

Specifying Web Stiffeners on TJI[®] Joist to Increase End Reaction Capacity

Introduction

Current iLevel[®] software (TJ-Beam[®], Javelin[®], Forte[™]) do not specify web stiffeners to increase a TJI[®] 's end reaction capacity. To do this, one must utilize ICC-ES ESR-1153 code report (www.icc-es.org) and determine if the installation of web stiffeners will increase the TJI[®] end reaction capacity enough to make the member structurally sufficient. ESR-1153 only gives end reaction capacities with web stiffeners for 1 ³/₄" and 3 ¹/₂" bearing lengths. By using the tables on page 5, you can verify if the addition of web stiffeners at the ends of joists will be adequate for a variety of end bearing lengths between 1 $\frac{3}{4}$ " and 3 $\frac{1}{2}$ ". The following pages go through scenarios where using web stiffeners may be a solution for a reaction failure on a TJI[®] joist or may be used at hanger locations to show that a standard hanger is acceptable when the software reports 'connector not found'.

Typically, the addition of web stiffeners are used in Multifamily and Commercial structures where the usage is more common and there is more frequent oversight. If the increase in strength is to be used in residential structures, it is recommended to review the installation for proper conformance.



TJI® 560 Joists Only





(1) PS1 or PS2 sheathing, face grain vertical (2) Construction grade or better

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TJI[®]'s supported by walls or beams

When iLevel[®] software fails a TJI[®] joist due to <u>end reaction capacity only</u>, there are 4 possible ways to make the member pass:

- 1) Increase bearing length until members passes (assuming you have room to add more bearing length)
- 2) Increase TJI[®] joist series until member passes (this is not a cost effective solution)
- 3) Reduce the on center spacing of the joist, thus reducing the reaction. (this is not a cost effective solution)
- 4) Verify if installing web stiffeners on the TJI[®] will make the member sufficient with the given bearing length (use table on page 5 to verify the adequacy of the joist with web stiffeners). See example calculation below.



- Looking at the table on page 5, an 11 ⁷/₈" TJI[®] 560 with 1 ³/₄" bearing length and web stiffeners has a reaction capacity (allowed) of <u>1740 lbs. which is greater than the actual reaction of 1299 lbs.</u> so this joist would work as shown if web stiffeners are added to each end bearing.

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TJI[®]'s supported by hangers

When designing TJI[®] joists that are supported by hangers, iLevel[®] software does analyze the allowable TJI[®] reaction based on the actual hanger seat length to select a hanger. When the program indicates that 'no connector was found', the allowable TJI[®] reaction capacity reported is the capacity of the TJI[®] joist assuming the hanger has 3 ½" bearing length. This can be troublesome as most hangers do not have a seat length of 3 $\frac{1}{2}$ ". When no connector is found within the program, you will need to do the following steps to manually select an appropriate hanger (see page 4 for example):

- 1) Find a hanger that can support the design reaction for the TJI[®] in guestion.
- 2) Note what the bearing length is for this hanger (typically reported as the 'B' or 'D' dimension) and any special nailing requirements for the hanger when web stiffeners are used with the TJI[®]. Go to the table on page 5 with the design reaction and hanger bearing length and determine the allowable reaction for the TJI[®] with web stiffeners.
- 3) If the allowable value for the TJI[®] with web stiffeners is greater than the design reaction, the hanger will work. If the value is less than the design reaction, look for a different hanger with a longer bearing length and go through the steps above again until the value for the TJI[®] with web stiffeners is larger than the design reaction.
- 4) For cases where both the TJI[®] end reaction fails and there is no hanger found, one must check that the value for the TJI[®] end reaction with web stiffeners exceeds the design reaction reported by the software based on the hanger seat length.

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First floor, Joist in hanger failure

1 PIECE(S) 11 7/8" TJI® 230 @ 16" OC FAILED

Support 1 failed the reaction check due to insufficient bearing capacity.





Member Type : Joist

Building Use : Residential

Building Code : IBC

Design Methodology : ASD

System : Floor

Design Results	Actual @ Location	Allowed	<u>Result</u>	LDF	Allowed reaction capacity for 2 ½" bearing
Member Reaction (lbs)	1523 @ 3.50"	1485	Failed (103%)	100%	the member would need at 1575 lbs. With this,
Shear (lbs)	1523 @ 3.50"	1655	Passed (92%)	100%	the member would pass at 1523 lbs/1575 lbs =
Moment (Ft-lbs)	3814 @ 7' 0.32"	4215	Passed (90%)	100%	97%
Live Load Defl. (in)	0.292 @ 7' 0.47"	0.450	Passed (L/556)		
Total Load Defl. (in)	0.366 @ 7' 0.43"	0.675	Passed (L/443)	22	
TJ Pro Rating	51	40	Passed		

· Deflection criteria: LL (L/360) and TL (L/240).

Design results assume a fully braced condition where sheathing is properly nailed to all compression edges at the top of the joist and that the compression edges at the bottom of the joist are properly braced to provide lateral stability.

Bracing (Lu): All compression edges (top and bottom) must be braced at 3' 9.55" o/c unless detailed otherwise. Proper attachment and positioning of lateral bracing is required to
achieve member stability.

· A structural analysis of the deck has not been performed.

• Deflection analysis is based on composite action with a single layer of 23/32" iLevel® Edge Panel (24" Span Rating) that is glued and nailed down.

Additional considerations for the TJ-Pro[™] Rating include: None

Supports		<u>Total</u> Bearing	Available Bearing	Required Bearing	Support Reactions Dead/Floor/Roof/S	(lbs) now	Accessories
1 - 11 7/8" Beam - Spruce P	ine Fir	3.50"	Hanger		533 / 1038 / 0 /	0	None
2 - Stud wall - Spruce Pine Fir		3.50"	2.25"		234 / 928 / 0 / 0		1 1/4" Rim Board
Loads	Location	Spacing	<u>Dead</u> (0.90)	Floor Live (1,00)	Roof Live (non snow: 1.25)	<u>Snow</u> (1.15)	Comments
1 - Uniform(PSF) 0 f	to 14' 0.00"	16"	25.0	100.0	0.0	0.0	Lobby Load
2 - Point(lb)	4.50"	N/A	300	100	0	0	
Connector: Simpson	Strong-Tie	Connectors					
Support	Model		<u>T</u>	op Nails	Face Nails	Member Nails	Accessories
1 - Face Mount Hanger	Connec	tor not found	N	/A	N/A	N/A	

- The first hanger that has capacity greater than 1523 lbs is a MIU2.37/11 (= 2840 lbs and a 'B' dimension = 2 1/2")

-From table on page 5, an 11 $\frac{7}{8}$ " TJI® 230 w/ web stiffeners and a bearing length of 2 $\frac{12}{2}$ " has a reaction capacity of <u>1575 lbs which is greater than the actual reaction of 1523</u> lbs so this joist would work as shown if web stiffeners are added to the hanger end.

-Solution: Specify a MIU2.37/11 to support a 11 7/3" TJI® 230 w/ web stiffeners



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Allowable TJI® End Reaction with Web Stiffeners

12		TJI® 110 A	Actual Bearin	ng Length			
Joist Depth	1 3⁄4"	2"	2 1/4"	2 1/2"	2 ³ /4"	3"	3 1/2"
11 7/8"	1225	1305	1375	1440	1505	1560	1560
14"	1225	1305	1375	1440	1505	1575	1705

TJI® 210 Actual Bearing Length						14	
Joist Depth	1 ³ ⁄4"	2"	2 1/4"	2 1/2"	2 ³ /4"	3"	3 1/2"
11 7⁄8"	1340	1405	1465	1530	1595	1655	1655
14"	1340	1405	1465	1530	1595	1660	1790
16"	1340	1405	1465	1530	1595	1660	1790

		TJI® 230 A	ctual Bearin	ng Length			
Joist Depth	1 3⁄4"	2"	2 1/4"	2 1/2"	2 ³ ⁄4"	3"	3 1/2"
11 7⁄8"	1395	<mark>1455</mark>	<mark>1515</mark>	1575	1635	1655	1655
14"	1395	1455	<mark>15</mark> 15	1575	1635	1695	1815
16"	1395	1455	1515	1575	1635	1695	1815

ί.		TJI® 360 A	ctual Beari	ng Length			
Joist Depth	1 3⁄4"	2"	2 1/4"	2 1/2"	2 3/4"	3"	3 1/2"
11 7⁄8"	1 <mark>44</mark> 0	1500	1560	1620	1680	1705	1705
14"	1440	1500	1560	1620	1680	1745	1865
16"	1440	1500	1560	1620	1680	1745	1865
18"	1440	1500	1560	1620	1680	1745	1865
20"	1440	1500	1560	1620	1680	1745	1865

		TJI® 560 A	ctual Bearin	ng Length			
Joist Depth	1 3⁄4"	2"	2 1/4"	2 1/2"	2 ³ ⁄4"	3"	3 1/2"
11 7⁄8"	1740	1805	1870	1935	2000	2050	2050
14"	1740	1805	<mark>1870</mark>	1935	2000	2065	2200
16"	1740	1805	1870	1935	2000	2065	2200
18"	1740	1805	1870	1935	2000	2065	2200
20"	1740	1805	1870	1935	2000	2065	2200

Bold value = shear controlled reaction

Capacities can be increased by the appropriate load duration factor (ie. 1.15 for snow load applications)