Bridging – How it Works and What to Work Around

AUGUST 15, 2018

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Polling Question

- 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

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Learning Objectives

- The types and roles of bridging will be covered.
- The governing criteria for the bridging spacing and sizing will be reviewed.
- The connection details and options will be explored, both the drawing details and the realities of field installation.
- A number of potential conflicts and resolutions for bridging locations will be discussed, such as working around sprinkler systems.

Bridging – How it Works and What to Work Around

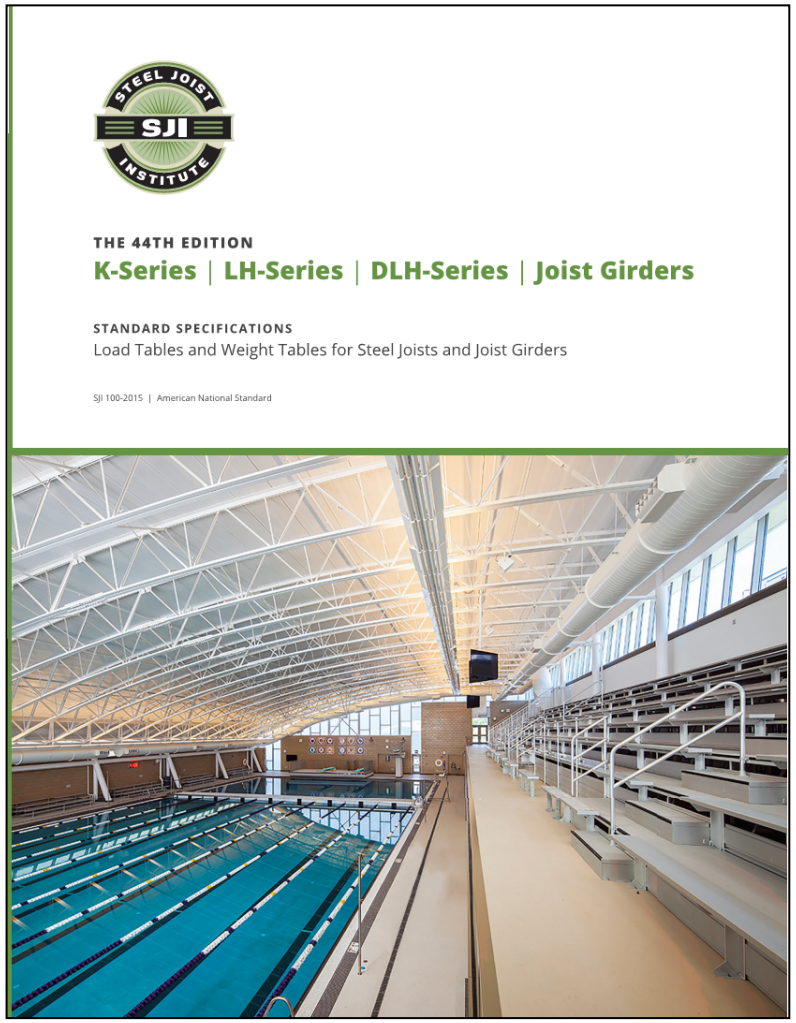
Bridging – How it Works and What to Work Around

The Steel Joist Institute hosts the webinar "Bridging – How it Works and What to Work Around."

Steel joists provide excellent economy for vertical, in-plane loads. The lateral support bracing system – bridging – is a key to the performance of a steel joist. This webinar will explore steel joist bridging from two perspectives. First, the types, roles, forces, and specification criteria – "How It Works." And second, the challenges, potential conflicts, and solutions for the bridging layout and installation – "What to Work Around."

Bridging – How it Works and What to Work Around

- Basic
- Safety
- Theory behind Bridging
- SJI specification Requirements
- Types of Bridging
- Bridging Spacing and Sizes with Tables
- Joist Girder Bridging
- Anchorage of Bridging
- Special Usages
- Field Conditions
- How to Specify Bridging


THE 44TH EDITION
K-Series | LH-Series | DLH-Series | Joist Girders
STANDARD SPECIFICATIONS
Load Tables and Weight Tables for Steel Joists and Joist Girders
SJI 100-2015 | American National Standard

Basics

Bridging is intended to deal with the internal bracing forces which occur in the joist system and not used for forces external to the joist system.

Since Joist are very strong in the vertical plane (strong axis) but less strong in the horizontal plane (weak axis) bridging plays a key role in the overall strength of a open web joist system.

- Bridging provides lateral stability during the erection process.

- Bridging provides lateral stability when the chords are not braced during the application of loads.
  - Bottom chords during uplift
  - Top chords when Standing Seam decks are used.
  - Brace the bottom chord for webs in compression.

Safety

- Bridging and metal deck installation are critical to developing the full load carrying capacity of a steel joist.
- Install Erection Stability Bridging, where required, before attempting to support any weight on the joist.
- Make sure horizontal bridging rows are continuous and anchored at both ends.
- Limit the magnitude and placement of construction loads.

Safety – Tie Joists

- Tie joists (at column lines) are often set first, before adjacent joists.
- This is potentially dangerous where Erection Stability Bridging is required.

Safety – Tie Joists

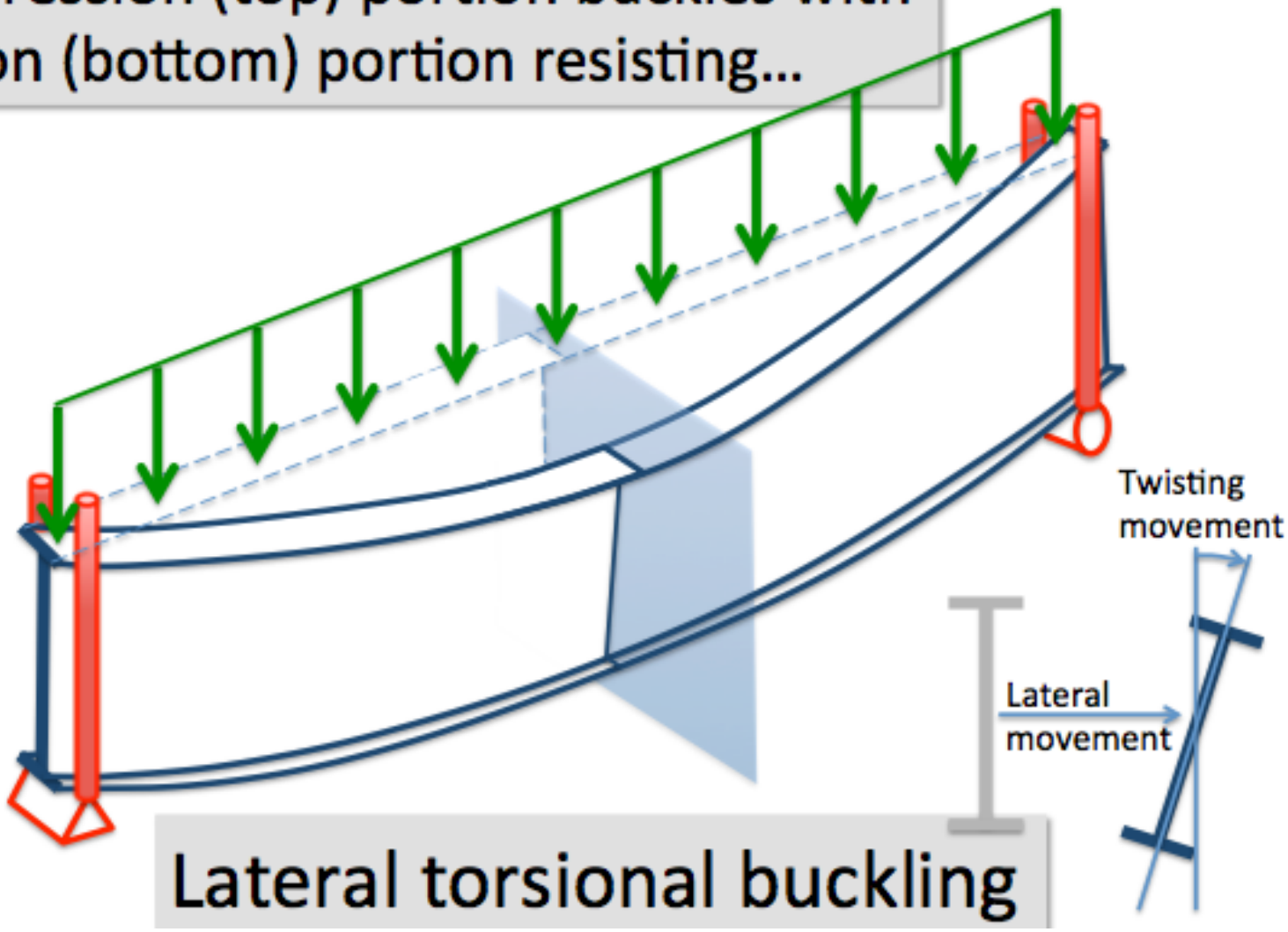
- A Danger Tag is used at tie joists as a warning, and OSHA requires alternate methods of stabilizing the tie joist.

Theory Behind Bridging

- Joist behave like wide flange beams with compression in the top chord and tension in bottom chord.
- The result is Lateral Torsional Buckling.
- Bridging provides lateral restraint either permanently or until other means of restraint are provided.
- When deck is attached this provides the lateral restraint to the joist top chord.

Joist behaves like a beam!

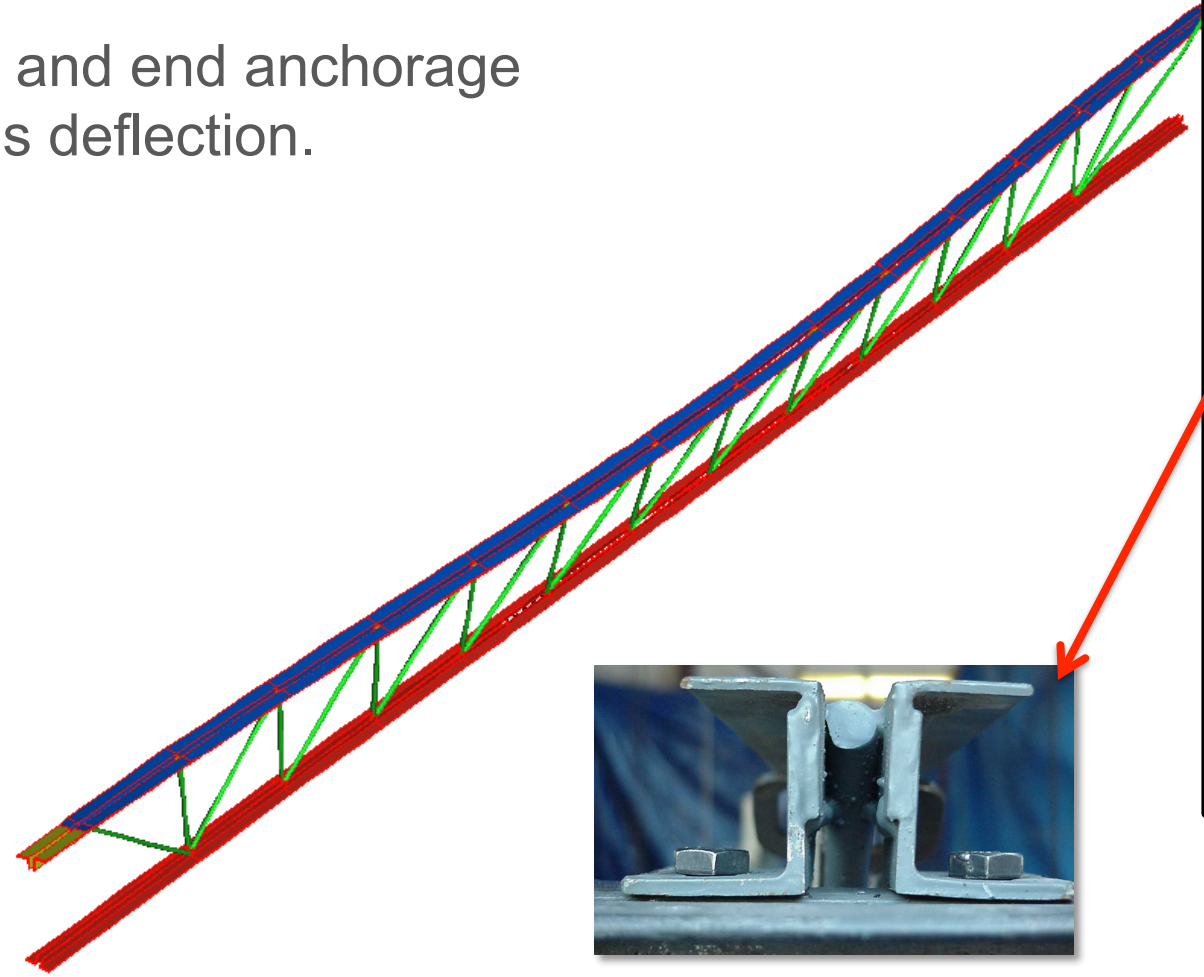
Compression (top) portion buckles with tension (bottom) portion resisting…

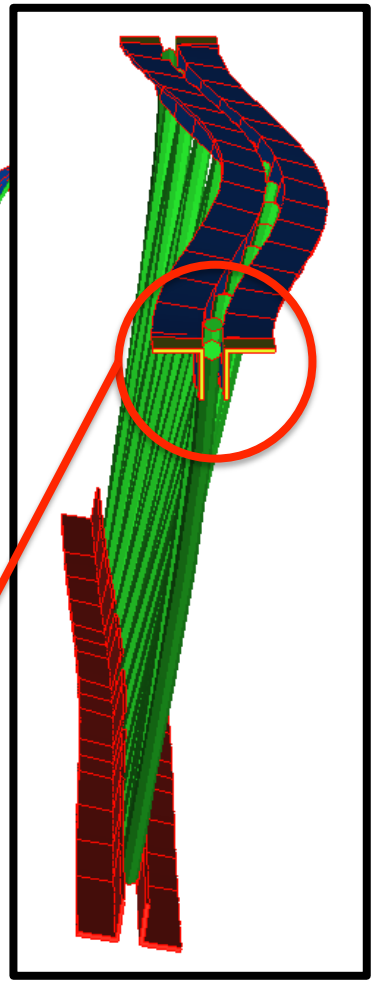


Lateral torsional buckling

Without lateral restraint joists tend to deflect out of plane.

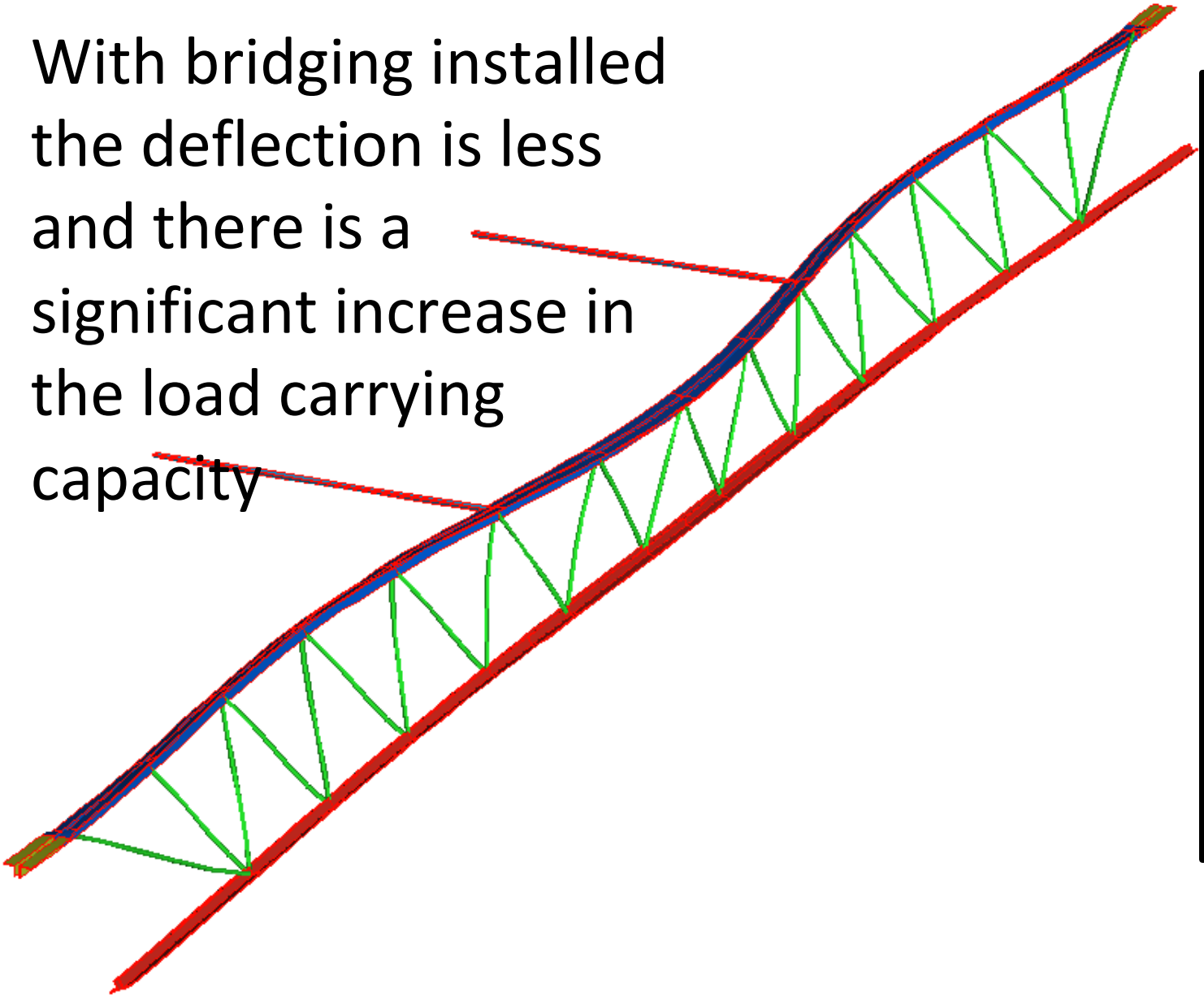
Bridging and end anchorage resist this deflection.

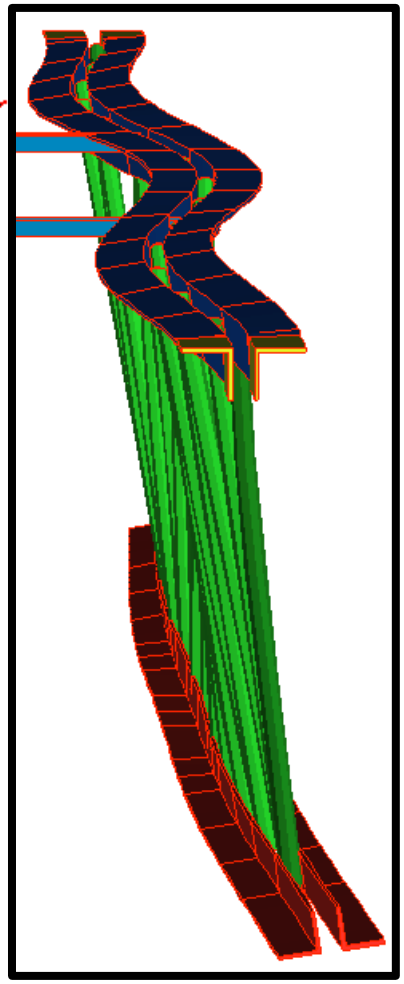




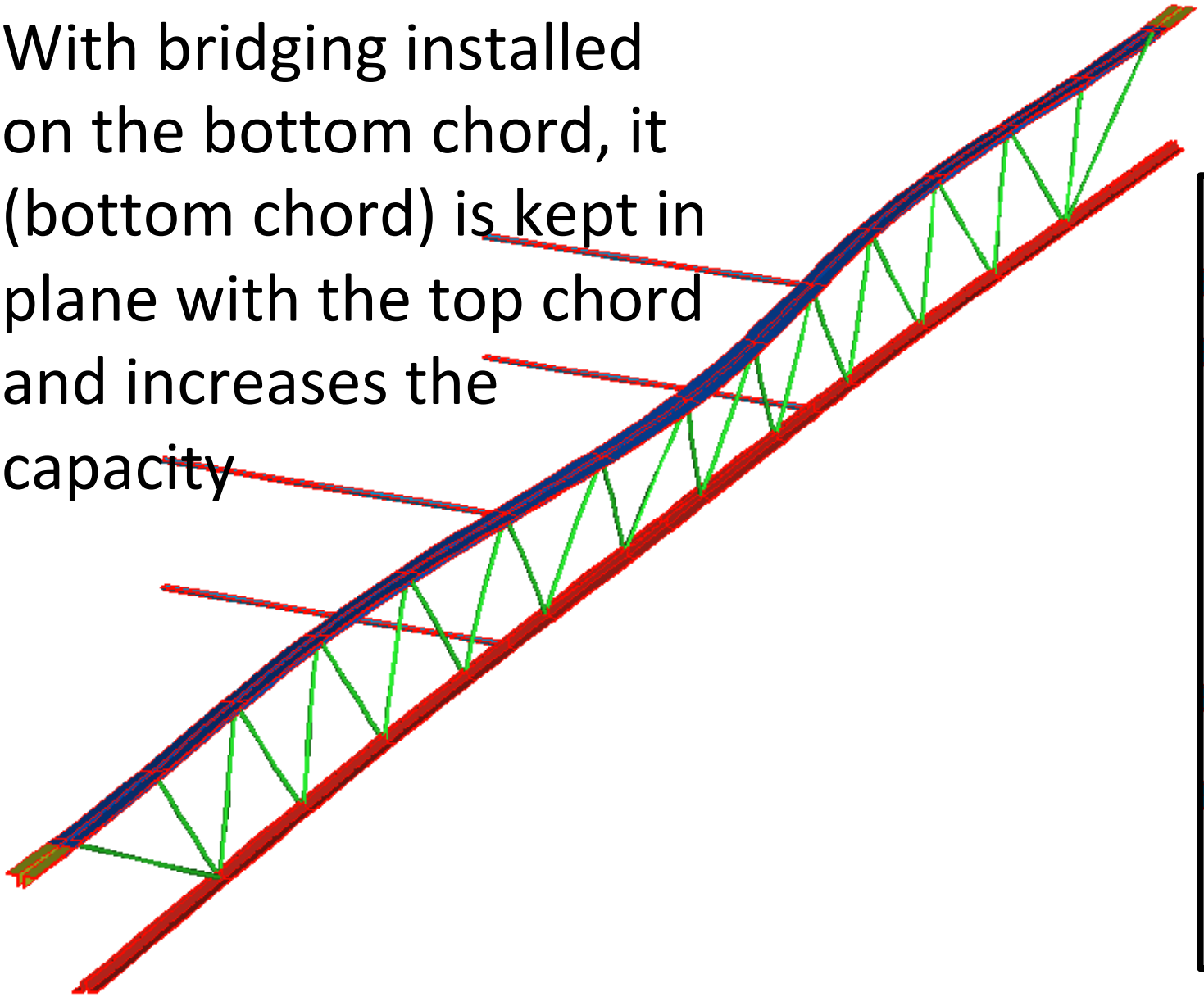
Joists have very low out-of-plane flexural and torsional stiffness!

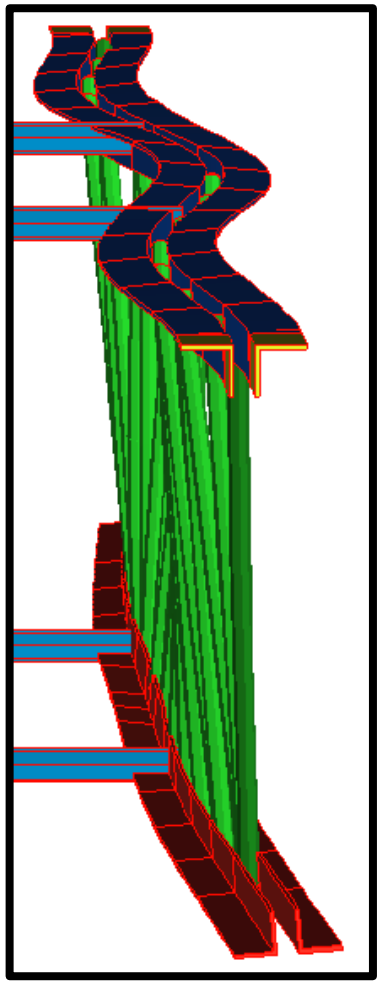
With bridging installed the deflection is less and there is a significant increase in the load carrying capacity



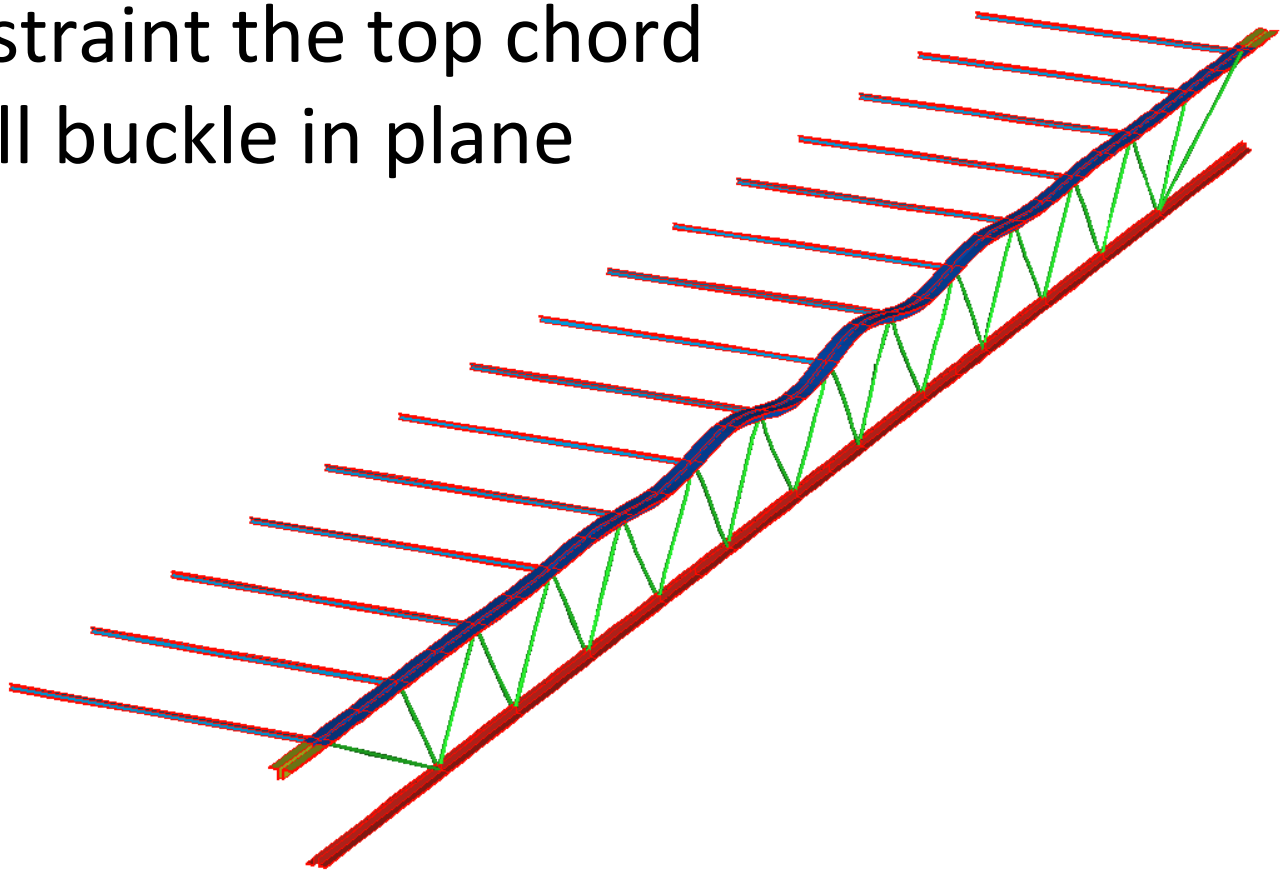


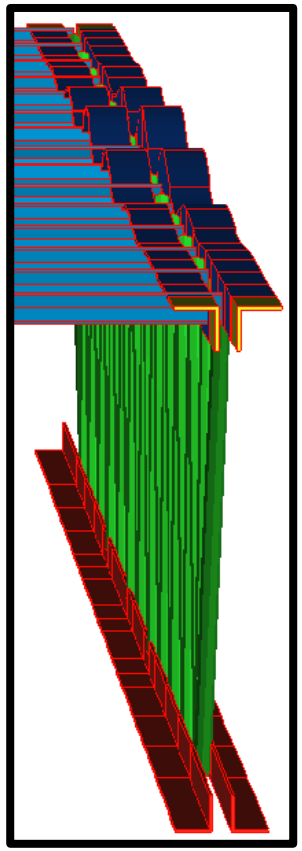
With bridging installed on the bottom chord, it (bottom chord) is kept in plane with the top chord and increases the capacity

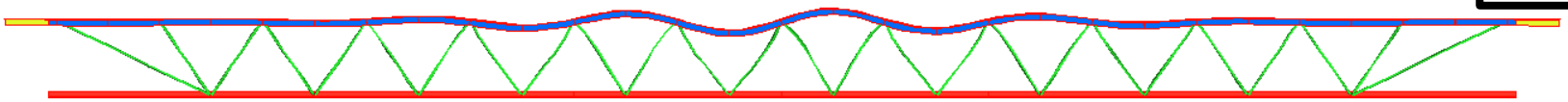




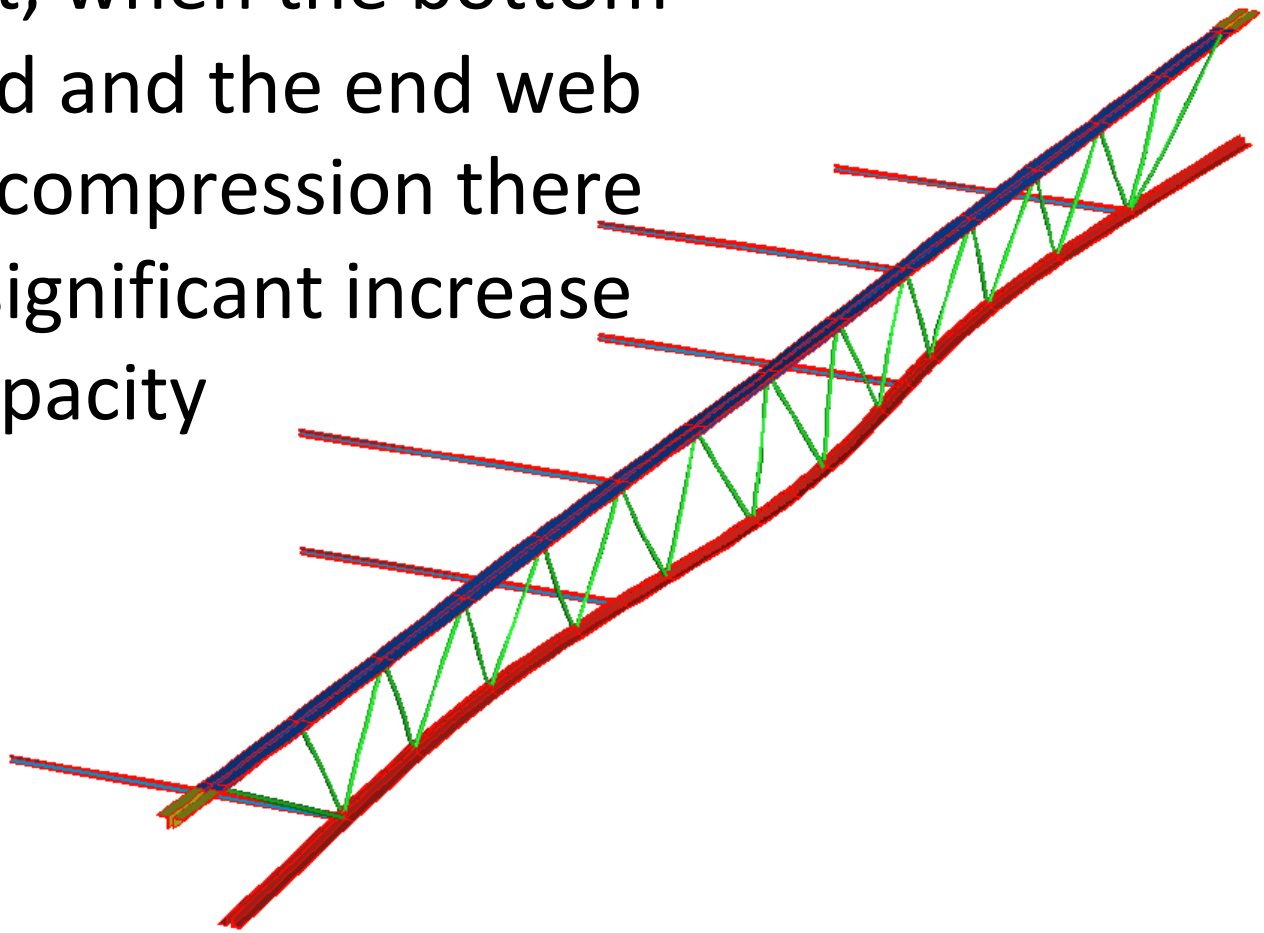
With full lateral restraint the top chord will buckle in plane

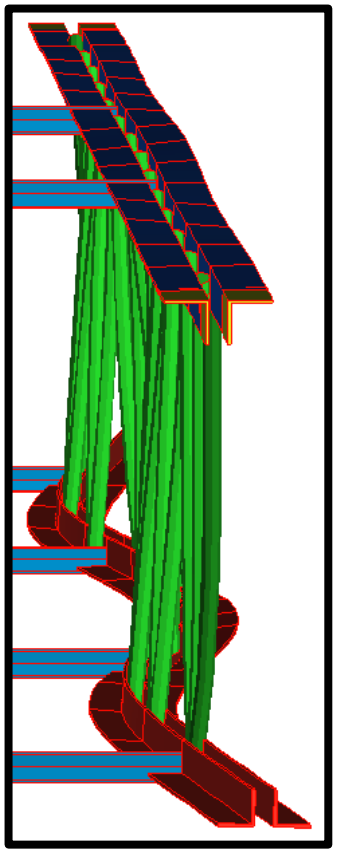




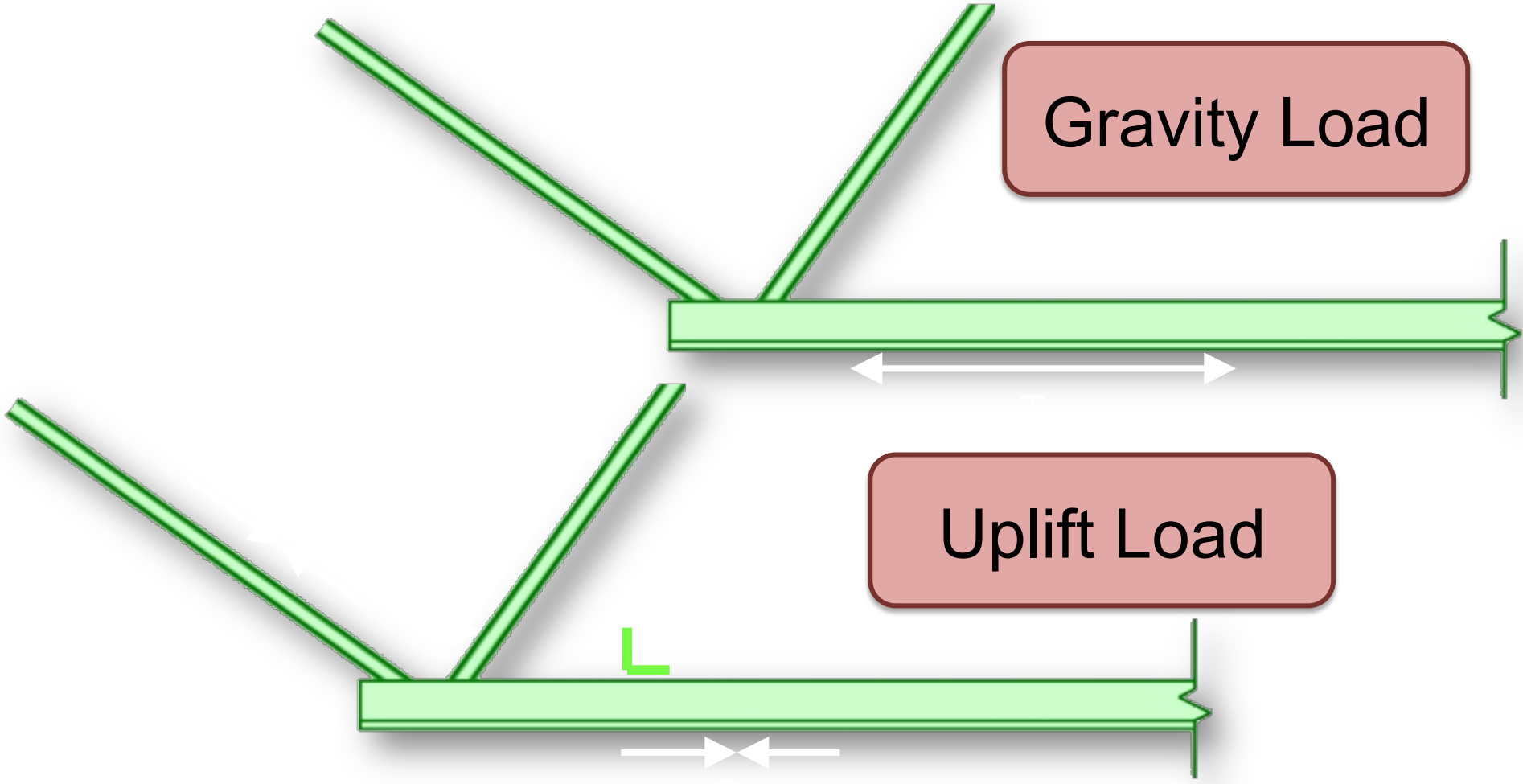


With bridging at the 1st bottom chord panel point, when the bottom chord and the end web is in compression there is a significant increase in capacity

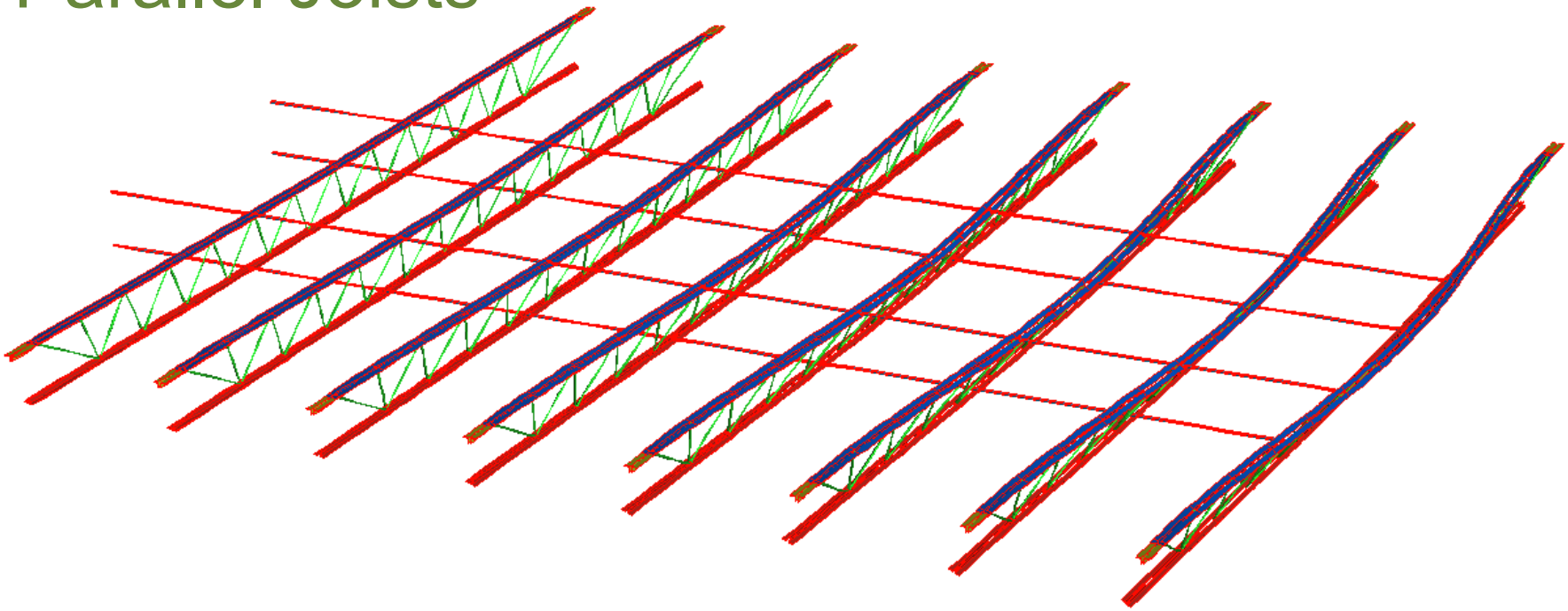


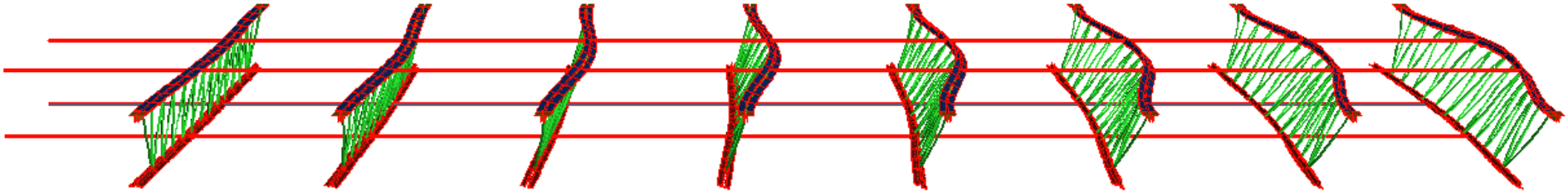


First Bottom Chord Panel Point Forces

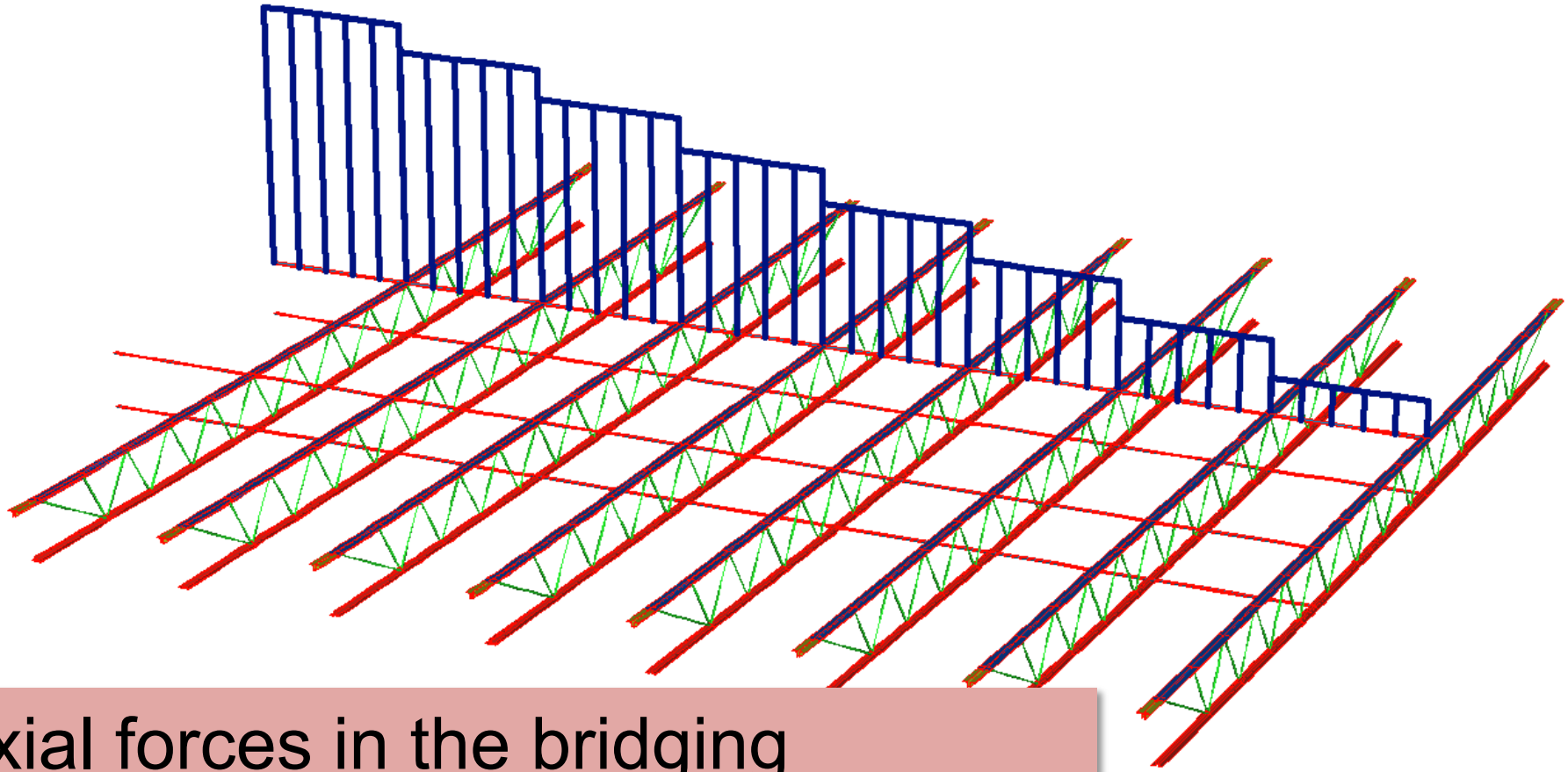


Parallel Joists





Axial force diagram for one line of bridging



Axial forces in the bridging accumulate

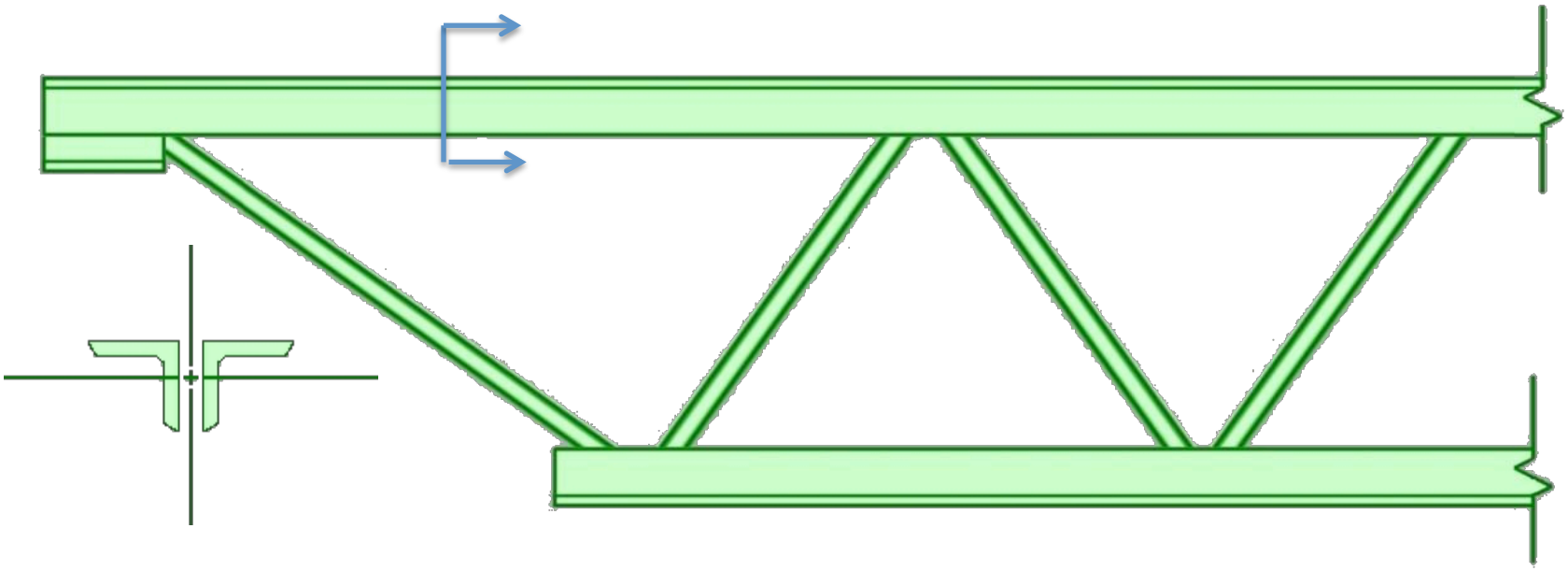
SJI Specification Requirements

- Slenderness Limits
- Uplift Bridging

Construction Loads and Strength

- The key to joist strength, before decking is attached, is top chord slenderness about the vertical axis.

- R_{yy}



Slenderness Limit Variation

- Before 2010 Spec…
  - K-Series L/Ryy = 145
  - LH-Series L/Ryy = 170
- In the 2010 and 2015 Spec (44th edition)
  - K and LH series are combined and the L/Ryy limits are the same for all joist types.
  - Variable Slenderness Limit
  - Recognize that construction stress varies with joist span (tributary area)
  - Recognize that construction stress varies with span to depth ratio

Radius of Gyration Requirement Limits

The radius of gyration of the top chord about its vertical axis shall not be less than:

$$r_y \geq \ell \Big/ \left(124 + 0.67\, d_j + 28 \frac{d_j}{L} \right) \text{, in.} \qquad \text{(103.4-1a)}$$

$$r_y \geq \ell \Big/ \left(124 + 0.026\, d_j + 0.34 \frac{d_j}{L} \right) \text{, mm} \qquad \text{(103.4-1b)}$$

or

$$r_y = \ell / 170 \qquad \text{(103.4-2)}$$

Where,

d_j is the steel joist depth, in. (mm)

L is the design length for the joist, ft. (m)

r_y is the out-of-plane radius of gyration of the top chord, in. (mm)

ℓ is the spacing in inches (millimeters) between lines of bridging as specified in Section 104.5(d).

Slenderness Limit Variation

JOIST DEPTH	JOIST SPAN																					
↓	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84	88	92	96
10"	154	148	145																			
12"	160	153	149	146																		
14"	166	158	153	150	147																	
16"	170	163	157	153	151	149																
18"	170	168	161	157	154	152	150															
20"		170	165	161	157	155	153	151														
22"			170	164	161	158	156	154	153													
24"			170	168	164	161	159	157	155	154												
26"				170	167	164	162	160	158	157	155											
28"					170	167	165	162	161	159	158	157										
30"						170	167	165	163	162	160	159	158									
32"						170	170	168	166	164	163	161	160	159								
36"							170	170	170	169	168	166	165	164	163	162						
40"								170	170	170	170	170	169	168	167	166	166	165				
44"									170	170	170	170	170	170	170	170	170	169	168	167		
48"										170	170	170	170	170	170	170	170	170	170	170	170	170

SLENDERNESS LIMIT

$$\left(124 + 0.67\,d_j + 28\frac{d_j}{L}\right)$$

Bottom Chord Bridging for Uplift

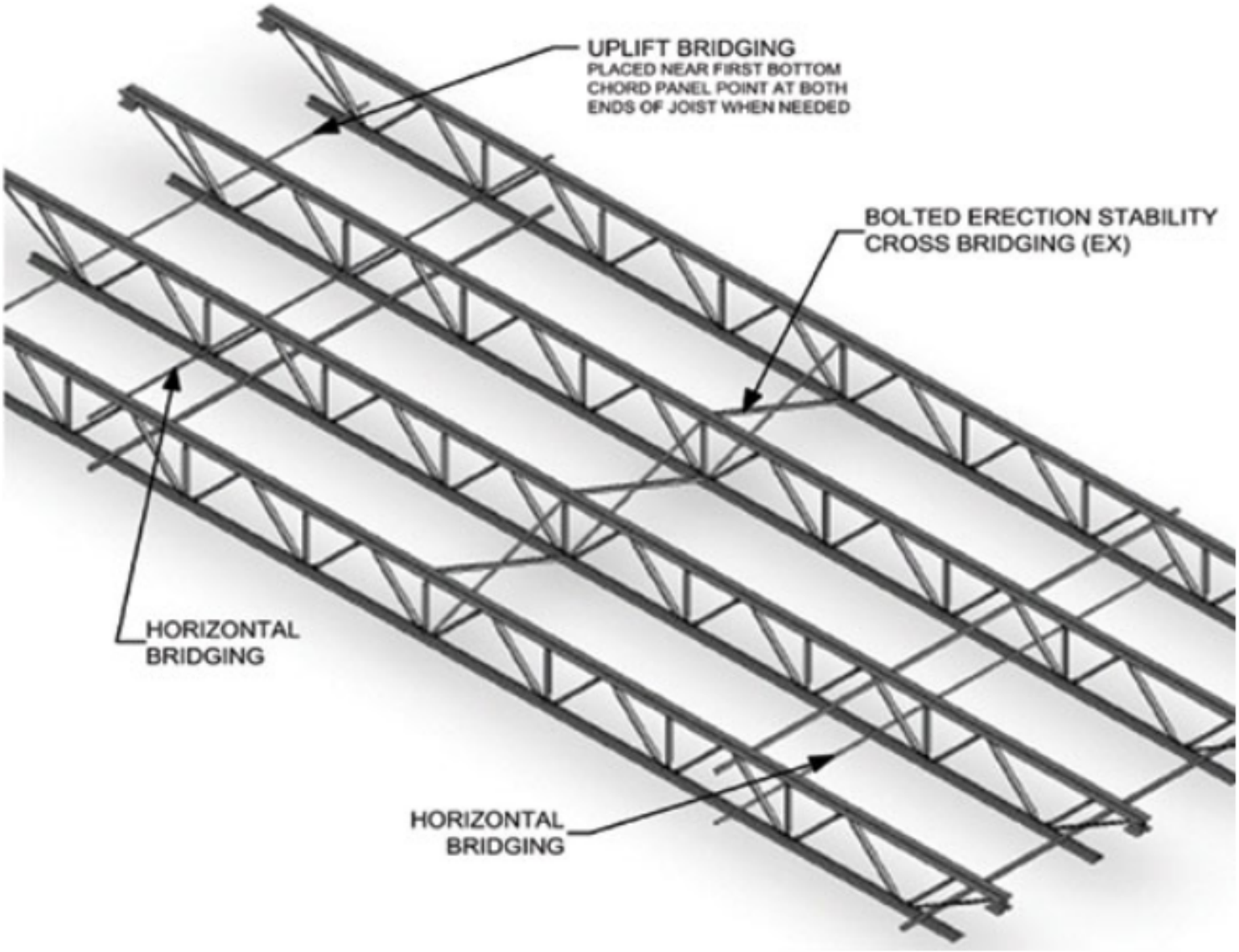
- SJI Standard Specifications,

  K, LH, DLH Series

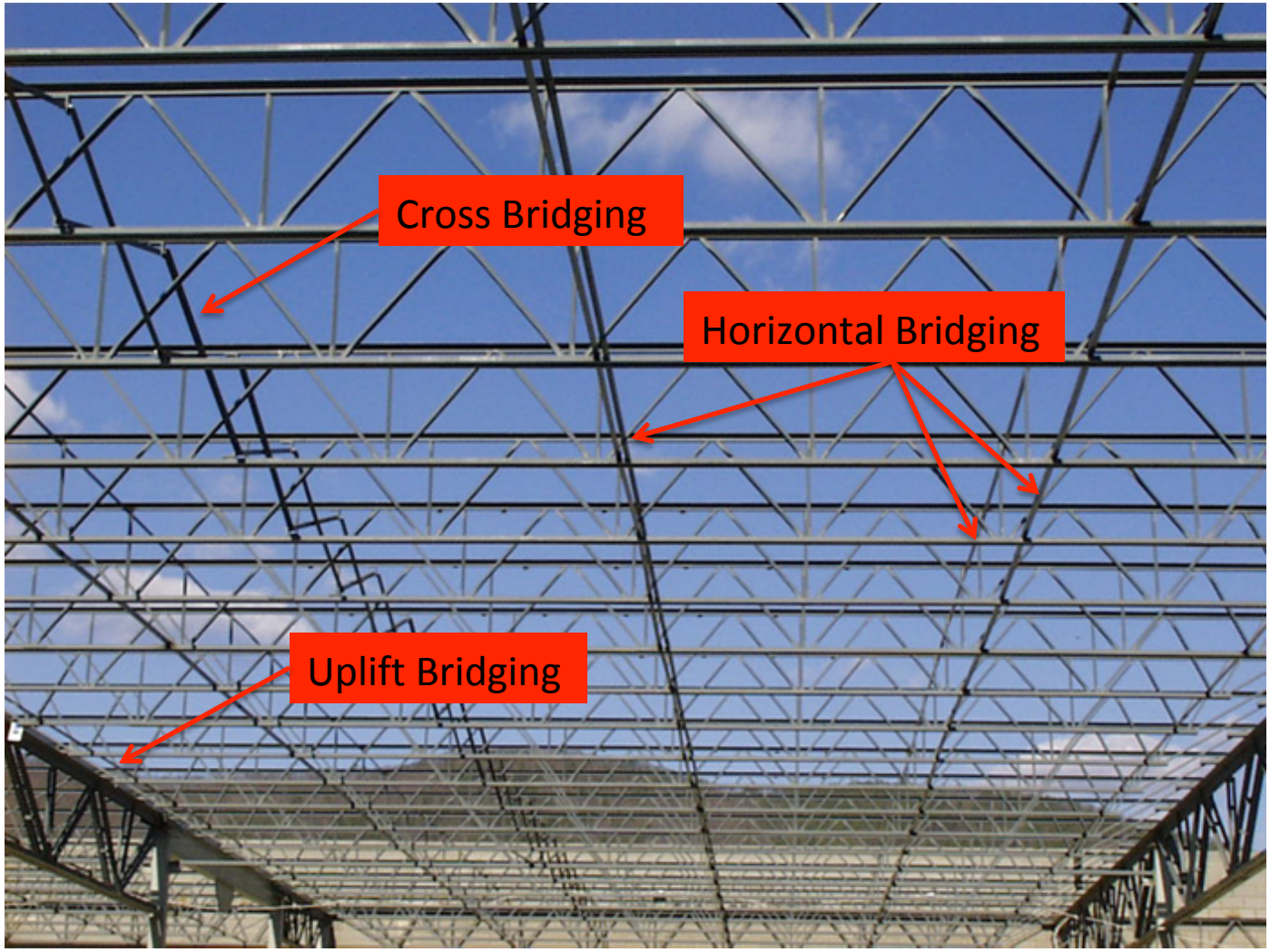
  "…When these forces are specified, they must be considered in the design of joists and/or bridging. A single line of bottom chord bridging must be provided near the first bottom chord panel points whenever uplift due to wind forces is a design consideration."

Types of Bridging

- Cross Bridging
- Horizontal Bridging
- Uplift Bridging
- Erection Bridging
- Construction Bridging
- Permanent Bridging

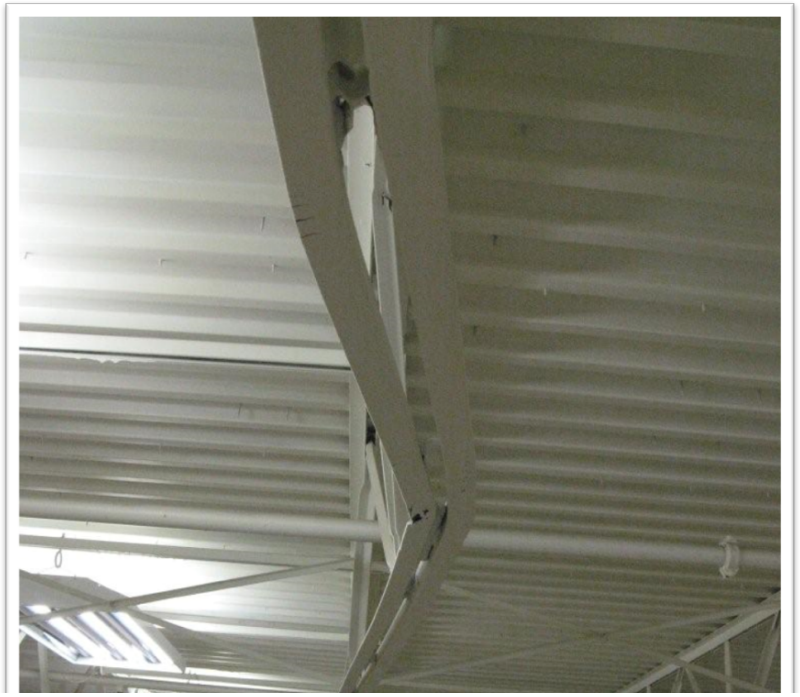

UPLIFT BRIDGING
PLACED NEAR FIRST BOTTOM CHORD PANEL POINT AT BOTH ENDS OF JOIST WHEN NEEDED
BOLTED ERECTION STABILITY CROSS BRIDGING (EX)
HORIZONTAL BRIDGING
HORIZONTAL BRIDGING

Types of Bridging



Bottom Chord Bridging for Uplift

- When the joist is subject to uplift, the bridging provides lateral restraint for the bottom chord in compression.
- Generally the joist bottom chord will fail out of plane between the rows of bridging.

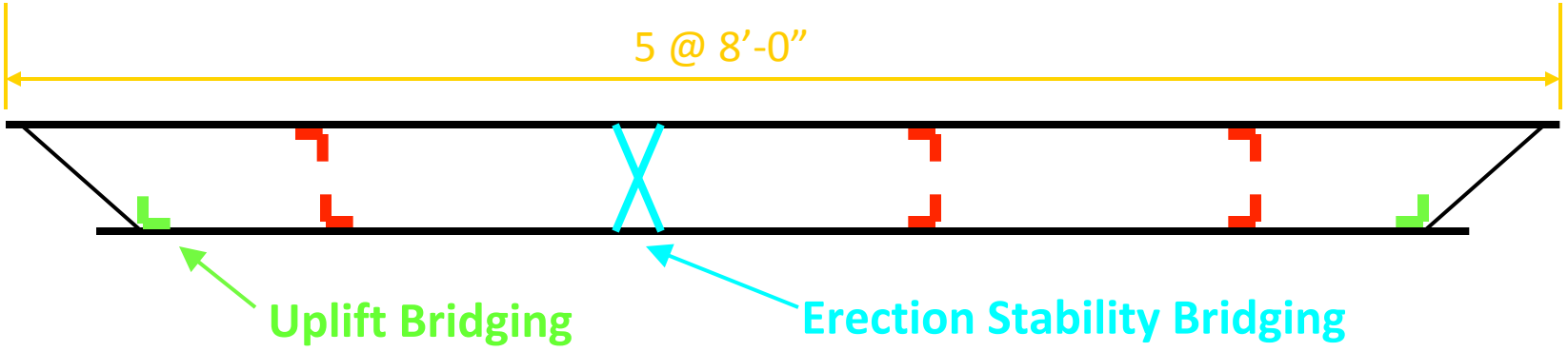


Bottom Chord Bridging Spacing

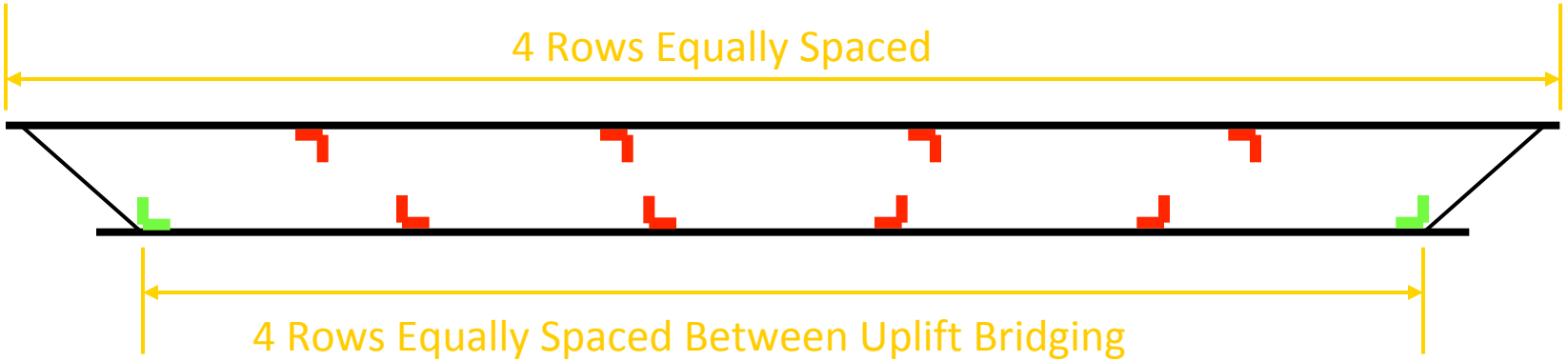
- Bottom Chord, Uplift Bridging
  - Bottom chord bridging need not align with top chord bridging
  - Total number of bottom chord rows shall not be less than the number of top chord rows
  - Can be advantageous to space rows more closely near center of span
  - A common option is to equally space bottom chord rows between the first bottom chord panel points

Bridging Spacing for Uplift

Typical Bridging Configuration:



A Common Alternative



Erection Stability Bridging

- Joists exhibit varying degrees of stability dependent upon the span, depth, member sizes, self weight and other parameters.
- Erection Bridging provides stability to the joist prior to any load (other than self weight) being placed on the joist.
- Bolted diagonal Erection Bridging which must be installed prior to releasing hoisting cables may be required.

Erection Stability Bridging

Erection Stability Bridging

$$W = \frac{-b \pm \sqrt{b^2 - 4 \cdot a \cdot c}}{2 \cdot a} \text{ lbs. ;} \qquad \text{If , } \frac{w_u}{w_{actual}} > 1.00 \text{ Erection Bridging is not required.}$$

$$b = P \cdot \frac{\pi^2 + 3}{12} \cdot \frac{\pi^2 + 4}{16} - \frac{\pi^4 \cdot E \cdot I_y}{2 \cdot (k \cdot L)^3} \cdot \left[\beta_x \cdot \left(\frac{\pi^2 - 3}{24} \right) - \frac{y_o}{2} \right]$$

$$a = \left(\frac{\pi^2 + 3}{24} \right)^2 = 0.732$$

$$c = (P)^2 \left(\frac{\pi^2 + 4}{16} \right)^2 - \frac{\pi^4 \cdot E \cdot I_y}{2 \cdot (k \cdot L)^3} \cdot \left[P \cdot \left(\beta_x \cdot \frac{\pi^2 - 4}{16} - a_e \right) + \frac{\pi^4 \cdot E \cdot C_w}{2 \cdot (k \cdot L)^3} + \frac{\pi^2 \cdot G \cdot J}{2 \cdot k \cdot L} \right]$$

Where:

P = Factored weight of erector = 1.2 x (assumed weight of 250 lbs.) = 300 lbs.

Erection Stability Bridging

- Bridging Lines
  - For spans up through 60 feet (18288 mm), welded horizontal bridging may be used except where the row of bridging nearest the center is required to be bolted diagonal bridging as indicated by the Red shaded area in the Load Table.
  - For spans over 60 feet (18288 mm) bolted diagonal bridging shall be used as indicated by the Blue and Gray shaded areas of the Load Table.

Shading for Erection Stability Bridging

- Red shading: one row nearest the center shall be bolted diagonal bridging and installed before release of hoisting cables

STANDARD LOAD TABLE FOR OPEN WEB STEEL JOISTS,K-SERIES
Based on a 50 ksi Maximum Yield Strength - Loads Shown In Pounds Per Linear Foot (plf)

Joist Designation	18K3	18K4	18K5	18K6	18K7	18K9	18K10	20K3	20K4	20K5	20K6	20K7	20K9	20K10	22K4	22K5	22K6	22K7	22K9	22K10	22K11
Depth (In.)	18	18	18	18	18	18	18	20	20	20	20	20	20	20	22	22	22	22	22	22	22
Approx. Wt. (lbs./ft.)	6.6	7.2	7.7	8.5	9.0	10.2	11.7	6.5	7.2	7.7	8.3	8.7	9.4	10.6	7.3	7.7	8.1	8.8	9.8	10.7	11.9
Span (ft.) ↓																					
18	550	550	550	550	550	550	550														
	550	550	550	550	550	550	550														
19	514	550	550	550	550	550	550	550	550	550	550	550	550	550							
	494	523	523	523	523	523	523	550	550	550	550	550	550	550							
20	463	550	550	550	550	550	550	517	550	550	550	550	550	550							
	423	490	490	490	490	490	490	517	550	550	550	550	550	550							
21	420	506	550	550	550	550	550	468	550	550	550	550	550	550	550	550	550	550	550	550	550
	364	426	460	460	460	460	460	453	520	520	520	520	520	520	550	550	550	550	550	550	550
22	382	460	518	550	550	550	550	426	514	550	550	550	550	550	550	550	550	550	550	550	550
	316	370	414	438	438	438	438	393	461	490	490	490	490	490	548	548	548	548	548	548	548
23	349	420	473	516	550	550	550	389	469	529	550	550	550	550	518	550	550	550	550	550	550
	276	323	362	393	418	418	418	344	402	451	468	468	468	468	491	518	518	518	518	518	518
24	320	385	434	473	528	550	550	357	430	485	528	550	550	550	475	536	550	550	550	550	550
	242	284	318	345	382	396	396	302	353	396	430	448	448	448	431	483	495	495	495	495	495
25	294	355	400	435	485	550	550	329	396	446	486	541	550	550	438	493	537	550	550	550	550
	214	250	281	305	337	377	377	266	312	350	380	421	426	426	381	427	464	474	474	474	474
26	272	328	369	402	448	538	550	304	366	412	449	500	550	550	404	455	496	550	550	550	550
	190	222	249	271	299	354	361	236	277	310	337	373	405	405	338	379	411	454	454	454	454
27	252	303	342	372	415	498	550	281	339	382	416	463	550	550	374	422	459	512	550	550	550
	169	198	222	241	267	315	347	211	247	277	301	333	389	389	301	337	367	406	432	432	432
28	234	282	318	346	385	463	548	261	315	355	386	430	517	550	348	392	427	475	550	550	550
	151	177	199	216	239	282	331	189	221	248	269	298	353	375	270	302	328	364	413	413	413
29	218	263	296	322	359	431	511	243	293	330	360	401	482	550	324	365	398	443	532	550	550
	136	159	179	194	215	254	298	170	199	223	242	268	317	359	242	272	295	327	387	399	399
30	203	245	276	301	335	402	477	227	274	308	336	374	450	533	302	341	371	413	497	550	550
	123	144	161	175	194	229	269	153	179	201	218	242	286	336	219	245	266	295	349	385	385
31	190	229	258	281	313	376	446	212	256	289	314	350	421	499	283	319	347	387	465	550	550
	111	130	146	158	175	207	243	138	162	182	198	219	259	304	198	222	241	267	316	369	369
32	178	215	242	264	294	353	418	199	240	271	295	328	395	468	265	299	326	363	436	517	549
	101	118	132	144	159	188	221	126	147	165	179	199	235	276	180	201	219	242	287	337	355
33	168	202	228	248	276	332	393	187	226	254	277	309	371	440	249	281	306	341	410	486	532
	92	108	121	131	145	171	201	114	134	150	163	181	214	251	164	183	199	221	261	307	334
34	158	190	214	233	260	312	370	176	212	239	261	290	349	414	235	265	288	321	386	458	516
	84	98	110	120	132	156	184	105	122	137	149	165	195	229	149	167	182	202	239	280	314
35	149	179	202	220	245	294	349	166	200	226	246	274	329	390	221	249	272	303	364	432	494
	77	90	101	110	121	143	168	96	112	126	137	151	179	210	137	153	167	185	219	257	292
36	141	169	191	208	232	278	330	157	189	213	232	259	311	369	209	236	257	286	344	408	467
	70	82	92	101	111	132	154	88	103	115	125	139	164	193	126	141	153	169	201	236	269
37								148	179	202	220	245	294	349	198	223	243	271	325	386	442
								81	95	106	115	128	151	178	116	130	141	156	185	217	247
38								141	170	191	208	232	279	331	187	211	230	256	308	366	419
								74	87	98	106	118	139	164	107	119	130	144	170	200	228
39								133	161	181	198	220	265	314	178	200	218	243	292	347	397
								69	81	90	98	109	129	151	98	110	120	133	157	185	211
40								127	153	172	188	209	251	298	169	190	207	231	278	330	377
								64	75	84	91	101	119	140	91	102	111	123	146	171	195
41															161	181	197	220	264	314	359
															85	95	103	114	135	159	181
42															153	173	188	209	252	299	342
															79	88	96	106	126	148	168
43															146	165	179	200	240	285	326
															73	82	89	99	117	138	157
44															139	157	171	191	229	272	311
															68	76	83	92	109	128	146

STANDARD LOAD TABLE FOR OPEN WEB STEEL JOISTS,K-SERIES
Based on a 50 ksi Maximum Yield Strength - Loads Shown In Pounds Per Linear Foot (plf)

Joist Designation	24K4	24K5	24K6	24K7	24K8	24K9	24K10	24K12	26K5	26K6	26K7	26K8	26K9	26K10	26K12
Depth (In.)	24	24	24	24	24	24	24	24	26	26	26	26	26	26	26
Approx. Wt.	7.9	8.5	9.0	9.4	9.9	11.6	13.5		8.1	8.6	9.0	9.7	10.4	11.6	13.7
	550	550	550	550	550	550	550								
	550	550	550	550	550	550	550								
	550	550	550	550	550	550	550								
	544	544	544	544	544	544	544								
	540	550	550	550	550	550	550	550	550	550	550	550	550	550	550
	511	520	520	520	520	520	520	520	550	550	550	550	550	550	550
	499	543	550	550	550	550	550	550	542	550	550	550	550	550	550
	453	493	499	499	499	499	499	499	535	541	541	541	541	541	541
	462	503	550	550	550	550	550	550	502	547	550	550	550	550	550
	404	439	479	479	479	479	479	479	477	519	522	522	522	522	522
	429	467	521	550	550	550	550	550	466	508	550	550	550	550	550
	362	393	436	456	456	456	456	456	427	464	501	501	501	501	501
	400	435	485	536	550	550	550	550	434	473	527	550	550	550	550
	325	354	392	429	436	436	436	436	384	417	463	479	479	479	479
	373	406	453	500	544	550	550	550	405	441	492	544	550	550	550
	293	319	353	387	419	422	422	422	346	377	417	457	459	459	459
	349	380	424	468	510	550	550	550	379	413	460	509	550	550	550
	266	289	320	350	379	410	410	410	314	341	378	413	444	444	444
	327	357	397	439	478	549	549	549	356	387	432	477	519	549	549
	241	262	290	318	344	393	393	393	285	309	343	375	407	431	431
	308	335	373	413	449	532	532	532	334	364	406	448	488	532	532
	220	239	265	289	313	388	388	388	259	282	312	342	370	404	404
	290	315	351	388	423	502	516	516	315	343	382	422	459	516	516
	201	218	242	264	286	337	344	344	237	257	285	312	338	378	378
	273	297	331	366	399	473	501	501	297	323	360	398	433	501	501
	184	200	221	242	262	308	324	324	217	236	261	286	310	356	356
	258	281	313	346	377	447	487	487	280	305	340	376	409	486	487
	169	183	203	222	241	283	306	306	199	216	240	263	284	334	334
	244	266	296	327	356	423	474	474	265	289	322	356	387	460	474
	155	169	187	205	222	280	280	280	183	199	221	242	262	308	315
	231	252	281	310	338	401	461	461	251	274	305	337	367	436	461
	143	156	172	189	204	240	275	275	169	184	204	223	241	284	299
	219	239	266	294	320	380	449	449	238	260	289	320	348	413	449
	132	144	159	174	189	222	261	261	156	170	188	206	223	262	283
	208	227	253	280	304	361	438	438	227	247	275	304	331	393	438
	122	133	148	161	175	206	247	247	145	157	174	191	207	243	269
	198	216	241	266	290	344	427	427	215	235	262	289	315	374	427
	114	124	137	150	162	191	235	235	134	146	162	177	192	225	256
	189	206	229	253	276	327	417	417	205	224	249	275	300	356	417
	106	115	127	139	151	177	224	224	125	136	150	164	178	210	244
	180	196	219	242	263	312	406	406	196	213	238	263	286	339	407
	98	107	118	130	140	165	213	213	116	126	140	153	166	195	232
	172	187	209	231	251	298	387	387	187	204	227	251	273	324	398
	92	100	110	121	131	154	199	199	108	118	131	143	155	182	222
	164	179	199	220	240	285	370	370	179	194	217	240	261	310	389
	86	93	103	113	122	144	185	185	101	110	122	133	145	170	212
	157	171	191	211	230	272	354	354	171	186	207	229	250	296	380
	80	87	97	106	114	135	174	174	95	103	114	125	135	159	203
	150	164	183	202	220	261	339	339	164	178	199	219	239	284	369
	75	82	90	99	107	126	163	163	89	96	107	117	127	149	192
	144	157	175	194	211	250	325	325	157	171	190	210	229	272	353
	70	77	85	93	101	118	153	153	83	90	100	110	119	140	180
									150	164	183	202	220	261	339
									78	85	94	103	112	131	169
									144	157	175	194	211	250	325
									73	80	89	97	105	124	159
									139	151	168	186	203	241	313
									69	75	83	91	99	116	150
									133	145	162	179	195	231	301
									65	71	79	86	93	110	142

STANDARD LOAD TABLE FOR OPEN WEB STEEL JOISTS,K-SERIES
Based on a 50 ksi Maximum Yield Strength - Loads Shown In Pounds Per Linear Foot (plf)

Joist Designation	28K6	28K7	28K8	28K9	28K10	28K12	30K7	30K8	30K9	30K10	30K11	30K12
Depth (In.)	28	28	28	28	28	28	30	30	30	30	30	30
Approx. Wt. (lbs./ft.)	8.9	9.2	9.8	10.5	11.6	14.5	9.6	10.0	10.6	11.9	13.3	15.0
Span (ft.) 27	550	550	550	550	550	550						
	550	550	550	550	550	550						
	508	520	520	520	520	520						
8	550	550	550	550	550							
1	543	543	543	543	543							
1	550	550	550	550	550	550	550	550	550	550	550	550
6	522	522	522	522	522	522	550	550	550	550	550	550
7	531	550	550	550	550	550	550	550	550	550	550	550
9	486	500	500	500	500	500	543	543	543	543	543	543
6	497	550	550	550	550	550	534	550	550	550	550	550
7	440	480	480	480	480	480	508	520	520	520	520	520
8	466	515	549	549	549	549	501	549	549	549	549	549
1	400	438	463	463	463		481	500	500	500	500	500
3	438	484	527	532	532	532	471	520	532	532	532	532
9	394	399	432	435	435	435	420	460	488	488	488	488
0	412	456	496	516	516	516	443	490	516	516	516	516
9	333	364	395	410	410	410	384	420	441	441	441	441
9	389	430	468	501	501	501	418	462	501	501	501	501
5	305	333	361	389	389	389	351	394	415	415	415	415
0	367	406	442	487	487	487	395	436	475	487	487	487
2	280	306	332	366	366	366	323	353	383	392	392	392
4	348	384	418	474	474	474	373	413	449	474	474	474
2	257	282	305	344	344	344	297	325	352	374	374	374
8	329	364	396	461	461	461	354	391	426	461	461	461
4	237	260	282	325	325	325	274	300	325	353	353	353
0	313	346	376	447	449	449	336	371	404	449	449	449
8	219	240	260	306	306	306	253	277	300	333	333	333
6	297	329	357	424	438	438	319	353	384	438	438	438
3	203	222	241	294	291	291	234	256	278	315	315	315
0	283	312	340	404	427	427	303	335	365	427	427	427
0	189	206	224	283	277	277	217	238	258	300	300	300
1	269	297	324	384	417	417	289	320	348	413	417	417
8	175	192	208	245	284	284	202	221	240	282	284	284
0	257	284	309	367	407	407	276	305	332	394	407	407
7	163	179	194	228	252	252	189	206	223	263	270	270
0	245	271	295	350	398	398	263	291	317	376	398	398
7	152	167	181	212	240	240	176	192	208	245	258	258
0	234	259	282	334	389	389	251	278	303	359	389	389
8	142	156	169	198	229	229	164	179	195	229	246	246
1	224	248	270	320	380	380	241	266	290	344	380	380
0	133	146	158	186	219	219	153	168	182	214	236	236
2	214	237	258	306	372	372	230	255	277	329	372	372
0	126	136	148	174	210	210	144	157	171	201	226	226
4	206	227	247	294	365	365	221	244	266	315	362	365
5	117	128	139	163	201	201	135	148	160	188	215	216
7	197	218	237	282	357	357	212	234	255	303	347	357
1	110	120	130	153	193	193	127	138	150	177	202	207
0	189	209	228	270	350	350	203	225	245	291	333	350
5	103	113	123	144	185	185	119	130	141	166	190	199
3	182	201	219	260	338	338	195	216	235	279	320	343
7	97	106	115	136	175	175	112	123	133	157	179	192
7	175	193	210	250	325	325	188	208	226	268	308	336
7	92	100	109	129	165	165	106	116	126	148	169	184
1	168	186	203	240	313	313	181	200	218	258	296	330
1	87	95	103	121	156	156	100	109	119	140	159	177
5	162	179	195	232	301	301	174	192	209	249	285	324
1	82	89	97	114	147	147	94	103	112	132	150	170
0	156	173	188	223	290	290	168	185	202	240	275	312
1	77	85	92	108	139	139	89	98	106	125	142	161
5	151	166	181	215	280	280	162	179	195	231	265	301
1	73	80	87	102	132	132	84	92	100	118	135	153
							156	173	188	223	256	290
							80	88	96	112	129	145
							151	167	181	215	247	280
							76	83	90	106	121	137
							146	161	175	208	239	271
							72	79	86	101	115	130
							141	156	169	201	231	262
							69	75	81	96	109	124

Shading for Erection Stability Bridging

- Blue shading: all rows shall be bolted diagonal and the two rows near 1/3 points shall be installed before the release of hoisting cables

A S D

STANDARD LOAD TABLE FOR LONGSPAN STEEL JOISTS, LH-SERIES
Based on a 50 ksi Maximum Yield Strength - Loads Shown In Pounds Per Linear Foot (plf)

Joist Designation	Approx. Wt in Lbs. Per Linear Ft. (Joists only)	Depth in inches	Max Load (plf)	SAFELOAD* in Lbs. Between	SPAN IN FEET														
			< 29	29-33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
24LH03	11	24	401	11620	342	339	336	323	307	293	279	267	255	244	234	224	215	207	199
					235	226	218	204	188	175	162	152	141	132	124	116	109	102	96
24LH04	12	24	491	14240	419	398	379	360	343	327	312	298	285	273	262	251	241	231	222
					288	265	246	227	210	195	182	169	158	148	139	130	122	114	107
24LH05	13	24	526	15260	449	446	440	419	399	380	363	347	331	317	304	291	280	269	258
					308	297	285	264	244	226	210	196	182	171	160	150	141	132	124
24LH06	16	24	708	20520	604	579	555	530	504	480	457	437	417	399	381	364	348	334	320
					411	382	356	331	306	284	263	245	228	211	197	184	172	161	152
24LH07	17	24	777	22540	665	638	613	588	565	541	516	491	468	446	426	407	389	373	357
					452	421	393	367	343	320	297	278	260	243	228	213	199	187	175
24LH08	18	24	829	24040	707	677	649	622	597	572	545	520	497	475	455	435	417	400	384
					480	447	416	388	362	338	314	292	272	254	238	222	208	196	184
24LH09	21	24	976	28300	832	808	785	764	731	696	663	632	602	574	548	524	501	480	460
					562	530	501	460	424	393	363	337	313	292	272	254	238	223	209
24LH10	23	24	1031	29900	882	856	832	809	788	768	737	702	668	637	608	582	556	533	511
					596	559	528	500	474	439	406	378	351	326	304	285	266	249	234
24LH11	25	24	1087	31520	927	900	875	851	829	807	787	768	734	701	671	642	616	590	567
					624	588	555	525	498	472	449	418	388	361	337	315	294	276	259
			< 34	34-41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
28LH05	13	28	415	14120	337	323	310	297	286	275	265	255	245	237	228	220	213	206	199
					219	205	192	180	169	159	150	142	133	126	119	113	107	102	97
28LH06	16	28	552	18760	448	429	412	395	379	364	350	337	324	313	301	291	281	271	262
					289	270	253	238	223	209	197	186	175	166	156	148	140	133	126
28LH07	17	28	623	21180	505	484	464	445	427	410	394	379	365	352	339	327	316	305	295
					326	305	285	267	251	236	222	209	197	186	176	166	158	150	142
28LH08	18	28	667	22680	540	517	496	475	456	438	420	403	387	371	357	344	331	319	308
					348	325	305	285	268	252	236	222	209	196	185	175	165	156	148
28LH09	21	28	821	27920	667	639	612	586	563	540	519	499	481	463	446	430	415	401	387
					428	400	375	351	329	309	291	274	258	243	228	216	204	193	183
28LH10	23	28	898	30540	729	704	679	651	625	600	576	554	533	513	495	477	460	444	429
					466	439	414	388	364	343	322	303	285	269	255	241	228	215	204
28LH11	25	28	964	32760	780	756	736	711	682	655	629	605	582	561	540	521	502	485	468
					498	475	448	423	397	373	351	331	312	294	278	263	249	236	223
28LH12	27	28	1058	35980	857	837	818	800	782	766	737	709	682	656	632	609	587	566	546
					545	520	496	476	454	435	408	383	361	340	321	303	285	270	256
28LH13	30	28	1103	37500	895	874	854	835	816	799	782	766	751	722	694	668	643	620	598
					592	543	518	495	472	452	433	415	398	373	353	332	314	297	281
			< 39	39-46	47-49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
32LH06	14	32	431	16820	16820	338	326	315	304	294	284	275	266	257	249	242	234	227	220	214
						211	199	189	179	169	161	153	145	138	131	125	119	114	108	104
32LH07	16	32	485	18920	18920	379	366	353	341	329	318	308	298	288	279	271	262	254	247	240
						239	223	211	200	189	179	170	162	154	146	140	133	127	121	116
32LH08	17	32	527	20540	20540	411	397	383	369	356	345	333	322	312	302	293	284	275	267	259
						255	242	229	216	205	194	184	175	167	159	151	144	137	131	125
32LH09	21	32	661	25780	25780	516	498	480	463	447	432	418	404	391	379	367	356	345	335	325
						319	302	285	270	256	243	230	219	208	198	189	180	172	164	157
32LH10	21	32	731	28500	28500	571	550	531	512	495	478	462	445	430	416	402	389	376	364	353
						352	335	317	301	286	272	257	244	232	221	210	199	188	178	169
32LH11	24	32	801	31220	31220	625	602	580	560	541	522	505	488	473	458	443	429	416	403	390
						385	363	343	325	308	292	277	263	251	239	227	216	206	196	187
32LH12	27	32	939	36640	36640	734	712	688	664	641	619	598	578	559	541	524	508	492	477	463
						450	428	406	384	364	345	327	311	295	281	267	255	243	232	221
32LH13	30	32	1048	40880	40880	817	787	758	731	705	680	656	633	611	590	570	551	533	516	500
						500	480	461	444	427	411	396	382	368	355	343	331	320	309	299
32LH14	33	32	1079	42080	42080	843	826	810	795	780	766	738	713	688	665	643	622	602	583	564
						515	495	476	458	440	417	395	374	355	337	321	304	290	276	264
32LH15	35	32	1115	43500	43500	870	853	837	821	805	791	776	763	750	725	701	678	656	635	616
						533	511	492	473	454	438	422	407	393	374	355	338	322	306	292
			< 43	43-46	47-5657	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
36LH07	16	36	393	16900	16900	292	283	274	266	258	251	244	237	230	224	218	212	207	201	196
						177	168	160	153	146	140	134	128	122	117	112	107	103	99	95
36LH08	18	36	433	18600	18600	321	311	302	293	284	276	268	260	253	246	239	233	227	221	215
						194	185	176	168	160	153	146	140	134	128	123	118	113	109	104
36LH09	21	36	554	23840	23840	411	398	386	374	363	352	342	333	323	314	306	297	289	282	275
						247	236	224	214	204	195	186	179	171	163	157	150	144	138	133
36LH10	21	36	611	26260	26260	454	440	426	413	401	389	378	367	357	347	338	328	320	311	303
						273	260	248	236	225	215	206	197	188	180	173	165	159	152	146
36LH11	23	36	667	28660	28660	495	480	465	451	438	425	412	401	389	378	368	358	348	339	330
						297	283	269	257	246	234	224	214	205	196	188	180	173	166	159
36LH12	25	36	798	34300	34300	593	575	557	540	523	508	493	478	464	450	437	424	412	400	388
						354	338	322	307	292	279	267	255	243	232	222	213	204	195	187
36LH13	30	36	938	40340	40340	697	675	654	634	615	596	579	562	546	531	516	502	488	475	463
						415	395	376	359	342	327	312	298	285	273	262	251	240	231	222
36LH14	36	36	1034	44460	44460	768	755	729	706	683	661	641	621	602	584	567	551	535	520	505
						456	434	412	392	373	358	339	323	309	295	283	270	259	247	237
36LH15	36	36	1090	46880	46880	809	795	781	769	744	721	698	677	656	637	618	600	583	567	551
						480	464	448	434	413	394	375	358	342	327	312	299	286	274	263

A S D

STANDARD LOAD TABLE FOR LONGSPAN STEEL JOISTS, LH-SERIES
Based on a 50 ksi Maximum Yield Strength - Loads Shown In Pounds Per Linear Foot (plf)

Joist Designation	Approx. Wt in Lbs. Per Linear Ft. (Joists Only)	Depth in inches	Max Load (plf)	SAFELOAD* in Lbs. Between	SPAN IN FEET														
			< 48	48-59	60-65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
40LH08	16	40	348	16680	16680	254	247	241	234	228	222	217	211	206	201	196	192	187	183	178
						150	144	138	132	127	122	117	112	108	104	100	97	93	90	86
40LH09	21	40	457	21920	21920	332	323	315	306	298	291	283	276	269	263	256	250	244	239	233
						196	188	180	173	166	160	153	147	141	136	131	126	122	118	113
40LH10	21	40	503	24120	24120	367	357	347	338	329	321	313	305	297	290	283	276	269	262	255
						216	207	198	190	183	176	169	162	156	150	144	139	134	129	124
40LH11	22	40	549	26340	26340	399	388	378	368	358	349	340	332	323	315	308	300	293	286	279
						234	224	215	207	198	190	183	176	169	163	157	151	145	140	135
40LH12	25	40	668	32060	32060	486	472	459	447	435	424	413	402	392	382	373	364	355	346	338
						285	273	261	251	241	231	222	213	205	197	189	182	176	169	163
40LH13	30	40	788	37800	37800	573	557	542	528	514	500	487	475	463	451	440	429	419	409	399
						334	320	307	295	283	271	260	250	241	231	223	214	207	199	192
40LH14	35	40	900	43220	43220	656	638	620	603	587	571	556	542	528	515	502	490	478	466	455
						383	367	351	336	323	309	297	285	273	263	252	243	233	225	216
40LH15	36	40	1007	48340	48340	734	712	691	671	652	633	616	599	583	567	552	538	524	511	498
						427	408	390	373	357	342	328	315	302	290	279	268	258	248	239
40LH16	42	40	1110	53280	53280	808	796	784	772	761	751	730	710	691	673	655	638	622	606	591
						469	455	441	428	416	404	387	371	356	342	329	316	304	292	282
			< 53	53-59	60-73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88
44LH09	19	44	379	20100	20100	272	265	259	253	247	242	236	231	226	221	216	211	207	202	198
						158	152	146	141	136	131	127	122	118	114	110	106	103	99	96
44LH10	21	44	419	22200	22200	300	293	286	279	272	266	260	254	249	243	238	233	228	223	218
						174	168	162	155	150	144	139	134	130	125	121	117	113	110	106
44LH11	22	44	453	24000	24000	325	317	310	302	295	289	282	276	269	264	258	252	247	242	236
						188	181	175	168	162	157	151	146	140	136	131	127	123	119	115
44LH12	25	44	561	29740	29740	402	393	383	374	365	356	347	339	331	323	315	308	300	293	287
						232	224	215	207	200	192	185	179	172	166	160	155	149	144	139
44LH13	30	44	665	35260	35260	477	466	454	444	433	423	413	404	395	386	377	369	361	353	346
						275	265	254	246	236	228	220	212	205	198	191	185	179	173	167
44LH14	31	44	766	40580	40580	549	534	520	506	493	481	469	457	446	436	425	415	406	396	387
						315	302	291	279	268	259	249	240	231	223	215	207	200	193	187
44LH15	36	44	891	47220	47220	639	623	608	593	579	565	551	537	524	512	500	488	476	466	455
						366	352	339	326	314	303	292	281	271	261	252	243	234	227	219
44LH16	42	44	1027	54440	54440	737	719	701	684	668	652	637	622	608	594	580	568	555	543	531
						421	405	390	375	362	348	336	324	313	302	291	282	272	263	255
44LH17	47	44	1103	58460	58460	790	780	769	759	750	732	715	699	683	667	652	638	624	610	597
						450	438	426	415	405	390	376	363	351	338	327	316	305	295	285
			< 57	57-59	60-81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
48LH10	21	48	352	20080	20080	246	241	236	231	226	221	217	212	208	204	200	196	192	188	185
						141	136	132	127	123	119	116	112	108	105	102	99	96	93	90
48LH11	22	48	382	21780	21780	266	260	255	249	244	239	234	229	225	220	216	212	208	204	200
						152	147	142	137	133	129	125	120	117	113	110	106	103	100	97
48LH12	25	48	482	27500	27500	336	329	322	315	308	301	295	289	283	277	272	266	261	256	251
						191	185	179	173	167	161	156	151	147	142	138	133	129	126	122
48LH13	29	48	578	32940	32940	402	393	384	376	368	360	353	345	338	332	325	318	312	306	300
						228	221	213	206	199	193	187	180	175	170	164	159	154	150	145
48LH14	32	48	682	38860	38860	475	464	454	444	434	425	416	407	399	390	383	375	367	360	353
						269	260	251	243	234	227	220	212	206	199	193	187	181	176	171
48LH15	36	48	784	44680	44680	545	533	521	510	499	488	478	468	458	448	439	430	422	413	405
						308	298	287	278	269	260	252	244	236	228	221	214	208	201	195
48LH16	42	48	904	51500	51500	629	615	601	588	576	563	551	540	528	518	507	497	487	477	468
						355	343	331	320	310	299	289	280	271	263	255	247	239	232	225
48LH17	47	48	1015	57840	57840	706	690	675	660	646	632	619	606	593	581	569	558	547	536	525
						397	383	371	358	346	335	324	314	304	294	285	276	268	260	252

Shading for Erection Stability Bridging

- Grey shading: all rows shall be bolted diagonal bridging and installed before release of hoisting cables

STANDARD LOAD TABLE LONGSPAN STEEL JOISTS,DLH-SERIES

Based on a 50 ksi Maximum Yield Strength - Loads Shown in Pounds per Linear Foot (plf)

Joist Designation	Approx. Wt in Lbs. Per Linear Ft (Joists only)	Depth in inches	Max Load (plf)	SAFE LOAD* in Lbs. Between																
			< 81	81-99	100-111	112	115	118	121	124										
80DLH15	40	80	644	52160	52160	466 321	442 296	421 275	401 255	383 236										
80DLH16	46	80	774	62680	62680	560 375	535 347	509 321	485 297	461 276										
80DLH17	53	80	894	72420	72420	647 451	617 416	587 386	559 358	533 332										
80DLH18	60	80	1010	81840	81840	731 516	696 477	662 441	631 409	602 380										
80DLH19	67	80	1179	95480	95480	853 578	812 533	773 493	736 458	701 425										
80DLH20	75	80	1325	107320	107320	964 646	921 596	882 552	845 512	807 475										
			< 89	89-99	100-120	121	124	127	130	133										
88DLH16	46	88	699	62180	62180	514 361	490 336	467 313	447 291	428 272										
88DLH17	51	88	790	70300	70300	581 404	553 375	526 349	502 325	479 304										
88DLH18	58	88	906	80620	80620	667 460	635 427	605 397	577 370	551 346										
88DLH19	65	88	1048	93260	93260	771 521	734 484	699 450	666 420	636 392										
88DLH20	76	88	1206	107300	107300	889 623	854 579	821 539	789 502	755 469										
88DLH21	89	88	1487	132260	132260	1099 724	1045 673	996 626	950 584	907 545										
			< 97	97-99	100-129	130	133	136	139	142										
96DLH17	52	96	724	70180	70180	540 389	517 363	496 339	474 318	456 298										
96DLH18	58	96	814	79000	79000	608 443	583 413	559 386	535 362	513 340										
96DLH19	66	96	974	94440	94440	727 502	697 469	667 438	638 410	611 385										
96DLH20	74	96	1096	106280	106280	824 569	789 531	754 496	722 465	691 436										
96DLH21	90	96	1375	133340	133340	1027 698	982 652	940 610	900 571	864 535										
96DLH22	102	96	1540	149380	149380	1150 811	1108 757	1067 708	1028 663	991 622										
			< 105	105-138		139	142	145	148	151										
104DLH18	59	104	733	76980		554 426	532 400	512 375	489 353	472 332	307	279	255	233	213	195	180	167	154	142	132
104DLH19	67	104	892	93620		674 484	647 453	622 426	598 401	574 377	546 349	513 317	485 289	457 265	432 242	409 222	387 204	368 189	350 175	332 162	315 150
104DLH20	75	104	1002	105260		764 548	738 513	714 483	688 453	661 427	629 395	591 359	555 327	522 299	493 274	465 251	440 232	417 214	395 198	375 184	357 170
104DLH21	90	104	1260	132320		956 673	917 632	881 593	847 558	813 525	773 486	727 442	685 403	647 368	611 337	578 307	547 284	519 263	493 244	469 226	446 209
104DLH22	104	104	1413	148360		1071 783	1034 734	999 689	966 648	934 610	893 564	841 513	792 468	747 428	706 392	668 359	633 331	600 306	570 283	542 262	516 244
104DLH23	109	104	1556	163400		1181 819	1141 768	1096 721	1052 678	1009 638	956 590	899 536	845 489	795 447	750 410	708 377	670 347	635 320	602 296	571 274	543 254

STANDARD LOAD TABLE LONGSPAN STEEL JOISTS,DLH-SERIES

Based on a 50 ksi Maximum Yield Strength - Loads Shown in Pounds per Linear Foot (plf)

Joist Designation	Approx. Wt in Lbs. Per Linear Ft (Joists Only)	Depth in inches	Max Load (plf)	SAFE LOAD* in Lbs. Between	SPAN IN FEET															
			< 113	113-147	148	151	155	160	165	170	175	180	185	190	195	200	205	210	215	220
112DLH19	67	112	815	92100	623 466	600 439	571 406	537 369	506 336	478 308	451 281	428 259	406 238	386 220	366 203	348 189	332 175	317 162	303 151	289 142
112DLH20	76	112	922	104240	710 528	688 497	657 459	618 418	582 381	549 348	520 319	493 293	468 270	445 249	422 231	402 213	383 198	365 184	348 171	333 160
112DLH21	91	112	1162	131300	891 650	858 612	816 566	767 514	722 469	681 429	644 393	610 361	578 333	549 306	521 283	496 263	473 244	450 227	430 211	411 198
112DLH22	104	112	1304	147340	999 755	967 711	928 657	880 598	833 545	787 498	744 457	705 419	668 386	635 356	602 329	574 306	546 283	521 264	497 246	474 229
112DLH23	110	112	1437	162360	1102 790	1067 744	1023 688	970 625	913 571	859 522	810 478	765 439	724 404	686 373	651 345	618 320	588 297	560 276	533 257	509 239
112DLH24	131	112	1703	192440	1304 957	1263 901	1212 834	1151 758	1087 691	1026 632	970 579	919 532	871 489	828 451	786 418	748 387	713 359	680 334	648 311	619 291
			< 121	121-165	166	170	175	180	185	190	195	200	205	210	215	220	225	230	235	240
120DLH20	77	120	819	99100	597 430	571 400	538 367	510 338	484 311	461 287	438 265	418 246	399 228	380 212	362 198	347 185	332 172	318 161	305 151	292 142
120DLH21	92	120	1019	123240	748 530	714 494	675 452	639 416	606 383	576 353	548 326	521 303	497 281	474 262	452 244	432 227	414 212	396 199	379 186	363 175
120DLH22	104	120	1168	141280	855 616	823 574	779 526	737 483	699 445	665 411	632 380	602 352	574 327	547 304	522 283	499 265	477 247	457 231	438 217	420 204
120DLH23	111	120	1292	156320	943 644	907 601	858 551	813 506	771 466	733 430	697 397	664 369	632 341	602 318	574 296	548 276	524 258	501 241	479 227	459 213
120DLH24	132	120	1532	185380	1117 781	1073 728	1015 667	961 613	912 565	867 521	824 482	785 447	748 414	713 386	681 359	651 335	623 313	596 293	571 275	548 258
120DLH25	152	120	1756	212420	1284 915	1231 853	1165 782	1104 718	1047 661	994 610	946 564	900 523	858 485	819 452	782 421	748 393	715 367	684 344	656 322	628 302

Construction Bridging

- Construction Bridging – Installed after the Erection Bridging.
- Construction Bridging All rows installed prior to construction loads being placed.
- Construction Bridging - Includes uplift bridging.

Construction Stress

$$F_{construction} = \left(\frac{\pi^2 E}{\left(\frac{0.9 \ell_{br}}{r_y} \right)^2} \right) \geq 12.2 \text{ ksi}$$

Note that this is an ultimate force

Where,

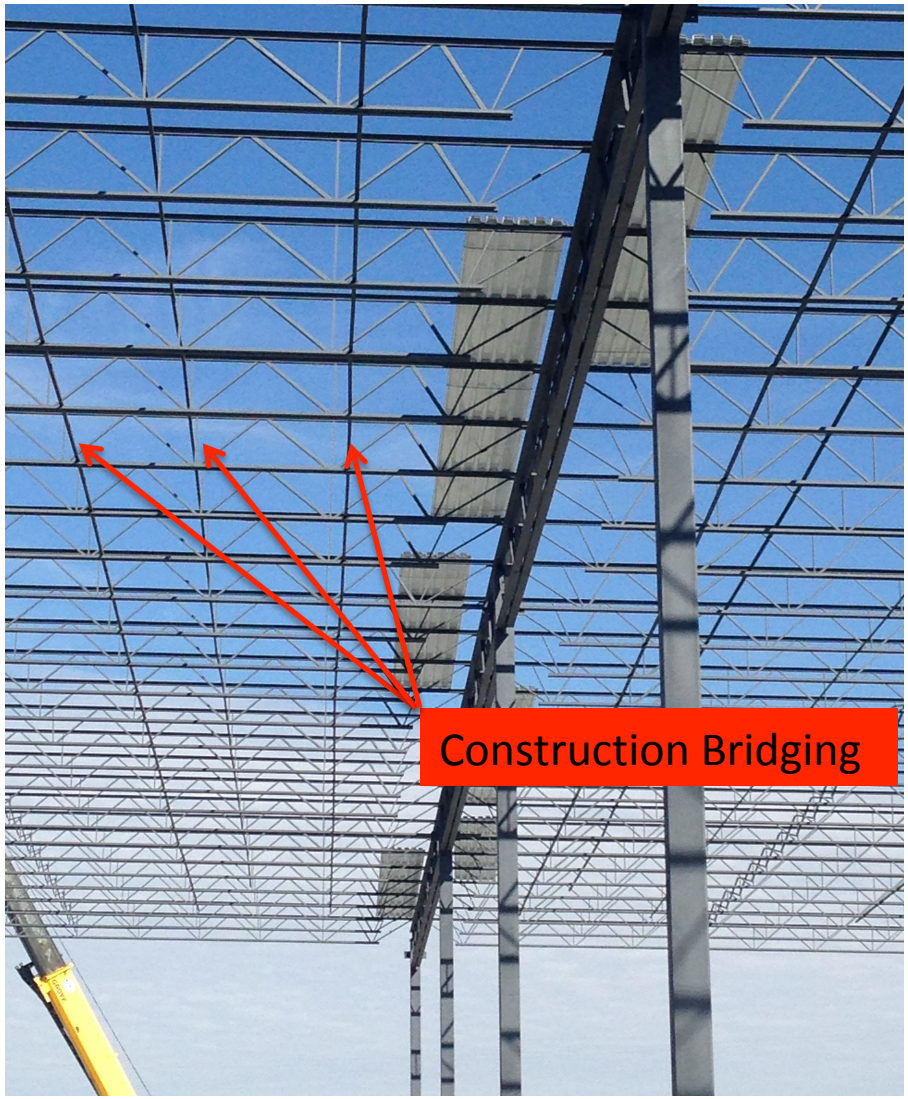
E = Modulus of Elasticity of steel = 29,000 ksi (200,000 Mpa) and $\frac{\ell_{br}}{r_y}$ is determined from Equations 103.4-1a, 103.4-1b or 103.4-2

Construction stress develops *approximately* 25% of the joist load carrying capacity.

Construction Loads

Construction Load – Deck Bundles

- Deck bundles are shown on joists with bridging installed.
- Typically, all bridging rows shall be installed before any construction loads are applied.
- OSHA allows an exception for placement of deck bundles, with certain conditions.



Construction Load – Deck Bundles

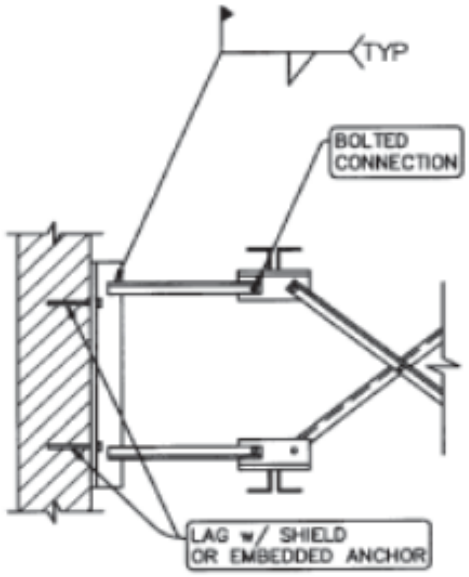
Placement of a deck bundle on joists that are not fully bridged is allowed with the following restrictions:

- The deck bundle shall be placed on a minimum of three joists.
- The joists supporting the deck bundle shall be attached to the support at both ends.
- At least one row of bridging shall be installed and anchored.
- The deck bundle weight shall not exceed 4,000 pounds.
- The edge of the deck bundle shall be placed within 1 foot from the end of the joists.

Horizontal Bridging Row at End Space

Where a bolted diagonal bridging row terminates to a wall or other vertically stiff support, bolted horizontal bridging is suggested for the end space.

This will allow for the difference in deflection between a longspan joist and the stiff support – a wall as shown in the sketch below, or a column as show in the photo.



BOLTED DIAGONAL BRIDGING TERMINUS AT WALL

Permanent Bridging

- Permanent Bridging - All rows should stay installed unless a qualified professional does an evaluation and determines that some bridging can be removed.

Polling Question 1

Are horizontal bridging rows required to be aligned from top to bottom chord?

A. True, they must be aligned
B. False, they need not be aligned

Bridging Spacing and Size Requirements with Tables

- How many rows of bridging?
- What type of bridging?
  - Horizontal / Diagonal
  - Welded / Bolted
- What is the bridging force?
- What is the bridging size?

Using the Bridging Tables

- Bridging requirements can be either calculated or looked up in a table.
- When joists are specified as load/foot (24K350/200) the joist manufacturer will calculate the bridging requirements.
- When the joist are specified with a SJI designation (24K6) the SJI tables will be used to for the bridging requirements.
- In some cases there can be some economic advantages to calculating the bridging requirements, since the tables are always conservative.

Bridging Spacing

Quantity and Spacing

The maximum spacing of lines of bridging, ℓ_{br} shall be the lesser of,

$$\ell_{br} = \left(124 + 0.67\, d_j + 28\,\frac{d_j}{L}\right) r_y \quad \text{, in.} \qquad (103.4\text{-}1a)$$

$$\ell_{br} = \left(124 + 0.026\, d_j + 0.34\,\frac{d_j}{L}\right) r_y \quad \text{, mm} \qquad (103.4\text{-}1b)$$

or

$$\ell_{br} = 170\, r_y \qquad (103.4\text{-}2)$$

Where,

d_j is the steel joist depth, in. (mm)

L is the Joist Span length, ft. (m)

r_y is the out-of-plane radius of gyration of the top chord, in. (mm)

Bridging Spacing Table for K and LH

American National Standard SJI 100 - 2015

TABLE 5.5-1

U.S. CUSTOMARY UNITS

NUMBER OF ROWS OF TOP CHORD BRIDGING[2]

Section Number[1]	Joist Depth	1 Row	2 Rows	3 Rows	4 Rows	5 Rows	6 Rows	7 Rows	8 Rows	9 Rows
K1	All	17	>17 to 26	>26 to 28						
K2	All	21	>21 to 30	>30 to 32						
K3	All	18	>18 to 26	>26 to 40						
K4	All	20	>20 to 30	>30 to 41	>41 to 48					
K5	12K to 24K	20	>20 to 30	>30 to 42	>42 to 48					
	26K	28	>28 to 41	> 41 to 52						
K6	14K to 24K	20	>20 to 31	>31 to 42	>42 to 48					
	26K & 28K	28	>28 to 41	>41 to 54	>54 to 56					
K7	16K to 24K	23	>23 to 34	>34 to 48						
	26K to 30K	29	>29 to 44	>44 to 60						
K8	24K	25	>25 to 39	>39 to 48						
	26K to 30K	29	>29 to 44	>44 to 60						
K9	16K to 24K	22	>22 to 34	>34 to 48						
	26K to 30K	29	>29 to 44	>44 to 60						
K10	18K to 24K	22	>22 to 38	>38 to 48						
	26K to 30K	29	>29 to 48	>48 to 60						
K11	22K	24	>24 to 39	>39 to 44						
	30K	34	>34 to 49	>49 to 60						
K12	24K	25	>25 to 43	>43 to 48						
	26K to 30K	29	>29 to 47	>47 to 60						
LH02-03	All	20	>20 to 30	>30 to 40	>40					
LH04-05	All	22	>22 to 33	>33 to 44	>44 to 55	>55				
LH06-08	All	26	>26 to 45	>45 to 60	>60 to 75	>75				
LH09	All	26	>26 to 48	>48 to 64	>64 to 80	>80				
LH/DLH10	All	28	>28 to 54	>54 to 72	>72 to 90	>90				
LH/DLH11	All	30	>30 to 54	>54 to 72	>72 to 90	>90 to 108	>108			
LH/DLH12	All	34	>34 to 55	>55 to 74	>74 to 92	>92 to 111	>111			
LH/DLH13	All	36	>36 to 63	>63 to 84	>84 to 105	>105 to 126	>126			
LH/DLH14	All	38	>38 to 64	>64 to 86	>86 to 107	>107 to 129	>129			
LH/DLH15	All	42	>42 to 73	>73 to 98	>98 to 122	>122 to 147	>147			
LH/DLH 16-17	All	44	>44 to 75	>75 to 100	>100 to 125	>125 to 150	>150 to 175	>175		
DLH18-20	All	52	>52 to 78	>78 to 104	>104 to 130	>130 to 156	>156 to 182	>182 to 208	>208 to 234	>234
DLH21-25	All	60	>60 to 90	>90 to 120	>120 to 150	>150 to 180	>180 to 210	>210		

(1) Last digit(s) of joist designation shown in Load Table.

(2) Distances are Joist Span lengths in feet – See "Definition of Span" Figure 5.2-1. Refer to the Joist Load Table and Specification Section 6 for required bolted diagonal bridging and additional stability requirements. See Section 5.12 for additional bridging required for uplift design.

KCS Joist Bridging

- The KCS Joist designation is not directly used to establish bridging requirements.
- Instead, the KCS Load Table provides an equivalent K-Series section number to use in the bridging tables.

JOIST DESIGNATION	DEPTH (in.)	MOMENT CAPACITY (k-in.)	SHEAR CAPACITY* (lbs)	APPROX. WEIGHT** (lbs/ft.)	GROSS MOMENT OF INERTIA (in^4)	ERECTION STABILITY BRIDGING REQ'D (ft.)	BRIDGING TABLE SECTION NUMBER
24KCS2	24	534	6300	10.0	232	39-0	6
24KCS3	24	720	7200	12.5	301	44-0	9
24KCS4	24	1108	8400	16.5	453	NA	12
24KCS5	24	1448	8900	20.5	584	NA	12

For Bridging,
24KCS3 =24K9

Bridging Forces

Horizontal and diagonal bridging shall be capable of resisting the nominal horizontal compressive force, P_{br} given in Equation 104.5-3.

$$P_{br} = 0.0025\, n\, A_t\, F_{construction}\text{ , lbs (N)} \qquad (104.5\text{-}3)$$

Where,

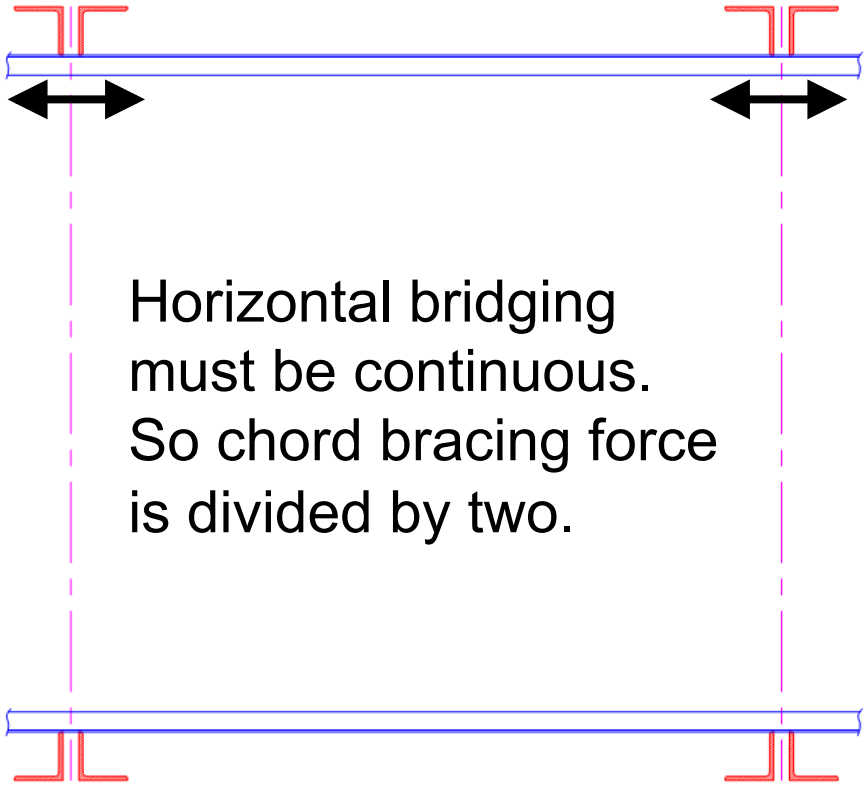
n = 8 for horizontal bridging

n = 2 for diagonal bridging

A_t = cross-sectional area of joist top chord, in.^{2} (mm^2)

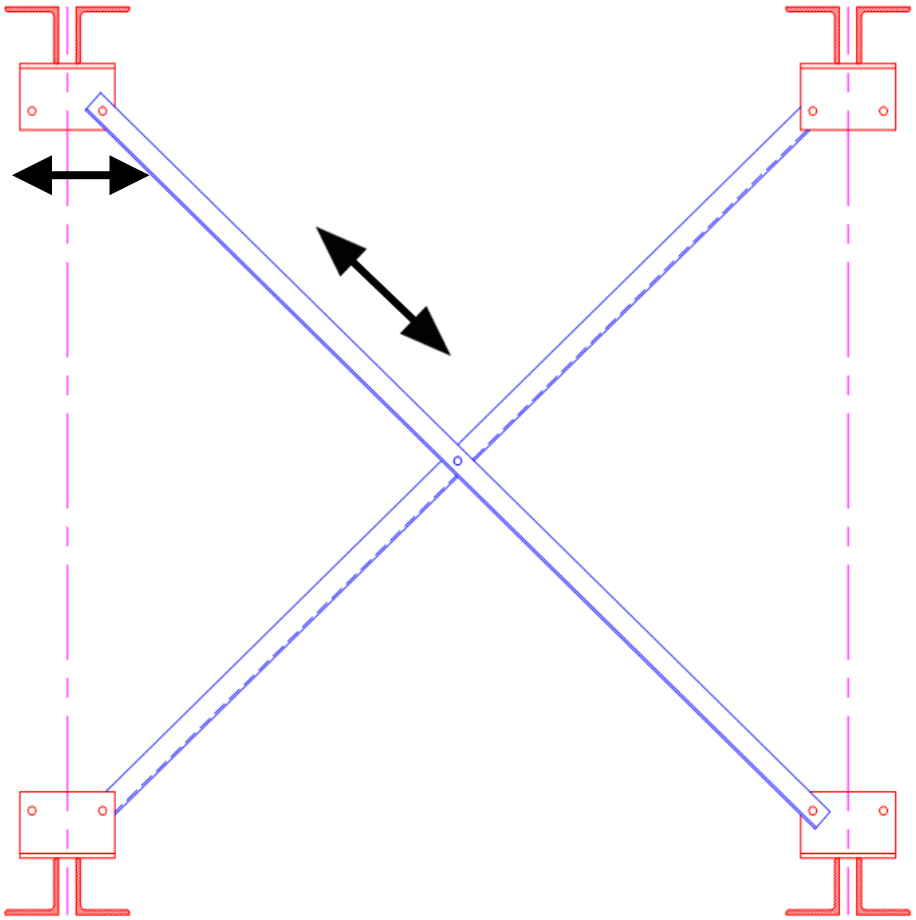
$F_{construction}$ = assumed nominal stress in top chord to resist construction loads

Horizontal Bridging Forces



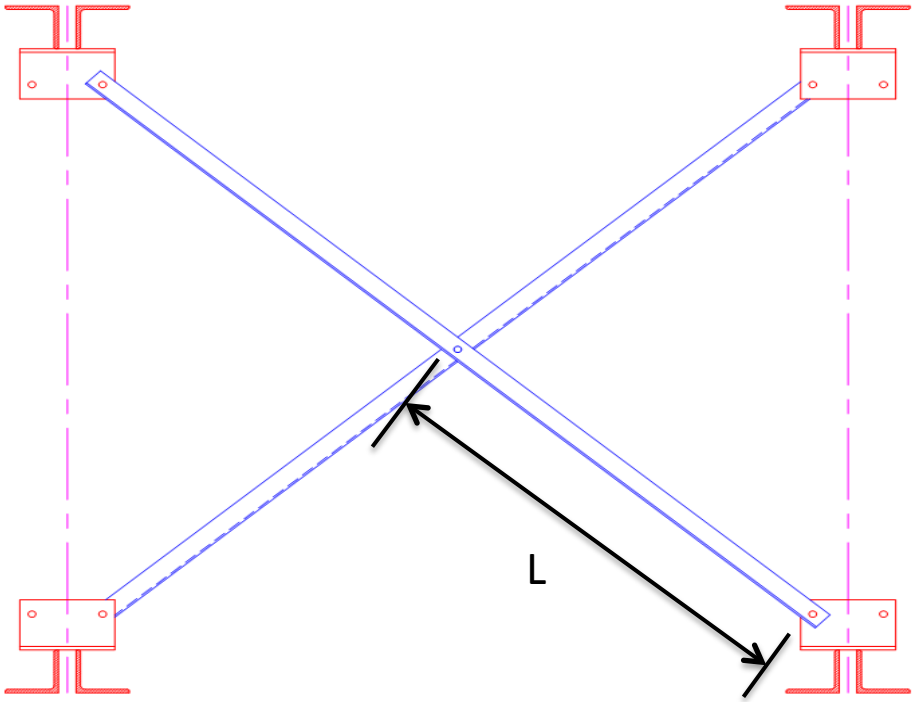
- The constant, 0.0025, takes into account “two way” action, with the bridging offering support from both sides of the joist, (tension and compression).
- In addition, there is a factor of two in the constant to adjust from *ultimate* construction stress to *nominal* bridging design forces.

Diagonal Bridging Forces



- Diagonal bridging need not be continuous.
- The bridging force P_{br} is the horizontal component, and the actual force in the diagonal bridging member is larger.
- n = 2 to account for the fact that there is not “two way” action.

Diagonal Bridging – Center Connection



- Diagonal bridging must resist compressive axial loads

The bridging design presumes a connection at the center of the “X”, so the unbraced length is taken as the distance from the chord attachment to the center intersection.

The center connection can be made by welding or bolting.

Alignment of Bridging Rows

- Note that in this example, the diagonal bridging rows are aligned with the end wall wind columns.
- It should not be presumed that this would automatically happen, just from a framing plan depiction.
- There are many constraints for making the bolted bridging connection that may not allow the exact alignment with and end wall element.
- If this a specific design intent, the contract drawings shall note this requirement.

Bridging Forces

TABLE 5.5-2

BRIDGING NOMINAL HORIZONTAL UNFACTORED COMPRESSSIVE FORCE					
JOIST SECTION NUMBER[1]	HORIZONTAL BRIDGING P_{br} (n=8)		REQUIRED BRIDGING CONNECTION WELD[2]	DIAGONAL BRIDGING P_{br} (n=2)	
	Lbs.	(N)	In.	Lbs.	(N)
K1-8	340	(1512)	1/8" x 1" (3mm x 25mm)	85	(378)
K9-10, LH02-03	450	(2002)		113	(503)
K11-12, LH04-05	560	(2491)		140	(623)
LH06-08	750	(3336)		188	(836)
LH09	850	(3781)		213	(945)
LH/DLH10	900	(4003)		225	(1001)
LH/DLH11	950	(4226)		238	(1056)
LH/DLH12	1100	(4893)		275	(1223)
LH/DLH13	1200	(5338)		300	(1334)
LH/DLH14	1300	(5783)		325	(1446)
LH/DLH15	1450	(6450)		363	(1612)
LH/DLH16-17	1850	(8229)	1/8" x 1 ½ " (3mm x 38mm)	463	(2057)
DLH18-20	2350	(10453)		585	(2602)
DLH21-22	3150	(14012)	1/8" x 2" (3mm x 51mm)	790	(3514)
DLH23-24	4130	(18371)	1/8" x 3" (3mm x 76mm)	1035	(4604)
DLH25	4770	(21218)		1195	(5316)

(1) Last digit(s) of joist designation shown in Load Table.
(2) Or other connection type designed for the required force.

Bridging Size

- **Horizontal** bridging shall consist of continuous horizontal steel members. The ratio of unbraced length to least radius of gyration, ℓ/r, of the bridging member shall not exceed **300**, where ℓ is the distance in inches (millimeters) between attachments and r is the least radius of gyration of the bridging member.

- **Diagonal** bridging shall consist of cross-bracing with a ℓ/r ratio of not more than **200**, where ℓ is the distance in inches (millimeters) between connections and r is the least radius of gyration of the bracing member. Where cross-bracing members are connected at their point of intersection, the ℓ distance shall be taken as the distance in inches (millimeters) between connections at the point of intersection of the bracing members and the connections to the chord of the joists.

Bridging Size

- Horizontal bridging must be designed for the bridging force, in compression.
- For smaller designations and joist spaces, the slenderness limit will control, rather than compressive strength.
- At larger designations and wider joist spaces, the compressive strength will control, rather than the slenderness limit.
- Diagonal bridging must resist an axial compressive force based on the horizontal bridging force component. However, the slenderness limit of 200 will typically provide sufficient strength.

Horizontal Bridging Size

TABLE 2.7-1

MAXIMUM JOIST SPACING FOR HORIZONTAL BRIDGING
SPANS OVER 60 ft. (18.3 m) REQUIRE BOLTED DIAGONAL BRIDGING

JOIST SECTION NUMBER[1]	Nominal Unfactored Force P_{br} lbs (N)	BRIDGING MATERIAL SIZE[2] Equal Leg Angles					
		1 x 7/64 (25 x 3 mm) r = 0.20" (5.08 mm)	1-1/4 x 7/64 (32 x 3 mm) r = 0.25" (6.35 mm)	1-1/2 x 7/64 (38 x 3 mm) r = 0.30" (7.62 mm)	1-3/4 x 7/64 (45 x 3 mm) r = 0.35" (8.89 mm)	2 x 1/8 (52 x 3 mm) r = 0.40" (10.16 mm)	2-1/2 x 5/32 (64 x 4 mm) r = 0.50" (12.70 mm)
		ft.-in. (mm)	ft.-in. (mm)	ft.-in. (mm)	ft.-in. (mm)	ft.-in. (mm)	ft.-in. (mm)
K1 – 8	340 (1512)	5'-0" (1524)	6'–3" (1905)	7'–6" (2286)	8'-9" (2667)	10'–0" (3048)	12'–6" (3810)
K9-10, LH02-03	450 (2002)	4'-4" (1321)	6'-1" (1854)	7'–6" (2286)	8'–9" (2667)	10'–0" (3048)	12'–6" (3810)
K11-12, LH04-05	560 (2491)	3'–11"(1194)	5'–6" (1676)	7'–4" (2235)	8'–9" (2667)	10'–0" (3048)	12'–6" (3810)
LH06-08	750 (3336)		4'–9" (1448)	6'–3" (1905)	7'–11" (2413)	10'–0" (3048)	12'–6" (3810)
LH09	850 (3781)		4'–5" (1346)	5'–10" (1778)	7'–5" (2261)	9'–9" (2972)	12'–6" (3810)
LH/DLH10	900 (4003)		4'–4" (1321)	5'–8" (1727)	7'–3" (2210)	9'–5" (2870)	12'–6" (3810)
LH/DLH11	950 (4226)		4'–2" (1270)	5'–7" (1702)	7'–0" (2134)	9'–2" (2794)	12'–6" (3810)
LH/DLH12	1100 (4893)		3'-11" (1194)	5'–2" (1575)	6'–8" (2032)	8'–6" (2591)	12'-6" (3810)
LH/DLH13	1200 (5338)		3'-9" (1143)	4'–11" (1499)	6'–3" (1905)	8'-2" (2489)	12-6" (3810)
LH/DLH14	1300 (5783)			4'-9" (1448)	6'-0" (1829)	7'-10" (2388)	12'-4" (3759)
LH/DLH15	1450 (6450)			4'-6" (1372)	5'-8" (1727)	7'-5" (2261)	11'-8" (3556)
LH/DLH16–17	1850 (8229)			4'-0" (1219)	5'-0" (1524)	6'-7"(2007)	10'-4" (3150)
DLH18–20	2350 (10453)			3'-7" (1067)	4'-4" (1321)	5'-10" (1778)	9'-1" (2769)
DLH21–22	3150 (14012)				3'-10" (1168)	5'-0" (1524)	7'-11" (2413)
DLH23–24	4130 (18371)				3'-4" (1016)	4'-5" (1346)	6'-11" (2108)
DLH25	4770 (21218)					4'-1"(1245)	6'-5" (1956)

(1) Refer to last two digit(s) of Joist Designation
(2) Connection to joist shall resist force listed in the Steel Joist Institute Standard Specifications Table 5.5-2

Diagonal Bridging Size

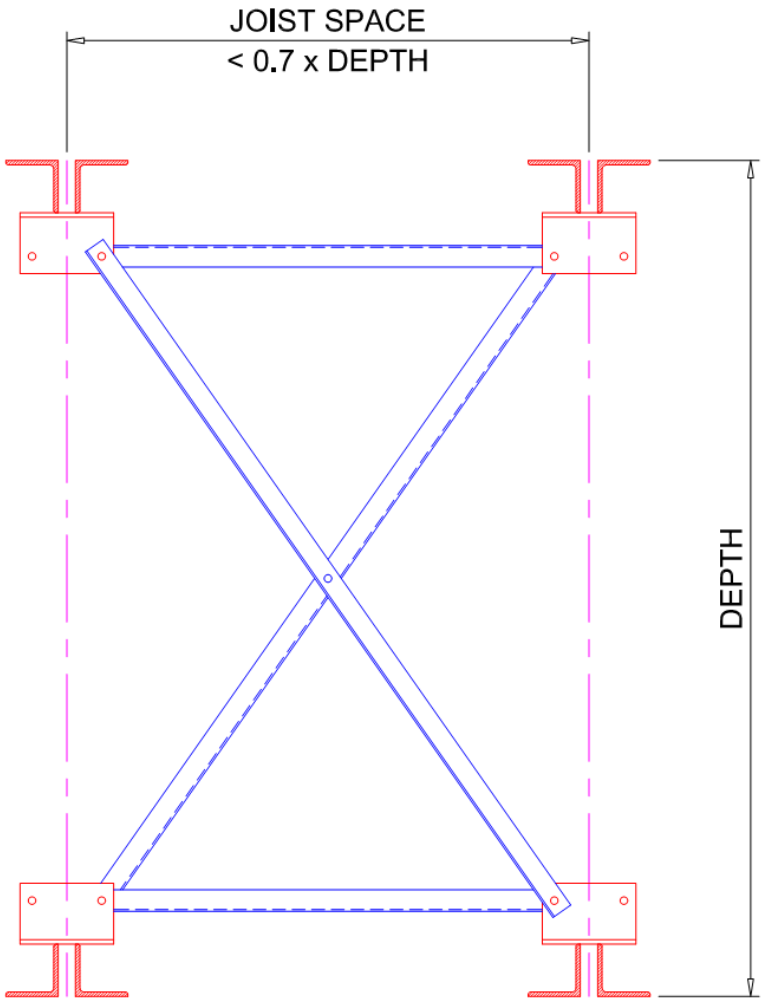
TABLE 2.7-3

K, LH, and DLH SERIES JOISTS
MAXIMUM JOIST SPACING FOR DIAGONAL BRIDGING

JOIST DEPTH	BRIDGING ANGLE SIZE – (EQUAL LEG ANGLE)							
	1 x 7/64 (25 x 3 mm) **r = 0.20"** (5.08 mm)	**1-1/4 x 7/64** (32 x 3 mm) **r = 0.25"** (6.35 mm)	**1-1/2 x 7/64** (38 x 3 mm) **r = 0.30"** (7.62 mm)	**1-3/4 x 7/64** (45 x 3 mm) **r = 0.35"** (8.89 mm)	**2 x 1/8** (50 x 3 mm) **r = 0.40"** (10.16 mm)	**2 ½ x 5/32** (64x 4 mm) **r=0.50"** (12.70 mm)	**3 x 3/16** (76 x 5 mm) **r = 0.60"** (15.24 mm)	**3 ½ x 1/4** (89 x 6 mm) **r = 0.70"** (17.78 mm)
in. (mm)	**ft.-in. (mm)**	**ft.-in. (mm)**	**ft.-in. (mm)**	**ft.-in. (mm)**	**ft.-in. (mm)**	**ft.-in. (mm)**	**ft.-in. (mm)**	**ft.-in. (mm)**
12" (305)	6'-7" (2007)	8'-3" (2514)	9'-11"(3022)	11'-7" (3530)	13'-3"(4038)	16'-7"(5055)	19'-11"(6070)	23'-3"(7086)
14" (356)	6'-6" (1981)	8'-3" (2514)	9'-11"(3022)	11'-7" (3530)	13'-3"(4038)	16'-7"(5055)	19'-11"(6070)	23'-3"(7086)
16" (406)	6'-6" (1981)	8'-2" (2489)	9'-10"(2997)	11'-7" (3530)	13'-3"(4038)	16'-7"(5055)	19'-11"(6070)	23'-3"(7086)
18" (457)	6'-6" (1981)	8'-2" (2489)	9'-10"(2997)	11'-6" (3505)	13'-3"(4038)	16'-7"(5055)	19'-11"(6070)	23'-3"(7086)
20" (508)	6'-5" (1955)	8'-2" (2489)	9'-10"(2997)	11'-6" (3505)	13'-2"(4013)	16'-7"(5055)	19'-11"(6070)	23'-3"(7086)
22" (559)	6'-4" (1930)	8'-1" (2463)	9'-10"(2997)	11'-6" (3505)	13'-2"(4013)	16'-6"(5029)	19'-11"(6070)	23'-3"(7086)
24" (610)	6'-4" (1930)	8'-1" (2463)	9'-9" (2971)	11'-5" (3479)	13'-2"(4013)	16'-6"(5029)	19'-10"(6045)	23'-3"(7086)
26" (660)	6'-3" (1905)	8'-0" (2438)	9'-9" (2971)	11'-5" (3479)	13'-1"(3987)	16'-6"(5029)	19'-10"(6045)	23'-2"(7061)
28" (711)	6'-3" (1905)	8'-0" (2438)	9'-8" (2946)	11'-5" (3479)	13'-1"(3987)	16'-6"(5029)	19'-10"(6045)	23'-2"(7061)
30" (762)	6'-2" (1879)	7'-11 (2413)	9'-8" (2946)	11'-4" (3454)	13'-1"(3987)	16'-5"(5004)	19'-10"(6045)	23'-2"(7061)
32" (813)	6'-1" (1854)	7'-10"(2387)	9'-7" (2921)	11'-4" (3454)	13'-0" (3962)	16'-5"(5004)	19'-9"(6020)	23'-2"(7061)
36" (914)	5'-11"(1803)	7'-9" (2362)	9'-6" (2895)	11'-3" (3429)	12'-11"(3973)	16'-4"(4979)	19'-9"(6020)	23'-1"(7035)
40" (1016)	5'-9"(1753)	7'-7" (2311)	9'-5" (2870)	11'-2" (3403)	12'-10"(3911)	16'-4"(4979)	19'-8"(5994)	23'-1"(7035)
44" (1118)	5'-6"(1676)	7'-5" (2260)	9'-3" (2819)	11'-0" (3352)	12'-9" (3886)	16'-3"(4953)	19'-7"(5969)	23'-0"(7010)
48" (1219)	5'-4"(1626)	7'-3" (2209)	9'-2" (2794)	10'-11"(3327)	12'-8" (3860)	16'-2"(4928)	19'-7"(5969)	22'-11"(6985)
52" (1321)	5'-0"(1524)	7'-1"(2159)	9'-0" (2743)	10'-10" (3302)	12'-7" (3835)	16'-1"(4902)	19'-6"(5943)	22'-11"(6985)
56" (1422)	4'-9"(1448)	6'-10"(2083)	8'-10"(2692)	10'-8" (3251)	12'-5" (3784)	16'-0"(4877)	19'-5"(5918)	22'-10"(6960)
60" (1524)	4'-4"(1321)	6'-8"(2032)	8'-7" (2616)	10'-6" (3200)	12'-4" (3759)	15'-10"(4826)	19'-4"(5893)	22'-9"(6935)
64" (1626)	**	6'-4"(1931)	8 -5" (2565)	10'-4" (3149)	12'-2" (3708)	15'-9" (4801)	19'-3"(5867)	22'-8"(6909)
68" (1727)	**	6'-1"(1854)	8'-2" (2489)	10'-2" (3098)	12'-0" (3657)	15'-8" (4775)	19'-2"(5842)	22'-7"(6884)
72" (1829)	**	5'-9"(1753)	8'-0" (2438)	10'-0" (3048)	11'-10"(3606)	15'-6" (4724)	19'-1" (5816)	22'-6" (6858)
80" (2032)	**	5'-0"(1524)	7'-5"(2260)	9'-6" (2895)	11'-6" (3505)	15'-3" (4648)	18'-10"(5740)	22'-4" (6808)
88" (2235)		**	6'-9"(2058)	9'-0" (2743)	11'-1" (3378)	14'-11"(4546)	18'-7" (5664)	22'-1" (6731)
96" (2438)		**	6'-0"(1829)	8'-5" (2565)	10'-8"(3251)	14'-7" (4445)	18'-4" (5588)	21'-11"(6680)
104" (2642)			**	7'-9" (2362)	10'-1"(3073)	14'-2" (4318)	18'-0" (5486)	21'-8" (6604)
112" (2845)			**	7'-0" (2134)	9'-6"(2895)	13'-9" (4191)	17'-8" (5385)	21'-4" (6503)
120" (3048)				**	8'-9"(2667)	13'-4"(4064)	17'-3" (5258)	21'-1" (6426)

****INTERPOLATION BELOW THE MINIMUM VALUES SHOWN IS NOT ALLOWED.**
SEE TABLE 2.7-4 FOR MINIMUM JOIST SPACE FOR DIAGONAL ONLY BRIDGING.

Horizontal and Cross Bridging Used Together



- As the ratio of joist depth to joist space increases, bridging at the slenderness limit may no longer provide adequate strength.
- The use of horizontal bridging, in addition to diagonal, changes the diagonal bridging to tension only.
- This is required where the joist spacing is less than 70% of the joist depth and the span is more than 60’

Bridging Size

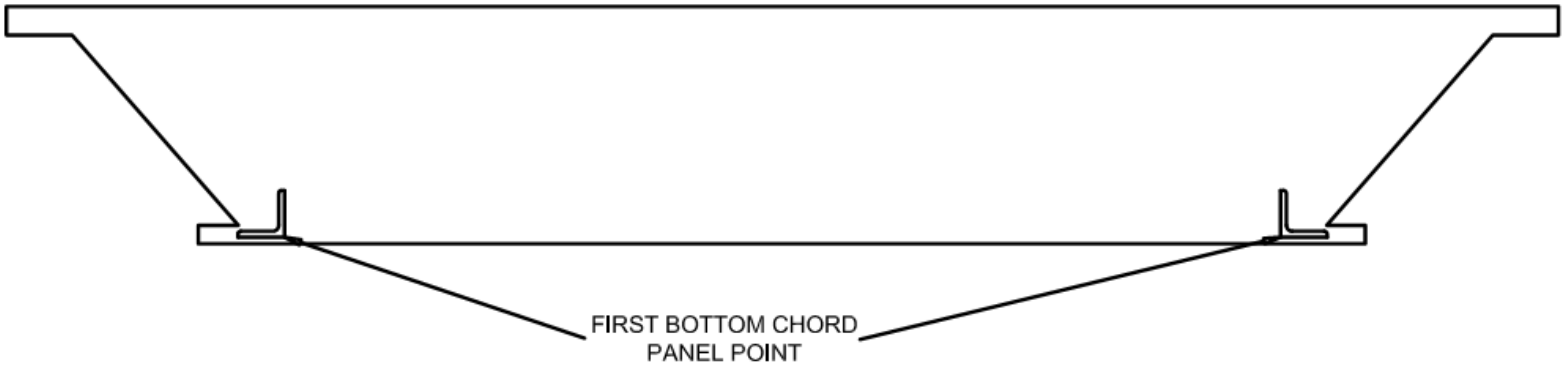
TABLE 2.7-4

LH AND DLH SERIES JOISTS HORIZONTAL PLUS DIAGONAL BRIDGING REQUIREMENTS		
JOIST DEPTH	**MINIMUM JOIST SPACE FOR DIAGONAL ONLY BRIDGING** **(0.70 x DEPTH)***	**HORIZONTAL AND DIAGONAL MINIMUM ANGLE SIZE REQUIRED** FOR JOIST SPACING < (0.70 X DEPTH) AND JOIST SPANS > 60'-0" (18.3 m)
in. (mm)	**ft.-in. (mm)**	**in. (mm)**
52" (1321)	3'- 0" (914)	1" x 1" x 7/64" (25 x 3)
56" (1422)	3'- 3" (990)	1" x 1" x 7/64" (25 x 3)
60" (1524)	3'- 6" (1066)	1" x 1" x 7/64" (25 x 3)
64" (1626)	3'- 8" (1117)	1¼" x 1¼" x 7/64" (32 x 3)
68" (1727)	3'-11" (1193)	1¼" x 1¼" x 7/64" (32 x 3)
72" (1829)	4'- 2" (1270)	1¼" x 1¼" x 7/64" (32 x 3)
80" (2032)	4'- 8" (1422)	1¼" x 1¼" x 7/64" (32 x 3)
88" (2235)	5'- 1" (1549)	1 ½" x 1 ½" x 7/64" (38 x 3)
96" (2438)	5'- 7" (1702)	1 ½" x 1 ½" x 7/64" (38 x 3)
104" (2642)	6'- 0" (1829)	1 ¾" x 1 ¾" x 7/64" (44 x 3)
112" (2845)	6'- 6" (1981)	1 ¾" x 1 ¾" x 7/64" (44 x 3)
120" (3048)	7'- 0" (2134)	2" x 2" x1/8" (51 x 3)

*NOTE: WHEN THE JOIST SPACING IS LESS THAN 0.70 x JOIST DEPTH, BOLTED HORIZONTAL BRIDGING SHALL BE USED IN ADDITION TO DIAGONAL BRIDGING.

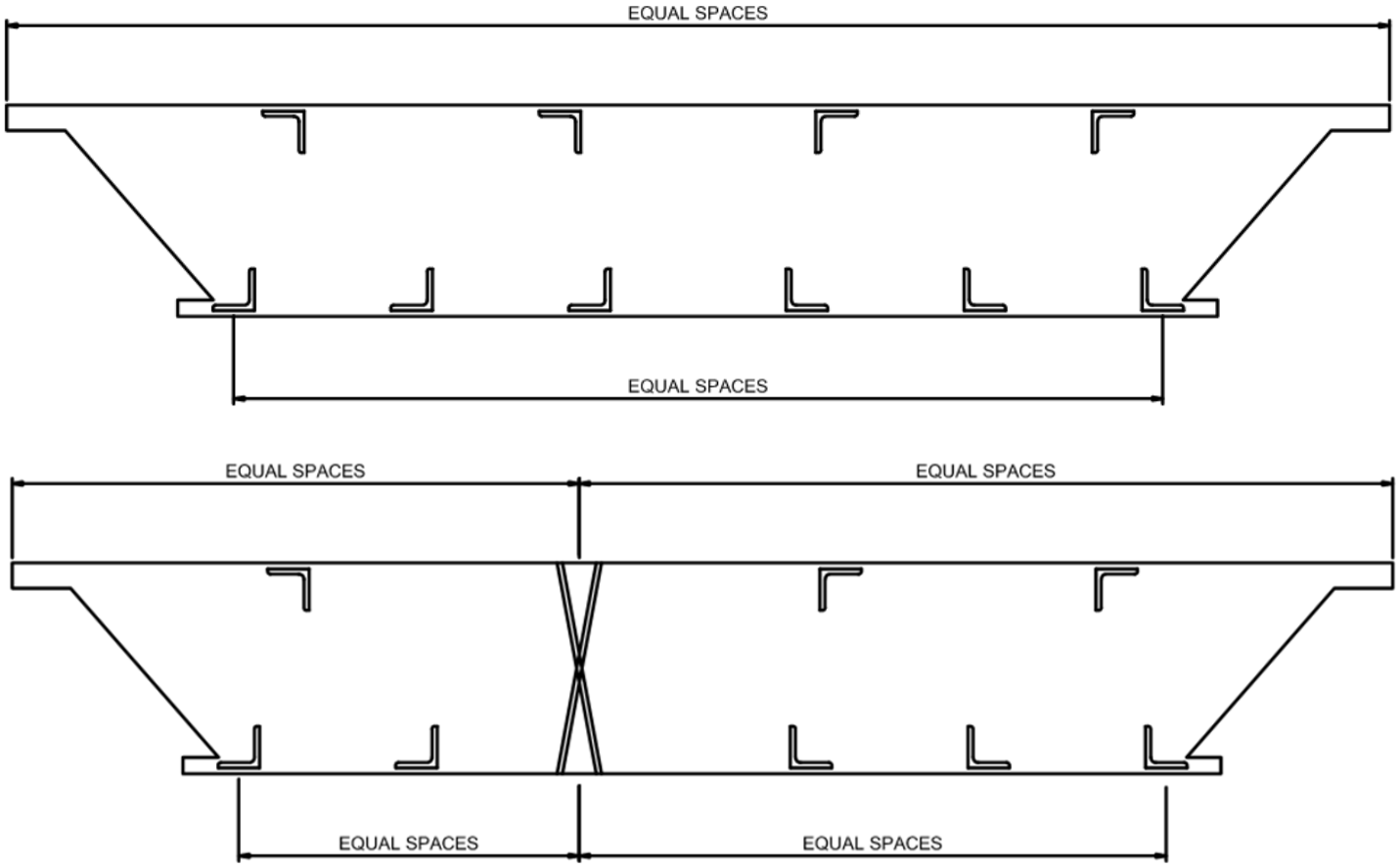
Bottom Chord Bridging for Uplift

- SJI Standard Specifications require bridging at the first bottom chord panel point, since two of the three intersecting primary members are in compression under uplift loading.



Bottom Chord Bridging Spacing

- Typical details used – equally space between first bottom chord panel points



Uplift Bridging Forces

- Bridging Load Requirements
  - Axial load based on bottom chord compressive axial load
    - $P_{br} = 0.005\ P_c$
    - Where P_c is the bottom chord compressive axial load

Uplift Bridging Forces

- Bridging Load Requirements
  - Randomness of initial lateral out-of-straightness
  - Bridging design force for number of joists, n, does not accumulate linearly
  - The following equation can be used

$$0.001\ n\ P_c + 0.004\ P_c \sqrt{n}$$

where P_c is the bottom chord compressive axial load

Uplift Bridging Forces

- Bridging Load Requirements

  - » $0.001\ n\ P_c + 0.004\ P_c \sqrt{n}$

  - For small to moderate net uplift and reasonable number of joists, n, P_c at bottom chord is no larger than at top chord

  - For more severe uplift, P_c at bottom chord can be computed and may determine bridging size, or require a limit on the value of n

  - As n increases, tributary roof area could be based on MWFRS rather than components and cladding

CJ-Series Bridging

- CJ-Series joists follow the same bridging rules and criteria, except that the slenderness limit equation is different.

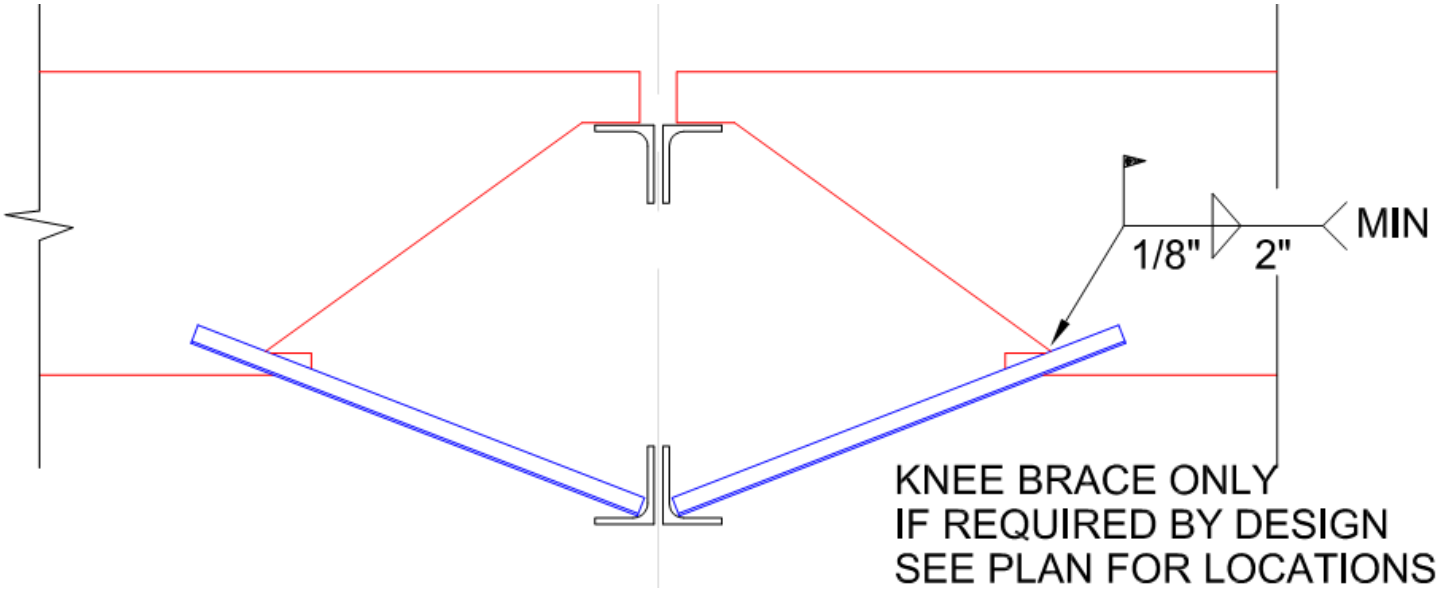
$$\left(100 + 0.67\,d_j + 40\,\frac{d_j}{L}\right)$$

- This is due to the typically smaller top chord on a CJ-Series joist as compared to a non-composite joist.

- Also, the maximum span to depth ratio for a CJ-Series joists is 30, as compared to a limit of 24 for a non-composite joist.

Joist Girder Bridging or Lack There Of

- Joist girders are erected without Erection Bridging.
- Ends of the bottom chord must be strutted and the top chord must have R_{yy} not less than Span/575.
- Attachment of joists provides stability for construction loads.
- For the bottom chord, permanent bridging is provided as shown below, called Knee Braces, Girder Braces or Uplift Braces.



Anchorage of Bridging

- All rows of bridging must be either anchored or terminated.
- Anchorage should occur to the supporting structure.
- Termination shall occur between joists.

Anchorage of Bridging Responsibilities

- From the SJI Code of Standard Practice:
  The **specifying professional** is responsible for bridging termination connections. The contract documents shall clearly illustrate these termination connections.

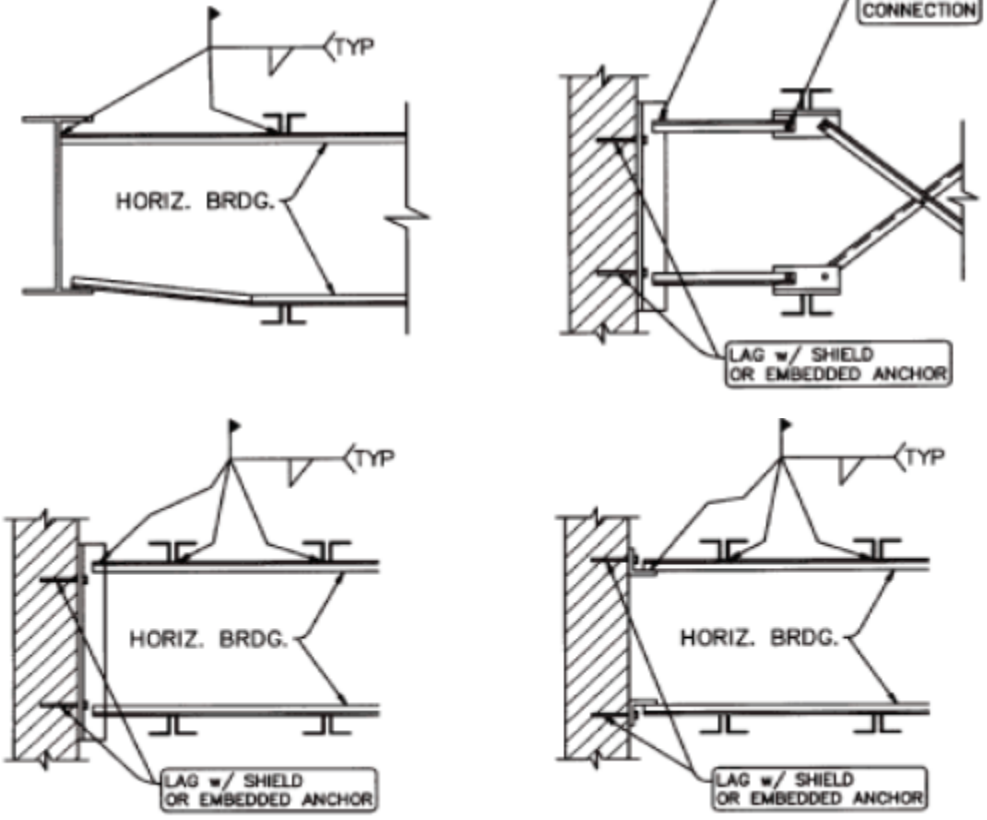
- Typical details are normally adequate for welded connections to steel, unless the joists are very large.

- Connections to masonry or concrete require attention for anchorage.

- Stiffness of steel members parallel to joists should be considered, and diagonal bridging can be an alternate terminus.

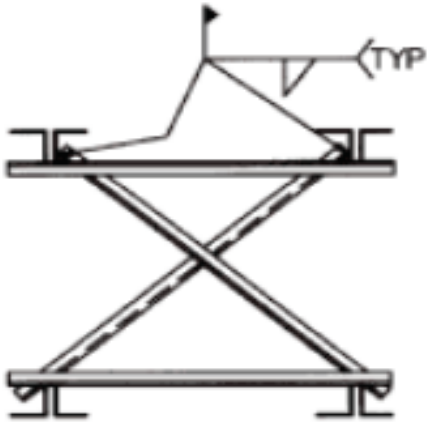
Anchorage of Bridging

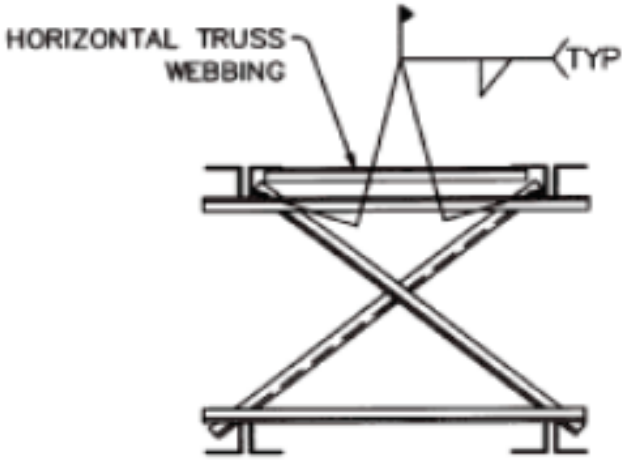
- Typical anchorage details:



Anchorage of Bridging

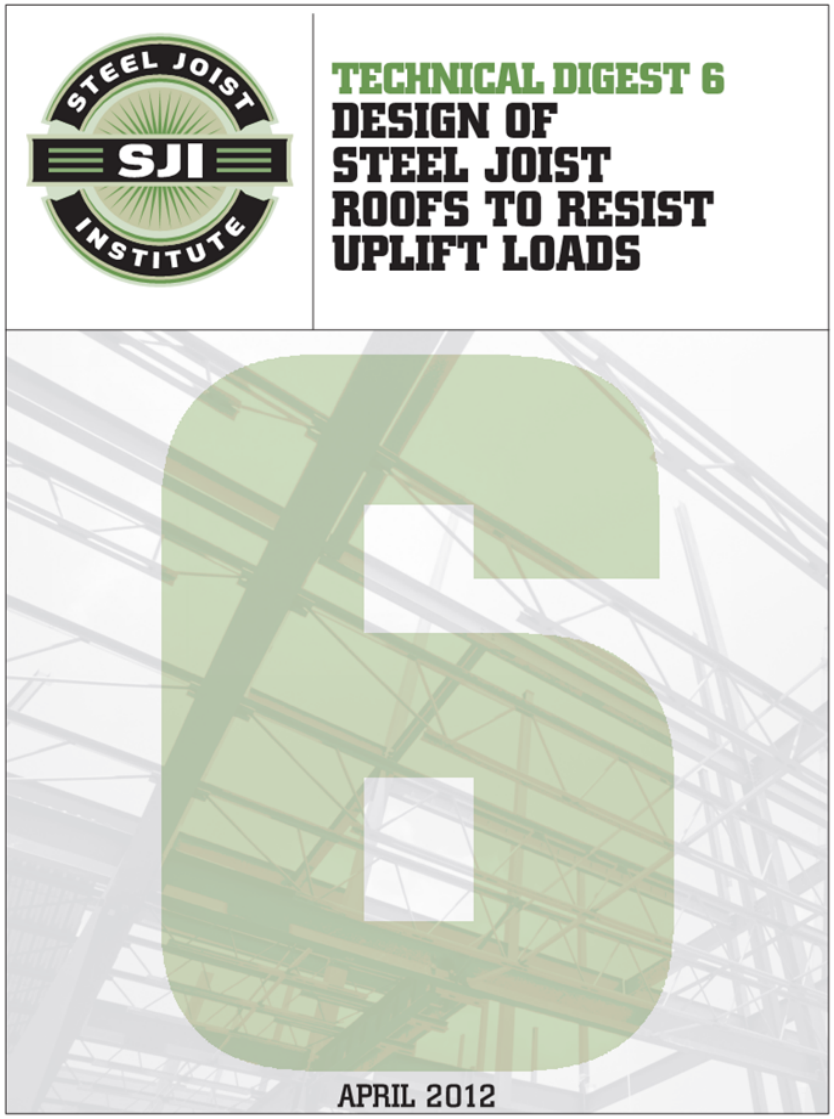
- Typical termination details:





End Anchorage

- For more on End Anchorage and joist design for uplift, refer to the Steel Joist Institute Technical Digest #6, *Design of Steel Joist Roofs to Resist Uplift Loads.*



Special Usages

- Standing Seam Roof
- ESFR
- Bottom Chord Bearing Joists
- Special Shapes
- Bridging Discontinuity
- Skewed walls
- Bridging Discontinuity
- Distance of uplift bridging from the first bottom chord panel point
- Nominal thickness of bridging
- Bridging connections - Tack welding of bridging
- Galvanized bridging must be bolted not welded.
- External, Additional Forces on Bridging

Standing Seam Roofs

5.8 FLOOR AND ROOF DECKS

(g) Joist With Standing Seam Roofing or Laterally Unbraced Top Chords

…Sufficient stability must be provided to brace the joists laterally under the full design load, in accordance with Section 5.8(e). … In any case where the attachment requirement of Section 5.8(e) is not achieved, out-of-plane strength shall be achieved by adjusting the bridging spacing and/or increasing the compression chord area and the y-axis radius of gyration. The effective slenderness ratio in the y-direction equals 0.94 L/r_y; where L is the bridging spacing in inches (millimeters).

Standing Seam Roofs

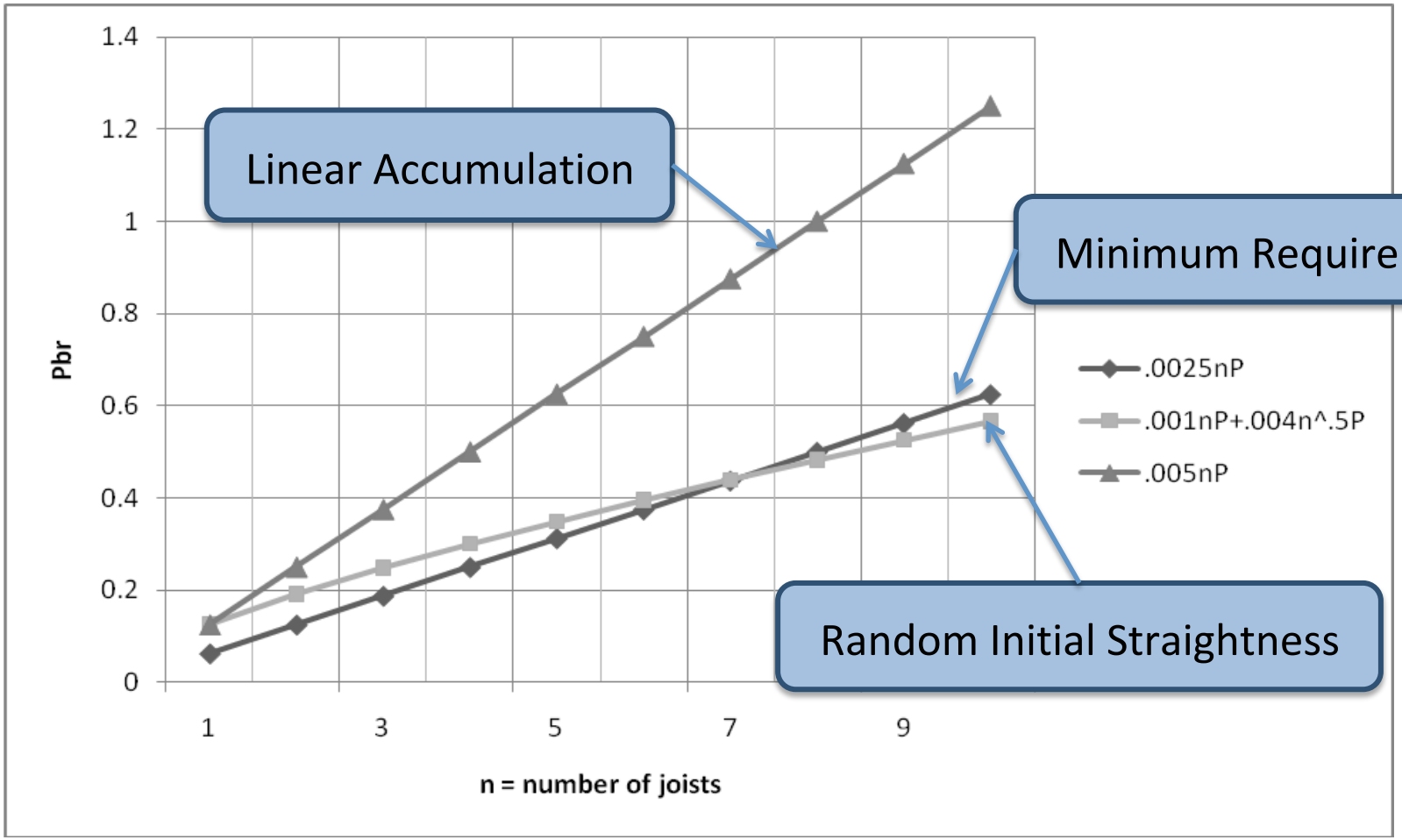
When deck diaphragm is not present

5.8 FLOOR AND ROOF DECKS

(g) Joist With Standing Seam Roofing

Horizontal bridging members attached to the compression chords and their anchorages must be designed for a compressive axial force of $0.001nP + 0.004P\sqrt{n} \geq 0.0025nP$, where n is the number of joists between end anchors and P is the chord design force in kips (Newtons). The attachment force between the horizontal bridging member and the compression chord is 0.01P.

Standing Seam Roofs



Sprinkler Systems and Bridging

- For warehouses with rack storage systems and high piled storage systems, **E**arly **S**uppression **F**ast **R**esponse (ESFR) sprinkler systems are common.
- National Fire Protection Association (NFPA) 13: Standard for the Installation of Sprinkler Systems the design and installation of ESFR systems.
- The ESFR sprinkler head elevations are normally set within the joist depth, less then 1 foot from the bottom of the metal roof deck.
- In addition to rigid rules about the placement and spacing of the ESFR heads, obstructions below an ESFR head must be limited.

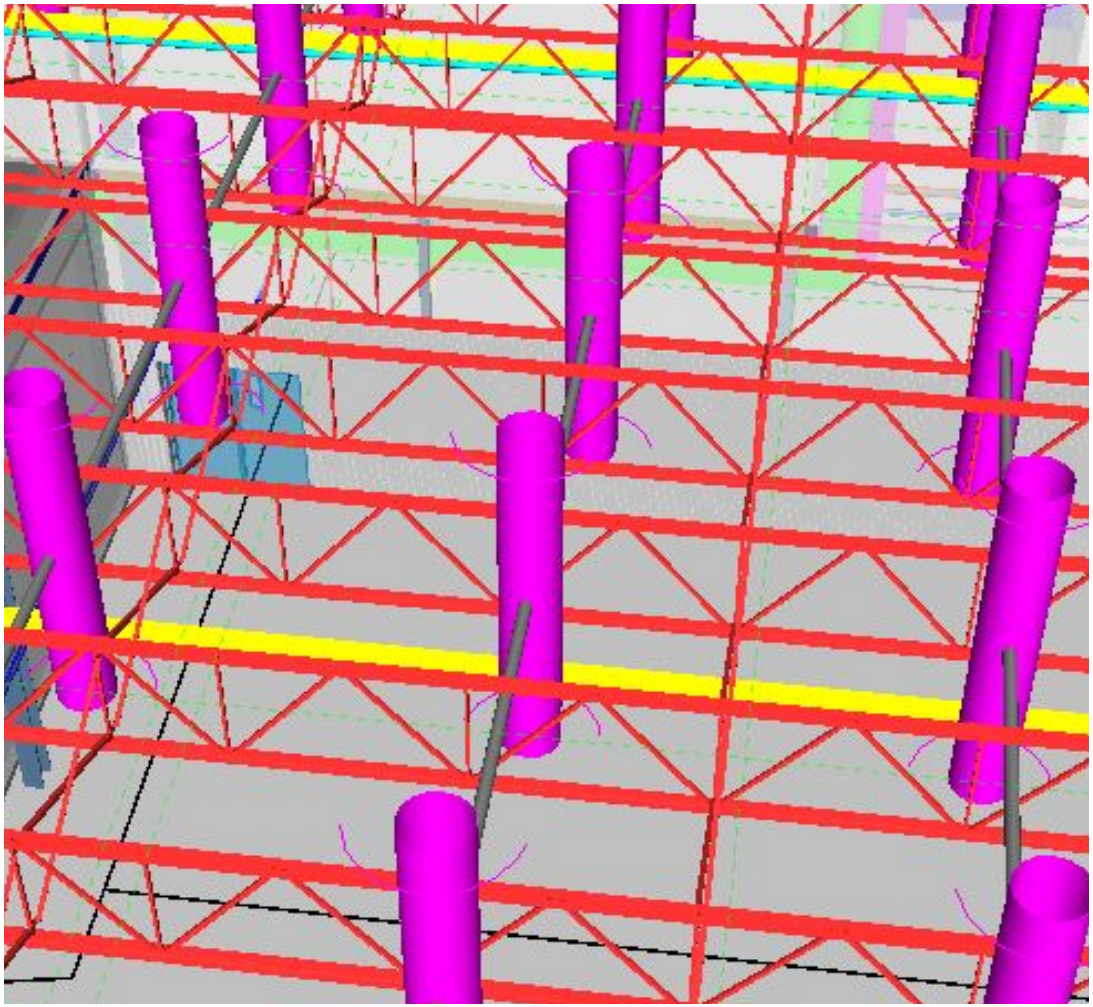
ESFR Systems

- The specific requirement from NFPA which influences bridging row locations states:

  > Additional sprinklers are not required where the obstruction is 2 in. or less in width and is located a minimum of 2 ft. below the elevation of the sprinkler deflector or is positioned a minimum of 1 ft. horizontally from the sprinkler.

- For joist bridging, the 1 ft. horizontal dimension normally governs.
- It is a “clear” dimension, not “center to center.”
- The erector must install horizontal bridging rows at the dimensions shown on the Joist Placement Plans when an ESFR system is being used, and an extra inch or two of tolerance may be provided.
- Excessive and unnecessary clearance requirements of say 1’-6” arbitrarily stated on the contract drawings make the joist and bridging cumbersome and possibly more costly.

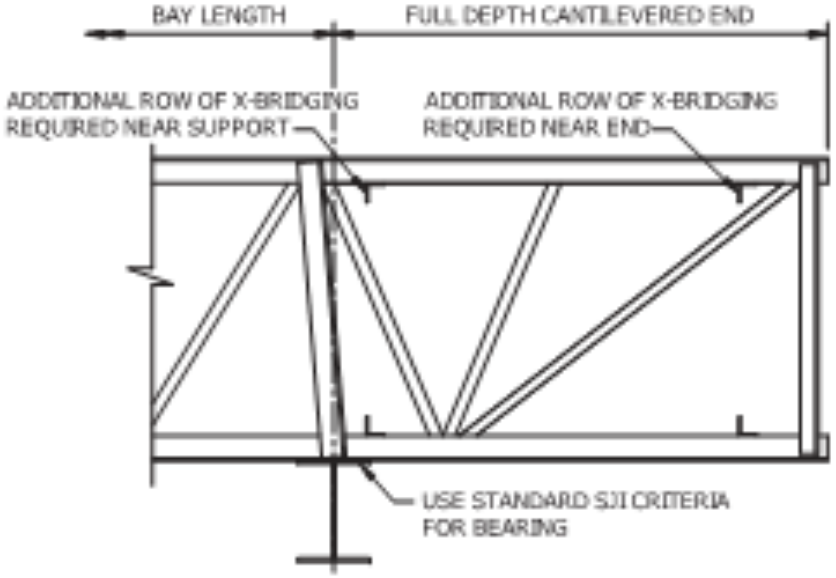
ESFR Clearance

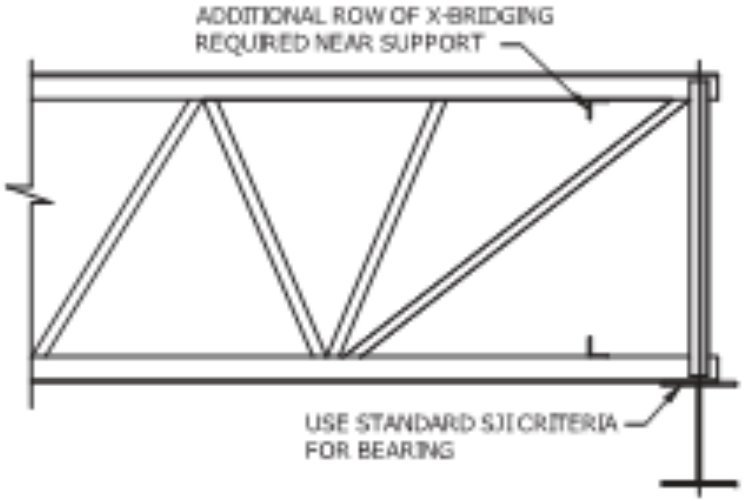


- In this BIM model, the ESFR sprinkler heads and their clearance requirements are represented by the purple cylinders.
- Bridging rows are routed so as to avoid any clashes with the ESFR cylinders.

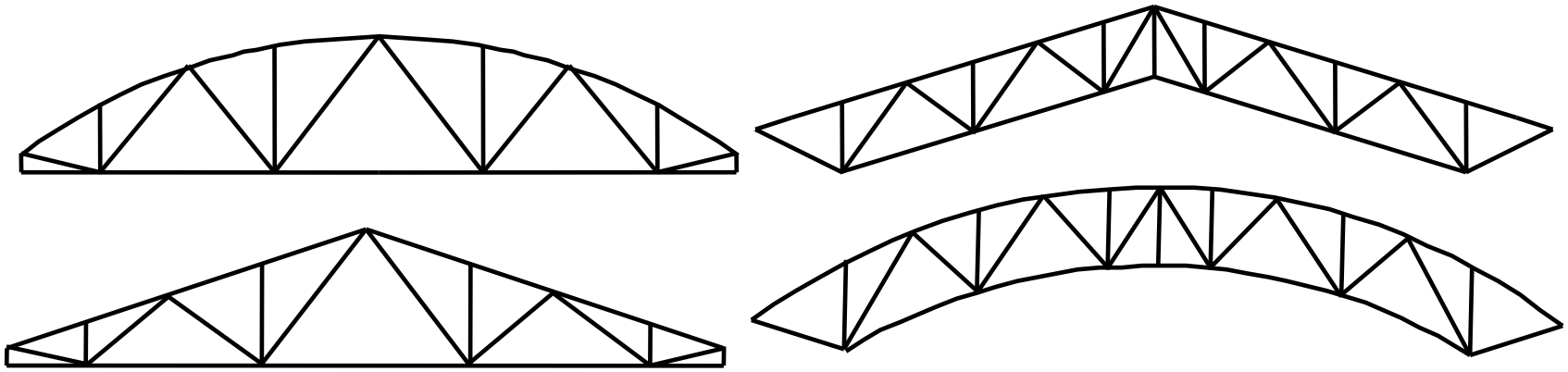
Bottom Bearing Joists

- Whenever joists are bottom chord bearing, diagonal cross bridging must be installed from joist to joist at or near the bearing location to provide additional lateral erection stability.

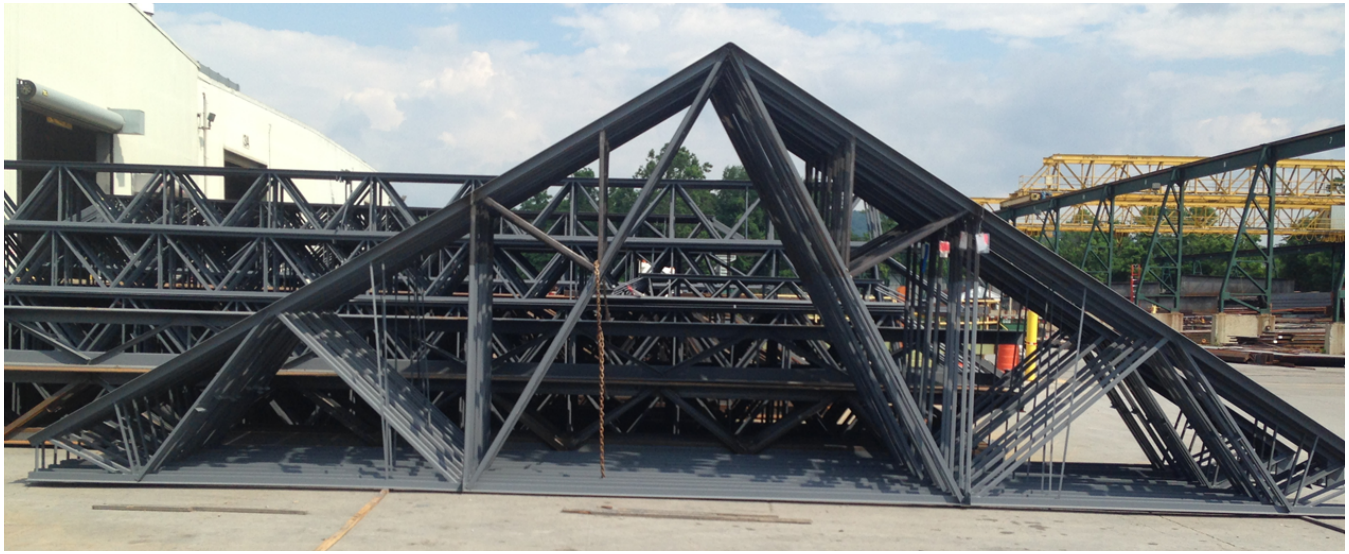




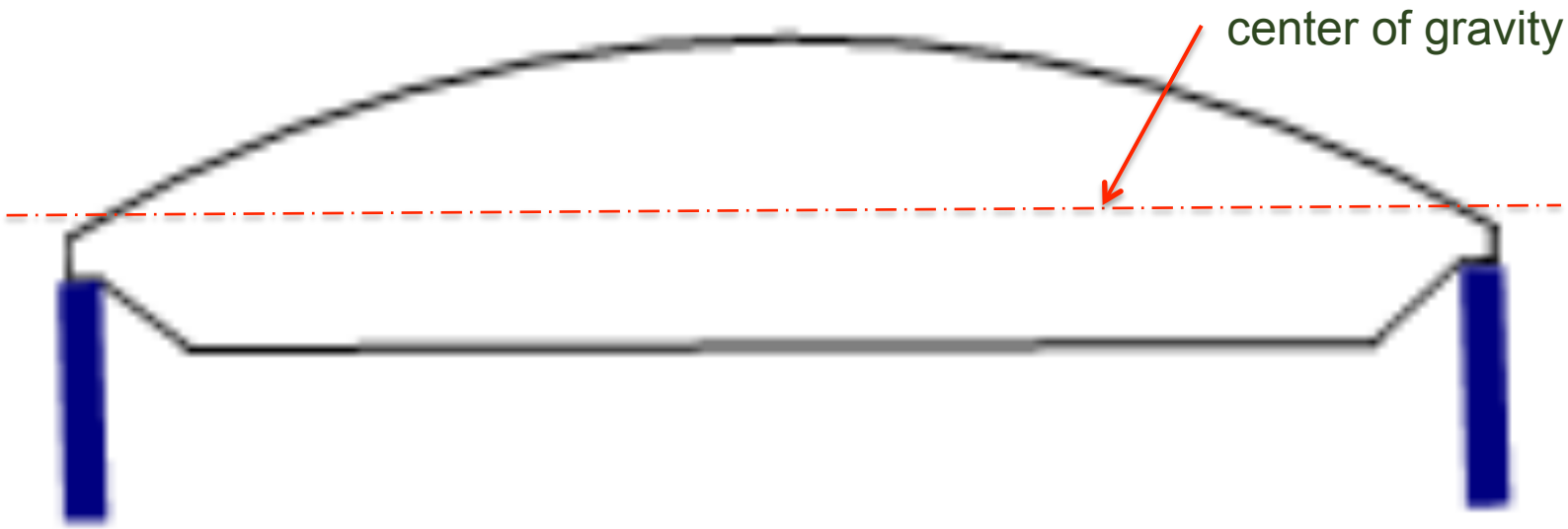
Special Shape Joists



- Special shape joists (bowstring, scissors, gables, barrels) can be “top heavy”

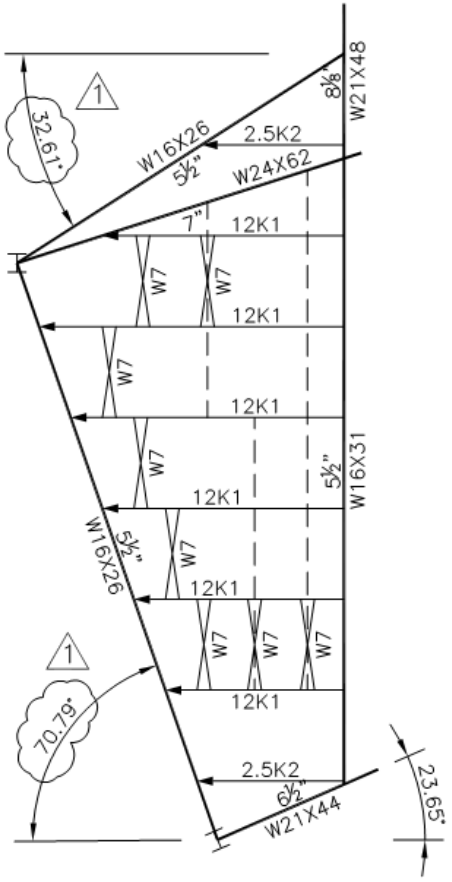


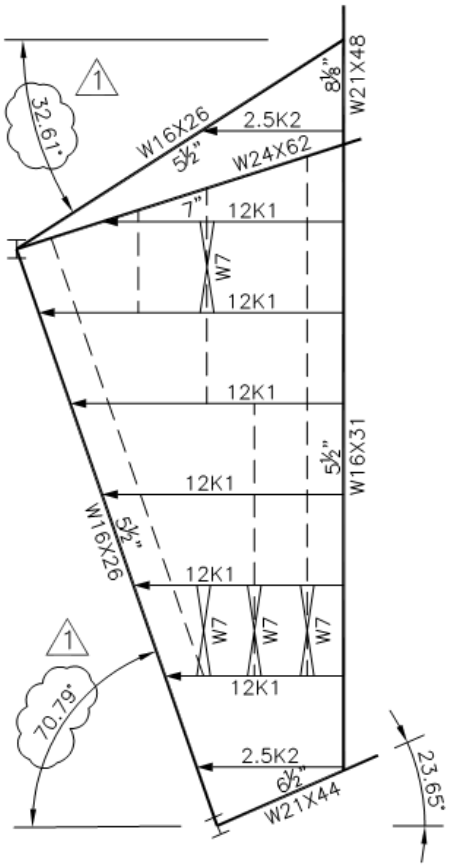
Special Shapes



- When the joist center of gravity is above the supports, it is recommended that all rows be diagonal bridging.
- The erector must also take special care to maintain stability, both as the joist is initially set and as construction loads are applied.

Bridging Anchorage to Skewed Walls

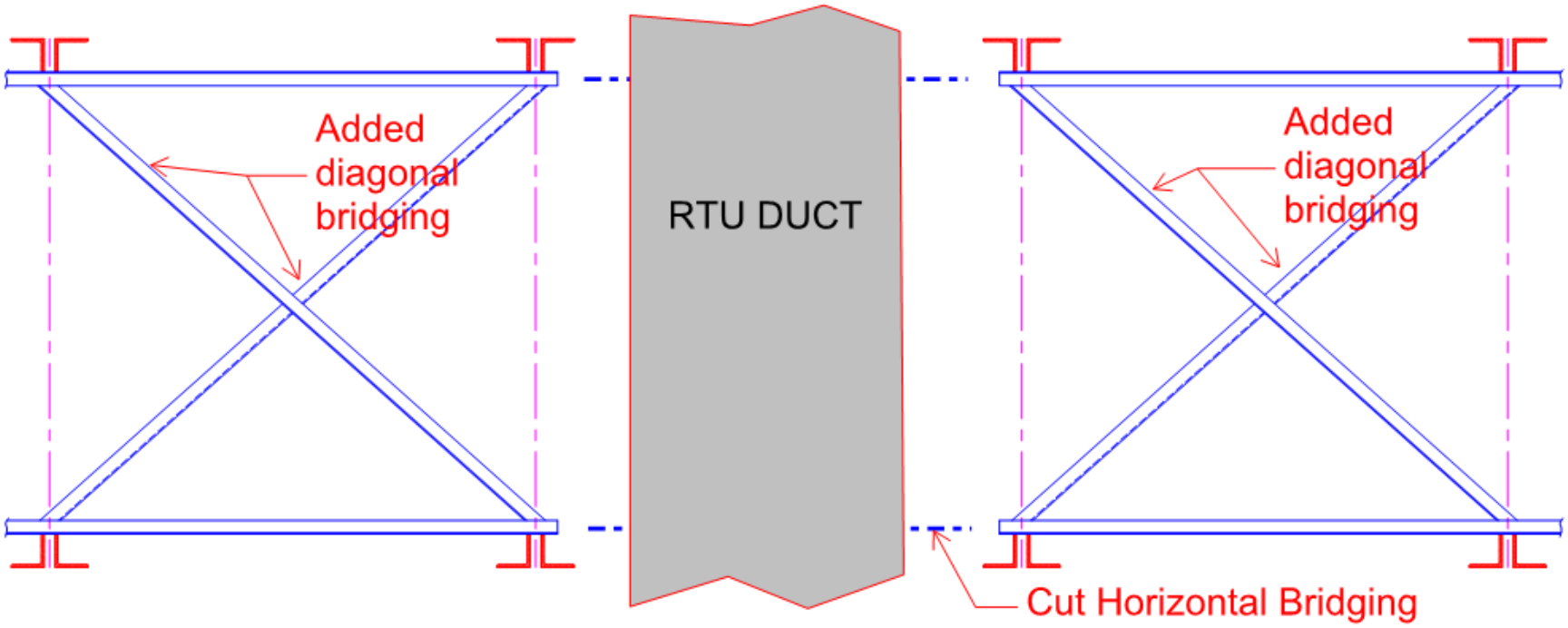




Bridging Discontinuity

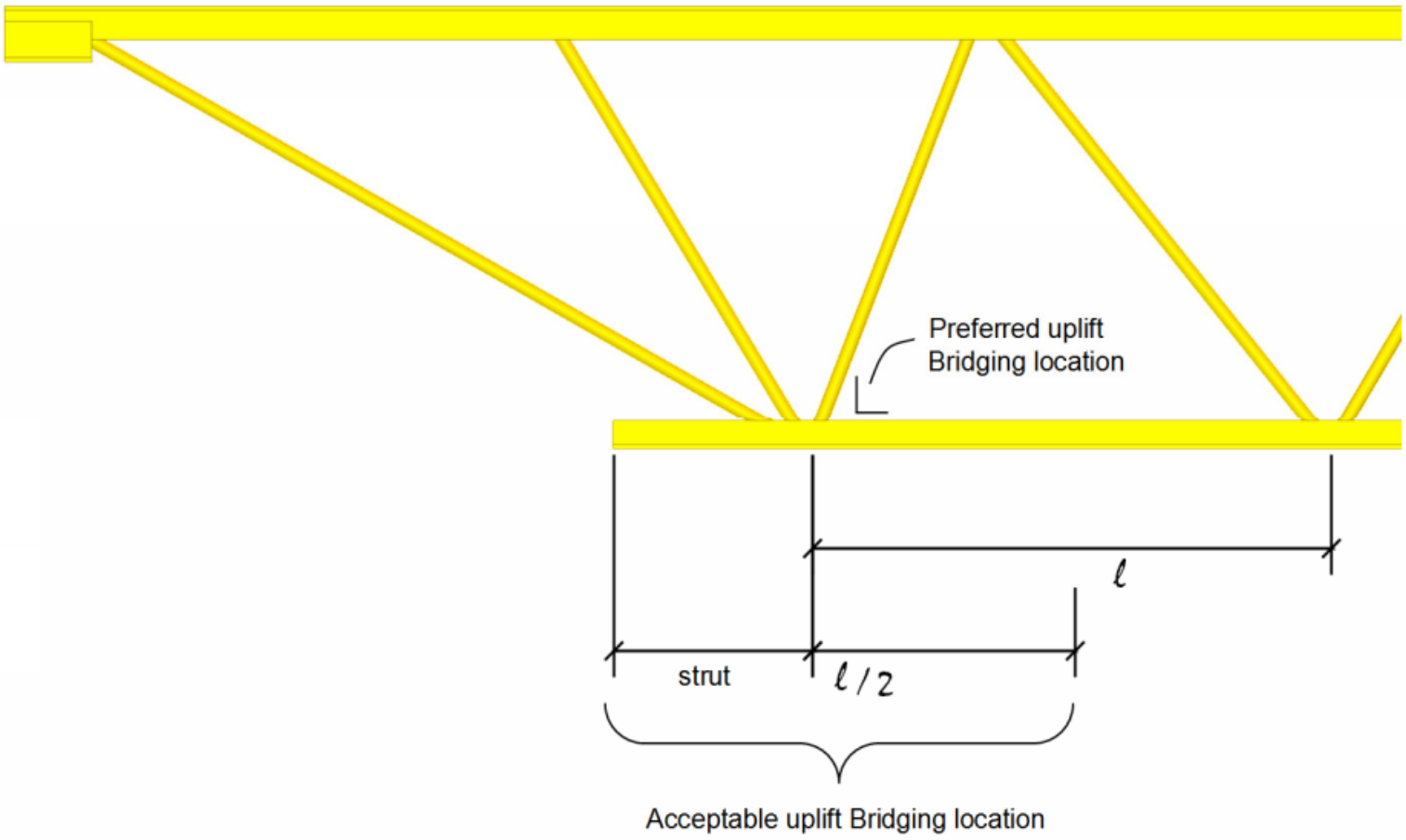
Horizontal bridging row without termination

Bridging Discontinuity



- Horizontal bridging must be continuous.
- Where horizontal bridging is interrupted, terminate with diagonal bridging in the joist space on each side.

Distance of Uplift Bridging From the First Bottom Chord Panel Point



Welded Bridging Connections

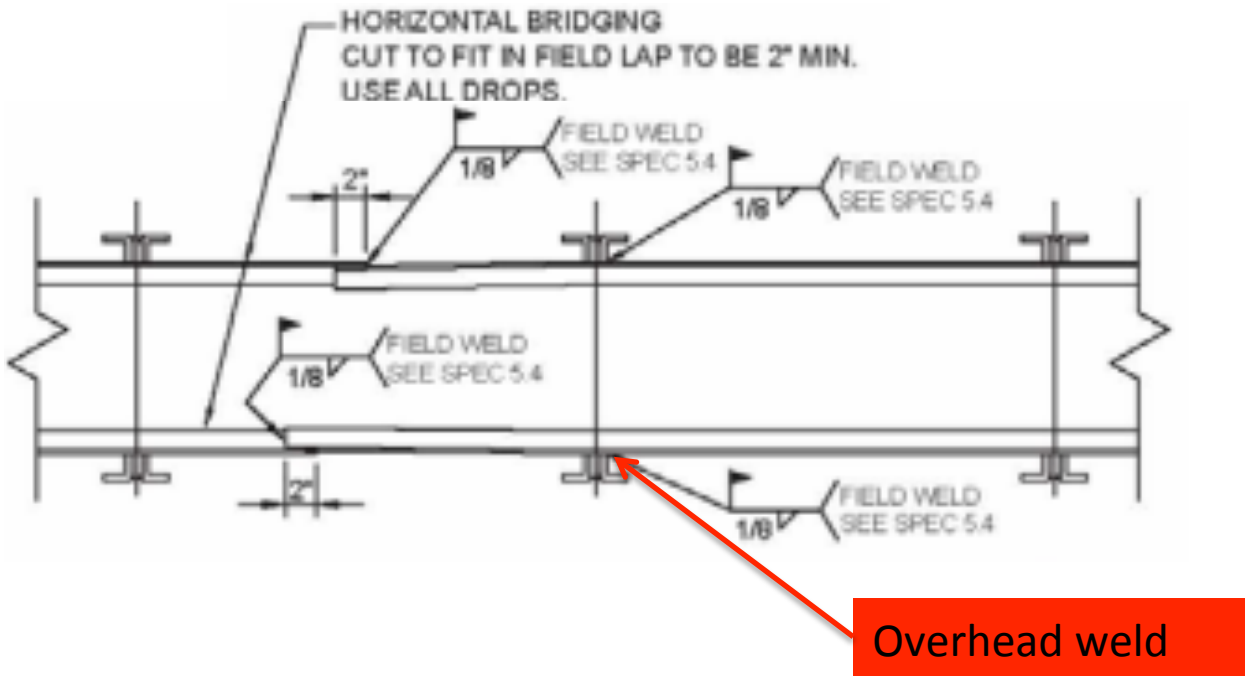
TABLE 5.5

BRIDGING NOMINAL HORIZONTAL UNFACTORED COMPRESSSIVE FORCE					
JOIST SECTION NUMBER[1]	HORIZONTAL BRIDGING P_{br} (n=8)		REQUIRED BRIDGING CONNECTION WELD[2]	DIAGONAL BRIDGING P_{br} (n=2)	
	Lbs.	(N)	In.	Lbs.	(N)
K1-8	340	(1512)	1/8" x 1" (3mm x 25mm)	85	(378)
K9-10, LH02-03	450	(2002)		113	(503)
K11-12, LH04-05	560	(2491)		140	(623)
LH06-08	750	(3336)		188	(836)
LH09	850	(3781)		213	(945)
LH/DLH10	900	(4003)		225	(1001)
LH/DLH11	950	(4226)		238	(1056)
LH/DLH12	1100	(4893)		275	(1223)
LH/DLH13	1200	(5338)		300	(1334)
LH/DLH14	1300	(5783)		325	(1446)
LH/DLH15	1450	(6450)		363	(1612)
LH/DLH16-17	1850	(8229)	1/8" x 1 ½" (3mm x 38mm)	463	(2057)
DLH18-20	2350	(10453)		585	(2602)
DLH21-22	3150	(14012)	1/8" x 2" (3mm x 51mm)	790	(3514)
DLH23-24	4130	(18371)	1/8" x 3" (3mm x 76mm)	1035	(4604)
DLH25	4770	(21218)		1195	(5316)

(1) Last digit(s) of joist designation shown in Load Table.
(2) Or other connection type designed for the required force.

Welded Bridging Connections

- In some cases the thickness of the bridging is not 0.125”, it could be less.
- 1/8” fillet welds can be placed on thinner material.
- Never use 4 tack welds on the toes of the bottom chords.

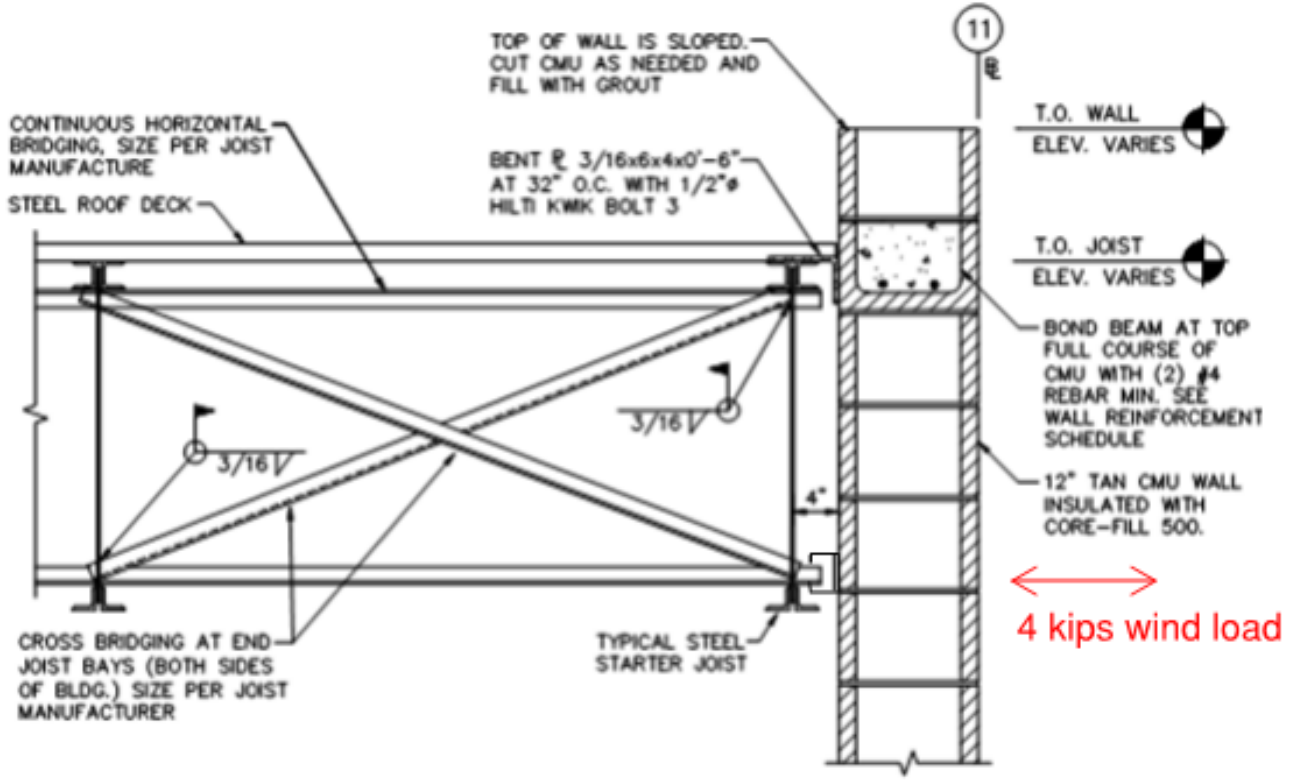


Galvanized Joist

- All bridging on galvanized joists must be bolted not welded

External, Additional Forces on Bridging

- Can an additional, external wind force be transferred through the joist bridging?



External, Additional Forces on Bridging

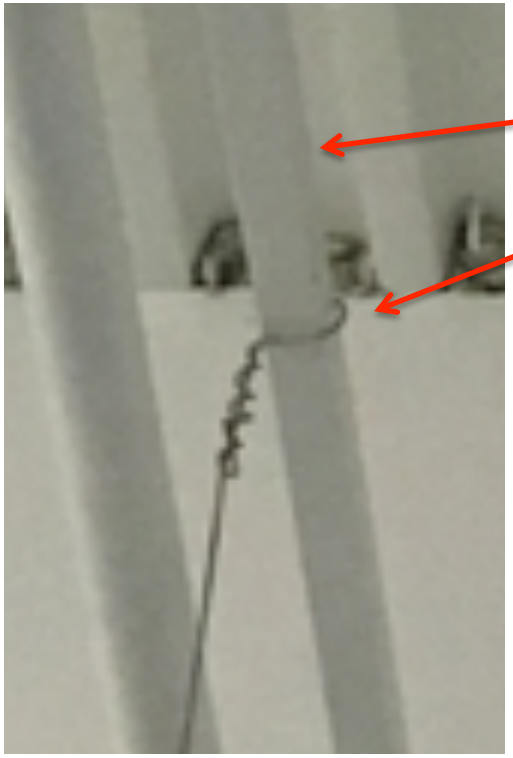
- Diagonal X bridging would be needed in multiple joist spaces to transfer force from the bottom chord level up to the deck diaphragm.
- Care must be taken to not exceed the bridging connection capacity, and welding in additional to bolting may be required.
- The deck weld attachments also must not be exceeded.
- A separate structural brace may be more advisable.

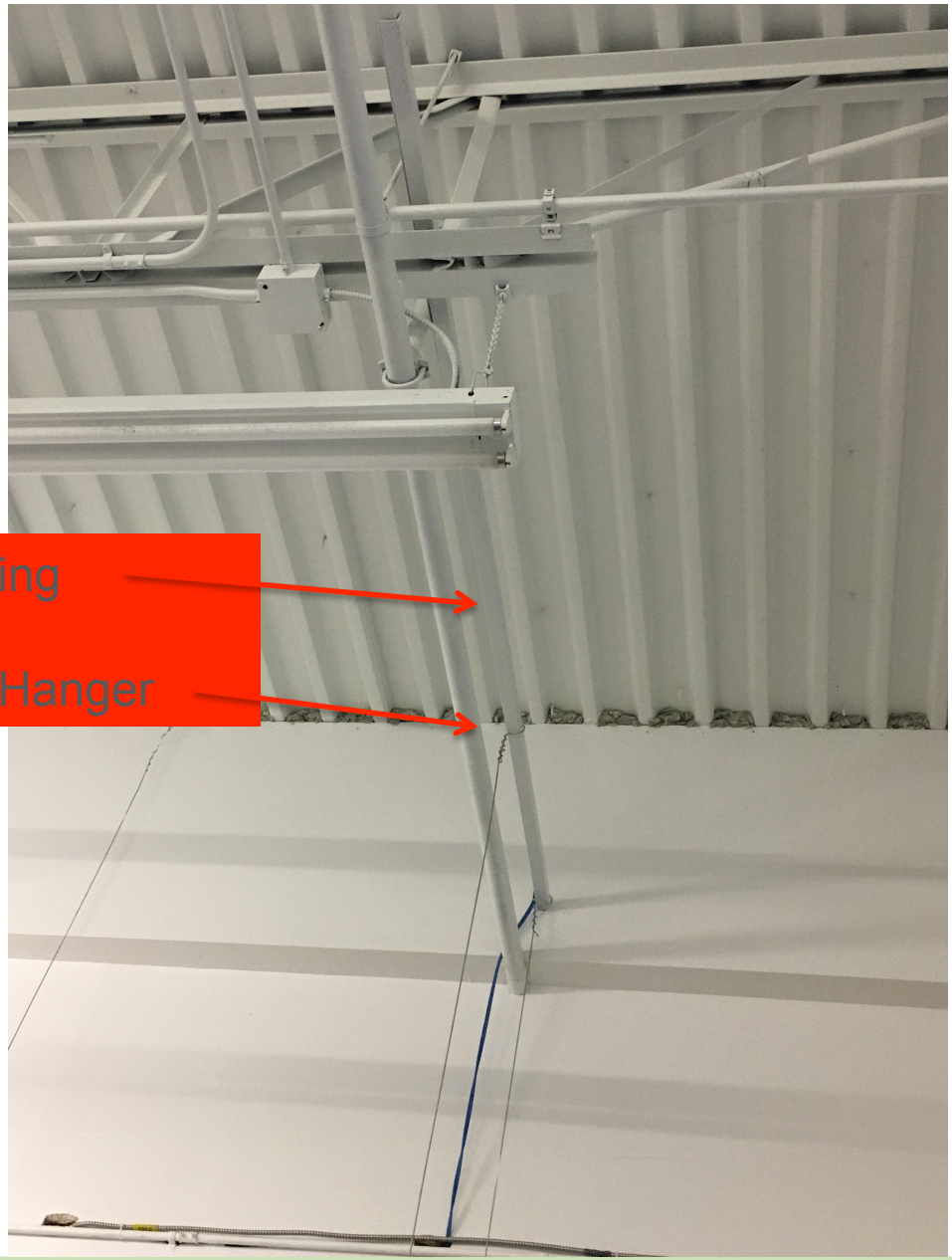
Field Conditions

- Field conditions can vary from what was designed.

Field Conditions

- Bridging is bracing – do not hang any loads from bridging.





Field Conditions

- Bridging is bracing – don't brace to a brace!

Field Connections

Rough looking welds

Burn through hole

How to Specify Bridging

- Should the contract drawings show the bridging lines on the framing plans or simply require bridging as required per the Steel Joist Institute Specifications?

- The joist manufacturer can assume the responsibility for proper application of the SJI Specs while preparing the framing plans.

What is Coming?

- SJI will update and publish Technical Digest #2, on the topic of Bridging
- It will include what you have seen in this presentation and much, much more!

Polling Question 2

For joist profiles where the center of gravity is above the support as a minimum the following provision shall be taken:

A. All rows should be bolted cross bridging
B. SJI bridging tables are not applicable as shown
C. Contract a joist supplier for bridging requirements

Polling Question Answers

1. Are horizontal bridging rows required to be aligned from top to bottom chord?

   B. False, the top and bottom chord horizontal bridging rows need not align. Follow the instructions provided on the Joist Placement Plans.

2. For joist with profiles where the center of gravity is above the support as a minimum the following provision shall be taken.

   A. All rows should be bolted cross bridging.

THANK YOU