in identifying members and make sorting easier.



Joists stored vertical, not horizontal.



Erecting Joist Products

Two key reminders about joists products

- They must be handled with greater care than rolled structural shapes to avoid damage.
- They are inherently unstable until they are completely installed, including attachment of joist products to supporting structural elements and the installation and anchorage of all required bridging or other bracing.

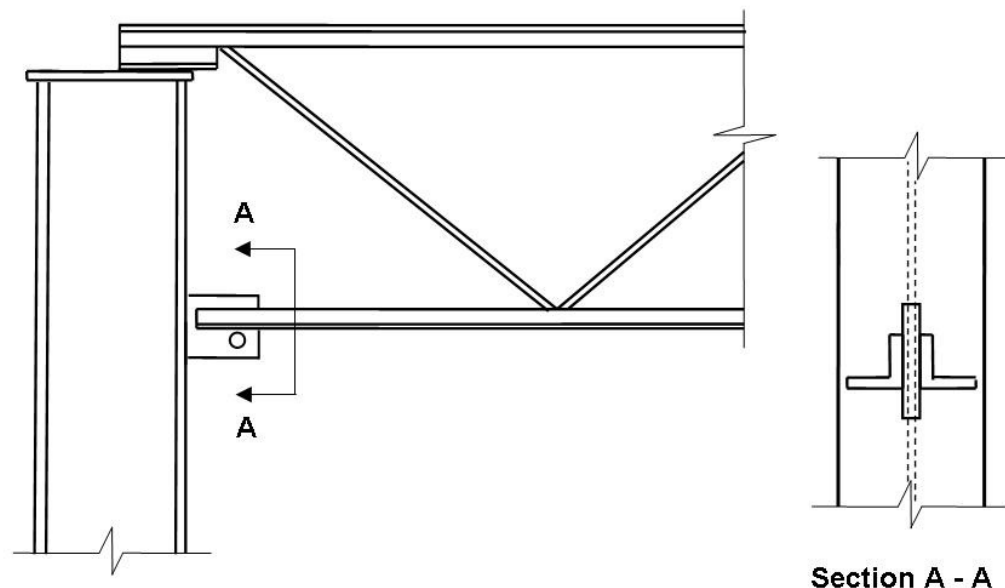


Erecting Joist Girders

- Joist girders are primary structural members that are normally supported by columns; they can, however, bear on steel plates on masonry or concrete supports.
- Joist girders must be erected singly.
- Since joist girders are not bridged, they are normally prevented from overturning by means of a vertical stabilizer plate at the bottom chord.

Erecting Joist Girders – Stabilizer Plates

- These plates "knife in" between the bottom chord angles that are spaced apart.
- Do not weld the joist girder bottom chord to the stabilizer plate unless called for on the joist placement plans or in the contract documents.



Erecting Joist Girders





Erecting Column Joists

- Joists located at or near column lines are referred to as OSHA Column Joists, tie joists, strut joists, or “OC” joists.
- The bearing seats of column joists will always be provided with slotted holes so that the bolts can be inserted at the time of joist placement.



"Tie Joists" Installed
Prior to Joist Panels



Stability of Column Joists

- OSHA requirement 1926.757(a)(3): “Where steel joists at or near columns span 60 feet (18.3 m) or less, the joist shall be designed with sufficient strength to allow one employee to release the hoisting cable without the need for erection bridging.”
- The Steel Joist Institute conducted extensive research to develop design methods to meet the original OSHA provision for column joists. However, it was determined that for some joist lengths there are no existing joist designs that would provide the necessary stability.
- OSHA policy: “for all joists at or near columns that span 60 feet or less, employers will be considered to be in compliance with 1926.757(a)(3) if they erect these joists either by: (1) installing bridging or otherwise stabilizing the joist prior to releasing the hoisting cable, or (2) releasing the cable without having a worker on the joists.”

Stability of Column Joists

- SJI recommends that employees never be allowed on unbridged column or tie joists.
- They will not support the weight of an employee unless the joist is properly stabilized and bridged
- SJI member companies warn erectors in various ways about erecting unbridged joists, including with “danger tags”
- If a tag is missing on a column joist, it is still not recommended to let an employee onto an unbridged column joist.

A safety warning sign with an orange background. At the top, there is a black silhouette of a person standing on a joist, with a large black circle and a diagonal slash over it, indicating a prohibition. Below this is a black rectangular box with a white border containing the word 'DANGER' in large, bold, white capital letters. Underneath the 'DANGER' box, there is a block of text in black and white, providing detailed safety instructions and warnings.

A FALL CAUSING SERIOUS INJURY OR DEATH MAY RESULT FROM FAILURE TO FOLLOW ALL SAFETY PRECAUTIONS

- Joists **HAVE NOT** been designed for stability or to support your weight without bridging installed.
- **DO NOT WALK, STAND, OR ALLOW LOADS** on joists until adequately stabilized.
- **ALWAYS USE FALL PROTECTION** when a fall hazard is present and **FOLLOW ALL OSHA SAFETY REGULATIONS!**
- Joists at or near columns **ARE NOT** designed to satisfy OSHA 29 CFR 1926.757 (a)(3).
- **ALWAYS STABILIZE** joists **BEFORE** **RELEASING HOISTING CABLES** using approved erection methods.



Long Column Joists

- If the column or tie joist spans more than 60 feet it needs to be set in tandem with an adjacent joist with all bridging installed unless an alternative method of erection is used that provides the same stability.
- This alternative method needs to have been designed by a qualified person and be included in a site-specific erection plan.



Typical Joist Erection

- Each joist must be placed in accordance with the joist placement plans
 - Make sure all the tags are turned in the proper direction as joists are not always symmetrical
- Each joist must be held with the hoisting equipment until:
 - both sides of the bearing seat on one end of the joist are attached
 - the required bolted diagonal erection bridging is installed
- Joists may require erection bridging: “the bolted diagonal bridging that is required to be installed prior to releasing the hoisting cables from the steel joists”
- The final attachment of the joist ends can then be made by either bolting or welding to the support structure as shown on the contract structural drawings.



Typical Joist Erection – Erection Bridging

Shading is used in the SJI Load Tables to indicate erection bridging requirements as a function of span and product designation

- NO SHADING indicates that erection bridging is not required.
- **RED** shading indicates that a single row of bridging must be installed as erection bridging (the row nearest mid-span)
- **BLUE** shading indicates that two rows of bridging must be installed as erection bridging (the two rows nearest the third points).
 - All joists with spans over 60 feet but less than and including 100 feet have blue shading.
- **GRAY** shading indicates that all rows of bridging must be installed as erection bridging.
 - All joists with spans over 100 feet have grey shading.



Typical Joist Erection – Erection Bridging

STANDARD LOAD TABLE/OPEN WEB STEEL JOISTS, LH-SERIES																			
Based on a 50 ksi Maximum Yield Strength - Loads Shown In Pounds Per Linear Foot (plf)																			
Joist Designation	32LH06	32LH07	32LH08	32LH09	32LH10	32LH11	32LH12	32LH13	32LH14	32LH15	32LH16	32LH17	32LH18	32LH19	32LH20	32LH21	32LH22	32LH23	32LH24
Depth (in.)	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
Approx. Wt. (lbs./ft.)	14	16	17	21	21	24	27	30	33	35	42	49	56	62	78	87	101	110	124
Span (ft.)																			
52	315 189	353 211	383 229	480 285	531 315	580 343	688 406	785 461	810 476	837 492	1111 645	1272 738	1471 843	1652 935	2071 1163	2313 1288	2545 1462	2877 1593	
53	304 179	341 200	369 216	463 270	512 297	560 325	664 384	771 444	795 458	821 473	1069 609	1224 697	1416 796	1589 882	1993 1098	2226 1216	2449 1380	2775 1504	2921 1628
54	294 169	329 189	357 205	447 256	495 282	541 308	641 364	742 420	780 440	805 454	1029 575	1179 658	1364 752	1531 834	1920 1038	2144 1150	2359 1305	2679 1421	2813 1539
55	284 161	318 179	345 194	432 243	478 267	522 292	619 345	715 397	766 417	791 438	992 544	1136 623	1314 712	1475 789	1850 982	2066 1088	2273 1234	2587 1344	2711 1456
56	275 153	308 170	333 184	418 230	462 254	505 277	598 327	690 376	738 395	776 422	957 516	1096 590	1267 674	1423 747	1784 930	1993 1030	2192 1169	2499 1273	2614 1379
57	266 145	298 162	322 175	404 219	445 240	488 263	578 311	666 354	713 374	763 407	923 489	1057 559	1223 639	1373 708	1722 882	1923 977	2116 1108	2416 1207	2523 1307
58	257 138	288 154	312 167	391 208	430 228	473 251	559 295	643 336	688 355	750 393	891 464	1021 531	1181 606	1326 672	1662 837	1857 927	2043 1051	2337 1145	2436 1240
59	249 131	279 146	302 159	379 196	416 217	458 239	541 281	621 319	665 337	725 374	861 440	986 504	1141 576	1281 638	1606 794	1794 880	1974 999	2262 1088	2354 1178
60	242 125	271 140	293 151	367 189	402 206	443 227	524 267	600 304	643 321	701 355	833 419	954 479	1103 547	1238 607	1553 755	1734 836	1908 949	2190 1034	2275 1120
61	234 119	262 133	284 144	356 180	389 196	429 216	508 255	581 288	622 304	678 338	805 398	922 456	1067 521	1198 577	1502 718	1678 796	1846 903	2122 984	2201 1065
62	227 114	254 127	275 137	345 172	376 186	416 206	492 243	562 275	602 290	656 322	779 379	893 434	1033 496	1159 549	1454 684	1624 758	1786 860	2057 937	2130 1014

Typical Joist Erection Notes

REFER TO THE STEEL JOIST INSTITUTES' (SJI) SPECIFICATIONS AND ITS TECHNICAL DIGEST (TD) 9

GC / ERECTOR NOTE:

DO NOT ERECT STEEL JOISTS WITHOUT OBTAINING A COPY AND THOROUGHLY READING THE SJI TD 9, HANDLING AND ERECTION OF STEEL JOISTS AND JOIST GIRDERS. SERIOUS INJURY OR DEATH CAN RESULT FROM FAILURE TO FAMILIARIZE AND COMPLY WITH ALL APPLICABLE SAFETY REQUIREMENTS OF FEDERAL, STATE, AND LOCAL REGULATIONS AND THE SAFETY GUIDELINES OUTLINED IN THE SJI TD 9. THIS MANUAL IS INTENDED TO BE AN AID AND GENERAL GUIDE FOR THE SAFE AND PROPER ERECTION OF STEEL JOIST PRODUCTS.

SJI TD 9 IS AVAILABLE FROM:

STEEL JOIST INSTITUTE PHONE: 843-407-4091
140 W EVANS ST. SUITE 203
FLORENCE, SC 29501 WEB: STEELJOIST.ORG

JOIST DELIVERY AND UNLOADING:

1. VERIFY QUANTITIES AND CONDITION OF JOISTS AND JOIST ACCESSORIES UPON ARRIVAL. INFORM IMMEDIATELY OF ANY SHORTAGES, DISCREPANCIES OR DAMAGE.
2. WILL SUPPLY ONLY THE MATERIAL LISTED ON THE BILL OF LADING.
3. WHEN UNLOADING JOISTS BY CRANE, ALWAYS HOIST JOISTS BY TOP OR BOTTOM CHORD PANEL POINTS (NOT BY WEB MEMBERS).
4. IF NOT ERECTED IMMEDIATELY, STORE JOISTS AND JOIST ACCESSORIES OFF THE GROUND AND KEEP THEM COVERED TO PROTECT THE PRIMER COATING.

JOIST INSTALLATION:

5. FOLLOW ALL APPLICABLE REGULATIONS OF THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) FEDERAL REGISTER SUBPART R 1926. IMMEDIATELY AFTER JOIST IS SET, ATTACH JOIST TO SUPPORTS AS REQUIRED BY SJI AND OSHA. AS BRIDGING IS INSTALLED, REMOVE SWEEP IN THE JOIST AND CORRECT ANY VERTICAL MISALIGNMENT. ONCE THE BRIDGING IS INSTALLED, ATTACH JOISTS TO SUPPORTS PER FINAL ERECTION DRAWINGS.
6. ONLY DRAWINGS HAVING A "FIELD USE" STAMP SHALL BE USED FOR ERECTION.
7. REFER TO THE ERECTION SECTIONS FOR JOIST AND JOIST GIRDER END ANCHORAGE REQUIREMENTS. PER JOISTS, JOIST GIRDERS, AND ACCESSORIES SHALL BE ATTACHED WITH A MINIMUM OF:

K-SERIES JOISTS – THE EQUIVALENT OF TWO 1/8" FILLET WELDS (W) 2 1/2" LONG (L), AND BOLTED WITH TWO 1/2" A307 BOLTS WHERE SLOTS ARE INDICATED IN SECTION.

LH-SERIES JOISTS, SECTION NUMBERS 02 THRU 06 – THE EQUIVALENT OF TWO 3/16" FILLET WELDS (W) 2 1/2" LONG (L), AND BOLTED WITH TWO 3/4" A307 BOLTS WHERE SLOTS ARE INDICATED IN SECTION.

LH-SERIES AND DLH-SERIES JOISTS, SECTION NUMBERS 07 THRU 17 – THE EQUIVALENT OF TWO 1/4" FILLET WELDS (W) 2 1/2" LONG (L), AND BOLTED WITH TWO 3/4" A307 BOLTS WHERE SLOTS ARE INDICATED IN SECTION.

DLH-SERIES JOISTS, SECTION NUMBERS 18 THRU 25 – THE EQUIVALENT OF TWO 1/4" FILLET WELDS (W) 4" LONG (L), AND BOLTED WITH TWO 3/4" A325 BOLTS WHERE SLOTS ARE INDICATED IN SECTION.

JOIST GIRDERS – THE EQUIVALENT OF TWO 1/4" FILLET WELDS (W) 2 1/2" LONG (L), AND BOLTED WITH TWO 3/4" A325 BOLTS WHERE SLOTS ARE INDICATED IN SECTION.

BRIDGING – THE EQUIVALENT OF A 1/8" FILLET WELD (W) 1" LONG (L), WITH THE EXCEPTION OF BOLTING, FOR K-SERIES JOISTS.


THE EQUIVALENT OF A 1/8" FILLET WELD (W) 1" LONG (L), WITH THE EXCEPTION OF BOLTING, FOR LH-SERIES AND DLH-SERIES JOISTS, SECTION NUMBERS 02 THRU 15.

THE EQUIVALENT OF A 1/8" FILLET WELD (W) 1 1/2" LONG (L), WITH THE EXCEPTION OF BOLTING, FOR DLH-SERIES JOISTS, SECTION NUMBERS 16 THRU 20.

THE EQUIVALENT OF A 1/8" FILLET WELD (W) 2" LONG (L), WITH THE EXCEPTION OF BOLTING, FOR DLH-SERIES JOISTS, SECTION NUMBERS 21 AND 22.

THE EQUIVALENT OF A 1/8" FILLET WELD (W) 3" LONG (L), WITH THE EXCEPTION OF BOLTING, FOR DLH-SERIES JOISTS, SECTION NUMBERS 23 THRU 25.

BOTTOM CHORD BRACES – THE EQUIVALENT OF A * FILLET WELD (W) ** LONG (L).
* = SAME AS BRACE ANGLE THICKNESS, ** = SAME AS BRACE ANGLE LEG LENGTH.

KEY: 

8. ALL STEEL BEARING JOISTS IN BAYS 40'-0" AND MORE, ARE TO BE BOLTED TO SUPPORTS PER OSHA, UNLESS JOISTS ARE PRE-ASSEMBLED INTO PANELS.
9. ACCORDING TO SJI, BEARING PLATES SHALL BE LOCATED NO MORE THAN 1/2" FROM THE FACE OF MASONRY OR CONCRETE SUPPORTS. REFERENCE SJI SPECIFICATIONS FOR MINIMUM BEARING PLATE WIDTHS.
10. UNBRIDGED JOISTS MAY EXHIBIT SOME DEGREE OF INSTABILITY UNDER THE ERECTOR'S WEIGHT, THEREFORE, EXTREME CAUTION MUST BE EXERCISED, WHEN IT IS NECESSARY FOR THE ERECTOR TO CLIMB ON THE JOIST, REFER TO SJI AND OSHA REQUIREMENTS.
11. VERIFY THAT ALL BRIDGING IS COMPLETELY INSTALLED, WITH JOIST AND JOIST GIRDER ENDS PERMANENTLY ATTACHED, BEFORE APPLYING CONSTRUCTION LOADS TO JOIST.
12. ADEQUATE MEANS FOR DISTRIBUTING CONCENTRATED LOADS SHOULD BE PROVIDED SO THAT THE CAPACITY OF ANY JOIST IS NOT EXCEEDED.
13. JOIST CHORDS ARE NOT DESIGNED FOR BENDING DUE TO CONCENTRATED LOADS, UNO ON PLANS. EITHER PLACE LOADS AT JOIST PANEL POINTS OR SEE THE "FIELD INSTALLED WEB MEMBERS AT CONCENTRATED LOADS" DETAIL.

GENERAL JOIST NOTES:

14. NI C – NOT IN CONTRACT. UNO – UNLESS NOTED OTHERWISE.
15. TYPICAL PRIMER COATING, UNO ON PLANS:
GRAY PRIMER FOR ALL JOISTS, JOIST GIRDERS & JOIST ACCESSORIES.
SHOP PRIMER COMPLIES WITH SSPC-PAIN 15.
NOTE: SHOP PRIMER IS APPLIED BY DIPPING. COATING MAY NOT BE UNIFORM AND REQUIRE REMOVAL OF ACCUMULATIONS BEFORE FINISH COAT IS APPLIED.
16. WELDED HORIZONTAL BRIDGING IS SUPPLIED IN 20'-0" LENGTHS. FIELD CUT WELDED HORIZONTAL BRIDGING AS REQUIRED AND UTILIZE ALL DROP.
NOTE: WELDED BRIDGING IS TO BE EQUALLY SPACED BETWEEN SUPPORTS, UNO ON PLANS. DECK MUST BE POSITIVELY ATTACHED TO JOIST TOP CHORDS IN ACCORDANCE WITH DECK FASTENING REQUIREMENTS, TO PROVIDE LATERAL STABILITY, UNO ON PLANS.
17. JOISTS MARKED TJ... INDICATES TIE-JOISTS. THESE JOISTS ARE NOT DESIGNED TO SATISFY OSHA 29 CFR 1926.757 (e)(3). REFER TO "DANGER" TAG ON JOIST FOR ERECTION REQUIREMENTS.
18. DO NOT CUT AWAY ANY CHORDS OR WEBS.
19. PRODUCTS ARE FABRICATED TO MEET THE ERECTION REQUIREMENTS OF OSHA. FIELD COMPLIANCE WITH OSHA IS NECESSARY.
20. FIELD BOLTS PROVIDED BY PRODUCTS ONLY. FOR BOLTING PRODUCTS TO PRODUCTS ONLY.

TD 9 Reference

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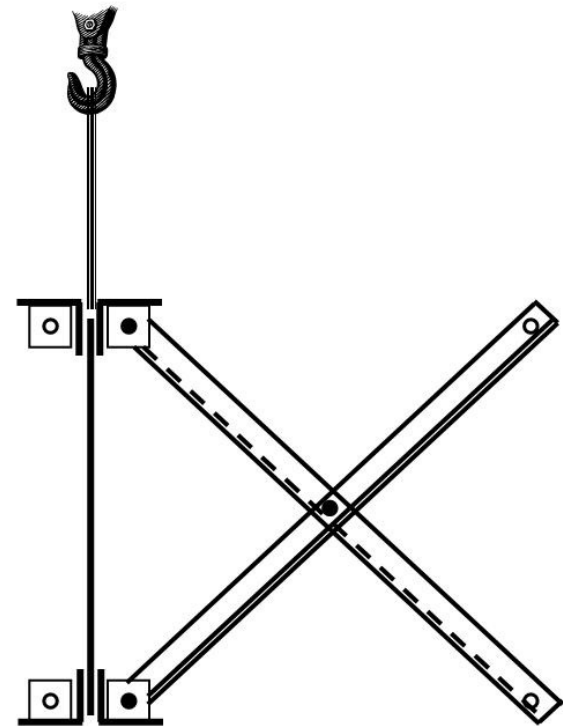
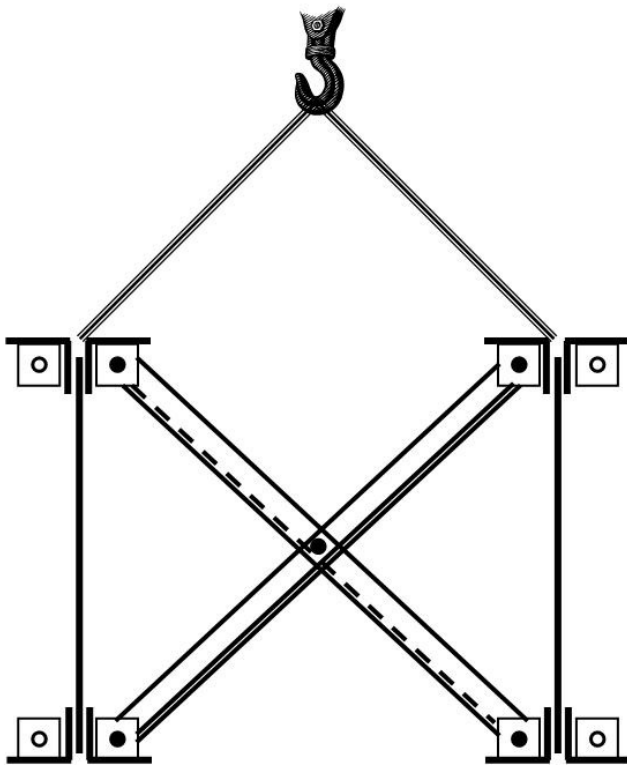
SJI TD 9 IS AVAILABLE FROM:

STEEL JOIST INSTITUTE PHONE: 843-407-4091
140 W EVANS ST. SUITE 203
FLORENCE, SC 29501 WEB: STEELJOIST.ORG

Field Welding Notes

Reference to OSHA Stability Requirements

Typical Joist Erection – Erection Bridging



Typical Joist Erection - Bundles

- In bays where erection bridging is not required and joists are parallel chord without pitch, it may be permissible to land the joists in bundles.
- Erectors should land the bundle on the supporting structure as close as possible to the center of the bay, but only if the supporting structure is determined to be stable to support the load



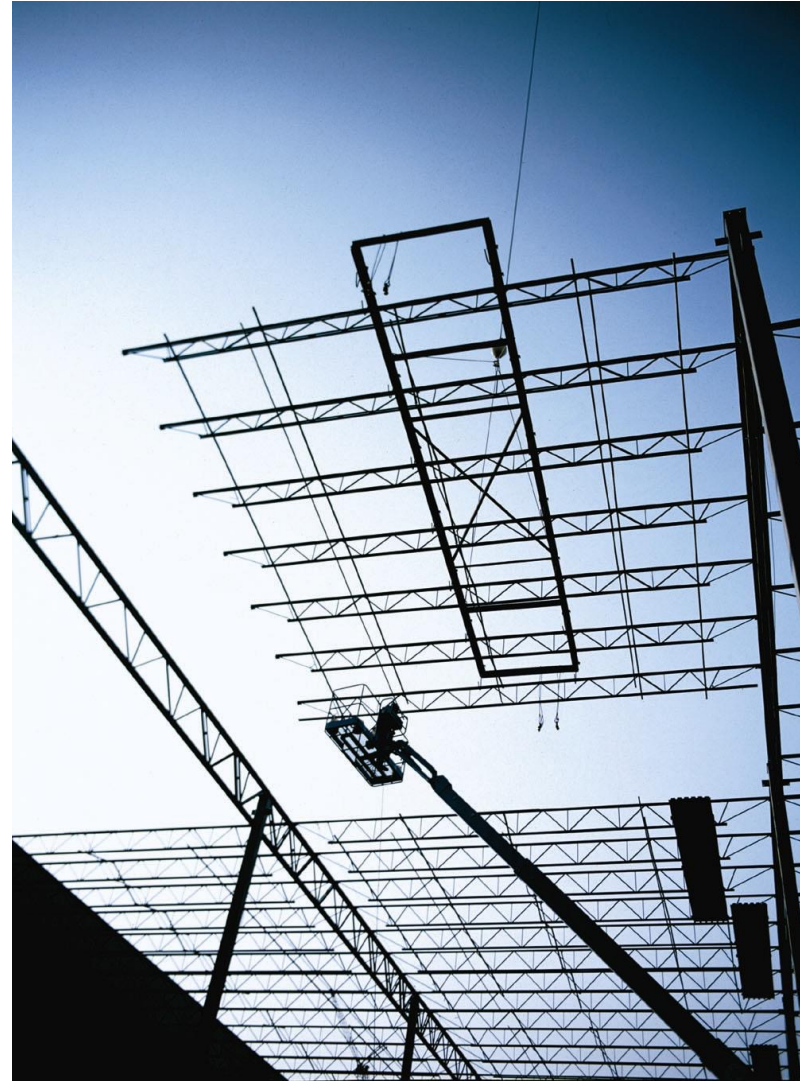


Typical Joist Erection

- Joists should be completely bridged immediately after final placement and the end attachment is completed.
- For bridging to function properly, it must have an adequate terminus.
- Under no circumstance are construction loads of any description to be placed on unbridged joists.

Panelized Erection

- Panelizing joists on the ground prior to erection can be safer and more efficient with proper planning.
- Some erectors prefer to assemble full bays, including the tie joist. Others install the tie joist prior to erecting the filler panel.





Joist Jig with Angle to ensure proper end alignment.
Also, Bridging on Beam Flange for sliding Joists into position.



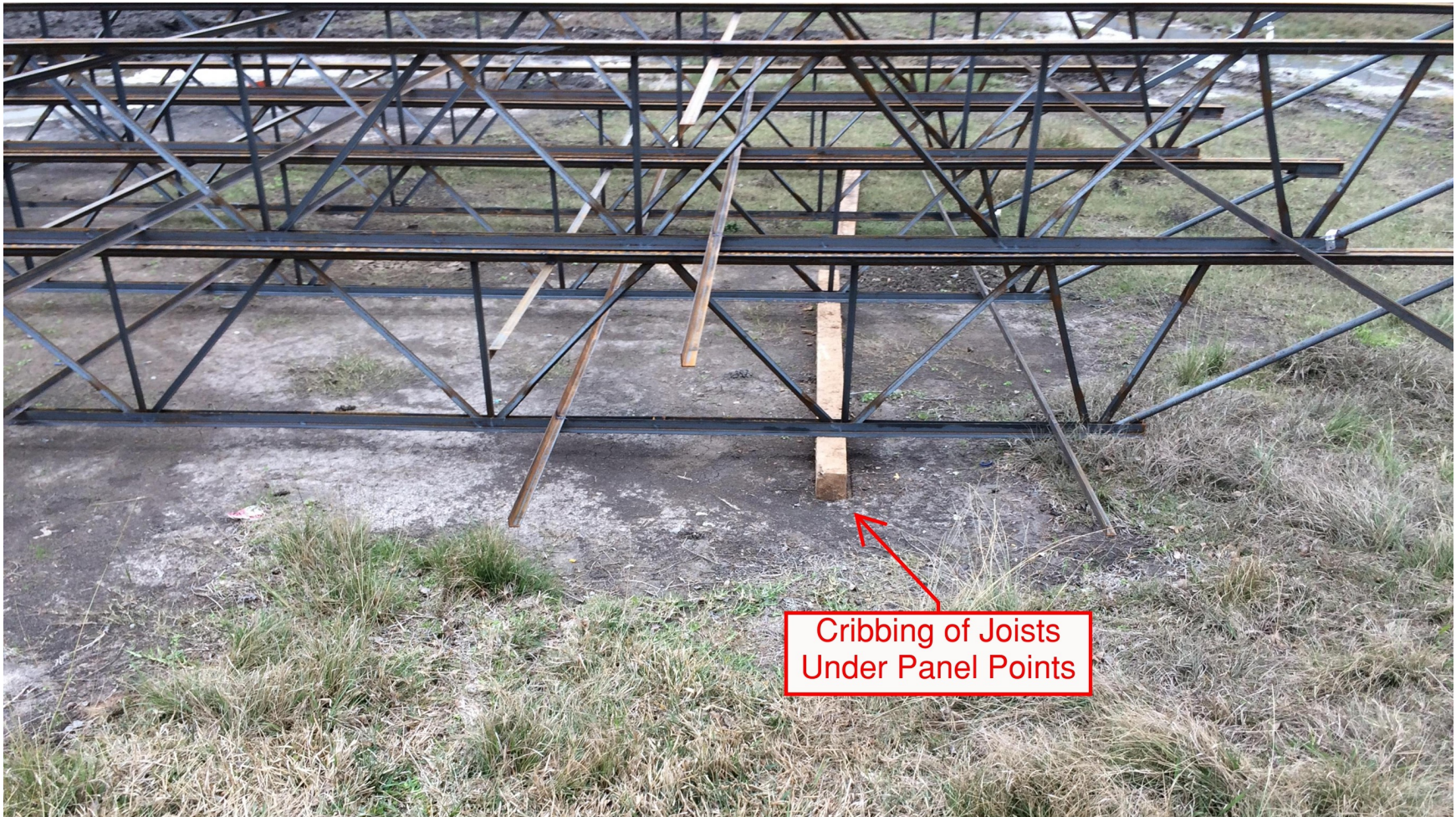
Joist Panel Spreader Bar w/Capacities Noted

Staging Joist Panels





Joist panel staged,
ready for installation



Cribbing of Joists
Under Panel Points

Joist locations aligned with
Joist Girder panel points

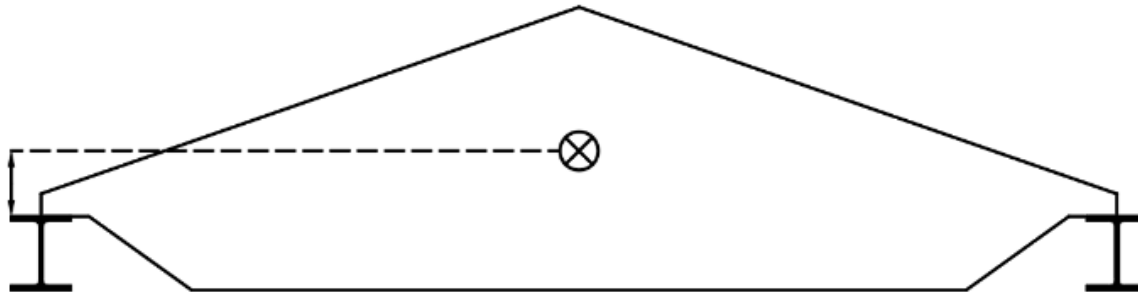


Deck Bundles
Landed on Bridged
Joists, Close to
Beam Lines



Erecting Special Configuration Joists

- Special profile steel joists tend to have profiles resulting in high centers-of-gravity relative to their bearing elevations; thus, they can be “top-heavy” and have a higher tendency to roll over.
- The erection procedures contained in the OSHA regulations should be considered minimum requirements and should be reviewed for application to special profile joists by a “qualified person”.



DEEM

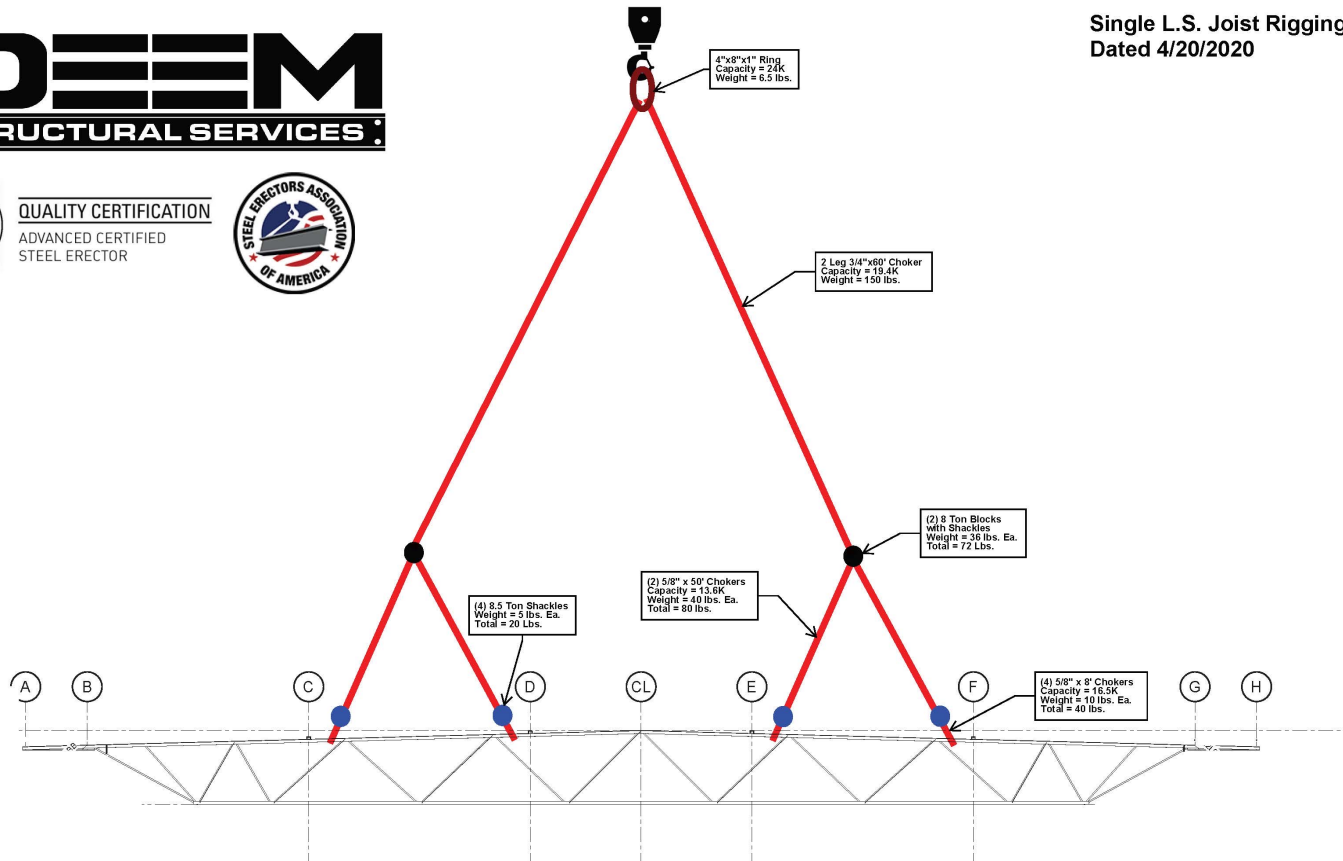
STRUCTURAL SERVICES



QUALITY CERTIFICATION
ADVANCED CERTIFIED
STEEL ERECTOR



Single L.S. Joist Rigging
Dated 4/20/2020



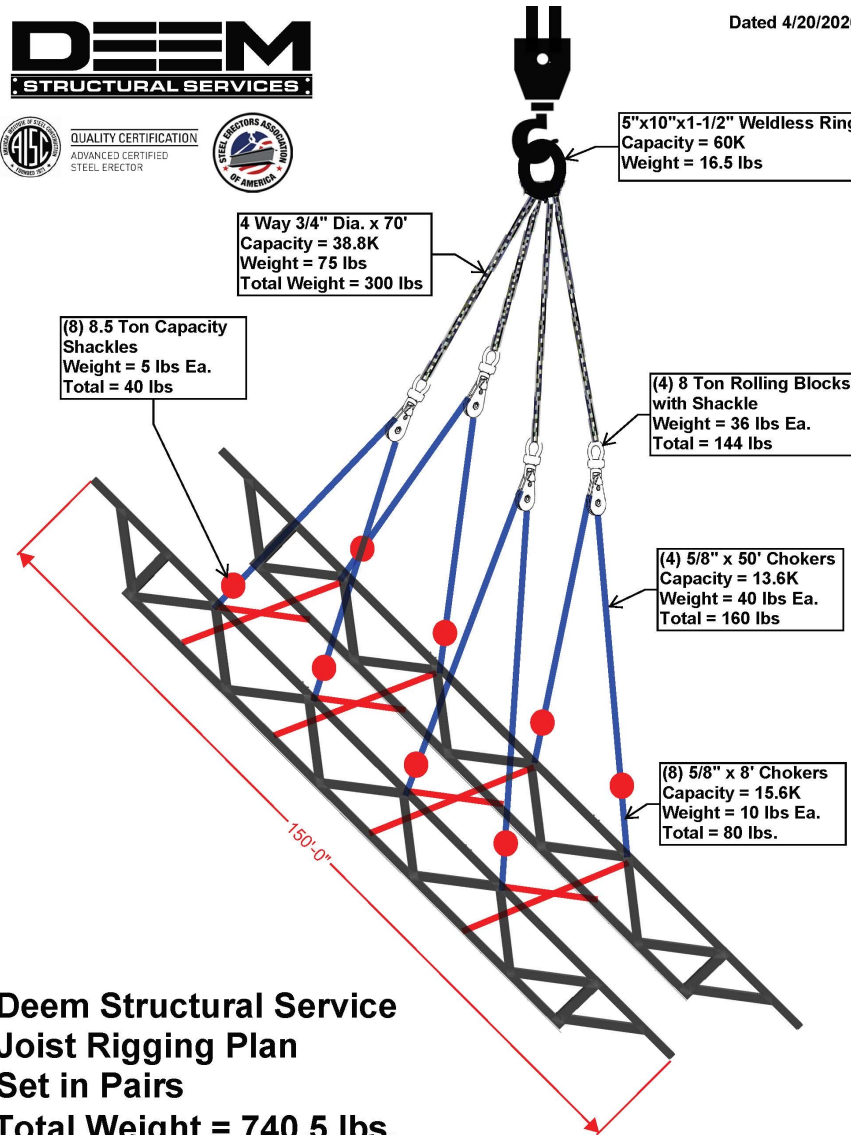
Total Rigging Weight = 368.5 lbs.



QUALITY CERTIFICATION
ADVANCED CERTIFIED
STEEL ERECTOR



Dated 4/20/2020



5"x10"x1-1/2" Weldless Ring
Capacity = 60K
Weight = 16.5 lbs

4 Way 3/4" Dia. x 70'
Capacity = 38.8K
Weight = 75 lbs
Total Weight = 300 lbs

(8) 8.5 Ton Capacity
Shackles
Weight = 5 lbs Ea.
Total = 40 lbs

(4) 8 Ton Rolling Blocks
with Shackle
Weight = 36 lbs Ea.
Total = 144 lbs

(4) 5/8" x 50' Chokers
Capacity = 13.6K
Weight = 40 lbs Ea.
Total = 160 lbs

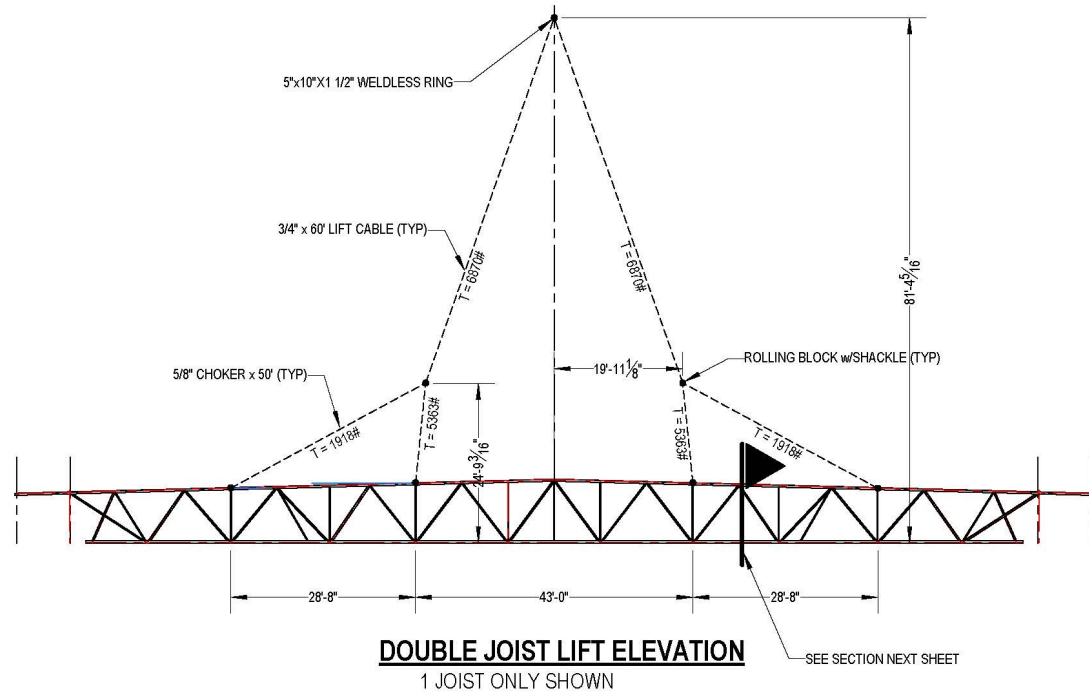
(8) 5/8" x 8' Chokers
Capacity = 15.6K
Weight = 10 lbs Ea.
Total = 80 lbs.

**Deem Structural Service
Joist Rigging Plan
Set in Pairs
Total Weight = 740.5 lbs.**

Malcolm A. Carter, PE, SE
Consulting Structural Engineer

14622 West 78th Street
 Lenexa, Kansas 66216
 (816) 853-2824

Project Name: USAFA Cadet Chapel Repair	Designed By: AC	Date: 7/13/2019	Sheet Of
Client Name: Deern Structural Services	Checked By:	Date:	
Sheet Title: Double Joist Lift			



SHEET NOTES:

- 1.) SHACKLES ARE CROSBY 209A 5/8" OR EQUIVALENT CAPACITY
- 2.) TEMPORARY BRACING TO BE 6x19 OR 6x37 IWRC EIPS WIRE ROPE OF THE DIAMETERS INDICATED
 - a.) CAPACITIES OF THE CABLES ARE SHOWN IN THE SCHEDULE.
 - b.) COMPATIBLE CABLE CLAMPS ARE SHOWN IN THE HARDWARE CHARTS.
 - c.) ALL CHOKERS, NYLON STRAPPING OR DEVICES USED TO CONNECT THE TEMPORARY BRACING SHALL HAVE A BREAKING STRENGTH THAT EQUALS OR EXCEEDS THE STRENGTH OF THE ATTACHED CABLE.

CABLE CAPACITIES

5/8" DIAMETER = 13,600#
 3/4" DIAMETER = 38,800#

WIRE ROPE ENDS

5/8" DIAMETER - 3 CLAMPS @ 3 3/4" O.C. 12" TURNBACK
 3/4" DIAMETER - 4 CALMPS @ 4 1/2" O.C. 18" TURNBACK



Malcolm A. Carter, PE, SE
Consulting Structural Engineer

14622 West 78th Street
Lenexa, Kansas 66216
(816) 853-2824

Project Name: USAFA Cadet Chapel Repair

Designed By: AC

Date: 7/13/2019

Client Name: Deem Structural Services

Checked By:

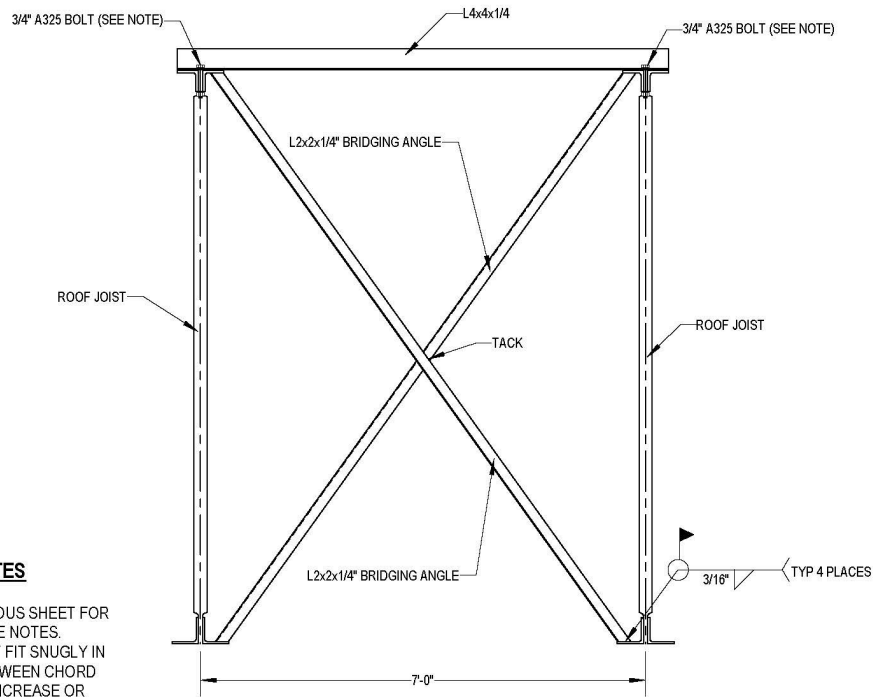
Date:

Sheet Title: Double Joist Lift

Sheet
Of

SHEET NOTES

- 1.) SEE PREVIOUS SHEET FOR APPLICABLE NOTES.
- 2.) BOLT MUST FIT SNUGLY IN SPACE BETWEEN CHORD ANGLES. INCREASE OR DECREASE BOLT DIAMETER ACCORDINGLY.



SECTION AT RIGGING ATTACHMENT

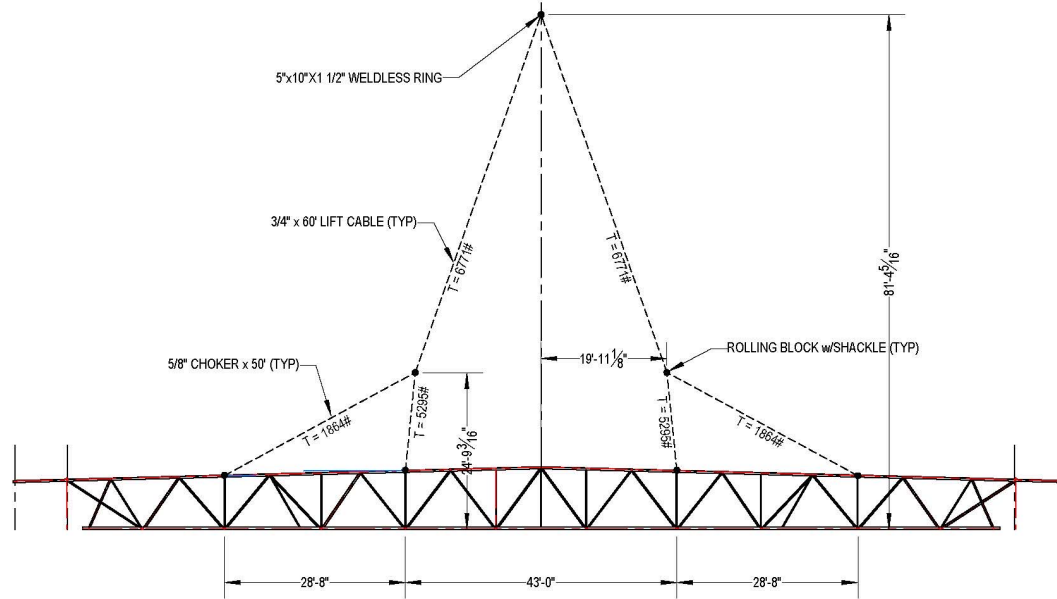
RIGGING NOT SHOWN FOR CLARITY



Malcolm A. Carter, PE, SE
Consulting Structural Engineer

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 Lenexa, Kansas 66216
 (816) 853-2824

Project Name: USAFA Cadet Chapel Repair	Designed By: AC	Date: 7/13/2019	Sheet
Client Name: Deem Structural Services	Checked By:	Date:	Of
Sheet Title: Single Joist Lift			



SINGLE JOIST LIFT ELEVATION

SHEET NOTES:

- 1.) SHACKLES ARE CROSBY 209A 5/8" OR EQUIVALENT CAPACITY
- 2.) TEMPORARY BRACING TO BE 6x19 OR 6x37 IWRC EIPS WIRE ROPE OF THE DIAMETERS INDICATED
 - a.) CAPACITIES OF THE CABLES ARE SHOWN IN THE SCHEDULE.
 - b.) COMPATIBLE CABLE CLAMPS ARE SHOWN IN THE HARDWARE CHARTS.
 - c.) ALL CHOKERS, NYLON STRAPPING OR DEVICES USED TO CONNECT THE TEMPORARY BRACING SHALL HAVE A BREAKING STRENGTH THAT EQUALS OR EXCEEDS THE STRENGTH OF THE ATTACHED CABLE.

CABLE CAPACITIES

5/8" DIAMETER = 13,600#
 3/4" DIAMETER = 38,800#

WIRE ROPE ENDS

5/8" DIAMETER - 3 CLAMPS @ 3 3/4" O.C, 12" TURNBACK
 3/4" DIAMETER - 4 CALMPS @ 4 1/2" O.C, 18" TURNBACK





Polling Question 2

True or false, column joists are typically stable enough for a worker to walk on them once the bolts are installed.

- A. True
- B. False



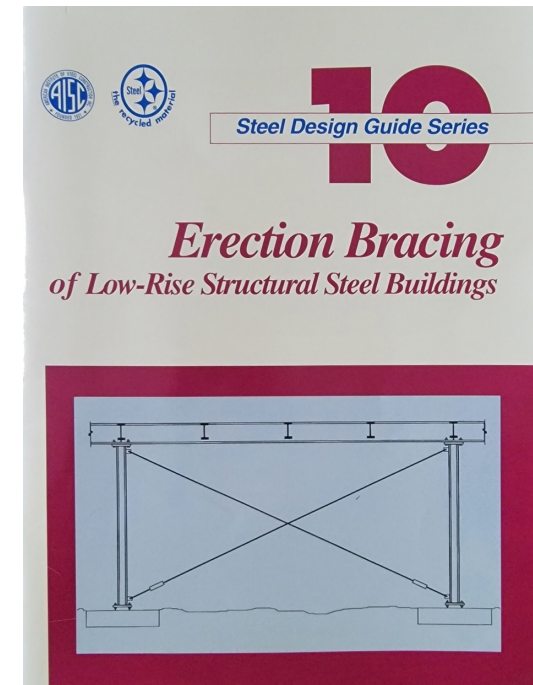
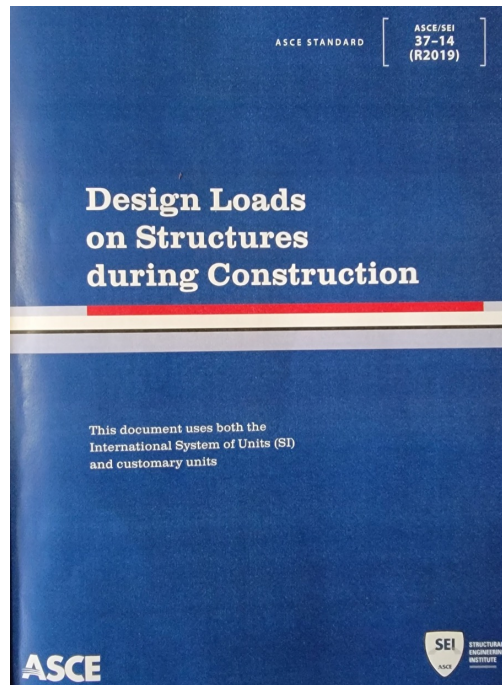
Erection Engineering

- The erector is responsible for the safety and stability of the structure during erection.
- Steel joist manufacturers do not evaluate joists or joist girders for temporary conditions during erection.
- For some projects, it may be required or desirable for the erector to work with an erection engineer to develop an engineered site-specific erection plan. For example,
 - Required by the building owner or by the engineer of record.
 - Desirable for complex jobs to ensure safety and efficiency.



Erection Engineering

- Erection engineers develop engineered erection plans by evaluating the structure at each stage of construction for temporary loading conditions.
- Dead loads and wind loads typically dominate the evaluation.
- Use of ASCE 37 Design Loads on Structures During Construction (ASCE 2014) to define temporary loads is widely recognized as part of the standard of care.
- AISC Design Guide 10, Erection Bracing of Low-Rise Structural Steel Buildings (AISC 2020) provides guidance for various erection issues.



Erection Bracing & Stability

Guidance for Erection Bracing

- ASCE/SEI 37-14 Design Loads on Structures during Construction
- AISC Design Guide 10 - Erection Bracing of Low-Rise Structural Buildings



Chapter 11: Erection Engineering

- As with any structural evaluation, the erection engineer identifies a load path and performs calculations to ensure the capacity exceeds the demand in each component.
- The NEW Chapter 11 contains:
 - Description of typical load path for one stage of erection
 - Approximate section properties for joists and joist girders
 - Discussion and tables of seat and chord strength
 - A design example

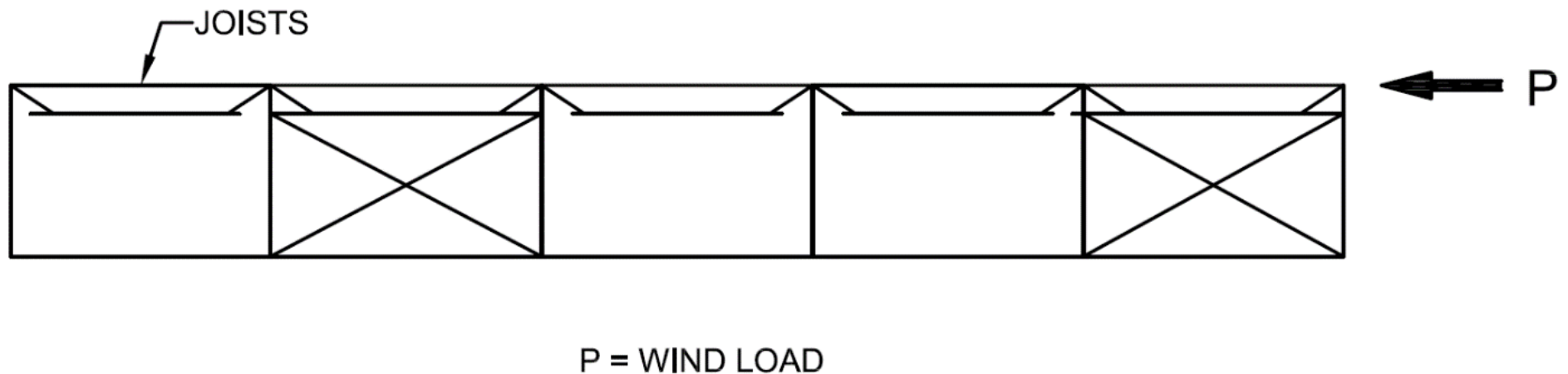


Load Path

- The load paths are described for a condition in which joists and joist girders are erected, but deck has not been installed.
 - Other conditions may be more severe
- The load paths are described for 1) wind perpendicular to the joist girders and 2) wind perpendicular to the joists.
 - ASCE 37 Section 6.2.2 requires evaluation of the two wind directions simultaneously

Load Path

- Temporary wire rope braces are installed in several bays to transfer lateral loads from the roof level to the ground level



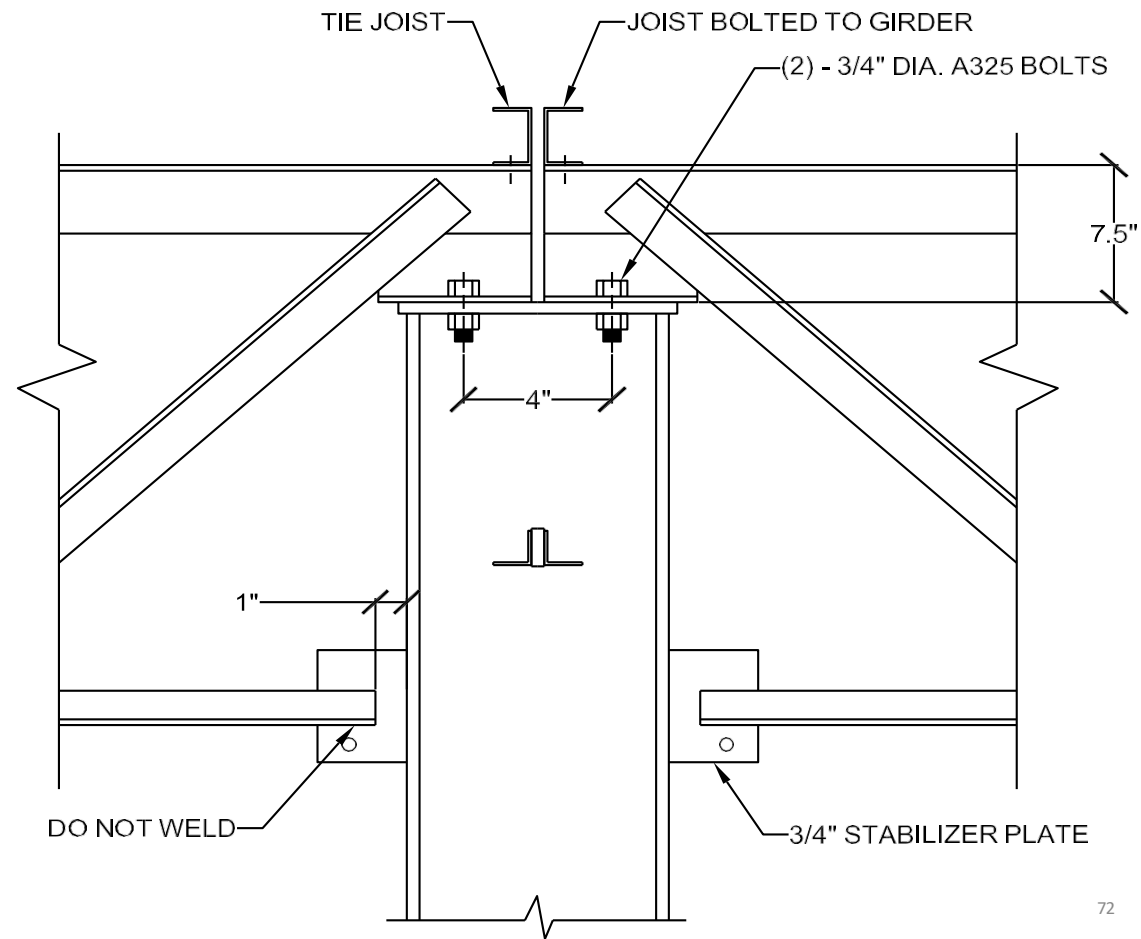


Load Path (Wind Perpendicular to Joist Girders)

- The wind force on a joist girder is assumed to be transmitted to the top chord of the joist girder via the web members.
- The wind force on the joist girder top chord is transferred to the ends of the girder by the lateral bending strength of the top chord.

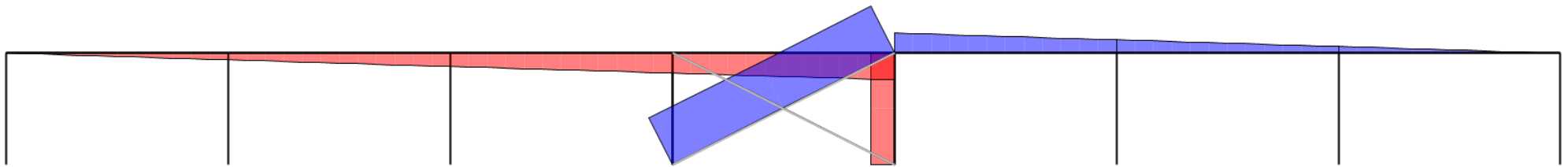
Load Path (Wind Perpendicular to Joist Girders)

- The force in the joist girder top chord is transferred to the tie joist top chord through the joist seat (tie joists are the joists that are supported on the joist girder seats at the column locations).

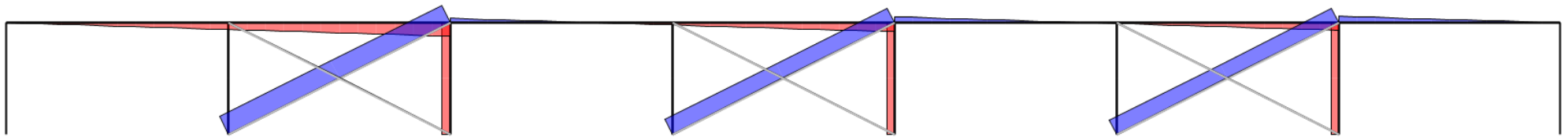


Load Path (Wind Perpendicular to Joist Girders)

- The force accumulates from tie joist to tie joist until it is transferred to the ground at the bay containing the vertical bracing.



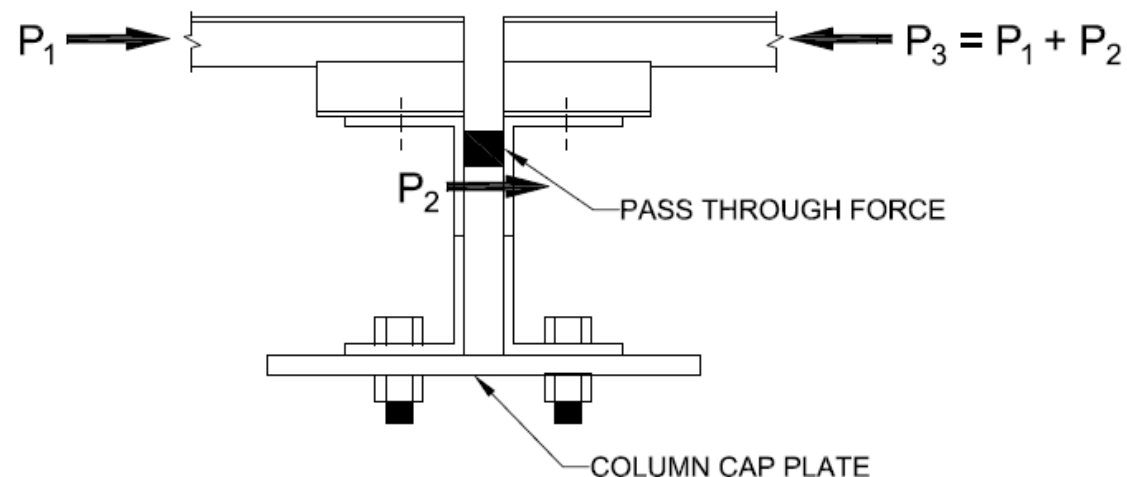
Axial load in seven-bay frame with **one** pair of wire rope braces for wind blowing left to right



Axial load in seven-bay frame with **three** pair of wire rope braces for wind blowing left to right

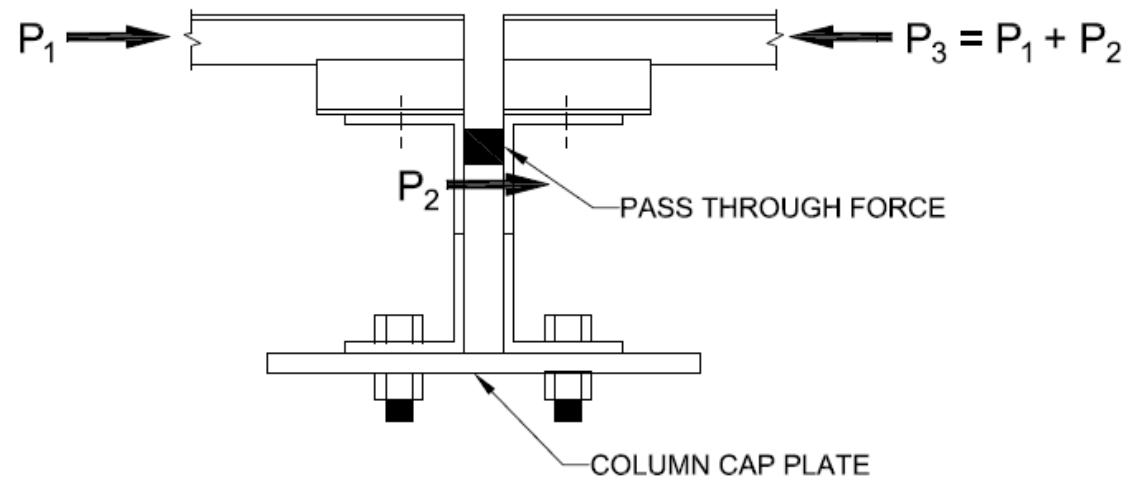
Load Path (Wind Perpendicular to Joist Girders)

- Since the tie joists start and stop at each column location, the accumulated force must transfer from the tie joist chord through the tie joist seat across the space between the joist girder chords and into the next tie joist.
- The force transferred through the space between joist girder chords is called the pass-through force.
- Joist manufacturers have determined that all joist girder seats have sufficient pass-through strength.



Load Path (Wind Perpendicular to Joist Girders)

- The erection bolts are required by OSHA at column locations.
- The joist seats have slotted holes.
- The joist seats must also be welded according to SJI Specifications Table 5.7-1.
- The welds prevent slippage of the joists and joist girders which is important to maintain column plumbness.



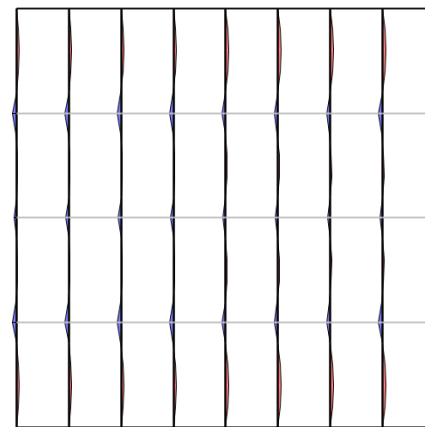
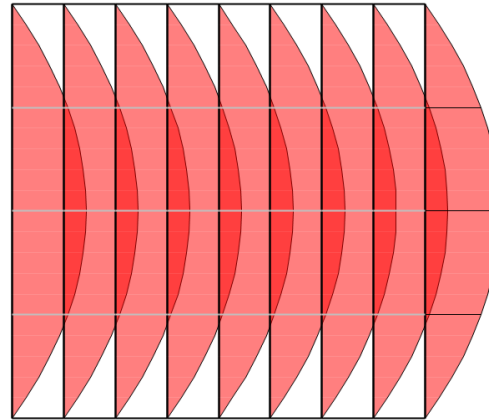
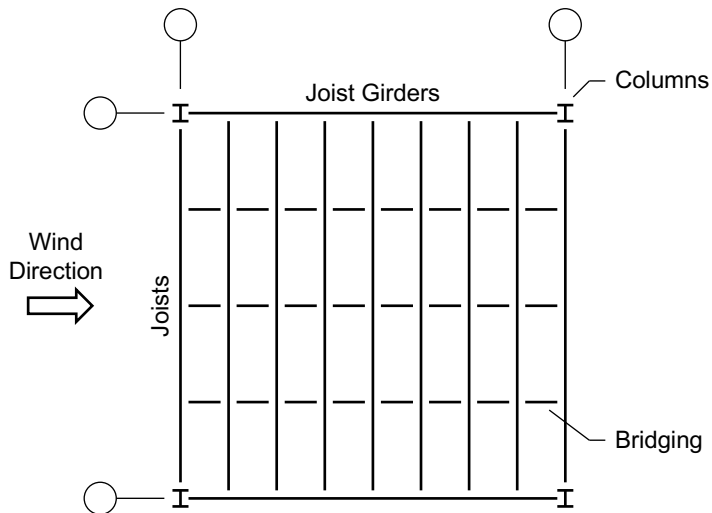


Key Strength Checks

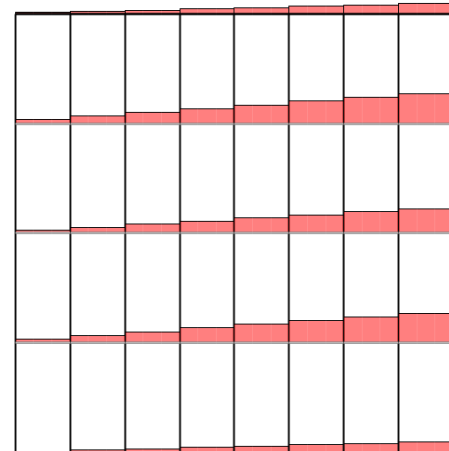
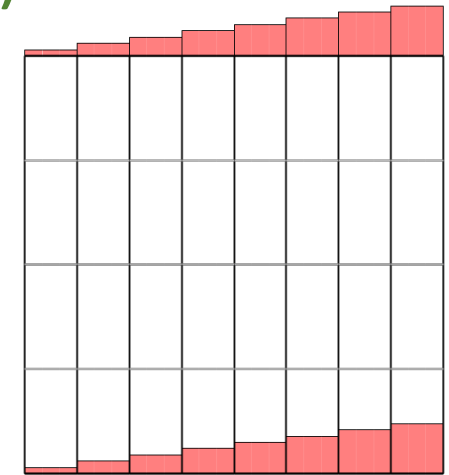
- Joist girder top chord in bending
- Joist girder seat rollover strength
- Tie joist seat axial strength
- Tie joist top chord axial strength (tension or compression)
- Column strength

Load Path (Wind Perpendicular to Joists)

Bridging not anchored →



Bridging anchored →





Key Strength Checks

- Joist top chord in bending
- Joist seat rollover strength
- Joist girder seat axial strength
- Joist girder top chord axial strength (tension or compression)
- Column strength



Approximate Section Properties for Joists

- The major-axis moment of inertia of a joist or joist girder, I_x , can be calculated using equations provided in the SJI Steel Joist Catalog.
- Other cross-sectional properties of joists and joist girders may be necessary for evaluation of temporary structural systems.
 - Cross-sectional area, A
 - Minor-axis moment of inertia, I_y
 - Torsional constant, J
- The approximations consist of two steps, first estimating the area of the chords, then estimating other cross-sectional properties based on the chord area. Different approaches can be taken for both steps.



Approximating Chord Areas

Top and bottom chord areas can be approximated from strength criteria.

1. Calculate the maximum moment in the joist or joist girder based on the total load from the SJI Load Tables for joists or the specified panel point load for joist girders.
2. Calculate chord forces assuming an effective depth equal to 95% of the total depth.
3. Approximate the top chord area by dividing the chord force by 24 ksi for ASD or 36 ksi for LRFD.
4. Approximate the bottom chord area by dividing the chord force by 30 ksi for ASD or 45 ksi for LRFD.



Approximating Other Cross-Sectional Properties

- Option 1: Identify a possible double angle shape that meets the criteria.
 - Table provided in Technical Digest 9 for K-Series and some LH-Series joists
- Option 2: Use conservative lower bound equations:

$$I_{y,2L} = 0.36 A_{2L}^2$$

$$J_{2L} = 0.005 A_{2L}^2$$



Chord Axial and Seat Strength

- The erection engineer may request that joists and joist seats be designed for forces they may experience during erection.
 - Such requests must be done as early as possible, and the erector is generally responsible for the cost of additional evaluation and changes to the structure needed for the temporary structural system during erection.
- SJI Technical Digest 9 Chapter 11 includes tables of minimum strengths.
 - Lower bound when strengths are not specified.



Joist Top Chord and Seat Axial Strength

Table 11.3 Approximate Top Chord Axial Strengths, K- and LH-Series (ASD)

Joist	$P_{n,seat}/\Omega$ kips	$P_{n,comp}/\Omega$ kips	$P_{n,tens}/\Omega$ kips	Joist	$P_{n,seat}/\Omega$ kips	$P_{n,comp}/\Omega$ kips	$P_{n,tens}/\Omega$ kips
10K1	1.1	3.9	15.6	24K4	2.1	8.8	23.5
12K1	1.1	3.9	15.6	24K5	2.3	10.0	26.4
12K3	1.8	5.7	19.9	24K6	3.2	13.6	31.0
12K5	2.3	6.2	26.4	24K7	3.2	10.5	31.0
14K1	1.1	3.9	15.6	24K8	4.3	12.0	35.7
14K3	1.8	5.7	19.9	24K9	4.5	16.0	37.5
14K4	2.1	5.5	23.5	24K10	5.2	18.6	42.9
14K6	3.0	8.4	28.7	24K12	6.8	19.4	55.7
16K2	1.7	3.9	18.9	26K5	2.3	5.1	26.4
16K3	1.8	5.7	19.9	26K6	3.0	6.5	28.7
16K4	2.1	5.5	23.5	26K7	3.2	6.6	31.0
16K5	2.3	6.2	26.4	26K8	4.3	9.6	35.7
16K6	3.0	8.4	28.7	26K9	4.3	8.9	35.7
16K7	3.2	6.9	31.0	26K10	5.2	10.8	42.9



Joist Girder Seat Axial Strength

Table 11.4 Approximate Joist Girder Axial Seat Strengths (ASD)

Joist Girder Top Chord Leg Size, inches	$P_{n,seat}/\Omega$, kips
2.5	4
3	8
3.5 and larger	10

Notes: Based on 7 1/2 inch deep seats, 3/4 inch A325 bolts and a minimum of two 1/4 inch fillet welds 5 inches long along the sides of the seat. This 5 inch weld length is longer than the minimum required by SJI Standard Specifications so the length would need to be specified as part of the connection design.



Design Example

Given:

- 40 foot x 40 foot bay size with a 30 foot eave height
- 24K8 joists spaced 5.71 feet apart (seven joists per bay)
- 40G7N12K joist girders
- W8x31 columns
- Vertical bracing erected in every 4th bay
- Wind Speed = 100 mph, Exposure B
- Wind reduction = 0.8 (Six week to one year exposure), ASCE 37-14
- Solidity Ratio, $\phi = 0.2$ for joists, 0.3 for joist girders, AISC Design Guide 10
- Temporary wire rope erection bracing installed in every third bay.



Polling Question 3

How can an erection engineer determine the available strength of a joist seat?

- A. A. From the contract documents.
- B. B. From the minimum strength tables in Chapter 11 of TD9.
- C. C. Contacting the joist manufacturer.
- D. D. Any of the above.



Summary

- Unlike solid structural members, joist products have spaces, separations, and openings between their various parts. Because of this, joist products are more susceptible to damage than other structural members, and it is important that they be handled with care.
- Joist products are also very slender and can lack stability until all components (including deck) have been installed.



Summary – Do the Following

1. Follow all OSHA requirements
2. Use proper equipment for unloading, handling, and erection.
3. Inspect all joist products for damage upon delivery.
4. Attach cables only at panel points of joists.
5. Place the tag end of joists as shown on the joist placement plans.
6. Attach both sides of one end of each joist immediately after placement in its final position.
7. Straighten joists both laterally and vertically as bridging is being installed.
8. Securely anchor the ends of all rows of bridging.
9. Permanently anchor ends of joists after all bridging has been completely installed.
10. Make permanent connections of the bottom chords of joist girders only as directed by the specifying professional (i.e. the registered design professional).



Summary – Don't do these things

1. Don't pull or push joists off a delivery truck or drop them in any way.
2. Don't attach cables, chains, or hooks to the web members of joists.
3. Don't place construction loads on unbridged joists.
4. Don't weld bridging to joist web members.
5. Don't hang any mechanical, electrical, etc. from bridging.
6. Don't place joists between panel points on joist girders unless specifically shown on the joist placement plans.
7. Don't repair or alter joists without the approval of the registered design professional.



Thank you for your time and attention.

Thank you to those who developed SJI Technical Digest 9:

- First Edition: E.T.E. Sprague
- Second Edition: Cary Andrews, Perry S. Green, and the SJI Erection Committee
- Third Edition: Michael Winarta, Perry S. Green, and the SJI Health and Safety Committee
- Fourth Edition: SJI Engineering Practice Committee, James Fisher, and Mark Denavit
- Many reviewers of each edition.

Thank you to the erectors who risk their lives to answer a calling to “walk the iron”

SJI Design Tools

- Free downloads
 - Floor Bay Comparison Tool w/ Vibration
 - Steel Joist Uplift Analysis Tool
 - Joist Girder Analysis Tool
 - Joist and Joist Girder Reinforcement Tool
 - Historical Load Tables
 - Roof Bay Analysis Tool w/ Ponding Analysis
 - Floor Bay Analysis Tool w/ Vibration Analysis
 - Joist Girder Moment Connection Design Tools
 - Virtual Joists
 - Virtual Joist Girders
- Floor Vibration Analysis





SJI Publications

Technical Digests

- #1 Utilizing and Specifying Steel Joists
- #2 Bridging and Bracing of Steel Joists and Joist Girders
- #4 Guidance for Building Design Using Steel Joists
- #5 Vibration of Steel Joist – Concrete Floors
- #6 Design of Steel Joist Roofs to Resist Uplift Loads
- #7 Special Profile Steel Joists and Joist Girders
- #8 Welding of Open Web Steel Joists and Joist Girders
- #9 Handling and Erection of Steel Joists and Joist Girders
- #10 Design of Fire-Resistive Assemblies With Steel Joists
- #11 Design of Lateral Load Resisting Frames Using Steel Joists and Joist Girders
- #12 Evaluation and Modification of Open Web Steel Joists and Joist Girders
- #13 Specification and Design of Composite Steel Joists
- Design Guide 35 Steel-Frames Storm Shelters
- Design Guide 40 Rain Loads and Ponding

Catalogs

- 45th Edition Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders - Free download
- Second Edition CJ-Series Composite Steel Joists – Free download
- 95 Years of Open Web Steel Joist Construction



SJI Webinars

Earn PDHs with the 2025 webinars:

- Our next live webinar is on October 22: Part 1: Evaluation and Modification of Open Web Steel Joists and Joist Girders
- Webinars On Demand
 - Watch 60+ pre-recorded webinars. Order the online accompanying quiz to earn your PDHs.
 - Topics include:
 - Lateral Loads
 - Floor Systems
 - Uplift
 - Special Profiles
 - Ponding
 - Bridging
 - Vibration
 - Roofs
 - CJ-Series Composite Steel Joists
 - Building Retrofit
 - Welding
 - Connections
 - Design Tools
 - Fire
 - Ethics
 - Joists 101



Q&A SESSION



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