NORDIC

TECHNICAL GUIDE
NORDIC JOIST

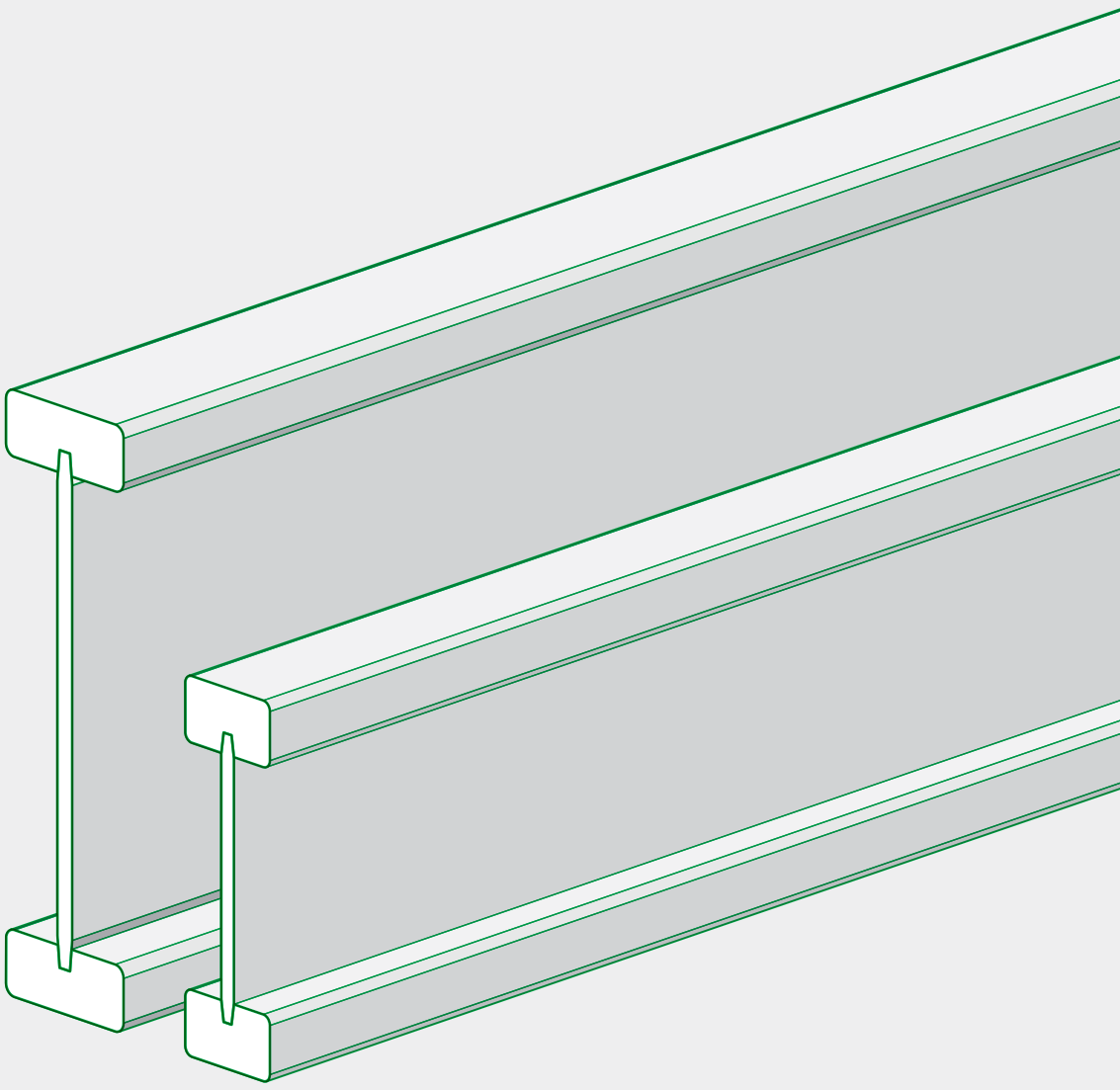
NS-GT3

VERSION
2024-08-01

Engineered Wood Products

NORDIC JOIST TECHNICAL GUIDE

NORDIC JOIST



NORDIC STRUCTURES

ABOUT NORDIC

NORDIC STRUCTURES

Nordic Structures is the leading innovator in engineered wood products. Its resource comes from responsibly managed lands within the regional boreal forest. Vertical integration, from forest to structure, bolstered by Nordic's experienced design and development team, ensures consistent quality and unparalleled level of service.

514-871-8526
1 866 817-3418

HEAD OFFICE

Nordic Structures
100-1100 Canadiens-de-Montréal Avenue
Montréal, Québec H3B 2S2
www.nordic.ca

GENERAL INFORMATION

info@nordic.ca

TECHNICAL SUPPORT

tech@nordic.ca

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ENGINEERED WOOD PRODUCTS

Standard size products available
from our distributors

NS-GT3

NORDIC JOIST

NORDIC I-JOISTS

Nordic I-joists are composed of sawn lumber flanges connected by a structural oriented strand board and bonded together with exterior-grade adhesives.

NI-40x — RESIDENTIAL SERIES

2×3 1950f MSR, 3/8 in. web
Depths
9-1/2, 11-7/8 and 14 in.

NI-60

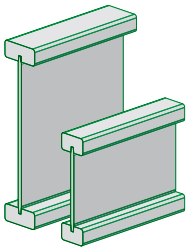
2×3 2100f MSR, 3/8 in. web
Depths
9-1/2, 11-7/8, 14 and 16 in.

NI-80

2×4 2100f MSR, 3/8 in. web
Depths
9-1/2, 11-7/8, 14 and 16 in.

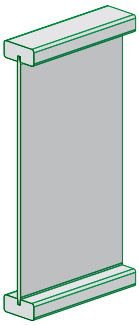
NI-90

2×4 2400f MSR, 7/16 in. web
Depths
11-7/8, 14 and 16 in.



NI-80x — COMMERCIAL SERIES

2×4 2100f MSR, 7/16 in. web
Depths
18, 20, 22 and 24 in.



NS-GT4

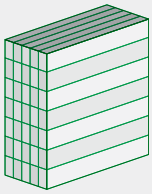
NORDIC LAM

NORDIC LAM
GLUED-LAMINATED TIMBER

Nordic Lam glued-laminated timber of industrial appearance classification consists of small wood laminations bonded together in parallel using structural adhesives.

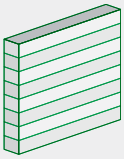
BEAMS AND HEADERS

Widths
1-3/4, 3-1/2, 5-1/2 and 7 in.
Depths
9-1/2, 11-7/8, 14, 16, 18, 20, 22 and 24 in.
Lengths*
Up to 48 ft
Stress grade
24F-1.9E



JOISTS

Width
1-1/2 in.
Depths
7-1/4, 9-1/4, 9-1/2, 11-1/4, 11-7/8 and 14 in.
Lengths*
Up to 48 ft
Stress grade
13F-1.7E



COLUMNS

Widths
3-1/2, 5-1/2 and 7 in.
Depths
3-1/2, 5-1/2 and 7 in.
Lengths*
Up to 48 ft
Stress grade
ES12

STUDS

Widths
1-1/2 and 1-3/4 in.
Depths
5-1/2 and 7-1/4 in.
Lengths*
Up to 48 ft
Stress grade
ES12

* Larger sizes available upon request

MASS TIMBER CONSTRUCTION

Products custom-manufactured
and machined for major projects

NS-GT5

NORDIC LAM+

NORDIC LAM+ GLUED-LAMINATED TIMBER

Nordic Lam+ glued-laminated timber of architectural appearance classification consists of small wood laminations bonded together in parallel using structural adhesives.

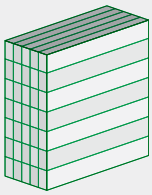
BEAMS AND COLUMNS

Widths*
38, 86, 137, 184, 215, 241, 292, 346, 395, 448, 502, 552 and 603 mm
(1-1/2, 3-3/8, 5-3/8, 7-1/4, 8-1/2, 9-1/2, 11-1/2, 13-5/8, 15-1/2, 17-5/8, 19-3/4, 21-3/4 and 23-3/4 in.)

Depths*
From 67 to 2435 mm
(2-5/8 to 95-7/8 in.)

Lengths*
Up to 24.4 m (80 ft)

Stress grade
24F-ES/NPG



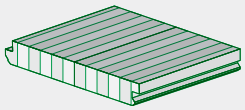
DECKING

Thicknesses*
38, 44, 54 and 89 mm
(1-1/2, 1-3/4, 2-1/8 and 3-1/2 in.)

Widths
203, 305 and 406 mm
(8, 12 and 16 in.)

Lengths
Up to 18.9 m (62 ft)

Stress grades
ES11, except 89 mm thickness in 20F-ES/CPG



* Larger sizes available upon request

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NORDIC X-LAM

NORDIC X-LAM CROSS-LAMINATED TIMBER

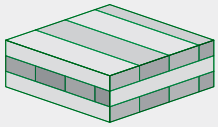
Nordic X-Lam cross-laminated timber is made of at least three orthogonal layers of graded sawn lumber that are laminated by bonding with structural adhesives.

SLABS AND PANELS

Layup combinations
89-3s, 105-3s,
143-5s, 175-5s,
197-7s, 213-7l, 245-7s, 245-7l
and 267-9l

Maximum sizes
2.565 × 19.5 m (101 in. × 64 ft)

Stress grade
E1 (L 1950Fb and T No. 3/Stud)



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2024-08-01

NORDIC JOIST 1

NORDIC
STRUCTURES

NORDIC JOIST

NORDIC I-JOISTS

Nordic I-joists are composed of sawn lumber flanges connected by a structural oriented strand board and bonded together with exterior-grade adhesives.

RESIDENTIAL SERIES

NI-40x
2×3 1950f MSR, 3/8 in. web
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2×4 2100f MSR, 3/8 in. web
Depths
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NI-90
2×4 2400f MSR, 7/16 in. web
Depths
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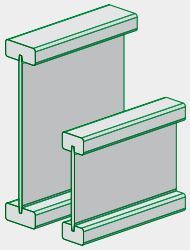
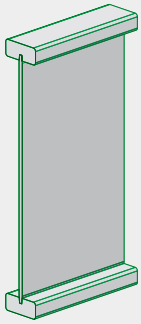
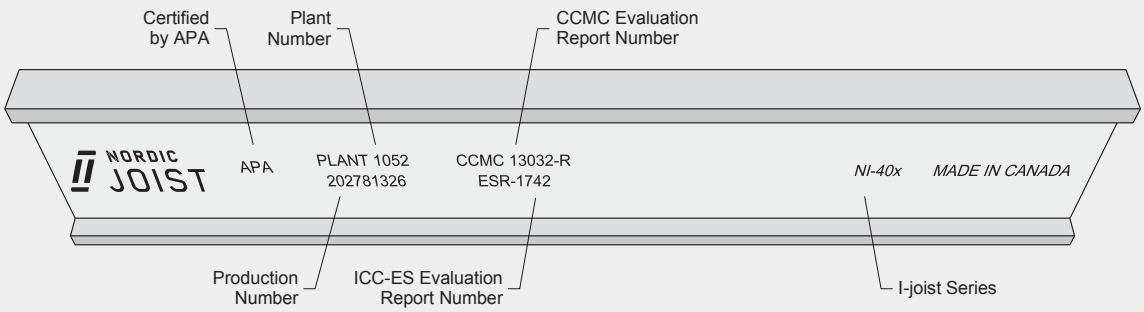


COMMERCIAL SERIES

NI-80x
2×4 2100f MSR, 7/16 in. web
Depths
18, 20, 22 and 24 in.



Check availability of products with your local distributor.



Nordic Joist – Specification Guide

Specifications

Scope – Prefabricated wood I-joists shall be used in dry service conditions, such as in most covered structures, where the average equilibrium moisture content of solid sawn lumber is less than 16 percent. Prefabricated wood I-joists are intended to resist the effects of moisture on structural performance as may occur due to construction delays or other conditions of similar severity.

Master format 06 17 33.01

REFERENCE STANDARD

.1 ASTM D5055, Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists.

INFORMATION SUBMITTALS

.1 Submit the product report published by a certification agency accredited by the International Accreditation Service.

STRUCTURAL ELEMENTS

.1 I-joists : to ASTM D5055, [FSC certified]

INSTALLATION

.1 Install I-joists in accordance with manufacturer's installation guide and applicable building code.

Short Form

I-joists specification contents:

1. Nordic Joist
2. Depth (9-1/2", 11-7/8", 14" or 16")
   On special order (18", 20", 22" or 24")
3. Series (NI-40x, NI-60, NI-80 or NI-90)
   On special order (NI-80x)
4. Addition information – (if necessary)
   Examples: Joist lengths required, quantity, etc.

Nordic Joist – Advantages

Nordic I-joists: The Strong and Reliable Type

Vertical Integration – Our vision is built on the founding principles of responsible forestry practices, consistent quality and reliable service. The company harvests its own trees, optimizing fiber and ensuring quality throughout the manufacturing process. Each phase, from the forest to the finished product, reflects our commitment to quality. Lastly, Nordic Structures offers a range of technical and engineering services.

Forestry Operations – The company has achieved Forest Stewardship Council (FSC) forest management certification, confirming that the forest is being managed in a way that preserves the natural ecosystem and benefits the lives of local people and workers, all while ensuring it sustains economical viability.

Black Spruce – Nordic I-joists are made from sawn lumber from the spruce-pine-fir (S-P-F) species combination, but mainly black spruce (scientific name: *Picea mariana*), providing consistent quality and superior strength. Black spruce is known for its narrow growth rings, exceptional density and fiber strength.

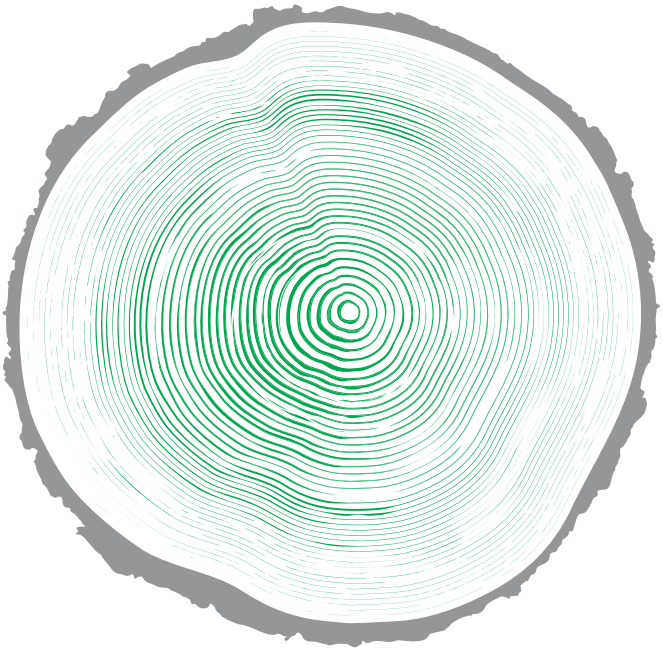
Sawn Lumber – The manufacturing process includes scanning lumber to identify species, grade and moisture content, as well as to eliminate defects such as wane, warp and splits, resulting in uniform quality material. The flanges are made from short-length end-jointed lumber, minimizing deviations and ensuring straightness.

OSB Web – The web is made of oriented strand board (OSB) conforming to DOC PS 2, Wood-Based Structural-Use Panels. The glue bond characteristics meet the requirements of the Exposure 1 grade, i.e. a bond classification for panels suitable for uses not permanently exposed to the weather.

Adhesives – Polyurethane adhesives are in accordance with ASTM D5055, i.e. for use under exterior exposure conditions and that have demonstrated heat durability performance. A tension test on each flange and quality control tests ensure the structural integrity of the joints.

Quality Control – Production controls, in-line tests, physical tests as well as rigorous manufacturing and product inspections at specific intervals contribute to the production of the highest quality product. Our compliance with quality control practices is more than a formality.

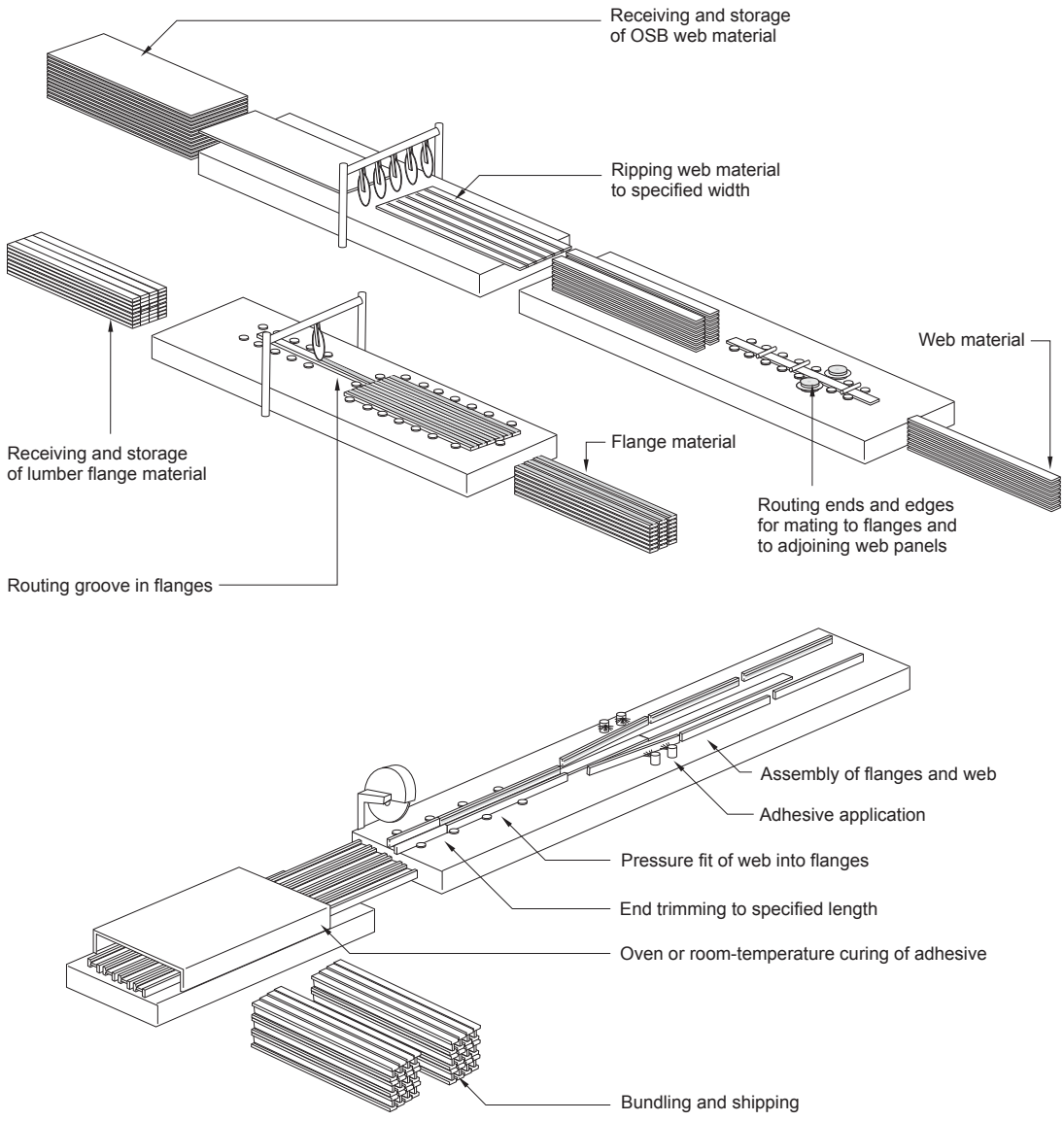
Certifications – Nordic products are certified by APA and are subject to regular audits by APA in accordance with the quality assurance program, to verify conformance to industry standards for lumber grade and glue bond quality. In addition, Nordic I-joists have been evaluated by CCMC and ICC-ES, among others.



Black spruce (*Picea mariana*)

Nordic Joist – Manufacture

Wood I-joists are proprietary products and the method of manufacture varies somewhat from one manufacturer to another. A general representation of the manufacturing process is shown in the figure below.



Based on: Wood Reference Handbook, Canadian Wood Council

Nordic Joist – Flexibility, Stability, Quality

Nordic I-joists are the ideal choice for designers and builders who want to provide their customers with high quality floor systems. They provide consistent performance for the most demanding residential applications.

Simple to Install – I-joists save builders time, and therefore money. I-joists are typically pre-cut in two-foot increments of length and shipped to the jobsite ready to install. This minimizes jobsite cutting and material waste. I-joists can be cut and fastened with traditional framing tools and fasteners – no special tools are required. Since I-joists can typically be used at greater joist spacings compared to lumber, fewer pieces must be cut and handled on the job site, making I-joist installation less costly and less wasteful for the builder.

Design Flexibility – The availability of long lengths allows multiple span installations thus speeding construction by eliminating the need to lap joists over bearing walls or support beams. This also means fewer pieces to handle. The availability of long lengths and relatively deep joists also gives designers the freedom to create more open spaces and reduces the need for supporting walls, columns, or beams.

Dimensionally Stable – I-joists will not warp, twist, or shrink, and are more uniform in their dimensions than sawn lumber joists. The L/480 maximum live load deflection criteria of I-joists combined with their straightness and uniformity provides a stiffer, more uniform floor with fewer squeaks, resulting in higher customer satisfaction.

Lightweight – Because I-joists typically weigh less than half of comparable conventional framing lumber, they can be installed quickly and efficiently.

Web Holes – The wood structural panel webs in I-joists permit holes or openings to be easily cut on the jobsite to permit the passage of electrical wiring, plumbing and ductwork. With sawn lumber joists, such mechanical systems often must be passed under the joist system.

APA Quality Assured – The APA trademark ensures superior I-joist quality and consistent performance. All products are subject to the proven quality assurance program of APA.

Resource-friendly – Wood I-joists use up to 50% less wood fiber in their production than conventional lumber joists, allowing more efficient use of our natural resources.

Nordic Joist – Certifications

Product Certifications
Nordic Joist wood I-joists, certified by APA – The Engineered Wood Association (apawood.org), are manufactured in accordance with the applicable standards and associated specifications indicated below:

- ASTM D5055, Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists
- PRI-400, Performance Standard for APA EWS I-Joists
- ICC-ES–APA Joint Evaluation Report ESR-1742
- APA Product Report PR-L274

APA is a not-for-profit trade association and is accredited by the ANSI National Accreditation Board (ANAB) as an inspection agency under ISO/IEC 17020 and as a testing laboratory under ISO/IEC 17025.

The ASTM D5055 standard is recognized in the International Building Code (IBC) and is required for using the design provisions specified in the National Design Specification (NDS) for Wood Construction.

Green Certifications
Wood – efficient and ecological
Overview of environmental certifications:

- Green Verification Report APA GR-L274
- Low Formaldehyde Emissions Products APA PR-E730
- Environmental Product Declaration (EPD), NA I-Joists
- Health Product Declaration (HPD), Nordic Joist
- Declare (ILFI), Nordic Joist
- Home Innovation NGBS Green Certified, Certificate #00198
- USDA Certified Biobased Product, Product 99%
- FSC-certified products available

Note: For independently verified ICC 700 NGBS (National Green Building Standard) and LEED (Leadership in Energy and Environmental Design) points, refer to APA GR-L274.

System Certifications
Numerous fire-rated assemblies or systems incorporate I-joists, wood structural panels and/or rim board. These assemblies or systems are illustrated in the following documents:

- APA PR-S274, Fire-Rated Assemblies (Nordic Structures)
- APA D350, APA Rim Board in Fire-Rated Assemblies
- 2018 International Building Code, Table 721.1(3)

Product Warranty
Nordic Structures guarantees that, in accordance with its specifications, Nordic products are free from manufacturing defects in material and workmanship. Furthermore, Nordic Structures warrants that their products, when utilized in accordance with the installation guide, will meet or exceed their specifications for the lifetime of the structure.

See nordic.ca for details.

Nordic Joist – Transparency Brief

The North American wood I-joists business-to-business environmental product declaration (EPD) is based on a cradle-to-gate life cycle analysis (LCA). The delivery of the product to the customer, its use and eventual end-of-life processing are excluded from the EPD.

Product Definition
Wood I-joists are manufactured by first manufacturing lumber that is used as top and bottom flanges, as well as oriented strand board that is used as the web. The wood components are then cut to specified dimensions, a joint is grooved into the flanges, and the components are then glued and pressed.

Lifecycle Impact Categories
The environmental impacts listed below were assessed throughout the product's lifecycle – including raw material extraction, transportation, manufacturing, packaging, use, and disposal at end of life.

Functional Unit – The declared unit is 10 linear meters of wood I-joist. This is equivalent to 32.81 linear feet. The average density of North American I-joist including resins and excluding moisture content is 36.44 oven dry kg. Results are expressed for a cradle-to-gate analysis and exclude use phase and end of life impacts.

Environmental impacts

Atmosphere		
	Global warming potential	16.74 kg CO_2 eq.
	Ozone depletion potential	0 kg CFC-11 eq.
	Photochemical ozone creation potential	0.28 kg O_3 eq.
Water		
	Acidification potential	8.64 H+ moles eq.
	Eutrophication potential	0.0071 kg N eq.
Earth		
	Depletion of abiotic resources (Elements)	---
	Depletion of abiotic resources (Fossil Fuels)	---

Material content

Component	Availability	Mass (%)
Wood (on oven dry basis)	Renewable	96.01 %
Resins (phenol formaldehyde)	Fossil resource, limited	2.65 %
Resins (methylene diphenyl diisocyanate (MDI))	Fossil resource, limited	0.43 %
Resins (phenol resorcinol formaldehyde (PRF))	Fossil resource, limited	0.13 %
Resins (polyurethane)	Fossil resource, limited	0.09 %
Wax		0.67 %
Filler		0.02 %
Total		100 %

Source: American Wood Council / Canadian Wood Council, North American Wood I-Joists EPD (Environmental Product Declaration) Transparency Summary

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TECHNICAL GUIDE
NORDIC JOIST

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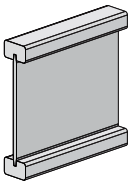
STRUCTURE 2

NORDIC
STRUCTURES

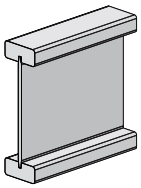
Nordic Joist – Design Properties

Products



NI-40x
2×3 1950f MSR
3/8 in. web
Depths
9-1/2, 11-7/8
and 14 in.
33 pieces per unit

NI-60
2×3 2100f MSR
3/8 in. web
Depths
9-1/2, 11-7/8,
14 and 16 in.
33 pieces per unit



NI-80
2×4 2100f MSR
3/8 in. web
Depths
9-1/2, 11-7/8,
14 and 16 in.
23 pieces per unit

NI-90
2×4 2400f MSR
7/16 in. web
Depths
11-7/8, 14
and 16 in.
23 pieces per unit

Refer to Chapter 5 for I-joists designed for light-commercial applications.

Design Properties

Joist depth	Joist series	EI [a]	M [b]	V [c]	3-1/2" Bearing		5-1/2" Bearing		1-3/4" Bearing		4" Bearing		K [f]	Weight
					IR [d]	IR [d] w/ BS	IR [d]	IR [d] w/ BS	ER [e]	ER [e] w/ BS	ER [e]	ER [e] w/ BS		
		(10^6 lbf-in.^{2})	(lbf-ft)	(lbf)	(lbf)	(lbf)	(lbf)	(lbf)	(lbf)	(lbf)	(lbf)	(lbf)	(10^6 lbf)	(plf)
9-1/2"	NI-40x	218	2,900	1,200	2,410	2,425	2,630	2,645	1,175	1,200	1,200	1,200	4.94	2.65
	NI-60	231	3,810	1,200	2,415	2,440	2,635	2,665	1,175	1,200	1,200	1,200	4.94	2.78
	NI-80	324	5,385	1,200	2,415	2,670	2,685	2,685	1,200	1,200	1,200	1,200	4.94	3.27
11-7/8"	NI-40x	371	3,760	1,480	3,000	3,030	3,540	3,575	1,275	1,480	1,480	1,480	6.18	2.85
	NI-60	396	4,935	1,570	3,005	3,070	3,550	3,625	1,275	1,480	1,550	1,570	6.18	2.99
	NI-80	547	6,980	1,590	3,005	3,330	3,670	3,670	1,350	1,590	1,550	1,590	6.18	3.45
	NI-90	601	8,780	1,925	3,355	3,355	3,670	3,670	1,400	1,480	1,885	1,925	6.18	3.75
14"	NI-40x	540	4,530	1,750	3,130	3,160	3,530	3,565	1,325	1,690	1,550	1,750	7.28	3.00
	NI-60	584	5,945	1,750	3,140	3,260	3,540	3,795	1,345	1,690	1,550	1,750	7.28	3.15
	NI-80	802	8,405	1,835	3,330	3,640	3,820	4,075	1,455	1,760	1,600	1,835	7.28	3.75
	NI-90	877	10,570	2,125	3,355	3,640	3,820	4,075	1,455	1,690	1,885	2,125	7.28	4.03
16"	NI-60	799	6,895	2,000	3,265	3,440	3,530	3,955	1,410	1,875	1,550	2,000	8.32	3.46
	NI-80	1,092	9,745	2,070	3,640	3,930	3,960	4,455	1,550	1,915	1,600	2,070	8.32	3.95
	NI-90	1,187	12,260	2,330	3,640	3,930	3,960	4,455	1,550	1,875	1,885	2,330	8.32	4.27

a) Bending stiffness, EI, of the I-joist.
b) Bending moment capacity, M, of the I-joist.
c) Shear capacity, V, of the I-joist.
d) Intermediate reaction capacity, IR, of the I-joist with and without bearing stiffeners (BS). Minimum bearing length shall be 3-1/2 inches for intermediate bearings. Interpolation of the resistance between 3-1/2-inch and 5-1/2-inch bearing is permitted.
e) End reaction capacity, ER, of the I-joist with and without bearing stiffeners (BS). Minimum bearing length shall be 1-3/4 inch for end bearings. Interpolation of the resistance between 1-3/4-inch and 4-inch bearing is permitted.
f) Coefficient of shear deflection, K. For calculating uniform load and center-point load deflections of the I-joist in a simple-span application, use equations (1) and (2).

Notes:
1. The tabulated design values are for normal duration of loading (C_D = 1.0).
2. The vertical (bearing) linear load capacity is 2,000 lbf/ft without bearing stiffeners.
3. Design of I-joists shall be in accordance with the NDS.

(1) Uniform load: $$\delta = \frac{5w\ell^4}{384EI} + \frac{w\ell^2}{K}$$

(2) Center-point load: $$\delta = \frac{P\ell^3}{48EI} + \frac{2P\ell}{K}$$

Where:
δ = calculated deflection (in.)
ℓ = design span (in.)
EI = bending stiffness of the I-joist (lbf-in.^{2})
K = coefficient of shear deflection (lbf)
w = uniform load (lbf/in.)
P = concentrated load (lbf)

Allowable Floor Spans

Design Criteria

Loads:	Live load = 40 psf and dead load = 10 psf
Deflection limit:	L/240 under total load
Sheathing:	APA Rated Sheathing or APA Rated Sturd-I-Floor, nailed-glued

Allowable Floor Spans

Live load deflection limit of L/480

Joist depth	Joist series	Simple span On center spacing				Multiple spans On center spacing			
		12"	16"	19.2"	24"	12"	16"	19.2"	24"
9-1/2"	NI-40x	18'-8"	17'-0"	16'-1"	15'-0"	20'-4"	18'-5"	16'-10"	15'-0"
	NI-60	18'-11"	17'-4"	16'-4"	15'-3"	20'-8"	18'-10"	17'-9"	16'-7"
	NI-80	20'-11"	19'-1"	18'-0"	16'-9"	22'-9"	20'-9"	19'-6"	18'-2"
11-7/8"	NI-40x	22'-2"	20'-3"	19'-2"	17'-2"	24'-2"	21'-0"	19'-2"	17'-1"
	NI-60	22'-8"	20'-8"	19'-6"	18'-2"	24'-8"	22'-6"	21'-2"	19'-8"
	NI-80	24'-11"	22'-8"	21'-4"	19'-11"	27'-1"	24'-8"	23'-3"	21'-7"
	NI-90	25'-7"	23'-4"	21'-11"	20'-5"	27'-11"	25'-4"	23'-10"	22'-2"
14"	NI-40x	25'-2"	22'-11"	21'-2"	18'-11"	26'-8"	23'-1"	21'-1"	18'-10"
	NI-60	25'-9"	23'-6"	22'-2"	20'-8"	28'-0"	25'-7"	24'-1"	21'-7"
	NI-80	28'-3"	25'-9"	24'-3"	22'-7"	30'-10"	28'-0"	26'-5"	24'-6"
	NI-90	29'-0"	26'-5"	24'-11"	23'-2"	31'-8"	28'-9"	27'-1"	25'-2"
16"	NI-60	28'-6"	26'-0"	24'-7"	22'-10"	31'-1"	28'-4"	26'-0"	23'-3"
	NI-80	31'-4"	28'-6"	26'-10"	25'-0"	34'-2"	31'-1"	29'-3"	27'-2"
	NI-90	32'-1"	29'-3"	27'-6"	25'-7"	35'-0"	31'-10"	29'-11"	27'-10"

Live load deflection limit of L/360

Joist depth	Joist series	Simple span On center spacing				Multiple spans On center spacing			
		12"	16"	19.2"	24"	12"	16"	19.2"	24"
9-1/2"	NI-40x	20'-7"	18'-6"	16'-11"	15'-1"	21'-4"	18'-5"	16'-10"	15'-0"
	NI-60	21'-0"	19'-2"	18'-1"	16'-11"	22'-10"	20'-10"	19'-4"	17'-3"
	NI-80	23'-2"	21'-1"	19'-11"	18'-7"	25'-3"	23'-0"	21'-8"	19'-0"
11-7/8"	NI-40x	24'-5"	21'-1"	19'-3"	17'-2"	24'-4"	21'-0"	19'-2"	17'-1"
	NI-60	25'-0"	22'-10"	21'-7"	19'-9"	27'-3"	24'-1"	22'-0"	19'-8"
	NI-80	27'-6"	25'-1"	23'-8"	22'-1"	30'-0"	27'-4"	25'-9"	23'-5"
	NI-90	28'-4"	25'-10"	24'-4"	22'-8"	30'-11"	28'-1"	26'-6"	24'-8"
14"	NI-40x	26'-9"	23'-2"	21'-2"	18'-11"	26'-8"	23'-1"	21'-1"	18'-10"
	NI-60	28'-5"	26'-0"	24'-3"	21'-8"	30'-7"	26'-6"	24'-2"	21'-7"
	NI-80	31'-3"	28'-6"	26'-10"	25'-0"	34'-1"	31'-1"	28'-9"	25'-9"
	NI-90	32'-1"	29'-3"	27'-7"	25'-8"	35'-0"	31'-11"	30'-0"	26'-7"
16"	NI-60	31'-6"	28'-7"	26'-1"	23'-4"	33'-0"	28'-7"	26'-0"	23'-3"
	NI-80	34'-8"	31'-7"	29'-9"	27'-9"	37'-9"	34'-0"	31'-0"	27'-8"
	NI-90	35'-6"	32'-4"	30'-6"	28'-5"	38'-9"	35'-3"	33'-3"	28'-11"

Notes:

1. The tabulated clear spans are applicable to residential floor construction meeting the above design criteria and are based on a sheathing thickness of 19/32 inch (40/20 or 20 oc) for a joist spacing of 19.2 inches or less and on a sheathing thickness of 23/32 inch (48/24 or 24 oc) for a joist spacing of 24 inches.
2. For multiple-span applications, the end spans shall be 40% or more of the adjacent span.
3. Minimum bearing length shall be 1-3/4 inch for end bearings and 3-1/2 inches for intermediate bearings.
4. Bearing stiffeners are not required when I-joists are used in accordance with this table, except as required for hangers.

Design Criteria

Loads:	Live load = 40 psf and dead load = 20 psf
Deflection limit:	L/360 under total load
Sheathing:	APA Rated Sheathing or APA Rated Sturd-I-Floor, nailed-glued

Allowable Floor Spans

Live load deflection limit of L/600

Joist depth	Joist series	Simple span On center spacing				Multiple spans On center spacing			
		12"	16"	19.2"	24"	12"	16"	19.2"	24"
9-1/2"	NI-40x	17'-3"	15'-9"	14'-10"	13'-9"	18'-9"	16'-10"	15'-4"	13'-8"
	NI-60	17'-6"	16'-0"	15'-1"	14'-0"	19'-1"	17'-4"	16'-4"	15'-3"
	NI-80	19'-4"	17'-7"	16'-7"	15'-5"	21'-0"	19'-1"	18'-0"	15'-9"
11-7/8"	NI-40x	20'-6"	18'-9"	17'-7"	15'-8"	22'-2"	19'-2"	17'-6"	15'-7"
	NI-60	20'-11"	19'-1"	18'-0"	16'-9"	22'-9"	20'-9"	19'-6"	17'-11"
	NI-80	23'-0"	20'-11"	19'-8"	18'-4"	25'-0"	22'-9"	21'-5"	19'-10"
	NI-90	23'-8"	21'-6"	20'-3"	18'-10"	25'-9"	23'-4"	22'-0"	20'-5"
14"	NI-40x	23'-3"	21'-2"	19'-3"	17'-3"	24'-4"	21'-1"	19'-3"	17'-2"
	NI-60	23'-9"	21'-8"	20'-5"	19'-0"	25'-11"	23'-7"	22'-0"	19'-8"
	NI-80	26'-1"	23'-9"	22'-4"	20'-9"	28'-5"	25'-10"	24'-4"	22'-0"
	NI-90	26'-10"	24'-5"	22'-11"	21'-4"	29'-2"	26'-6"	24'-11"	22'-2"
16"	NI-60	26'-4"	24'-0"	22'-8"	21'-1"	28'-9"	26'-0"	23'-9"	21'-3"
	NI-80	28'-11"	26'-4"	24'-9"	23'-0"	31'-6"	28'-8"	26'-11"	24'-1"
	NI-90	29'-8"	27'-0"	25'-5"	23'-7"	32'-4"	29'-4"	27'-7"	24'-1"

Live load deflection limit of L/480

Joist depth	Joist series	Simple span On center spacing				Multiple spans On center spacing			
		12"	16"	19.2"	24"	12"	16"	19.2"	24"
9-1/2"	NI-40x	17'-11"	16'-4"	15'-5"	13'-9"	19'-5"	16'-10"	15'-4"	13'-8"
	NI-60	18'-2"	16'-7"	15'-8"	14'-7"	19'-9"	18'-0"	17'-0"	15'-9"
	NI-80	20'-1"	18'-3"	17'-2"	16'-0"	21'-10"	19'-10"	18'-8"	15'-9"
11-7/8"	NI-40x	21'-4"	19'-3"	17'-7"	15'-8"	22'-2"	19'-2"	17'-6"	15'-7"
	NI-60	21'-8"	19'-10"	18'-8"	17'-5"	23'-8"	21'-7"	20'-1"	17'-11"
	NI-80	23'-10"	21'-9"	20'-6"	19'-0"	26'-0"	23'-8"	22'-3"	19'-10"
	NI-90	24'-7"	22'-4"	21'-0"	19'-7"	26'-9"	24'-3"	22'-10"	21'-3"
14"	NI-40x	24'-1"	21'-2"	19'-3"	17'-3"	24'-4"	21'-1"	19'-3"	17'-2"
	NI-60	24'-8"	22'-6"	21'-3"	19'-9"	26'-11"	24'-2"	22'-0"	19'-8"
	NI-80	27'-1"	24'-8"	23'-3"	21'-7"	29'-6"	26'-10"	25'-3"	22'-0"
	NI-90	27'-10"	25'-4"	23'-10"	22'-2"	30'-4"	27'-7"	25'-11"	22'-2"
16"	NI-60	27'-4"	24'-11"	23'-6"	21'-4"	29'-10"	26'-0"	23'-9"	21'-3"
	NI-80	30'-0"	27'-4"	25'-9"	23'-11"	32'-9"	29'-9"	28'-0"	24'-1"
	NI-90	30'-10"	28'-0"	26'-5"	24'-6"	33'-7"	30'-6"	28'-8"	24'-1"

Notes:

1. The tabulated clear spans are applicable to residential floor construction meeting the above design criteria and are based on a sheathing thickness of 19/32 inch (40/20 or 20 oc) for a joist spacing of 19.2 inches or less and on a sheathing thickness of 23/32 inch (48/24 or 24 oc) for a joist spacing of 24 inches.
2. For multiple-span applications, the end spans shall be 40% or more of the adjacent span.
3. Minimum bearing length shall be 1-3/4 inch for end bearings and 3-1/2 inches for intermediate bearings.
4. Bearing stiffeners are not required when I-joists are used in accordance with this table, except as required for hangers.

Allowable Roof Spans

Design Criteria

Span:	Simple
Load:	Dead load = 15 psf
Deflection limits:	L/240 under snow load
	L/180 under total load

Allowable Roof Spans

Snow load = 20 psf

Joist depth	Joist series	Slope of 1/4:12 to 4:12 On center spacing			Slope of >4:12 to 8:12 On center spacing			Slope of >8:12 to 12:12 On center spacing		
		12"	16"	24"	12"	16"	24"	12"	16"	24"
9-1/2"	NI-40x	25'-4"	23'-0"	19'-2"	23'-10"	21'-7"	18'-7"	22'-0"	19'-11"	17'-4"
	NI-60	25'-10"	23'-5"	20'-4"	24'-3"	22'-0"	19'-1"	22'-5"	20'-4"	17'-8"
	NI-80	28'-11"	26'-2"	22'-9"	27'-2"	24'-7"	21'-5"	25'-1"	22'-9"	19'-9"
11-7/8"	NI-40x	30'-4"	26'-9"	21'-10"	28'-6"	25'-10"	21'-2"	26'-3"	23'-10"	20'-4"
	NI-60	31'-0"	28'-1"	24'-5"	29'-1"	26'-4"	22'-11"	26'-10"	24'-4"	21'-2"
	NI-80	34'-6"	31'-3"	27'-2"	32'-5"	29'-4"	25'-6"	29'-11"	27'-1"	23'-7"
	NI-90	35'-7"	32'-3"	28'-0"	33'-5"	30'-3"	26'-4"	30'-10"	27'-11"	24'-4"
14"	NI-40x	34'-0"	29'-5"	24'-0"	32'-3"	28'-6"	23'-3"	29'-10"	27'-0"	22'-4"
	NI-60	35'-3"	32'-0"	27'-6"	33'-2"	30'-0"	26'-2"	30'-7"	27'-9"	24'-2"
	NI-80	39'-2"	35'-6"	30'-10"	36'-10"	33'-4"	29'-0"	34'-0"	30'-10"	26'-10"
	NI-90	40'-4"	36'-7"	31'-9"	37'-11"	34'-4"	29'-11"	35'-0"	31'-9"	27'-7"
16"	NI-60	39'-2"	35'-6"	29'-7"	36'-10"	33'-4"	28'-9"	34'-0"	30'-10"	26'-10"
	NI-80	43'-6"	39'-5"	34'-3"	40'-10"	37'-0"	32'-2"	37'-8"	34'-2"	29'-9"
	NI-90	44'-8"	40'-6"	35'-2"	42'-0"	38'-1"	33'-1"	38'-9"	35'-2"	30'-7"

Snow load = 30 psf

Joist depth	Joist series	Slope of 1/4:12 to 4:12 On center spacing			Slope of >4:12 to 8:12 On center spacing			Slope of >8:12 to 12:12 On center spacing		
		12"	16"	24"	12"	16"	24"	12"	16"	24"
9-1/2"	NI-40x	23'-4"	20'-9"	16'-11"	22'-0"	19'-11"	16'-6"	20'-5"	18'-6"	16'-0"
	NI-60	23'-9"	21'-6"	18'-8"	22'-5"	20'-4"	17'-8"	20'-10"	18'-10"	16'-5"
	NI-80	26'-7"	24'-0"	20'-10"	25'-1"	22'-8"	19'-9"	23'-3"	21'-1"	18'-4"
11-7/8"	NI-40x	27'-4"	23'-8"	19'-3"	26'-3"	23'-1"	18'-10"	24'-5"	22'-1"	18'-3"
	NI-60	28'-6"	25'-9"	22'-1"	26'-10"	24'-4"	21'-2"	24'-11"	22'-7"	19'-8"
	NI-80	31'-8"	28'-8"	24'-11"	29'-11"	27'-1"	23'-6"	27'-9"	25'-2"	21'-10"
	NI-90	32'-8"	29'-7"	25'-8"	30'-10"	27'-11"	24'-3"	28'-8"	25'-11"	22'-7"
14"	NI-40x	30'-0"	26'-0"	21'-2"	29'-4"	25'-4"	20'-8"	27'-8"	24'-7"	20'-0"
	NI-60	32'-5"	29'-5"	24'-3"	30'-7"	27'-9"	23'-9"	28'-5"	25'-9"	22'-5"
	NI-80	36'-0"	32'-7"	28'-4"	34'-0"	30'-10"	26'-9"	31'-7"	28'-7"	24'-11"
	NI-90	37'-1"	33'-7"	29'-2"	35'-0"	31'-9"	27'-7"	32'-6"	29'-6"	25'-7"
16"	NI-60	36'-0"	32'-1"	26'-2"	34'-0"	30'-10"	25'-7"	31'-7"	28'-7"	24'-9"
	NI-80	39'-11"	36'-2"	31'-2"	37'-8"	34'-2"	29'-8"	35'-0"	31'-9"	27'-7"
	NI-90	41'-1"	37'-2"	32'-4"	38'-9"	35'-1"	30'-6"	36'-0"	32'-7"	28'-4"

Notes:

1. The tabulated spans are based on the horizontal distance between inside face of supports and are applicable to residential roof construction meeting the above design criteria.
2. Minimum bearing length shall be 1-3/4 inch for end bearings and 3-1/2 inches for intermediate bearings.
3. Bearing stiffeners are not required when I-joists are used in accordance with this table, except as required for hangers.

Design Criteria

Span:	Simple
Load:	Dead load = 15 psf
Deflection limits:	L/240 under snow load
	L/180 under total load

Allowable Roof Spans

Snow load = 40 psf

Joist depth	Joist series	Slope of 1/4:12 to 4:12 On center spacing			Slope of >4:12 to 8:12 On center spacing			Slope of >8:12 to 12:12 On center spacing		
		12"	16"	24"	12"	16"	24"	12"	16"	24"
9-1/2"	NI-40x	21'-9"	18'-9"	15'-4"	20'-7"	18'-5"	15'-0"	19'-2"	17'-5"	14'-7"
	NI-60	22'-2"	20'-1"	17'-5"	21'-0"	19'-0"	16'-6"	19'-7"	17'-9"	15'-5"
	NI-80	24'-10"	22'-5"	19'-6"	23'-6"	21'-3"	18'-5"	21'-11"	19'-10"	17'-3"
11-7/8"	NI-40x	24'-9"	21'-5"	17'-6"	24'-3"	21'-0"	17'-1"	22'-11"	20'-5"	16'-8"
	NI-60	26'-7"	24'-1"	20'-0"	25'-2"	22'-10"	19'-8"	23'-5"	21'-3"	18'-6"
	NI-80	29'-7"	26'-9"	23'-3"	28'-0"	25'-4"	22'-0"	26'-1"	23'-8"	20'-7"
	NI-90	30'-6"	27'-7"	24'-0"	28'-11"	26'-2"	22'-9"	26'-11"	24'-5"	21'-2"
14"	NI-40x	27'-2"	23'-6"	19'-2"	26'-8"	23'-1"	18'-10"	25'-11"	22'-5"	18'-4"
	NI-60	30'-4"	27'-0"	22'-0"	28'-8"	26'-0"	21'-7"	26'-9"	24'-3"	21'-0"
	NI-80	33'-8"	30'-6"	26'-2"	31'-10"	28'-10"	25'-1"	29'-8"	26'-11"	23'-5"
	NI-90	34'-8"	31'-4"	27'-3"	32'-10"	29'-9"	25'-10"	30'-7"	27'-9"	24'-1"
16"	NI-60	33'-7"	29'-1"	23'-8"	31'-10"	28'-6"	23'-3"	29'-8"	26'-11"	22'-7"
	NI-80	37'-4"	33'-10"	28'-2"	35'-4"	32'-0"	27'-8"	32'-11"	29'-10"	25'-11"
	NI-90	38'-4"	34'-9"	30'-2"	36'-4"	32'-11"	28'-7"	33'-10"	30'-8"	26'-8"

Snow load = 50 psf

Joist depth	Joist series	Slope of 1/4:12 to 4:12 On center spacing			Slope of >4:12 to 8:12 On center spacing			Slope of >8:12 to 12:12 On center spacing		
		12"	16"	24"	12"	16"	24"	12"	16"	24"
9-1/2"	NI-40x	20'-0"	17'-3"	14'-1"	19'-6"	17'-0"	13'-10"	18'-3"	16'-6"	13'-6"
	NI-60	20'-10"	18'-10"	16'-2"	19'-11"	18'-0"	15'-7"	18'-7"	16'-10"	14'-7"
	NI-80	23'-4"	21'-1"	18'-3"	22'-3"	20'-1"	17'-5"	20'-9"	18'-10"	16'-4"
11-7/8"	NI-40x	22'-9"	19'-9"	16'-1"	22'-5"	19'-5"	15'-10"	21'-10"	18'-11"	15'-5"
	NI-60	25'-0"	22'-7"	18'-5"	23'-10"	21'-7"	18'-1"	22'-3"	20'-2"	17'-6"
	NI-80	27'-10"	25'-2"	21'-10"	26'-6"	24'-0"	20'-10"	24'-9"	22'-5"	19'-6"
	NI-90	28'-8"	25'-11"	22'-6"	27'-4"	24'-9"	21'-6"	25'-7"	23'-2"	20'-1"
14"	NI-40x	25'-0"	21'-8"	17'-8"	24'-7"	21'-3"	17'-4"	24'-1"	20'-10"	17'-0"
	NI-60	28'-6"	24'-10"	20'-3"	27'-2"	24'-5"	19'-11"	25'-5"	23'-0"	19'-5"
	NI-80	31'-8"	28'-8"	24'-1"	30'-2"	27'-4"	23'-8"	28'-2"	25'-6"	22'-2"
	NI-90	32'-7"	29'-6"	25'-7"	31'-1"	28'-1"	24'-5"	29'-0"	26'-4"	22'-10"
16"	NI-60	30'-11"	26'-9"	21'-10"	30'-2"	26'-4"	21'-5"	28'-2"	25'-7"	21'-0"
	NI-80	35'-1"	31'-9"	25'-11"	33'-6"	30'-4"	25'-6"	31'-3"	28'-4"	24'-7"
	NI-90	36'-1"	32'-8"	28'-4"	34'-5"	31'-2"	27'-0"	32'-2"	29'-2"	25'-4"

Notes:

1. The tabulated spans are based on the horizontal distance between inside face of supports and are applicable to residential roof construction meeting the above design criteria.
2. Minimum bearing length shall be 1-3/4 inch for end bearings and 3-1/2 inches for intermediate bearings.
3. Bearing stiffeners are not required when I-joists are used in accordance with this table, except as required for hangers.

Allowable Uniform Loads

Allowable Uniform Floor Loads (plf)

Joist depth	Joist series	Criteria	Clear span (ft)											
			8	10	12	14	16	18	20	22	24	26	28	30
9-1/2"	NI-40x	Live load (L/480)			116	76	52	37	28	21	16	13	10	-
		Total load (L/240)	233	187	155	114	88	69	56	42	33	26	21	17
	NI-60	Live load (L/480)			122	80	55	39	29	22	17	13	11	-
		Total load (L/240)	233	187	157	135	111	79	59	44	34	27	22	18
	NI-80	Live load (L/480)				108	75	54	40	30	24	19	15	12
		Total load (L/240)	233	187	157	135	118	105	81	61	48	38	30	25
11-7/8"	NI-40x	Live load (L/480)			189	125	87	62	46	35	27	22	17	14
		Total load (L/240)	288	231	193	148	114	90	73	60	51	43	35	29
	NI-60	Live load (L/480)				132	92	66	49	37	29	23	18	15
		Total load (L/240)	288	231	193	166	146	118	96	75	59	46	37	30
	NI-80	Live load (L/480)					122	88	66	51	39	31	25	21
		Total load (L/240)	288	231	193	166	146	129	117	102	79	63	51	42
	NI-90	Live load (L/480)				187	132	96	72	55	43	34	28	23
		Total load (L/240)	326	262	219	188	165	147	132	111	87	69	56	46
14"	NI-40x	Live load (L/480)					123	89	66	51	39	31	25	20
		Total load (L/240)	304	245	204	176	137	109	88	73	61	52	45	39
	NI-60	Live load (L/480)					132	96	71	54	42	34	27	22
		Total load (L/240)	305	245	205	176	154	137	116	96	81	68	55	45
	NI-80	Live load (L/480)						126	95	73	57	45	37	30
		Total load (L/240)	324	260	218	187	164	146	131	119	109	91	74	61
	NI-90	Live load (L/480)						136	102	79	62	49	40	33
		Total load (L/240)	326	262	219	188	165	147	132	120	110	99	80	66
16"	NI-60	Live load (L/480)						128	96	74	57	46	37	30
		Total load (L/240)	317	255	213	183	161	143	129	111	94	80	69	60
	NI-80	Live load (L/480)							126	97	76	61	49	41
		Total load (L/240)	354	284	238	204	179	159	144	131	120	111	97	82
	NI-90	Live load (L/480)							135	105	82	66	53	44
		Total load (L/240)	354	284	238	204	179	159	144	131	120	111	103	88

Notes:

1. The tabulated values may be used for simple or multiple spans.
2. For multiple-span applications, the end spans shall be 40% or more of the adjacent span.
3. I-joist shall satisfy both live load and total load. Where the live load is blank, the total load governs the design.
4. I-joist shall be laterally supported at points of bearing and along all compression edges.
5. Minimum bearing length shall be 1-3/4 inch for end bearings and 3-1/2 inches for intermediate bearings.
6. Bearing stiffeners are not required when I-joists are used in accordance with this table, except as required for hangers.
7. The tabulated values take into account a live load deflection limit of L/480 and a total load deflection limit of L/240. Final design shall include a complete analysis including the verification of the bending moment and shear capacities.
8. For a live load deflection limit of L/360, multiply live load values by 1.33.
9. For double joists, double the table values and nail joists together per detail 1p.

Allowable Uniform Roof Loads (plf)

Joist depth	Joist series	Criteria	Clear span (ft)											
			8	10	12	14	16	18	20	22	24	26	28	30
9-1/2"	NI-40x	Snow load (L/240)						75	56	42	33	26	21	17
		Total load (L/180)	268	216	178	131	101	80	65	54	44	34	28	22
	NI-60	Snow load (L/240)					111	79	59	44	34	27	22	18
		Total load (L/180)	268	216	180	155	133	105	78	59	46	36	29	24
	NI-80	Snow load (L/240)						108	81	61	48	38	30	25
		Total load (L/180)	268	216	180	155	136	121	108	82	64	51	41	33
11-7/8"	NI-40x	Snow load (L/240)									55	44	35	29
		Total load (L/180)	331	266	222	171	131	104	84	70	58	50	43	37
	NI-60	Snow load (L/240)						133	99	75	59	46	37	30
		Total load (L/180)	331	266	222	191	167	136	111	91	77	62	50	41
	NI-80	Snow load (L/240)							133	102	79	63	51	42
		Total load (L/180)	331	266	222	191	167	149	134	122	106	84	68	56
	NI-90	Snow load (L/240)							144	111	87	69	56	46
		Total load (L/180)	375	302	252	217	190	169	152	138	116	92	74	61
14"	NI-40x	Snow load (L/240)											51	41
		Total load (L/180)	350	281	235	202	158	125	101	84	71	60	52	45
	NI-60	Snow load (L/240)								109	85	68	55	45
		Total load (L/180)	351	282	236	203	178	158	133	110	93	79	68	59
	NI-80	Snow load (L/240)									115	91	74	61
		Total load (L/180)	372	299	250	215	188	168	151	137	126	112	97	81
	NI-90	Snow load (L/240)									124	99	80	66
		Total load (L/180)	375	302	252	217	190	169	152	138	127	117	107	88
16"	NI-60	Snow load (L/240)											74	61
		Total load (L/180)	365	293	245	211	185	164	148	128	108	92	79	69
	NI-80	Snow load (L/240)										123	99	82
		Total load (L/180)	407	327	274	235	206	183	165	150	138	127	112	98
	NI-90	Snow load (L/240)											107	88
		Total load (L/180)	407	327	274	235	206	183	165	150	138	127	118	110

Notes:

1. The tabulated values may be used for simple or multiple spans.
2. For multiple-span applications, the end spans shall be 40% or more of the adjacent span.
3. I-joist shall satisfy both snow load and total load. Where the snow load is blank, the total load governs the design.
4. I-joist shall be laterally supported at points of bearing and along all compression edges.
5. Minimum bearing length shall be 1-3/4 inch for end bearings and 3-1/2 inches for intermediate bearings.
6. Bearing stiffeners are not required when I-joists are used in accordance with this table, except as required for hangers.
7. The tabulated values take into account a snow load deflection limit of L/240 and a total load deflection limit of L/180. Final design shall include a complete analysis including the verification of the bending moment and shear capacities.
8. For a snow load deflection limit of L/360, multiply snow load values by 0.67.
9. For double joists, double the table values and nail joists together per detail 1p.
10. For sloped roofs, the horizontal clear span must be multiplied by the corresponding slope adjustment factor:

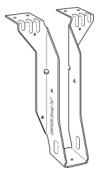
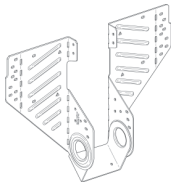
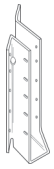
Roof slope adjustment factor

Slope	1:12	2:12	3:12	4:12	5:12	6:12	7:12	8:12	9:12	10:12	11:12	12:12
Ajustment factor	1.003	1.014	1.031	1.054	1.083	1.118	1.158	1.202	1.250	1.302	1.357	1.414

Hangers – Simpson Strong-Tie

Hangers – Simpson Strong-Tie

Capacities (lbf) – Single joist

Joist		Single joist – Face mount				Single joist – Top mount			
									
Series	Depth	Hanger	Fastener		Capacity (lbf)	Hanger	Fastener		Capacity (lbf)
			Header	Joist			Header	Joist	
NI-40x NI-60	9-1/2"	IUS2.56/9.5	10d	-	815	ITS2.56/9.5	10d	-	1,045
	11-7/8"	IUS2.56/11.88	10d	-	1,020	ITS2.56/11.88	10d	-	1,150
	14"	IUS2.56/14	10d	-	1,220	ITS2.56/14	10d	-	1,150
	16"	IUS2.56/16	10d	-	1,390	ITS2.56/16	10d	-	1,150
NI-80 NI-90	9-1/2"	IUS3.56/9.5	10d	-	1,020	ITS3.56/9.5	10d	-	1,150
	11-7/8"	IUS3.56/11.88	10d	-	1,220	ITS3.56/11.88	10d	-	1,150
	14"	IUS3.56/14	10d	-	1,220	ITS3.56/14	10d	-	1,150
	16"	IUS3.56/16	10d	-	1,425	ITS3.56/16	10d	-	1,150
Joist		Single joist – Slopeable & skewable				Single joist – 45° skew			
									
Series	Depth	Hanger	Fastener		Capacity (lbf)	Hanger	Fastener		Capacity (lbf)
			Header	Joist			Header	Joist	
NI-40x NI-60	9-1/2"	LSSR2.56Z [a, b]	10d x 2-1/2	10d x 1-1/2	950	SUR/L2.56/9	16d	10d x 1-1/2	1,090
	11-7/8"	LSSR2.56Z [a, b]	10d x 2-1/2	10d x 1-1/2	950	SUR/L2.56/11	16d	10d x 1-1/2	1,355
	14"	LSSR2.56Z [a, b]	10d x 2-1/2	10d x 1-1/2	950	SUR/L2.56/14	16d	10d x 1-1/2	1,470
	16"	Refer to Simpson Strong-Tie's literature				SUR/L2.56/14	16d	10d x 1-1/2	1,935
NI-80 NI-90	9-1/2"	LSSR410Z [a, b]	16d x 2-1/2	16d x 2-1/2	1,200	SUR/L410	16d	16d	1,200
	11-7/8"	LSSR410Z [a, b]	16d x 2-1/2	16d x 2-1/2	1,480	SUR/L410	16d	16d	1,480
	14"	LSSR410Z [a, b]	16d x 2-1/2	16d x 2-1/2	1,555	SUR/L414	16d	16d	1,705
	16"	Refer to Simpson Strong-Tie's literature				SUR/L414	16d	16d	1,910

a) The LSSR requires web stiffeners that are 4-inch wide and attached with four nails each side.

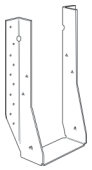
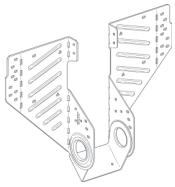
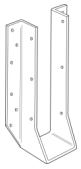
b) LSSR nails and loads shown are for skewed rafter condition. Refer to Simpson Strong-Tie's literature for nailing options with higher loads.

Notes:

1. Shaded hangers require web stiffeners at joist ends.
2. The capacity values are for Nordic Lam or S-P-F sawn lumber headers, downward loads, and normal duration of loading.
3. Fill all round, dimple, and positive-angle nail holes.
4. Leave 1/16 inch (1/8 inch maximum) clearance between the end of the supported joist and the header or hanger.
5. To verify hanger suitability for a specific application and for additional information, refer to Simpson Strong-Tie's literature.

Hangers – Simpson Strong-Tie

Capacities (lbf) – Double joist

Joist		Double joist – Face mount				Double joist – Top mount			
									
Series	Depth	Hanger	Fastener		Capacity (lbf)	Hanger	Fastener		Capacity (lbf)
			Header	Joist			Header	Joist	
NI-40x NI-60	9-1/2"	MIU5.12/9	16d	10d x 1-1/2	1,980	MIT39.5-2	16d	10d x 1-1/2	1,665
	11-7/8"	MIU5.12/11	16d	10d x 1-1/2	2,475	MIT311.88-2	16d	10d x 1-1/2	1,665
	14"	MIU5.12/14	16d	10d x 1-1/2	2,725	MIT314-2	16d	10d x 1-1/2	1,665
	16"	MIU5.12/16	16d	10d x 1-1/2	2,970	MIT5.12/16	16d	10d x 1-1/2	1,665
NI-80 NI-90	9-1/2"	HU410-2	16d	16d	2,305	BA7.12/9.5	16d	10d x 1-1/2	2,400
	11-7/8"	HU412-2	16d	16d	2,815	BA7.12/11.88	16d	10d x 1-1/2	2,960
	14"	HU414-2	16d	16d	3,330	BA7.12/14	16d	10d x 1-1/2	3,425
	16"	HU414-2	16d	16d	3,330	BA7.12/16	16d	10d x 1-1/2	3,855
Joist		Double joist – Slopeable & skewable				Double joist – 45° skew			
									
Series	Depth	Hanger	Fastener		Capacity (lbf)	Hanger	Fastener		Capacity (lbf)
			Header	Joist			Header	Joist	
NI-40x NI-60	9-1/2"	LSU5.12 [a]	16d	10d x 1-1/2	1,550	HSUR/L5.12/9	16d	10d x 1-1/2	1,535
	11-7/8"	LSU5.12 [a]	16d	10d x 1-1/2	1,550	HSUR/L5.12/11	16d	10d x 1-1/2	2,045
	14"	LSU5.12 [a]	16d	10d x 1-1/2	1,550	HSUR/L5.12/14	16d	10d x 1-1/2	2,560
	16"	Refer to Simpson Strong-Tie's literature				HSUR/L5.12/16	16d	10d x 1-1/2	2,865
NI-80 NI-90	9-1/2"	Refer to Simpson Strong-Tie's literature				HU410-2X [a]	16d	16d	1,845
	11-7/8"					HU412-2X [a]	16d	16d	2,250
	14"					HU414-2X [a]	16d	16d	2,665
	16"					HU414-2X [a]	16d	16d	2,665

a) Hanger is special order.

Notes:

1. Shaded hangers require web stiffeners at joist ends.
2. The capacity values are for Nordic Lam or S-P-F sawn lumber headers, downward loads, and normal duration of loading.
3. Fill all round, dimple, and positive-angle nail holes.
4. Leave 1/16 inch (1/8 inch maximum) clearance between the end of the supported joist and the header or hanger.
5. To verify hanger suitability for a specific application and for additional information, refer to Simpson Strong-Tie's literature.

Hangers – MiTek

Hangers – MiTek

Capacities (lbf) – Single joist

Joist		Single joist – Face mount				Single joist – Top mount			
									
Series	Depth	Hanger	Fastener		Capacity (lbf)	Hanger	Fastener		Capacity (lbf)
			Header	Joist			Header	Joist	
NI-40x NI-60	9-1/2"	THFI2595	10d	-	845	TFL2595	10d	10d x 1-1/2	1,215
	11-7/8"	THFI25118	10d	-	995	TFL25118	10d	10d x 1-1/2	1,215
	14"	THFI2514	10d	-	1,265	TFL2514	10d	10d x 1-1/2	1,215
	16"	IHFL2516	10d	-	1,455	TFL2516	10d	10d x 1-1/2	1,215
NI-80 NI-90	9-1/2"	IHFL35925	10d	-	1,040	THO35950	10d	10d x 1-1/2	2,370
	11-7/8"	IHFL35112	10d	-	1,040	THO35118	10d	10d x 1-1/2	2,265
	14"	IHFL3514	10d	-	1,245	THO35140	10d	10d x 1-1/2	1,835
	16"	IHFL3516	10d	-	1,455	THO35160	10d	10d x 1-1/2	1,835
Joist		Single joist – Slopeable & skewable				Single joist – 45° skew			
									
Series	Depth	Hanger	Fastener		Capacity (lbf)	Hanger	Fastener		Capacity (lbf)
			Header	Joist			Header	Joist	
NI-40x NI-60	9-1/2"	LSSH25-TZ	16d	10d x 1-1/2	1,260	SKH2520L/R	10d	10d x 1-1/2	1,380
	11-7/8"	LSSH25-TZ	16d	10d x 1-1/2	1,260	SKH2520L/R	10d	10d x 1-1/2	1,380
	14"	LSSH25-TZ	16d	10d x 1-1/2	1,260	SKH2524L/R	10d	10d x 1-1/2	1,635
	16"	LSSH25-TZ	16d	10d x 1-1/2	1,260	SKH2524L/R	10d	10d x 1-1/2	1,635
NI-80 NI-90	9-1/2"	LSSH35-TZ	16d	10d x 1-1/2	1,255	HD410_SK45L/R_BV [b]	16d	10d	1,895 [a]
	11-7/8"	LSSH35-TZ	16d	10d x 1-1/2	1,255	HD410_SK45L/R_BV [b]	16d	10d	1,895 [a]
	14"	LSSH35-TZ	16d	10d x 1-1/2	1,255	HD414_SK45L/R_BV [b]	16d	10d	2,440 [a]
	16"	LSSH35-TZ	16d	10d x 1-1/2	1,255	HD414_SK45L/R_BV [b]	16d	10d	2,440 [a]

a) Bevel cut required on end of joist to achieve design loads.

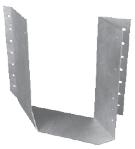
b) Hanger is special order.

Notes:

1. Shaded hangers require web stiffeners at joist ends.
2. The capacity values are for Nordic Lam or S-P-F sawn lumber headers, downward loads, and normal duration of loading.
3. Fill all round, dimple, and positive-angle nail holes.
4. Leave 1/16 inch (1/8 inch maximum) clearance between the end of the supported joist and the header or hanger.
5. To verify hanger suitability for a specific application and for additional information, refer to MiTek's literature.

Hangers – MiTek

Capacities (lbf) – Double joist

Joist		Double joist – Face mount				Double joist – Top mount			
									
Series	Depth	Hanger	Fastener		Capacity (lbf)	Hanger	Fastener		Capacity (lbf)
			Header	Joist			Header	Joist	
NI-40x NI-60	9-1/2"	IHF25925-2	10d	10d x 1-1/2	1,100	THO25950-2	16d	10d	2,790
	11-7/8"	IHF25112-2	10d	10d x 1-1/2	1,100	THO25118-2	16d	10d	2,790
	14"	THF25140-2	10d	10d	2,340	THO25140-2	16d	10d	3,390
	16"	THF25160-2	10d	10d	2,810	THO25160-2	16d	10d	3,390
NI-80 NI-90	9-1/2"	HD7100	16d	16d	1,895	BPH7195	16d	10d	2,370
	11-7/8"	HD7120	16d	16d	2,165	BPH71118	16d	10d	2,350
	14"	HD7140	16d	16d	2,710	BPH7114	16d	10d	2,350
	16"	HD7160	16d	10d	3,520	BPH7116	16d	10d	2,350
Joist		Double joist – Slopeable & skewable				Double joist – 45° skew			
		Refer to MiTek's literature							
Series	Depth	Hanger	Fastener		Capacity (lbf)	Hanger	Fastener		Capacity (lbf)
			Header	Joist			Header	Joist	
NI-40x NI-60	9-1/2"	Refer to MiTek's literature				SKH2520L/R-2	10d	10d	1,480 [a]
	11-7/8"					SKH2520L/R-2	10d	10d	1,480 [a]
	14"					SKH2524L/R-2	10d	10d	1,690 [a]
	16"					SKH2524L/R-2	10d	10d	1,690 [a]
NI-80 NI-90	9-1/2"	Refer to MiTek's literature				HD7100_SK45L/R_BV [b]	16d	16d	1,895 [a]
	11-7/8"					HD7120_SK45L/R_BV [b]	16d	16d	2,165 [a]
	14"					HD7140_SK45L/R_BV [b]	16d	16d	2,710 [a]
	16"					HD7160_SK45L/R_BV [b]	16d	10d	3,250 [a]

a) Bevel cut required on end of joist to achieve design loads.

b) Hanger is special order.

Notes:

1. Shaded hangers require web stiffeners at joist ends.
2. The capacity values are for Nordic Lam or S-P-F sawn lumber headers, downward loads, and normal duration of loading.
3. Fill all round, dimple, and positive-angle nail holes.
4. Leave 1/16 inch (1/8 inch maximum) clearance between the end of the supported joist and the header or hanger.
5. To verify hanger suitability for a specific application and for additional information, refer to MiTek's literature.

NORDIC

TECHNICAL GUIDE
NORDIC JOIST

NS-GT3

VERSION
2024-08-01

CONSTRUCTION DETAILS 3

NORDIC STRUCTURES

GENERAL NOTES

1.0 General

1.1 This document supersedes all previous versions. For the latest version, consult nordic.ca or contact Nordic Structures.

1.2 While this guide emphasizes residential construction, much of the basic design information can be used for other construction applications. Review by a design professional is required for applications beyond the scope of this document.

1.3 For more information, consult nordic.ca or contact Nordic Structures.

2.0 Structure

2.1 All nails shown in the details are assumed to be common nails unless otherwise noted. Refer to page 3.3 for diameters. Individual components not shown to scale for clarity.

2.2 Table 4 of APA Product Report PR-L274 shows the allowable lateral shear capacities of Nordic Joist Series I-joists in diaphragm applications.

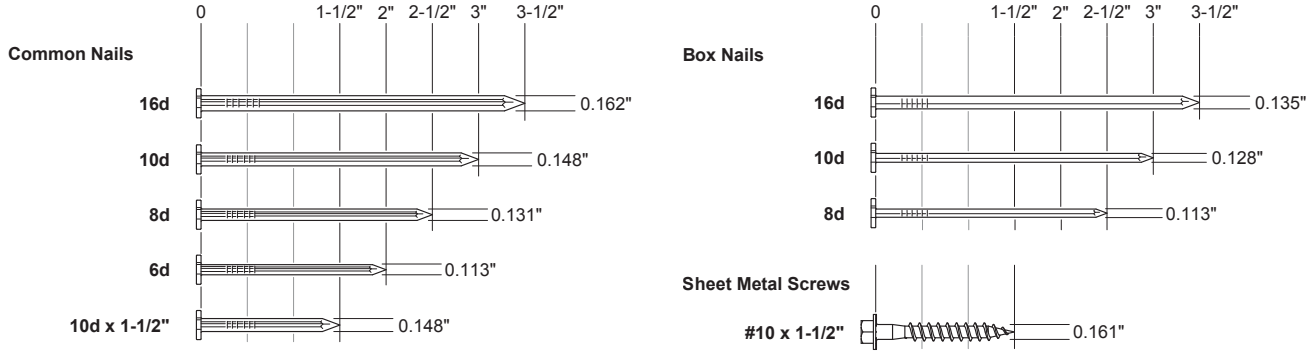
2.3 For APA Rim Board Plus specifications, see ANSI/APA PRR 410, Standard for Performance-rated Engineered Wood Rim Boards.

3.0 Fire Safety

3.1 For fire-rated assemblies and fire protection of floor assemblies, refer to Chapter 4.

3.2 I-joists are often used in conjunction with both steel and chlorinated polyvinyl chloride (CPVC) sprinkler systems. Details 9 provide some basic guidance on appropriate methods of attachment of steel and CPVC sprinkler systems to I-joists. All designs should be checked by a design professional to assure the adequacy of not only the hangers and fasteners used but the capacity of the I-joists themselves. For more information, refer to APA J745, Sprinkler Pipe Installation for APA Performance Rated I-Joists.

FASTENERS

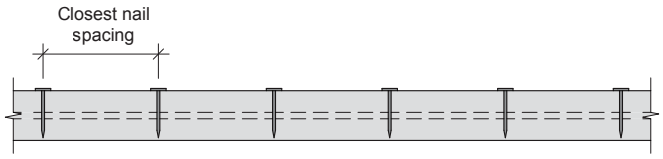


Note:

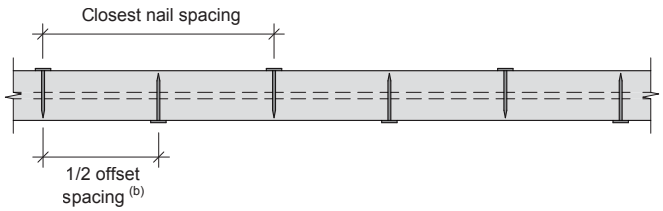
1. 10d box nails (0.128 x 3 inches) may be substituted for 8d common nails shown in details.

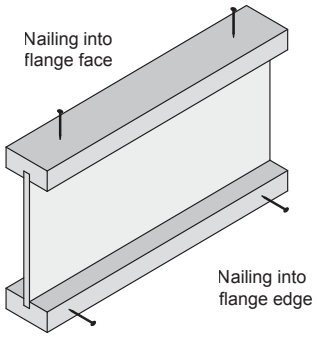
NAIL SPACING

Nailed to Only One Flange Edge (Top View)



Nailed to Both Flange Edges (Top View)





Recommended Closest Nail Spacing for Fastening Sheathing to I-joist Flanges to Minimize Splitting

Fastener size (diameter x length)	Flange face nailing (a)		Flange edge nailing (b)		
				Nail spacing (in.)	
	End distance (in.)	Nail spacing (in.)	End distance (in.)	Nailed to only one flange edge	Nailed to both flange edges
0.128" or smaller in diameter, and 3-1/4" or shorter in length (8d box or sinker, 10d box or sinker, or 12d box)	2	2	2	2	4
Greater than 0.128" up to 0.148" in diameter, and 3-1/4" or shorter in length (8d common, 10d common, 12d sinker or common, or 16d sinker)	2	3	2	3	6

(a) If more than one row is required, offset rows a minimum of 1/2 inch and stagger.
(b) Closest nail spacing measured from one flange edge. Nails on opposite flange edge must be offset one-half the minimum spacing.

INSTALLATION NOTES

Floor Systems

1. Installation of Nordic I-joists shall be as shown in details 1.
2. Except for cutting to length, I-joist flanges should never be cut, drilled or notched.
3. Install I-joists so that top and bottom flanges are within 1/2 inch of true vertical alignment.
4. Concentrated loads should only be applied to the top surface of the top flange. Concentrated loads should not be suspended from the bottom flange with the exception of light loads, such as ceiling fans or light fixtures.
5. I-joists must be protected from the weather prior to installation.
6. I-joists must not be used in applications where they will be permanently exposed to weather, or will reach a moisture content of 16 percent or greater, such as in swimming pool or hot tub areas. They must not be installed where they will remain in direct contact with concrete or masonry.
7. End bearing length must be at least 1-3/4 inch. For multiple-span joists, intermediate bearing length must be at least 3-1/2 inches.
8. Ends of floor joists shall be restrained to prevent rollover. Use rim board or I-joist blocking panels.
9. I-joists installed beneath bearing walls perpendicular to the joists shall have full-depth blocking panels, rim board, or squash blocks (cripple blocks) to transfer gravity loads from above the floor system to the wall or foundation below.
10. For I-joists installed directly beneath bearing walls parallel to the joists or used as rim board or blocking panels, the maximum allowable vertical load using a single I-joist is 2,000 plf, and 4,000 plf if double I-joists are used.
11. Continuous lateral support of the I-joist's compression flange is required to prevent rotation and buckling. In simple span uses, lateral support of the top flange is normally supplied by the floor sheathing. In multiple-span or cantilever applications, bracing of the I-joist's bottom flange is also required at interior supports of multiple-span joists, and at the end support next to the cantilever extension. The ends of all cantilever extensions must be laterally braced as shown in details 3, 4, or 5.
12. Nails installed in flange face or edge shall be spaced in accordance with the applicable building code requirements or approved building plans, but should not be closer than those specified on page 3.3.
13. Details 1 on the following pages show only I-joist-specific fastener requirements. For other fastener requirements, see the applicable building code.
14. For proper temporary bracing of wood I-joists and placement of temporary construction loads, see APA Technical Note: Temporary Construction Loads over I-Joist Roofs and Floors, Form J735.

Floor Performance

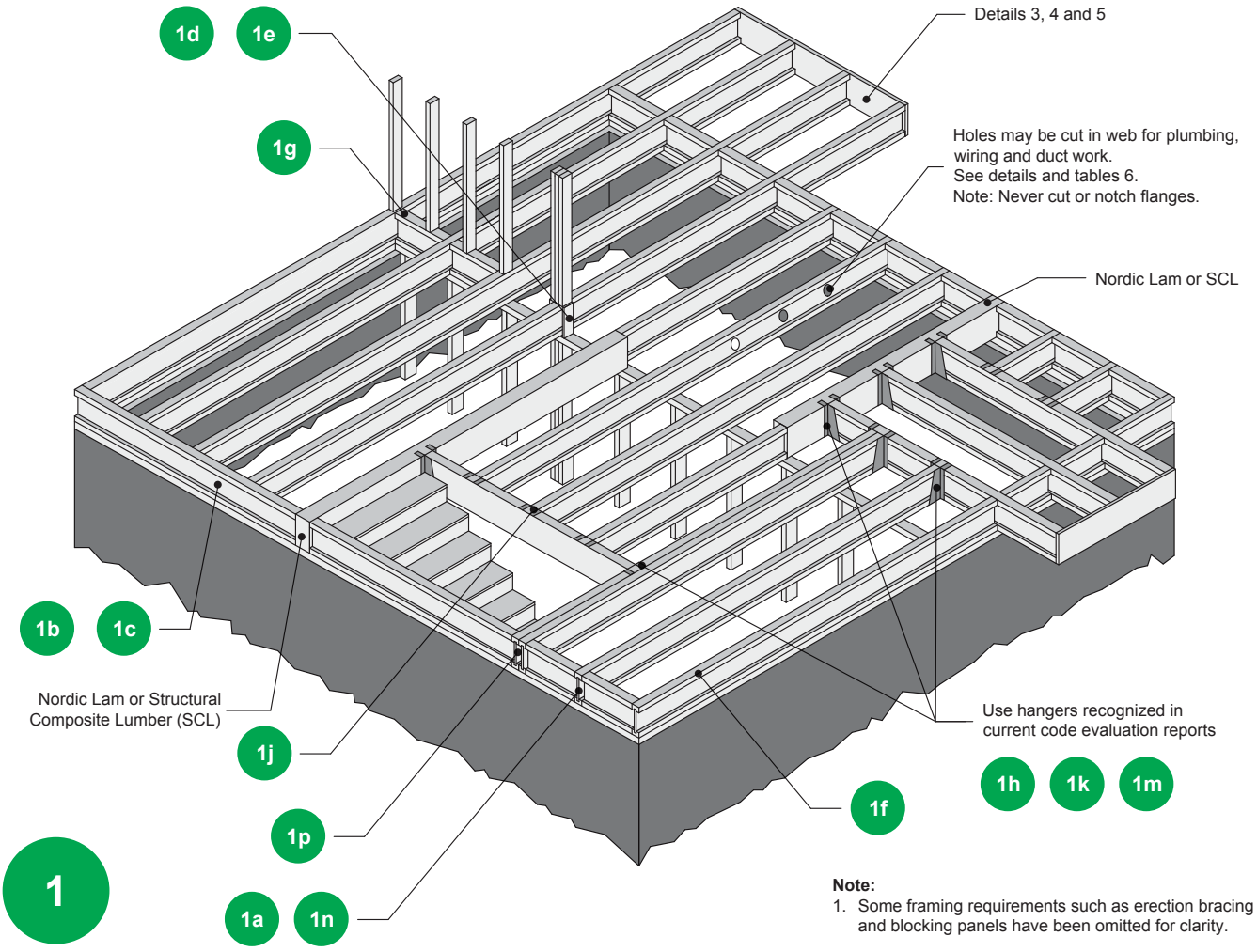
Researchers have proposed several methods that can be used to reduce floor vibration. These methods include:

- Gluing the wood structural panel floor to the joists.
- Attaching wood structural panels or gypsum board to the bottom of the floor joists.
- Decreasing the floor-joist spacing by one increment based on allowable floor span.
- Using full-depth blocking at regular intervals between all of the floor joists over the entire floor (detail 1r-1).

By far the most practical and most economical way to further increase the stiffness of your floor when using Nordic I joists is to select the most economical I-joist from our allowable span tables and then maintain the same joist designation but upgrade to the next depth.

For example: If a 9-1/2" NI-40x is selected for a given application, specifying an 11-7/8" NI-40x will provide an increase in stiffness of over 70%, resulting in an increased performance.

TYPICAL FLOOR FRAMING AND CONSTRUCTION DETAILS

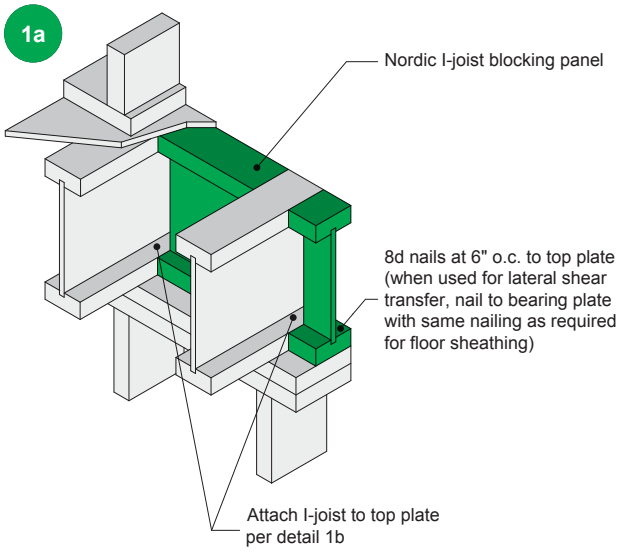


Note:
1. Some framing requirements such as erection bracing and blocking panels have been omitted for clarity.

FOR ALL
construction details →DC3

installation guide →GI31

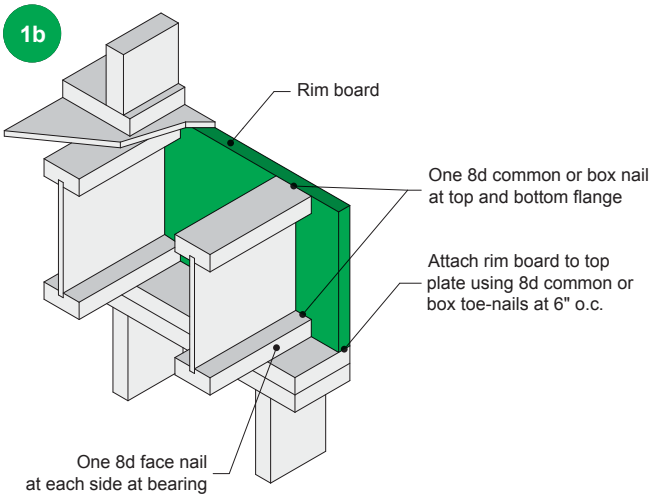
1a



Blocking panel and/or rim joist	Uniform vertical load transfer capacity (plf) [a]
Nordic I-joists	2,000

[a] The uniform vertical load transfer capacity is limited to a depth of 16 inches or less and shall not be increased for any load duration shorter than the normal (10-year) load duration. It shall not be used in the design of a bending member, such as joist, header, or rafter. For concentrated vertical load transfer capacity, see detail 1d.

1b



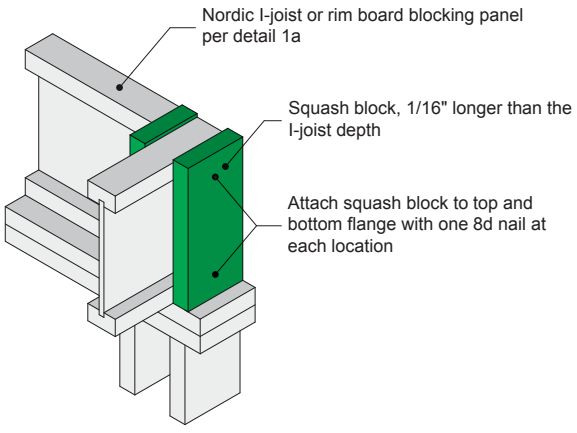
Blocking panel and/or rim joist	Uniform vertical load transfer capacity (plf) [a]
1-1/8" APA Rim Board Plus	4,850

[a] The uniform vertical load transfer capacity is limited to a depth of 16 inches or less and shall not be increased for any load duration shorter than the normal (10-year) load duration. It shall not be used in the design of a bending member, such as joist, header, or rafter. For concentrated vertical load transfer capacity, see detail 1d.

Note:

1. To avoid splitting flange, start nails at least 1-1/2 inch from end of I-joist. Nails may be driven at an angle to avoid splitting of bearing plate.

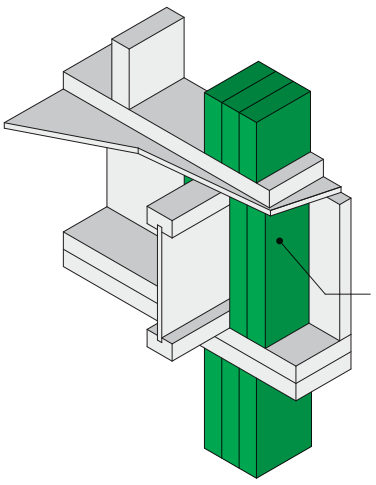
1d



Pair of squash blocks [a]	Vertical load transfer capacity (lbf)	
	3-1/2" wide	5-1/2" wide
2x lumber	3,800	5,900
1-1/8" APA Rim Board Plus	2,800	4,400

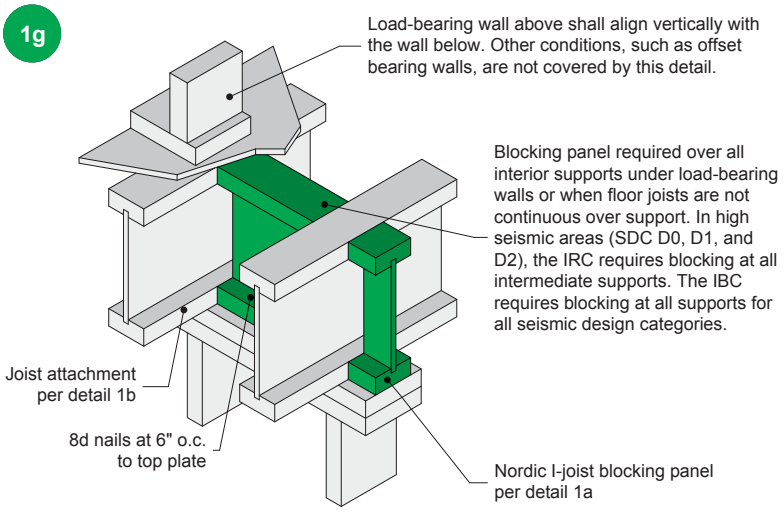
[a] The squash blocks are assumed to be in full bearing on the plate below.

1e



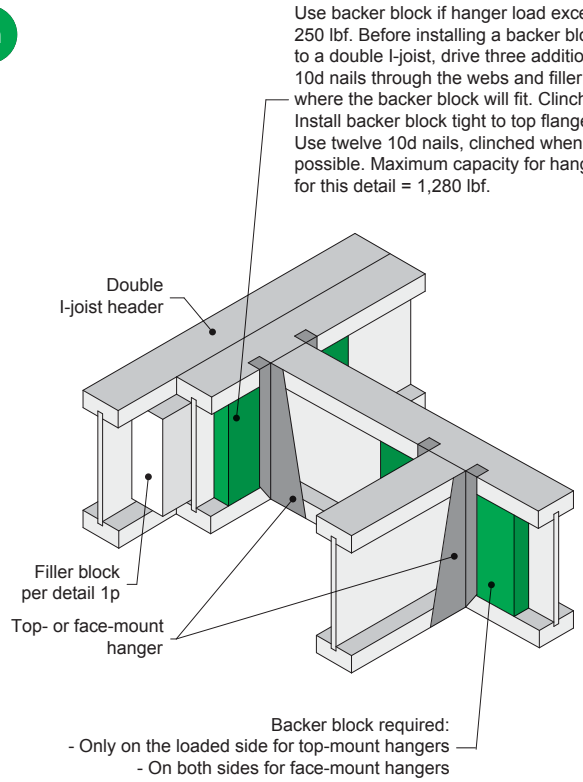
Transfer load from above to bearing below. Install squash blocks per detail 1d. Match bearing area of blocks below to post above. Stagger nails to avoid splitting.

1g



Notes:
1. An occasional blocking panel (one per line of blocking) may be left out for the passage of plumbing or ventilation ducts. For other applications, contact Nordic Structures.
2. For other options, see details 1g-1 to 1g-7.

1h

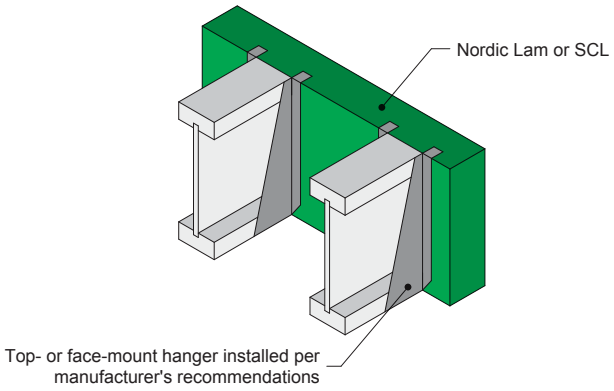


Flange width (in.)	Material thickness required (in.) [a]	Minimum depth (in.) [b]
2-1/2	1	5-1/2
3-1/2	1-1/2	7-1/4

[a] Minimum grade for backer block material shall be Utility grade S-P-F (south) or better for solid sawn lumber and Rated Sheathing grade for wood structural panels.
[b] For face-mount hangers use net joist depth minus 3-1/4 inches.

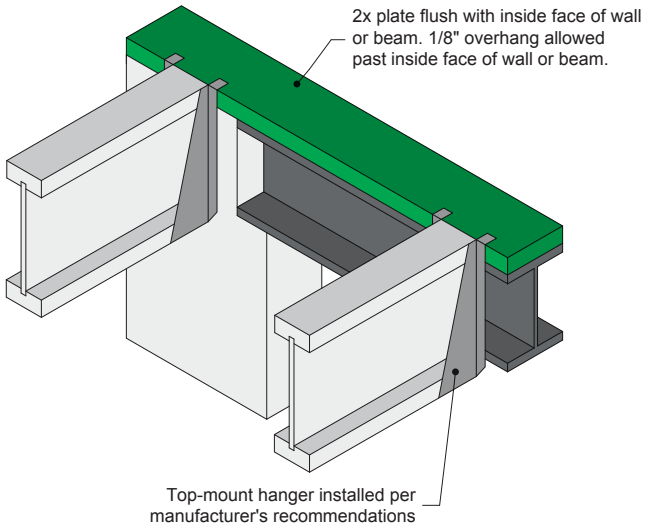
Notes:
1. Unless hanger sides laterally support the top flange, bearing stiffeners shall be used.
2. For hanger capacity, see manufacturer's recommendations.
3. Verify double I-joist capacity to support concentrated loads.
4. Backer blocks must be long enough to permit required nailing without splitting.
5. For other options, see details 1h-1 and 1h-2.

1j



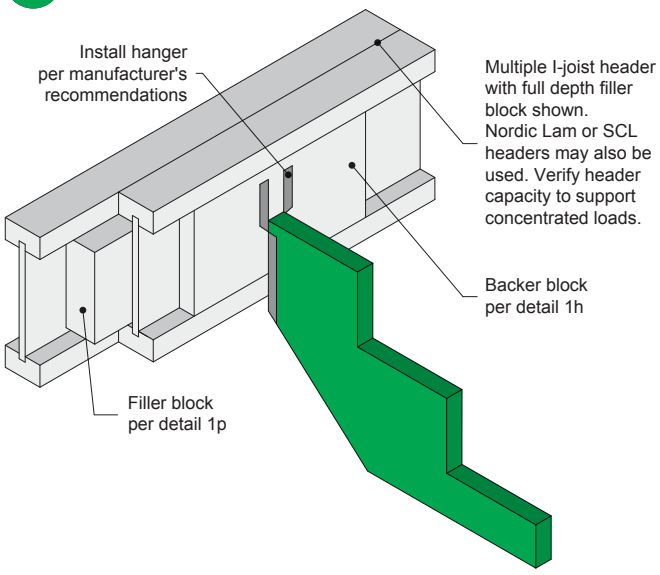
Notes:
1. Unless hanger sides laterally support the top flange, bearing stiffeners shall be used.
2. For nailing schedules for multiple Nordic Lam or SCL beams, see the manufacturer's recommendations.

1k



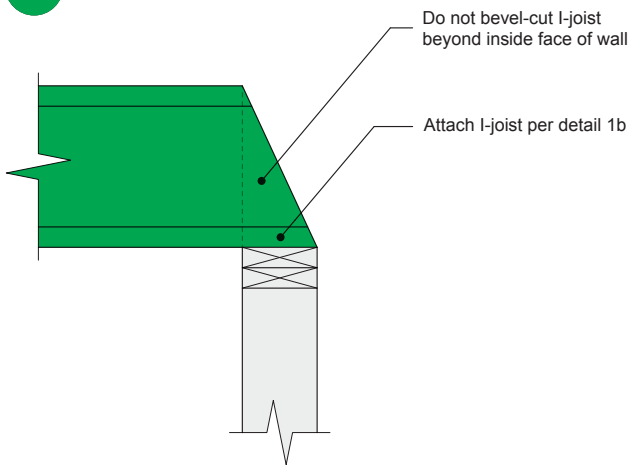
Note:
1. Unless hanger sides laterally support the top flange, bearing stiffeners shall be used.

1m



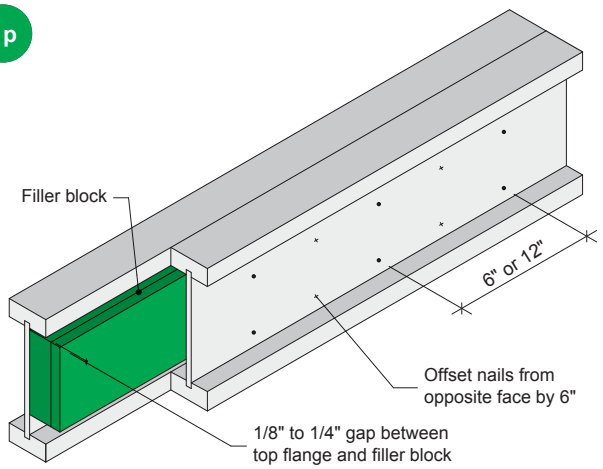
Note:
1. See detail 1h for maximum support capacity.

1n



Note:
1. Blocking required at bearing for lateral support, not shown for clarity.

1p



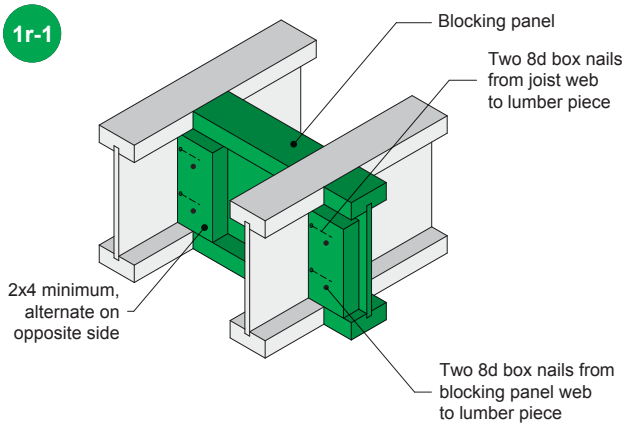
Filler Block Requirements for Double I-joist Construction

Flange width (in.)	Net depth (in.)	Filler block size (in.)	Example
2-1/2	9-1/2	2-1/8 to 2-1/4 x 6	2x6 + 5/8" or 3/4" sheathing
	11-7/8	2-1/8 to 2-1/4 x 8	2x8 + 5/8" or 3/4" sheathing
	14	2-1/8 to 2-1/4 x 10	2x10 + 5/8" or 3/4" sheathing
	16	2-1/8 to 2-1/4 x 12	2x12 + 5/8" or 3/4" sheathing
3-1/2	9-1/2	3 x 6	2 x 2x6
	11-7/8	3 x 8	2 x 2x8
	14	3 x 10	2 x 2x10
	16	3 x 12	2 x 2x12

Note:
1. The height of the filler block may be different from that specified in the table, as long as it allows nailing and respects the required gap.

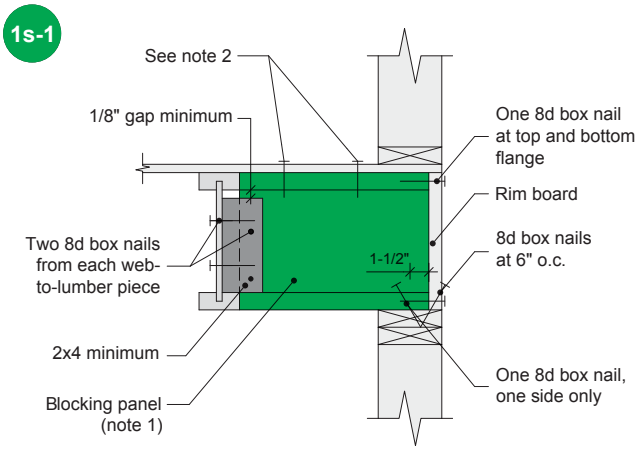
Notes:
1. Support back of I-joist web during nailing to prevent damage to web/flange connection.
2. Leave a 1/8-inch to 1/4-inch gap between top of filler block and bottom of top I-joist flange.
3. Filler block is required between joists for full length of span.
4. For flange width of 2-1/2 inches, nail joists together with two rows of 10d nails at 12 inches o.c. (clinched when possible) on each side of the double I-joist (total of four nails per foot). For flange width of 3-1/2 inches, use two rows of 10d nails at 6 inches o.c. on each side of the double I-joist (total of eight nails per foot).
5. The maximum load that may be applied to one side of the double I-joist using this detail is 620 lbf/ft.

1r-1



Notes:
1. This detail may be used to reduce floor vibration.
2. Blocking panels may be of any I-joist series. Box nails attaching lumber piece to I-joist web should be driven from the web side and clinched on the lumber side.
3. One occasional blocking panel may be left out for the passage of ventilation ducts. Otherwise, a hole of not more than 2/3 of the lesser dimension of the blocking depth or length may be drilled in the blocking panel.

1s-1



Notes:
1. In some local codes, blocking panels are prescriptively required in the first joist space (or first and second joist spaces) next to the starter joist. Where required, see local code requirements for spacing of the blocking panels. As a minimum, it is recommended to use blocking panels spaced at 4 feet on center.
2. Details shown are for minimum blocking attachment. Transfer of lateral loads may require additional fasteners. In such cases, nail size, spacing and specific design detailing shall be provided by the building designer.
3. Common nails of the same pennyweight may be substituted for the box nails shown above.
4. Where blocking panels are required between adjacent joists, the blocking panels may be staggered by approximatively 3 inches, and end-nailed as shown.
5. Box nails attaching lumber piece to I-joist web should be driven from the web side and clinched on the lumber side.

Installing the Nailed-glued Floor System

1. Wipe any mud, dirt, water, or ice from I-joist flanges before gluing.
2. Snap a chalk line across the I-joists four feet in from the wall for panel edge alignment and as a boundary for spreading glue.
3. Spread only enough glue to lay one or two panels at a time, or follow specific recommendations from the glue manufacturer.
4. Lay the first panel with tongue side to the wall, and nail in place. This protects the tongue of the next panel from damage when tapped into place with a block and sledgehammer.
5. Apply a continuous line of glue (about 1/4-inch diameter) to the top flange of a single I-joist. Apply glue in a winding pattern on wide areas, such as with double I-joists.
6. Apply two lines of glue on I-joists where panel ends butt to assure proper gluing of each end.
7. After the first row of panels is in place, spread glue in the groove of one or two panels at a time before laying the next row. Glue line may be continuous or spaced, but avoid squeeze-out by applying a thinner line (1/8 inch) than used on I-joist flanges.
8. Tap the second row of panels into place, using a block to protect groove edges.
9. Stagger end joints in each succeeding row of panels. A 1/8-inch space between all end joints and 1/8-inch at all edges, including T&G edges, is recommended. (Use a spacer tool or an 8d common nail to assure accurate and consistent spacing.)
10. Complete all nailing of each panel before glue sets. Check the manufacturer's recommendations for cure time. (Warm weather accelerates glue setting.) Use 6d ring- or screw-shank nails for panels 3/4-inch thick or less, and 8d ring- or screw-shank nails for thicker panels. Space nails per the table below. Closer nail spacing may be required by some codes, or for diaphragm construction. The finished deck can be walked on right away and will carry construction loads without damage to the glue bond.

APA Rated Sturd-I-Floor Fastener Schedules

Maximum joist spacing	Panel thickness [a]	Nail size and type [b]	Fastening: nailed-glued [c]	
			Maximum spacing	
			Edges	Intermediate supports
16"	23/32" [d]	6d ring-or screw-shank	12"	12"
19.2"	23/32" [d]	6d ring-or screw-shank	12"	12"
24"	23/32", 3/4"	6d ring-or screw-shank	12"	12"
	7/8"	8d ring-or screw-shank	6"	12"

a) Panels in a given thickness may be manufactured in more than one allowable span. Panels with an allowable span greater than the actual joist spacing may be substituted for panels of the same thickness with an allowable span matching the actual joist spacing. For example, 19/32-inch-thick Sturd-I-Floor 20 oc may be substituted for 19/32-inch-thick Sturd-I-Floor 16 oc over joists 16 inches on center.

b) 8d common nails may be substituted if ring- or screw-shank nails are not available.

c) Use only adhesives conforming to APA Specification AFG-01, or ASTM D3498 applied in accordance with the manufacturer's recommendations. If OSB panels with sealed surfaces and edges are to be used, use only solvent-based glues; check with panel manufacturer.

d) Recommended minimum thickness for use with I-joists.

Note:

1. Special conditions may impose heavy traffic and concentrated loads that require construction in excess of the minimums shown.

I-joist Web Stiffeners

A web stiffener is a wood block that is used to reinforce the web of an I-joist at locations where:

- The webs of the I-joist are in jeopardy of buckling out of plane. This usually occurs in deeper I-joists.
- The webs of the I-joist are in jeopardy of "knifing" through the I-joist flanges. This can occur at any I-joist depth when the design reaction loads exceed a specific level.
- The I-joist is supported in a hanger and the sides of the hanger do not extend up to the top flange. The web stiffener supports the I-joist along a vertical axis as designed.

There are two kinds of web stiffeners: ***bearing stiffeners*** and ***load stiffeners***. They are differentiated by the applied load and the location of the gap between the slightly undersized stiffener and the top or bottom flange. See detail 2.

Bearing stiffeners are located at the supports, both interior and end, when required. Nordic I-joists do not need bearing stiffeners at any support when subjected to the normal residential uniform loads and installed in accordance with the allowable spans printed in this document.

Load stiffeners are located between supports where significant point loads are applied to the top flange of an I-joist.

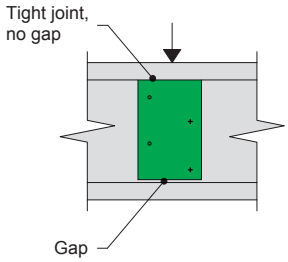
Web stiffener blocks may be comprised of lumber, rim board, or wood structural panels. The minimum grade of wood structural panels is Rated Sheathing; minimum lumber is Utility grade S-P-F (south) or better. The depth of the web stiffener should equal the distance between the flanges of the joist minus 1/8 inch – 1/4 inch.

Recommendations:

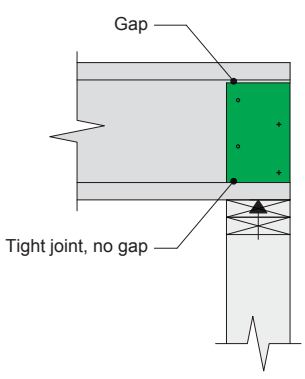
1. A ***bearing stiffener*** is required in all engineered applications with factored reactions greater than shown in the I-joist properties table on page 2.3. The gap between the stiffener and the flange is at the top.
2. A ***bearing stiffener*** is required when the I-joist is supported in a hanger and the sides of the hanger do not extend up to, and support, the top flange. The gap between the stiffener and flange is at the top.
3. A ***load stiffener*** is required at locations where a factored concentrated load greater than 1,500 lbf is applied to the top flange between supports, or in the case of a cantilever, anywhere between the cantilever tip and the support. These values are for normal duration of loading, and may be adjusted for other load durations as permitted by the code. The gap between the stiffener and the flange is at the bottom.

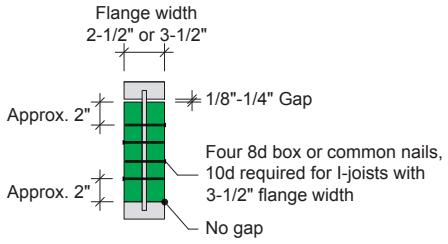
2

Concentrated Load
(Load Stiffener)



End Bearing
(Bearing Stiffener)





Stiffener Size Requirements

Flange width (in.)	Web stiffener size each side of web (in.)
2-1/2	1 x 2-5/16 Minimum width
3-1/2	1-1/2 x 2-5/16 Minimum width

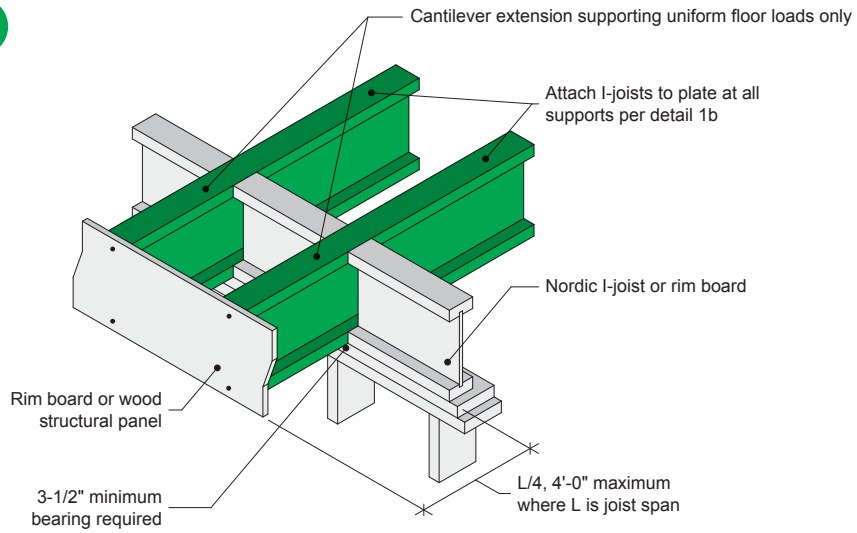
Cantilever Details for Balconies

Balconies may be constructed using either continuous Nordic I-joists (detail 3a) or by adding lumber extensions to the I-joist (detail 3b). Continuous I-joist cantilevers are limited to one-fourth the adjacent span when supporting uniform loads only. For applications supporting concentrated loads at the end of the cantilever, such as a wall, see details 4 and 5.

Unless otherwise engineered, cantilevers are limited to a maximum of 4 feet when supporting uniform loads only. Blocking panel is required at the cantilever support, as shown. Uniform floor loads shall not exceed 40 psf live load and 10 psf dead load. The balcony uniform load shall not exceed 60 psf live load and 10 psf dead load.

Caution: *Cantilevered balcony details address structural considerations only. Cantilevered balcony details for moisture control, weathering and durability are beyond the scope of this publication.*

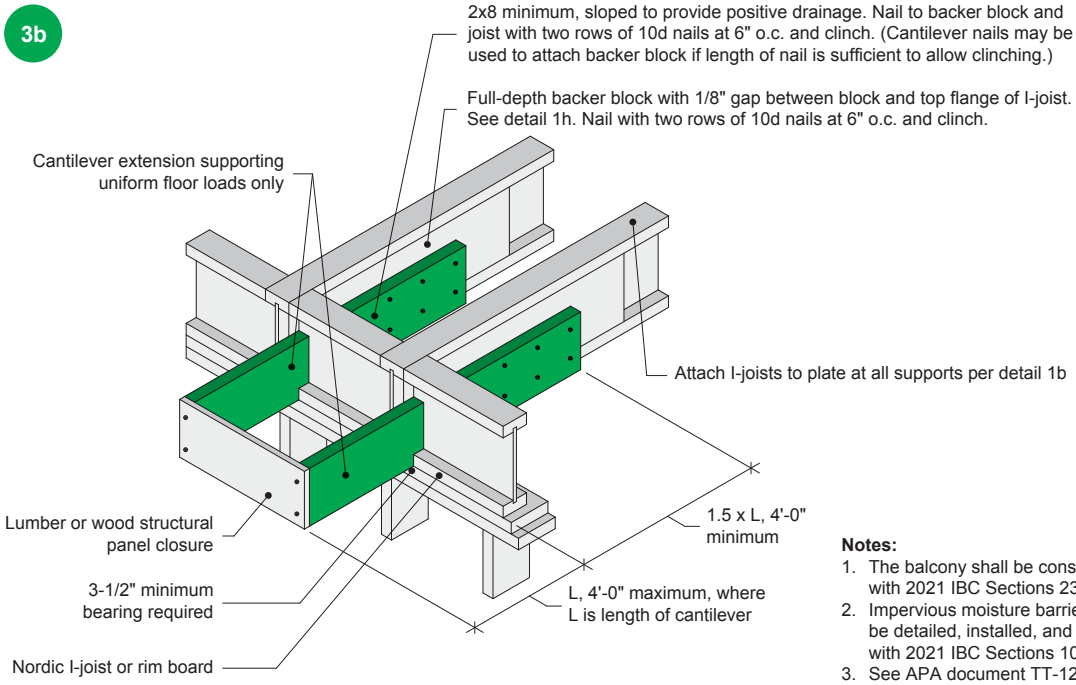
3a



Caution

Cantilevers formed this way are limited to interior balconies.

3b



Notes:

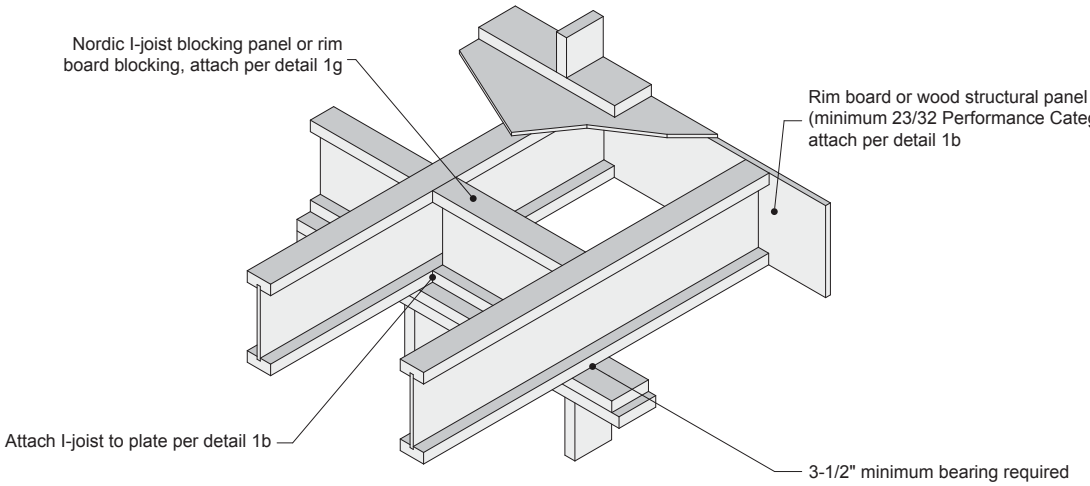
1. The balcony shall be constructed in accordance with 2021 IBC Sections 2304.12.2.4 and 2304.12.2.5.
2. Impervious moisture barrier systems, if required, shall be detailed, installed, and inspected in accordance with 2021 IBC Sections 107.2.5 and 110.3.7.
3. See APA document TT-125 for more information.

Cantilever Details for Vertical Building Offset

Nordic I-joists may also be used in cantilever applications supporting a uniform wall load applied to the end of the cantilever, such as with a vertical building offset. For cantilever-end load applications that require reinforcing based on table 4.1, the cantilever is limited to 2 feet maximum. In addition, blocking panel is required along the cantilever support.

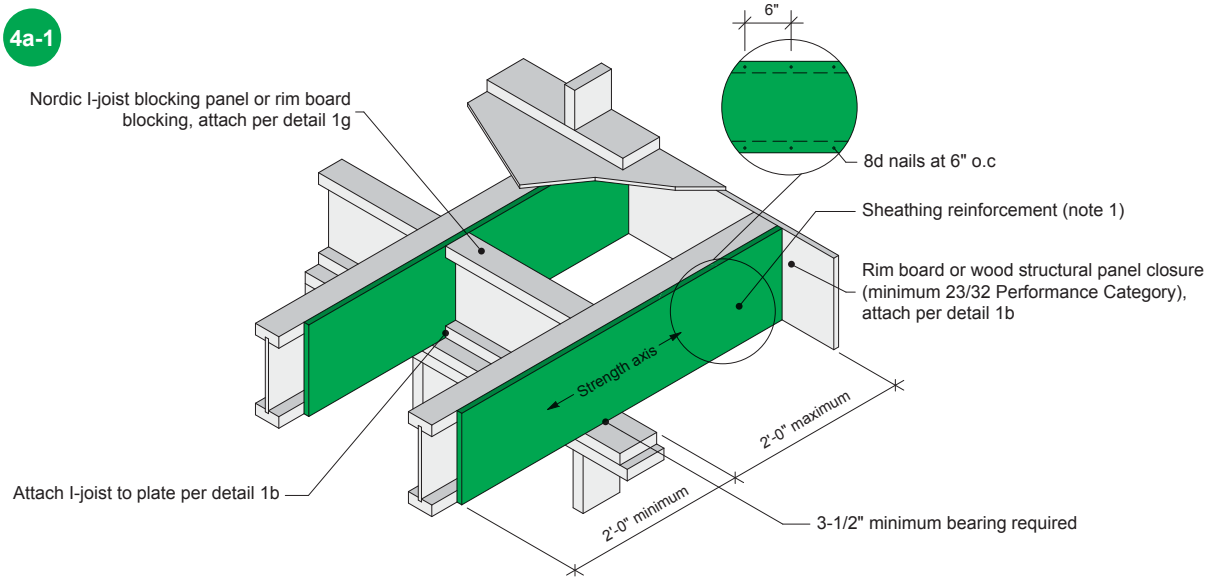
Subject to the roof loads and layout (see table 4.1), three methods of reinforcing are allowed: sheathing reinforcement applied to one side of the I-joist (detail 4a-1), sheathing reinforcement applied to both sides of the I joist (detail 4a-2), or double I-joists (detail 4b).

4a



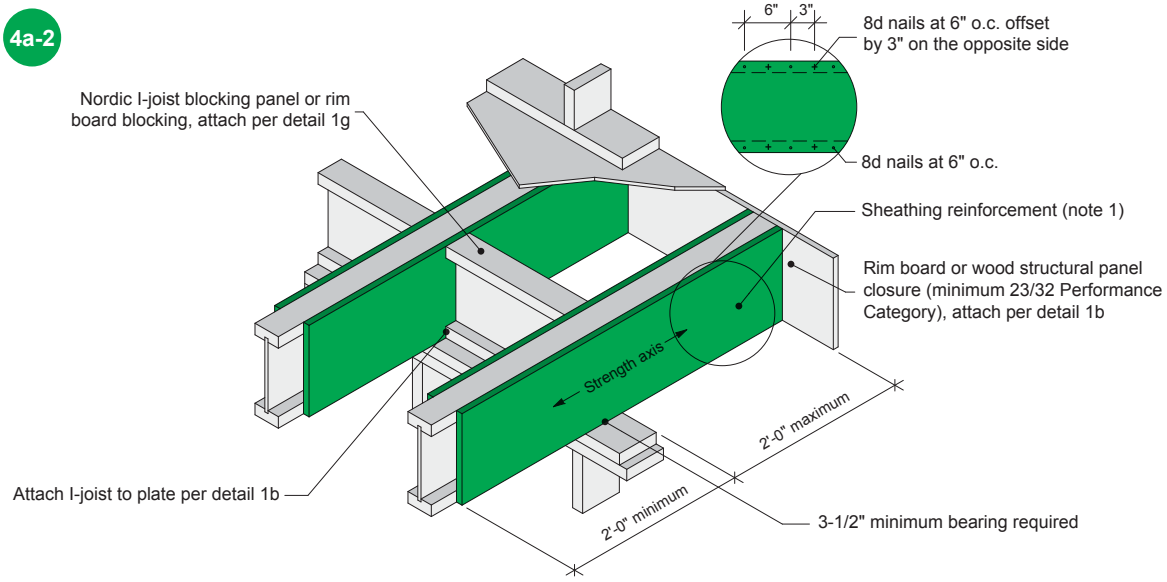
Notes:
1. Cantilevered joists must be properly sized to support all design loads. Refer to table 4.1.
2. Blocking is required along the cantilever support.
3. Refer to detail 6c for holes in lateral-restraint-only blocking panels.

4a-1



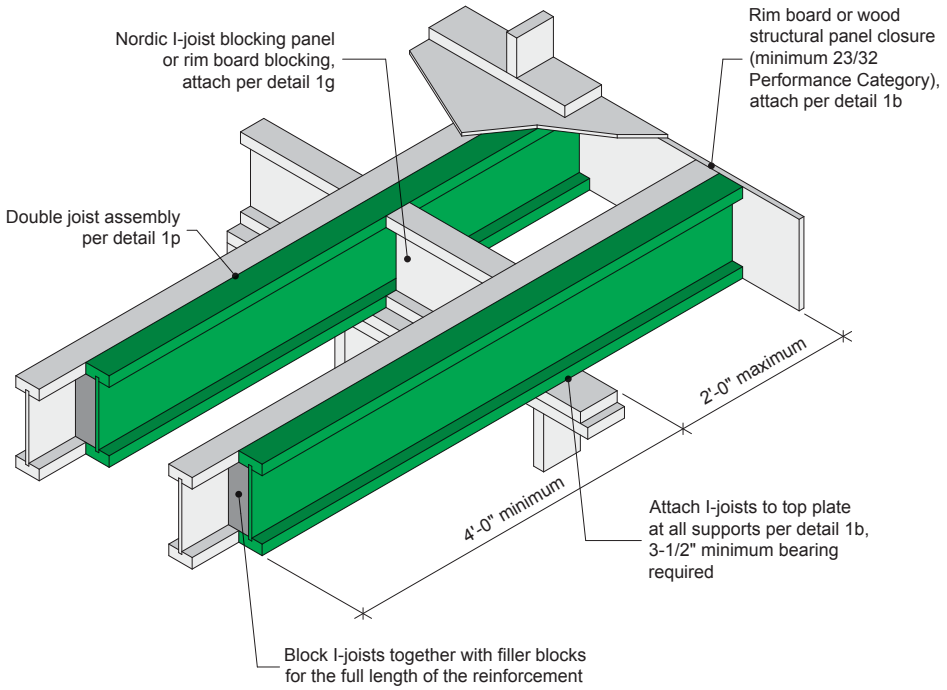
Notes:
1. APA Rated Sheathing 48/24 or APA Rated Sturd-I-floor 24 oc (minimum 23/32 Performance Category) required on one side of joist. Depth shall match the full height of the joist. Nail with 8d nails at 6 inches o.c., top and bottom flange. Install with face grain horizontal. Attach I-joist to plate at all supports per detail 1b.
2. Cantilevered joists must be properly sized to support all design loads. Refer to table 4.1.
3. Blocking is required along the cantilever support.
4. Refer to detail 6c for holes in lateral-restraint-only blocking panels.

4a-2



Notes:
1. APA Rated Sheathing 48/24 or APA Rated Sturd-I-floor 24 oc (minimum 23/32 Performance Category) required on both sides of joist. Depth shall match the full height of the joist. Nail with 8d nails at 6 inches o.c., top and bottom flange, offset on opposite side. Install with face grain horizontal. Attach I-joist to plate at all supports per detail 1b.
2. Cantilevered joists must be properly sized to support all design loads. Refer to table 4.1.
3. Blocking is required along the cantilever support.
4. Refer to detail 6c for holes in lateral-restraint-only blocking panels.

4b



Notes:
1. Cantilevered joists must be properly sized to support all design loads. Refer to table 4.1.
2. Blocking is required along the cantilever support.
3. Refer to detail 6c for holes in lateral-restraint-only blocking panels.

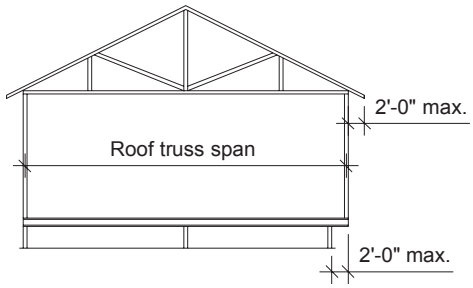
Table 4.1 – Cantilever Reinforcements for Vertical Building Offset

Design Criteria

Roof	
Load:	Dead load = 15 psf
Soffit:	Roof truss soffit up to 24 inches

Wall	
Load:	Dead load = 80 plf
Openings:	Maximum 3 feet wide, spaced at least 6 feet on center

Floor	
Span:	Simple or multiple
Loads:	Live load = 40 psf and dead load = 10 psf
Deflection limits:	L/480 under live load and L/240 under total load
Sheathing:	APA Rated Sheathing or APA Rated Sturd-I-Floor, nailed-glued.
	19/32-inch thick (40/20 or 20 oc) for joist spacing up to 19.2 in.
	23/32-inch thick (48/24 or 24 oc) for joist spacing of 24 in.



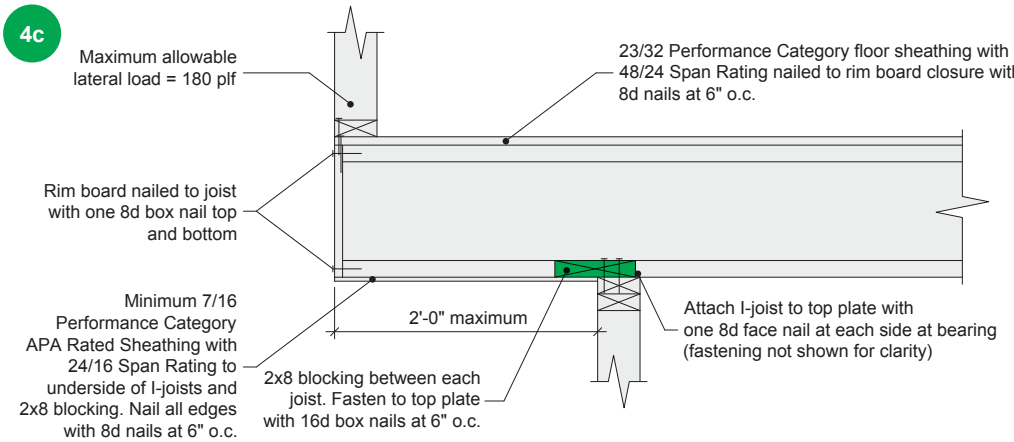
Cantilever Reinforcements for Vertical Building Offset

Joist depth	Roof truss span	Roof loading											
		Snow load = 20 psf				Snow load = 30 psf				Snow load = 40 psf			
		Joist spacing				Joist spacing				Joist spacing			
	(ft)	12"	16"	19.2"	24"	12"	16"	19.2"	24"	12"	16"	19.2"	24"
9-1/2"	26	n	n	n	1	n	n	n	2	n	n	1	x
	28	n	n	n	1	n	n	1	2	n	1	2	x
	30	n	n	n	1	n	n	1	2	n	1	2	x
	32	n	n	n	1	n	n	1	2	n	1	2	x
	34	n	n	n	1	n	1	1	x	n	1	2	x
	36	n	n	1	2	n	1	2	x	n	2	x	x
11-7/8"	26	n	n	n	n	n	n	n	1	n	n	n	1
	28	n	n	n	n	n	n	n	1	n	n	n	1
	30	n	n	n	n	n	n	n	1	n	n	1	2
	32	n	n	n	n	n	n	n	1	n	n	1	2
	34	n	n	n	n	n	n	n	1	n	n	1	2
	36	n	n	n	1	n	n	1	1	n	1	1	2
14"	26	n	n	n	n	n	n	n	n	n	n	n	1
	28	n	n	n	n	n	n	n	n	n	n	n	1
	30	n	n	n	n	n	n	n	1	n	n	n	1
	32	n	n	n	n	n	n	n	1	n	n	n	1
	34	n	n	n	n	n	n	n	1	n	n	1	2
	36	n	n	n	n	n	n	n	1	n	n	1	2
16"	26	n	n	n	n	n	n	n	n	n	n	n	1
	28	n	n	n	n	n	n	n	1	n	n	n	1
	30	n	n	n	n	n	n	n	1	n	n	n	1
	32	n	n	n	n	n	n	n	1	n	n	1	1
	34	n	n	n	n	n	n	n	1	n	n	1	2
	36	n	n	n	1	n	n	n	1	n	n	1	2

Notes:

1. n = No reinforcement required (detail 4a);
   1 = I-joist reinforced with APA Rated Sheathing 48/24 or APA Rated Sturd-I-floor 24 oc (minimum 23/32 Performance Category) on one side (detail 4a-1);
   2 = I-joist reinforced with APA Rated Sheathing 48/24 or APA Rated Sturd-I-floor 24 oc (minimum 23/32 Performance Category) on both sides, or double I-joist (detail 4a-2 or detail 4b);
   x = Try a deeper joist or closer spacing.
2. The reinforcements are applicable to residential roof construction meeting the above design criteria.
3. Cantilever I-joists supporting girder trusses may require additional reinforcement. A beam is usually required.

4c



Caution

Cantilevers formed this way must be carefully detailed to prevent moisture intrusion into the structure and potential decay of untreated I-joist extensions.

Notes:

1. The above detail is applicable only to single family residential construction, and when the cantilever is loaded by uniform floor loads only (i.e. wall is not load-bearing).
2. Cantilevered joists must be properly sized to support design loads.
3. Blocking over bearing wall must be provided at all areas of wall bracing (at end of walls and at least every 25'-0" of wall length). See IRC Table R602.10.1 Wall Bracing.
4. This detail is adequate for I-joist lateral stability. Additional lateral resistance may be required in high wind and/or seismic load areas. In such cases, specific design detailing shall be provided by the building designer.
5. During erection, provide temporary blocking over bearing wall in order to prevent rollover of floor joists.

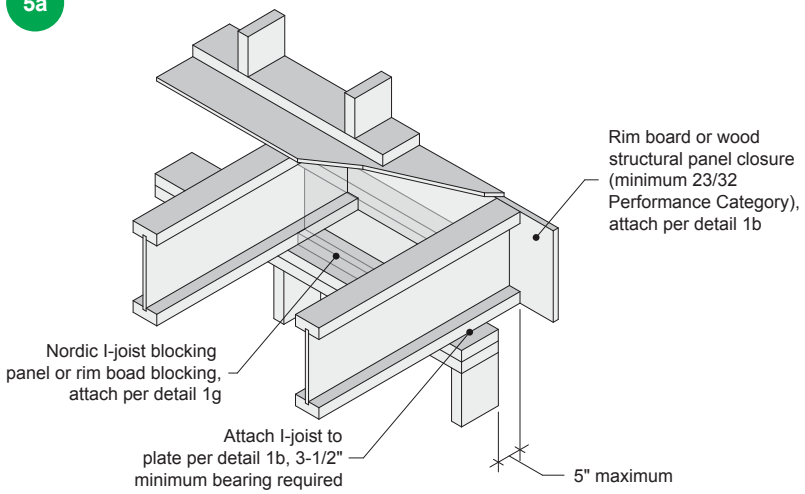
Short Cantilever Details for Vertical Building Offset

Nordic I-joists may be used in cantilever applications supporting a uniform wall load applied to the end of the cantilever, such as with a vertical building offset for the brick. For cantilever-end load applications that require reinforcing based on table 5.1, the cantilever is limited to 5 inches maximum. In addition, blocking panel is required along the cantilever support.

Subject to the roof loads and layout (see table 5.1), three methods of reinforcing are allowed: sheathing reinforcement applied to one side of the I-joist (detail 5a-1), sheathing reinforcement applied to both sides of the I joist (detail 5a-2), or double I-joists (detail 5b).

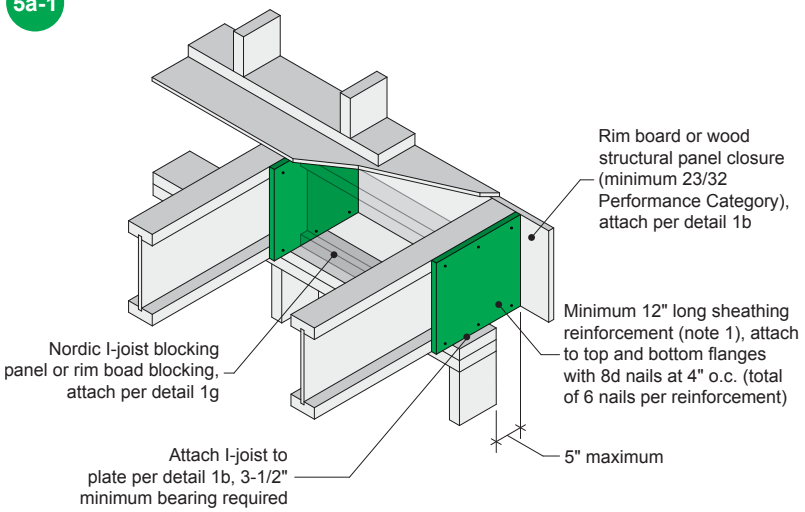
Otherwise, detail 5c (without blocking panel) can only be used when no I-joist reinforcement is required.

5a



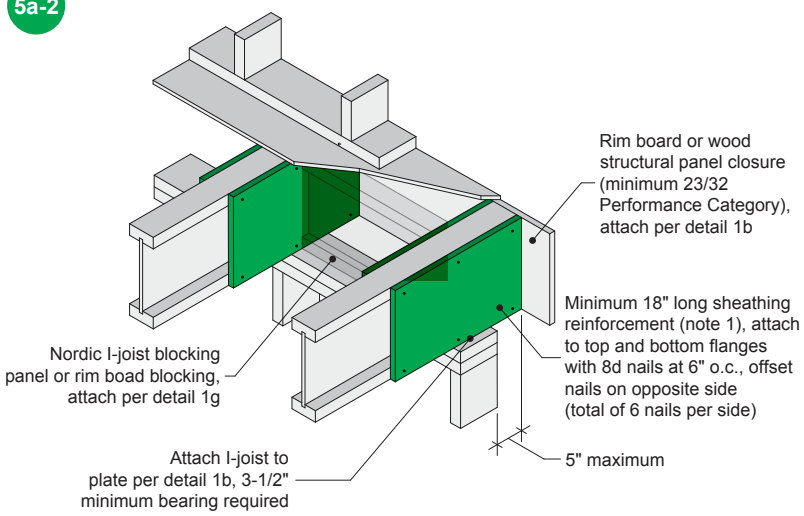
Notes:
1. Cantilevered joists must be properly sized to support all design loads. Refer to table 5.1.
2. Blocking is required along the cantilever support.
3. Refer to detail 6c for holes in lateral-restraint-only blocking panels.

5a-1



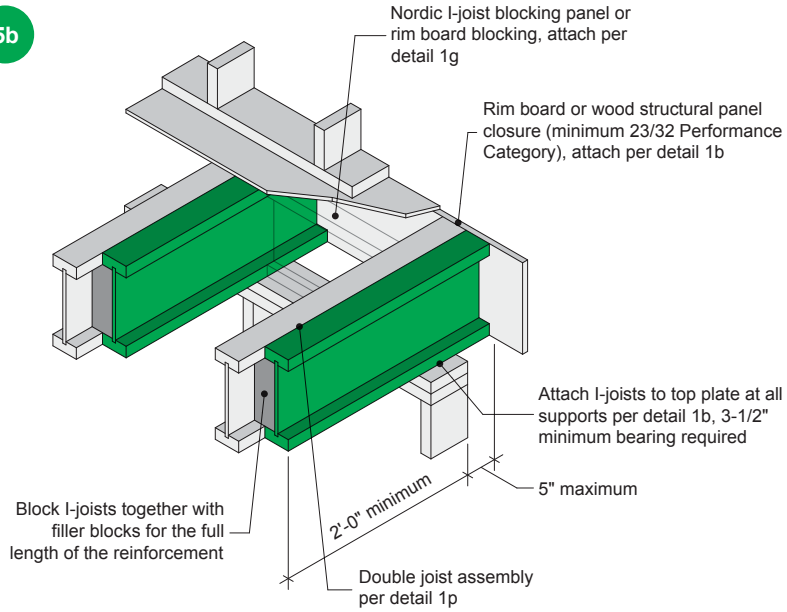
Notes:
1. APA Rated Sheathing 48/24 or APA Rated Sturd-I-floor 24 oc (minimum 23/32 Performance Category) required on one side of joist. Depth shall match the full height of the joist. Install with face grain horizontal. Attach I-joist to plate at all supports per detail 1b.
2. Cantilevered joists must be properly sized to support all design loads. Refer to table 5.1.
3. Blocking is required along the cantilever support.
4. Refer to detail 6c for holes in lateral-restraint-only blocking panels.

5a-2



Notes:
1. APA Rated Sheathing 48/24 or APA Rated Sturd-I-floor 24 oc (minimum 23/32 Performance Category) required on both sides of joist. Depth shall match the full height of the joist. Install with face grain horizontal. Attach I-joist to plate at all supports per detail 1b.
2. Cantilevered joists must be properly sized to support all design loads. Refer to table 5.1.
3. Blocking is required along the cantilever support.
4. Refer to detail 6c for holes in lateral-restraint-only blocking panels.

5b

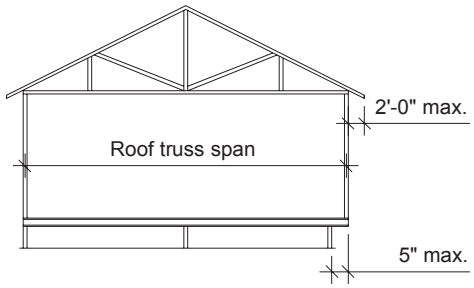


Notes:
1. Cantilevered joists must be properly sized to support all design loads. Refer to table 5.1.
2. Blocking is required along the cantilever support.
3. Refer to detail 6c for holes in lateral-restraint-only blocking panels.

Table 5.1 – Short Cantilever Reinforcements for Vertical Building Offset

Design Criteria

Roof	
Load:	Dead load = 15 psf
Soffit:	Roof truss soffit up to 24 inches
Wall	
Load:	Dead load = 80 plf
Openings:	Maximum 3 feet wide, spaced at least 6 feet on center
Floor	
Span:	Simple or multiple
Loads:	Live load = 40 psf and dead load = 10 psf
Deflection limits:	L/480 under live load and L/240 under total load
Sheathing:	APA Rated Sheathing or APA Rated Sturd-I-Floor, nailed-glued.
	19/32-inch thick (40/20 or 20 oc) for joist spacing up to 19.2 in.
	23/32-inch thick (48/24 or 24 oc) for joist spacing of 24 in.



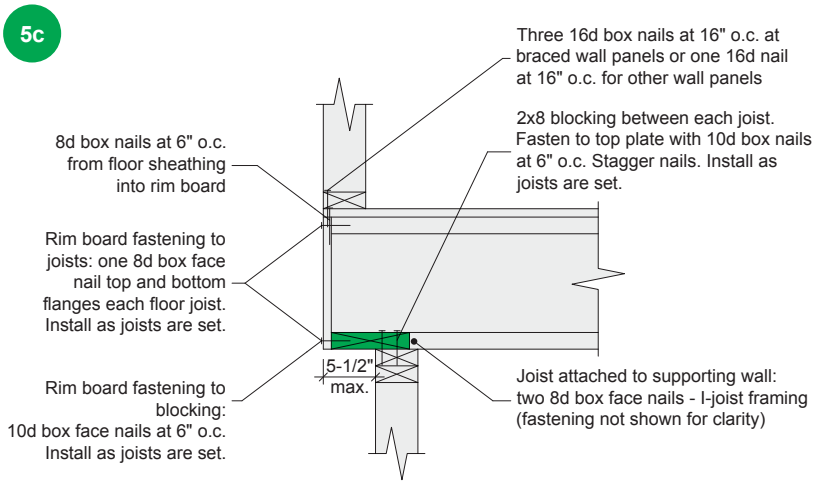
Short Cantilever Reinforcements for Vertical Building Offset

Joist depth	Roof truss span	Roof loading											
		Snow load = 20 psf Joist spacing				Snow load = 30 psf Joist spacing				Snow load = 40 psf Joist spacing			
	(ft)	12"	16"	19.2"	24"	12"	16"	19.2"	24"	12"	16"	19.2"	24"
9-1/2"	26	n	1	2	x	n	2	x	x	1	2	x	x
	28	n	1	2	x	n	2	x	x	1	x	x	x
	30	n	1	2	x	1	2	x	x	1	x	x	x
	32	n	2	x	x	1	2	x	x	1	x	x	x
	34	n	2	x	x	1	x	x	x	2	x	x	x
	36	n	2	x	x	1	x	x	x	2	x	x	x
11-7/8"	26	n	n	1	2	n	1	2	x	n	1	2	x
	28	n	n	1	2	n	1	2	x	n	2	x	x
	30	n	n	1	x	n	1	2	x	n	2	x	x
	32	n	1	2	x	n	1	2	x	1	2	x	x
	34	n	1	2	x	n	2	x	x	1	2	x	x
	36	n	1	2	x	n	2	x	x	1	x	x	x
14"	26	n	n	1	2	n	1	2	x	n	1	x	x
	28	n	n	1	x	n	1	2	x	n	2	x	x
	30	n	1	1	x	n	1	2	x	n	2	x	x
	32	n	1	2	x	n	1	2	x	1	2	x	x
	34	n	1	2	x	n	2	x	x	1	2	x	x
	36	n	1	2	x	n	2	x	x	1	x	x	x
16"	26	n	1	1	x	n	1	2	x	n	2	x	x
	28	n	1	2	x	n	1	2	x	n	2	x	x
	30	n	1	2	x	n	1	2	x	1	2	x	x
	32	n	1	2	x	n	2	x	x	1	2	x	x
	34	n	1	2	x	n	2	x	x	1	x	x	x
	36	n	1	2	x	1	2	x	x	1	x	x	x

Notes:

1. n = No reinforcement required (detail 5a);
   1 = I-joist reinforced with APA Rated Sheathing 48/24 or APA Rated Sturd-I-floor 24 oc (minimum 23/32 Performance Category) on one side (detail 5a-1);
   2 = I-joist reinforced with APA Rated Sheathing 48/24 or APA Rated Sturd-I-floor 24 oc (minimum 23/32 Performance Category) on both sides, or double I-joist (detail 5a-2 or detail 5b);
   x = Try a deeper joist or closer spacing.
2. The reinforcements are applicable to residential roof construction meeting the above design criteria.
3. Cantilever I-joists supporting girder trusses may require additional reinforcement. A beam is usually required.

5c



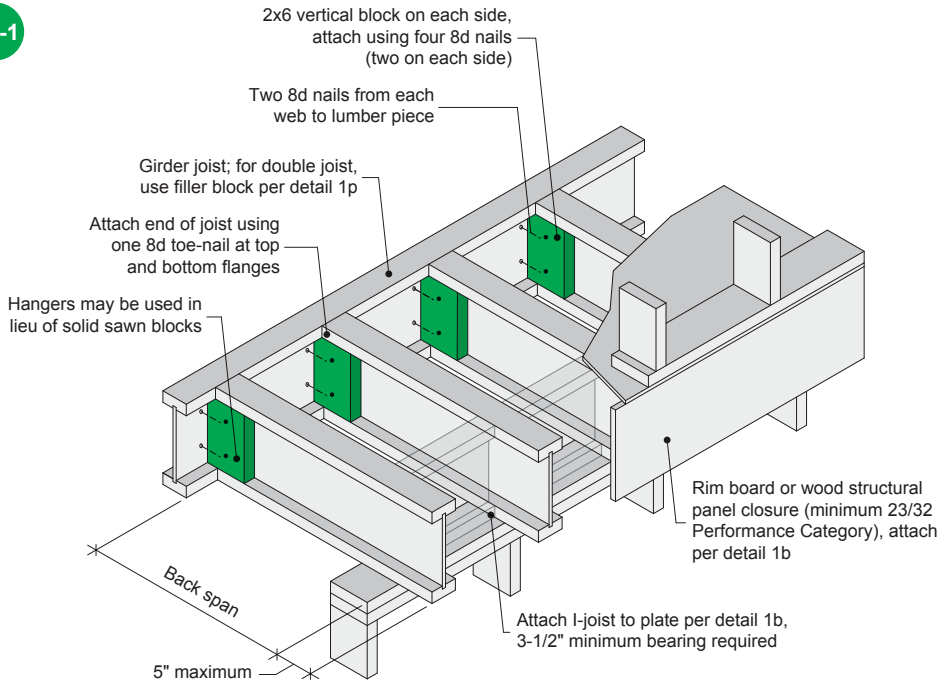
Caution

Cantilevers formed this way must be carefully detailed to prevent moisture intrusion into the structure and potential decay of untreated I-joist extensions.

Notes:

1. The above detail is appropriate for one- and two-family residential structures constructed in accordance with the 2021 International Residential Code Sections R301.2.2.6 and R602.10, and Table R602.3(1).
2. Cantilevered joists must be properly sized and spaced, and may require reinforcements to support vertical wall loads. Note that this detail can only be used when no I-joist reinforcement is required.

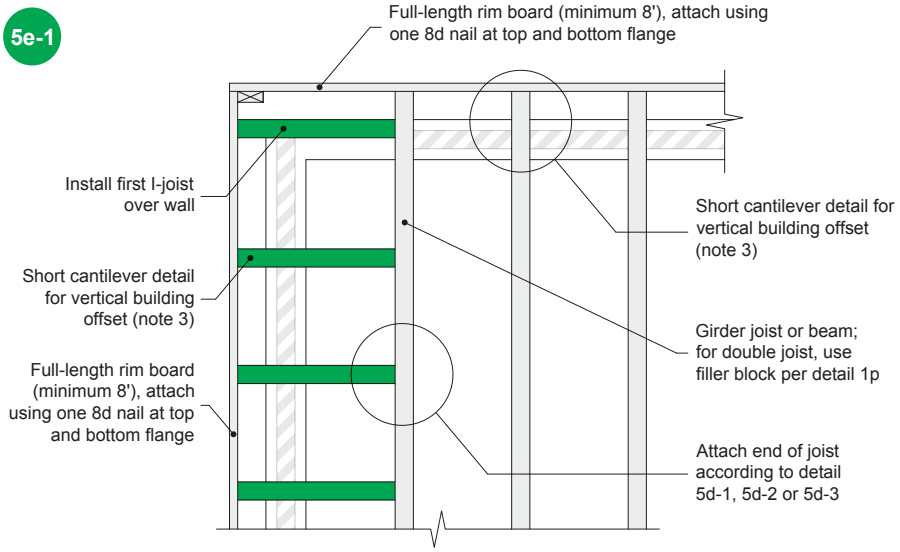
5d-1



Notes:

1. Verify girder joist capacity if the back span exceeds the joist spacing. Limit the differential deflection between adjacent I-joists.
2. Cantilevered joists must be properly sized to support all design loads.
3. Blocking is required along the cantilever support.
4. Maximum capacity for pair of 2x6 blocks for this detail is 370 lbf (total of four nails). For higher capacities, use hangers in lieu of solid sawn blocks.

5e-1



Notes:
1. This detail is limited to a 5-inch brick cantilever on two adjacent sides of the building. Use in conjunction with the short cantilever details for vertical building offset.
2. Verify girder joist capacity if the back span exceeds the joist spacing. Limit the differential deflection between adjacent I-joists.
3. Cantilevered joists must be properly sized to support all design loads.
4. Blocking is required along the cantilever support.

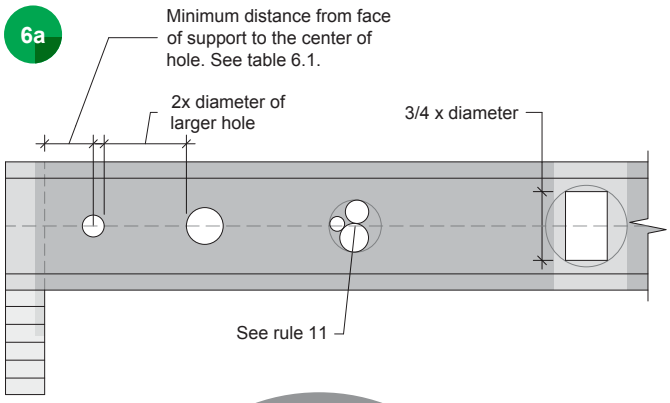
Web Hole Specifications

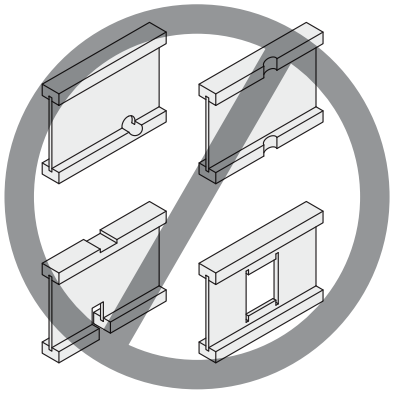
One of the benefits of using I-joists in residential floor construction is that holes may be cut in the joist webs to accommodate electrical wiring, plumbing lines and other mechanical systems, therefore minimizing the depth of the floor system.

Rules for Cutting Holes in I-joists

1. The distance between the inside edge of the support and the centerline of any hole shall be in compliance with the requirements of table 6.1.
2. I-joist top and bottom flanges must never be cut, notched or otherwise modified.
3. Whenever possible, field-cut holes should be centered on the middle of the web.
4. The maximum size hole that can be cut into an I-joist web shall equal the clear distance between the flanges of the I-joist minus 1/4 inch. A minimum of 1/8 inch should always be maintained between the top or bottom of the hole and the adjacent I-joist flange.
5. The sides of square holes or longest sides of rectangular holes should not exceed 3/4 of the diameter of the maximum round hole permitted at that location.
6. Where more than one hole is necessary, the distance between adjacent hole edges shall exceed twice the diameter of the largest round hole or twice the size of the largest square hole - or twice the length of the longest side of the longest rectangular hole -, and each hole must be sized and located in compliance with the requirements of table 6.1.
7. Holes measuring 1-1/2 inch or smaller shall be permitted anywhere in a cantilevered section of a joist. Holes of greater size may be permitted subject to verification.
8. A 1-1/2 inch hole or smaller can be placed anywhere in the web provided that it meets the requirements of rule number 6 above. For more than three holes per span, refer to rule 11, space holes at minimum 15 inches on center, or contact Nordic Structures.
9. All holes shall be cut in accordance with the restrictions listed above and as illustrated in detail 6a.
10. Limit three maximum-size holes per span.
11. A group of round holes at approximately the same location shall be permitted if it meets the requirements for a single round hole circumscribed around them. For multiple web holes, consult APA document TT-132.

6a





Notes:

1. Never drill, cut or notch the flange, or over-cut the web.
2. Holes in web should be cut with a sharp saw.
3. For rectangular holes, avoid over-cutting the corners, as this can cause unnecessary stress concentrations. Slightly rounding the corners is recommended. Starting the rectangular hole by drilling a 1-inch-diameter hole in each of the four corners and then making the cuts between the holes is another good method to minimize damage to the I-joist.

Table 6.1 – Location of Web Holes

Design Criteria	
Span:	Simple or multiple
Joist spacing:	Up to 24 inches
Loads:	Live load = 40 psf and dead load = 10 psf
Deflection limits:	L/480 under live load and L/240 under total load

Minimum distance from inside face of any support to center of hole (ft-in.)

Joist depth	Joist series	Round hole diameter (in.)															L_{ref}
		2	3	4	5	6	6-1/4	7	8	8-5/8	9	10	10-3/4	11	12	12-3/4	
9-1/2"	NI-40x	0'-7"	1'-4"	2'-8"	4'-2"	5'-8"	6'-2"	-	-	-	-	-	-	-	-	-	15'-0"
	NI-60	1'-0"	2'-4"	3'-9"	5'-3"	6'-10"	7'-3"	-	-	-	-	-	-	-	-	-	15'-3"
	NI-80	2'-0"	3'-5"	4'-10"	6'-4"	8'-0"	8'-5"	-	-	-	-	-	-	-	-	-	16'-9"
11-7/8"	NI-40x	0'-7"	0'-8"	1'-0"	2'-4"	3'-8"	4'-0"	5'-2"	6'-8"	8'-0"	-	-	-	-	-	-	17'-2"
	NI-60	0'-7"	1'-4"	2'-8"	4'-0"	5'-5"	5'-10"	7'-0"	8'-8"	9'-9"	-	-	-	-	-	-	18'-2"
	NI-80	1'-4"	2'-8"	4'-0"	5'-4"	6'-10"	7'-3"	8'-5"	10'-2"	11'-3"	-	-	-	-	-	-	19'-11"
	NI-90	0'-7"	0'-8"	1'-3"	2'-11"	4'-8"	5'-2"	6'-6"	8'-6"	9'-11"	-	-	-	-	-	-	20'-5"
14"	NI-40x	0'-7"	0'-8"	0'-8"	0'-9"	2'-0"	2'-4"	3'-4"	4'-9"	5'-9"	6'-3"	8'-0"	9'-9"	-	-	-	18'-11"
	NI-60	0'-7"	0'-8"	1'-3"	2'-6"	4'-0"	4'-3"	5'-3"	6'-9"	7'-9"	8'-3"	10'-2"	11'-10"	-	-	-	20'-8"
	NI-80	0'-8"	1'-10"	3'-2"	4'-6"	6'-0"	6'-3"	7'-4"	8'-10"	9'-10"	10'-6"	12'-3"	13'-8"	-	-	-	22'-7"
	NI-90	0'-7"	0'-8"	0'-9"	2'-3"	3'-10"	4'-3"	5'-6"	7'-3"	8'-5"	9'-2"	11'-2"	12'-9"	-	-	-	23'-1"
16"	NI-60	0'-7"	0'-8"	0'-8"	1'-2"	2'-5"	2'-9"	3'-9"	5'-0"	6'-0"	6'-6"	8'-0"	9'-2"	9'-8"	11'-9"	13'-9"	22'-10"
	NI-80	0'-7"	1'-2"	2'-4"	3'-8"	5'-0"	5'-4"	6'-4"	7'-10"	8'-9"	9'-4"	11'-0"	12'-2"	12'-6"	14'-4"	16'-0"	25'-0"
	NI-90	0'-7"	0'-8"	0'-8"	1'-6"	3'-0"	3'-5"	4'-6"	6'-3"	7'-3"	7'-10"	9'-8"	11'-0"	11'-6"	13'-6"	15'-3"	25'-7"

Notes:

1. Tabulated values are applicable to residential floor construction meeting the above design criteria.
2. If the actual measured span is less than the reference span, L_{ref}, the minimum distance from inside face of any support to center of hole may be reduced as follows:

$$D_{reduced} = (L_{actual} / L_{ref}) \times D$$

Where:

- $D_{reduced}$ = Reduced distance from inside face of any support to center of hole (ft). The reduced distance shall not be less than 6 inches from the face of the support to edge of the hole.
- L_{actual} = Actual measured span distance between the inside face of supports (ft).
- L_{ref} = Reference span given in this table (ft).
- D = Minimum distance from the inside face of any support to center of hole from this table (ft).

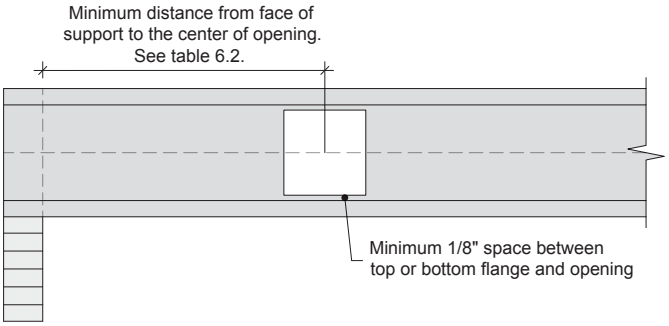
Duct Chase Opening Specifications

One of the benefits of using I-joists in residential floor construction is that openings may be cut in the joist webs to accommodate a duct chase (supply duct for heating, ventilation or air-conditioning), therefore minimizing the depth of the floor system.

Rules for Cutting Duct Chase Openings in I-joists

1. The distance between the inside edge of the support and the centerline of a duct chase opening shall be in compliance with the requirements of table 6.2.
2. I-joist top and bottom flanges must never be cut, notched or otherwise modified.
3. The maximum depth of a duct chase opening that can be cut into an I-joist web shall equal the clear distance between the flanges of the I-joist minus 1/4 inch. A minimum of 1/8 inch should always be maintained between the top or bottom of the opening and the adjacent I-joist flange.
4. All openings shall be cut in accordance with the restrictions listed above and as illustrated in detail 6b.
5. Limit one maximum-size duct chase opening per span.

6b



Notes:
1. Never drill, cut or notch the flange, or over-cut the web.
2. Holes in web should be cut with a sharp saw.
3. Avoid over-cutting the corners, as this can cause unnecessary stress concentrations. Slightly rounding the corners is recommended. Starting the rectangular hole by drilling a 1-inch-diameter hole in each of the four corners and then making the cuts between the holes is another good method to minimize damage to the I-joist.

I-joist depth (in.)	Maximum depth of the opening (in.)
9-1/2	6-1/4
11-7/8	8-5/8
14	10-3/4
16	12-3/4

Table 6.2 – Location of Duct Chase Openings

Design Criteria	
Span:	Simple
Joist spacing:	Up to 24 inches
Loads:	Live load = 40 psf and dead load = 10 psf
Deflection limits:	L/480 under live load and L/240 under total load

Minimum distance from inside face of any support to center of opening (ft-in.)

Joist depth	Joist series	Duct chase length (in.)								
		8	10	12	14	16	18	20	22	24
9-1/2"	NI-40x	5'-2"	5'-7"	6'-0"	6'-4"	6'-8"	7'-2"	7'-7"	-	-
	NI-60	5'-3"	5'-8"	6'-0"	6'-6"	7'-0"	7'-3"	7'-9"	-	-
	NI-80	5'-2"	5'-7"	6'-0"	6'-4"	6'-8"	7'-2"	7'-7"	8'-1"	8'-6"
11-7/8"	NI-40x	6'-7"	7'-1"	7'-6"	8'-1"	8'-6"	9'-1"	9'-7"	-	-
	NI-60	7'-1"	7'-7"	8'-0"	8'-4"	8'-10"	9'-3"	9'-9"	-	-
	NI-80	7'-1"	7'-5"	8'-0"	8'-4"	8'-10"	9'-2"	9'-8"	10'-2"	10'-8"
	NI-90	4'-3"	4'-10"	5'-4"	5'-11"	6'-6"	7'-1"	7'-8"	8'-3"	8'-11"
14"	NI-40x	7'-9"	8'-3"	8'-10"	9'-5"	10'-1"	10'-7"	11'-3"	-	-
	NI-60	8'-8"	9'-2"	9'-6"	10'-1"	10'-6"	11'-1"	11'-7"	-	-
	NI-80	8'-9"	9'-2"	9'-8"	10'-1"	10'-6"	11'-1"	11'-6"	12'-1"	12'-8"
	NI-90	5'-10"	6'-5"	7'-0"	7'-6"	8'-2"	8'-9"	9'-4"	9'-11"	10'-8"
16"	NI-60	10'-1"	10'-7"	11'-0"	11'-6"	12'-1"	12'-7"	13'-4"	-	-
	NI-80	10'-3"	10'-9"	11'-2"	11'-7"	12'-1"	12'-7"	13'-2"	13'-9"	14'-6"
	NI-90	7'-4"	7'-11"	8'-6"	9'-1"	9'-8"	10'-3"	13'-0"	11'-7"	12'-3"

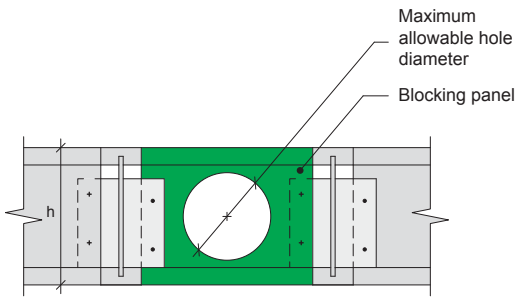
Note:

1. Tabulated values are applicable to residential floor construction meeting the above design criteria.

Holes in Lateral-restraint-only Blocking Panels

This detail concerns the placement of holes in the web of I-joists or rim board used as blocking for lateral restraint of floor and roof joists. Blocking for lateral restraint are those members used between floor joists, ceiling joists or rafters to prevent them from rolling over. As a rule of thumb, any blocking that is not supporting a load-bearing wall (vertical or lateral load) or part of an engineered diaphragm perimeter load path can be considered a lateral-restraint-only blocking panel.

6c



Maximum Allowable Hole Size

1. The maximum allowable hole size for a lateral-restraint-only blocking panel is 2/3 of the lesser dimension of the blocking's depth or length. Assuming the blocking panel is longer than its height (or depth), the table aside applies. For other applications, contact Nordic Structures.
2. Holes cut into the blocking panels are subject to the following limitations:
   - The top and bottom flanges of an I-joist blocking panel must never be cut, notched or otherwise modified.
   - Field-cut holes must be centered in the blocking horizontally.
   - While round holes are preferred, rectangle holes may be used provided the corners are not over cut. Slightly rounding corners or pre-drilling corners with a 1-inch-diameter bit is recommended.
   - All holes must be cut in a workman-like manner in accordance with the limitations listed above.

I-joist or rim board blocking depth (in.)	Maximum allowable hole diameter (in.) [(a)]
9-1/2	6-1/4
11-7/8	7-3/4
14	9-1/4
16	10-1/2

(a) Maximum allowable hole diameter in blocking panel, where the blocking panel is longer than its height.

Stairwell Openings in I-joist Floors

When designing a floor for a residential structure, the designer is often faced with detailing an unsupported stairwell opening in the floor. The following information simplifies the selection of trimmers and headers, provides guidance on the appropriate detailing for their use, and quantifies hanger capacity requirements for I-joist-to-header and header-to-trimmer intersections.

These recommendations are based on the use of Nordic I-joists used in either simple or multiple allowable spans for residential applications, and on a live load of 40 psf plus dead load of 10 psf for the floor and stair areas. The information provided is appropriate for stairwell openings from 10.5 feet to 12 feet in length and 48 inches in width, whose long dimension is either running parallel or perpendicular to the joist span, as shown in details 7a-1 and 7a-2. It is also assumed that there is a non-load-bearing partition with a load of 64 plf along the stairwell opening perimeter.

The stair stringers may be attached to the header/trimmer at either end of the stairwell opening. For stairwells parallel or perpendicular to the I-joist spans, the opening may be placed anywhere in the floor without regard to the support of the floor framing.

Stairwells Parallel to I-joist Span
The most common method for placing a stairwell in a wood-framed floor is to run the long axis of the opening parallel to the span of the I-joist. This generally requires smaller headers and trimmers than the perpendicular orientation.

Table shown on the following page is a guide for determining the I-joist requirement or the minimum sections of other engineered wood members required to frame the headers and trimmers seen in detail 7a-1.

Caution: *In situations where the stairwell runs parallel to the floor joists and the floor joists are installed over two or more spans, the header supporting the continuous floor joists may be subjected to uplift loads caused by the floor joists it supports. Cutting the interrupted joists at the center support will eliminate this uplift load. If this method is selected, the designer will have to insure that the maximum simple span for the I-joist is not exceeded. An alternative method would be to leave the floor joists continuous over the interior support and design the header and hangers for the resulting uplift loads.*

Stairwells Perpendicular to I-joist Span
Often the floor plan or architectural details of the building are such that it is not possible to orient the stairwell axis parallel to the I-joist span.

In such cases, the trimmers are placed parallel to the I-joist span and support the headers by way of metal hangers. The headers, in turn, support the cut ends of the floor joists also via metal hangers. This relationship can be seen in detail 7a-2. In addition to the header load, the trimmers are designed to carry the concentrated loads of the stair stringers.

Caution: *Because the headers intersect the span of the floor joists over a large length (up to 12 feet), in cases where the floor joists are used continuous over multiple spans, special design consideration must be given to the adjacent clear span to ensure adequate floor performance. To eliminate design problems and allow maximum flexibility in locating the stairwell, consider limiting the maximum spans for continuous floors containing stairwells perpendicular to I-joist spans to those given for simple span floors.*

Upward thrust acting on the header adjacent to a center support can be eliminated by cutting the I-joists at the center of the support, thus providing two simple spans where the I-joists are interrupted by the headers. An alternative method would be to leave the floor joists continuous over the interior support and design the header and hangers for the resulting uplift loads.

Design Criteria	
Floor loads:	Live load = 40 psf and dead load = 10 psf
Wall load:	Dead load = 64 plf (along stairwell opening perimeter)
Stairwell length:	Not to exceed 12 feet
Stairwell width:	Not to exceed 48 inches

Stairwells Parallel to I-joist Span

I-joist clear span (ft)	Header			Hanger – Capacity
	Suggested I-joist	Alternative		Joist to header
		SCL [b]	Nordic Lam 24F-1.9E	
14	(1 ea.) 9-1/2" NI-40x	1-3/4" x 9-1/2"	1-3/4" x 9-1/2"	1,450 lbf
16	(1 ea.) 9-1/2" NI-40x	1-3/4" x 9-1/2"	1-3/4" x 9-1/2"	1,450 lbf
18	(1 ea.) 11-7/8" NI-40x	1-3/4" x 11-7/8"	1-3/4" x 11-7/8"	1,450 lbf
20	(1 ea.) 11-7/8" NI-40x	1-3/4" x 11-7/8"	1-3/4" x 11-7/8"	1,450 lbf
22	(1 ea.) 11-7/8" NI-80	1-3/4" x 11-7/8"	1-3/4" x 11-7/8"	1,450 lbf
I-joist clear span (ft)	Trimmer			Hanger – Capacity
	Suggested I-joist [a]	Alternative		Header to trimmer
		SCL [b]	Nordic Lam 24F-1.9E	
14	(2 ea.) 9-1/2" NI-60	3-1/2" x 9-1/2"	2-1/2" x 9-1/2"	1,450 lbf
16	(2 ea.) 9-1/2" NI-60	3-1/2" x 9-1/2"	3-1/2" x 9-1/2"	1,450 lbf
18	(2 ea.) 11-7/8" NI-60	3-1/2" x 11-7/8"	2-1/2" x 11-7/8"	1,450 lbf
20	(2 ea.) 11-7/8" NI-80	3-1/2" x 11-7/8"	3-1/2" x 11-7/8"	1,450 lbf
22	(2 ea.) 11-7/8" NI-80	3-1/2" x 11-7/8"	5-1/2" x 11-7/8"	1,450 lbf

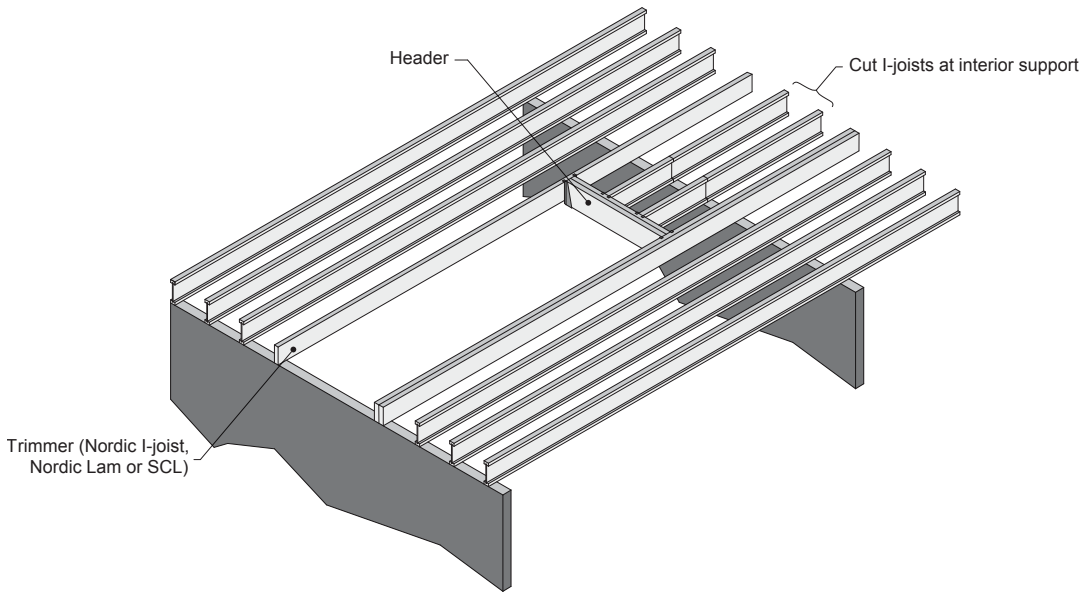
a) Refer to detail 1p for double I-joist construction.

b) SCL sizes are based on the following design properties: E = 2,000,000 psi (apparent), F_b = 2,900 psi et F_v = 285 psi.

Notes:

1. This table is applicable to trimmers and headers meeting the above design criteria.
2. Minimum bearing length shall be 1-3/4 inch for end bearings, except for shaded areas, which shall be 3-1/2 inches.

7a-1



Design Criteria

Floor loads:	Live load = 40 psf and dead load = 10 psf
Wall load:	Dead load = 64 plf (along stairwell opening perimeter)
Stairwell length:	Not to exceed 12 feet
Stairwell width:	Not to exceed 48 inches

Stairwells Perpendicular to I-joist Span

I-joist clear span (ft)	Header			Hanger – Capacity
	Suggested I-joist	Alternative		Joist to header
		SCL [b]	Nordic Lam 24F-1.9E	
14	(1 ea.) 9-1/2" NI-40x	1-3/4" x 9-1/2"	2-1/2" x 9-1/2"	1,450 lbf
16	(1 ea.) 9-1/2" NI-60	3-1/2" x 9-1/2"	2-1/2" x 9-1/2"	1,450 lbf
18	(1 ea.) 11-7/8" NI-40x	1-3/4" x 11-7/8"	1-3/4" x 11-7/8"	1,450 lbf
20	(1 ea.) 11-7/8" NI-60	1-3/4" x 11-7/8"	1-3/4" x 11-7/8"	1,450 lbf
22	(1 ea.) 14" NI-40x	1-3/4" x 11-7/8"	1-3/4" x 14"	1,450 lbf
I-joist clear span (ft)	Trimmer			Hanger – Capacity
	Suggested I-joist	Alternative		Header to trimmer
		SCL [b]	Nordic Lam 24F-1.9E	
14	Use alternative	5-1/4" x 9-1/2"	5-1/2" x 9-1/2"	2,500 lbf
16		7" x 9-1/2"	7" x 9-1/2"	2,500 lbf
18		5-1/4" x 11-7/8"	5-1/2" x 11-7/8"	2,500 lbf
20		7" x 11-7/8"	7" x 11-7/8"	2,700 lbf
22		5-1/4" x 14"	5-1/2" x 14"	3,000 lbf

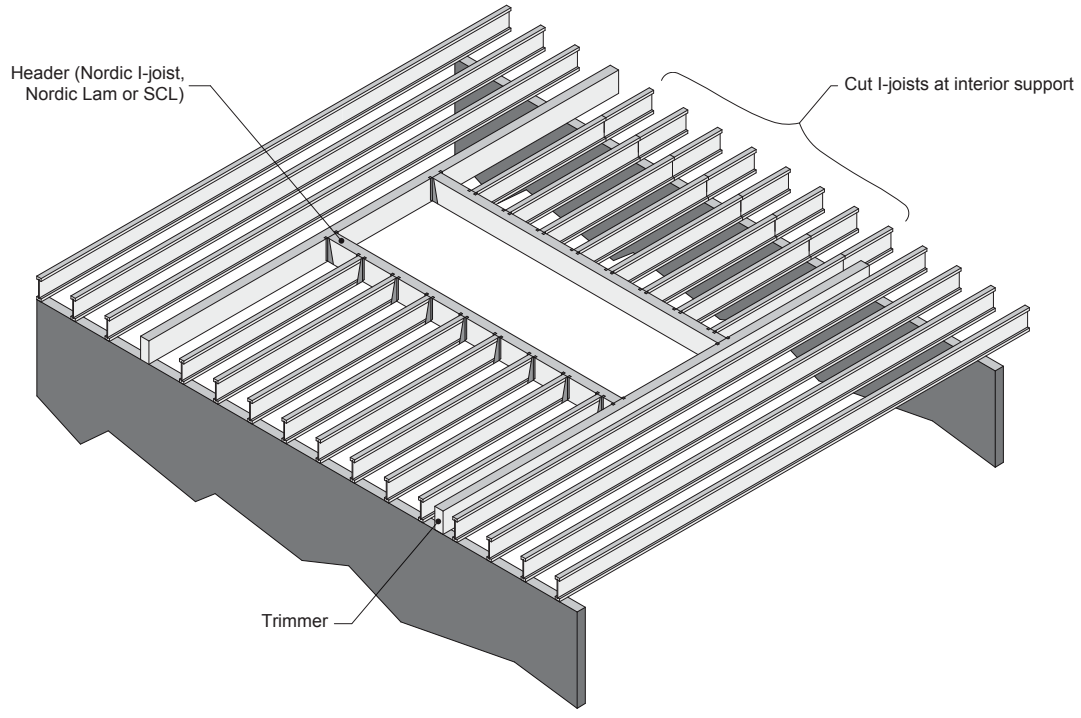
a) Refer to detail 1p for double I-joist construction.

b) SCL sizes are based on the following design properties: E = 2,000,000 psi (apparent), F_b = 2,900 psi et F_v = 285 psi.

Notes:

1. This table is applicable to trimmers and headers meeting the above design criteria.
2. Minimum bearing length shall be 1-3/4 inch for end bearings, except for shaded areas, which shall be 3-1/2 inches.

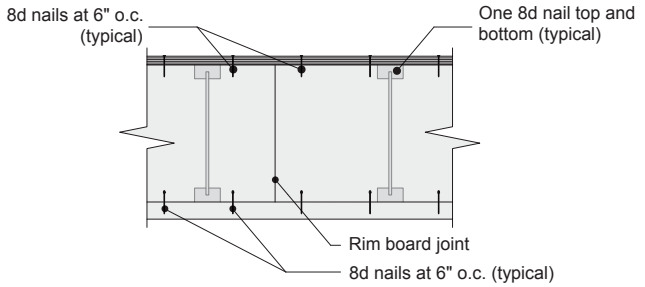
7a-2



Details for Rim Boards

8a

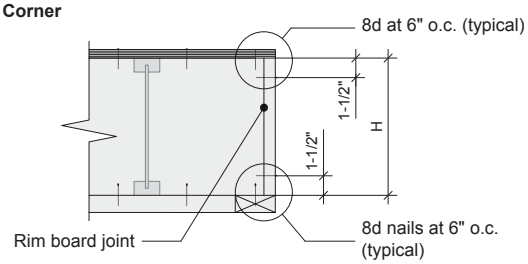
Rim Board Joint Between Floor Joists



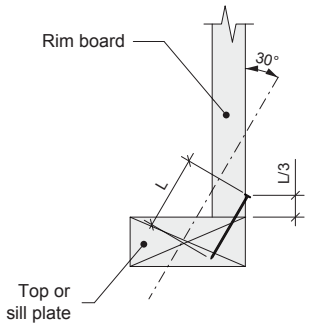
Notes:

1. Floor sheathing to rim board - Use 8d nails (box or common) at 6 inches o.c. ***Caution:*** *The horizontal load capacity is not necessarily increased with a decreased nail spacing. Under no circumstances should the nail spacing be less than 3 inches. The 16d nails (box or common) used to connect the bottom plate of a wall to the rim board through the sheathing do not reduce the horizontal load capacity of the rim board provided that the 8d nail spacing (sheathing-rim board) is 6 inches o.c. and the 16d nail spacing (bottom plate-sheathing-rim board) is in accordance with the prescriptive requirements of the applicable code. APA recommends a minimum 3/8-inch panel edge distance be maintained when nailing. Calculations show that the tongue does not need to be removed for floor sheathing 7/8-inch thick or less when used in conjunction with rim boards of 1-1/8 inch. Some local code jurisdictions, however, may require removal of the tongue at the edge of floor framing when nailing it to rim board.*
2. Rim board to I-joist - Use two 8d nails (box or common), one each into the top and bottom flanges.

Rim Board Joint at Corner



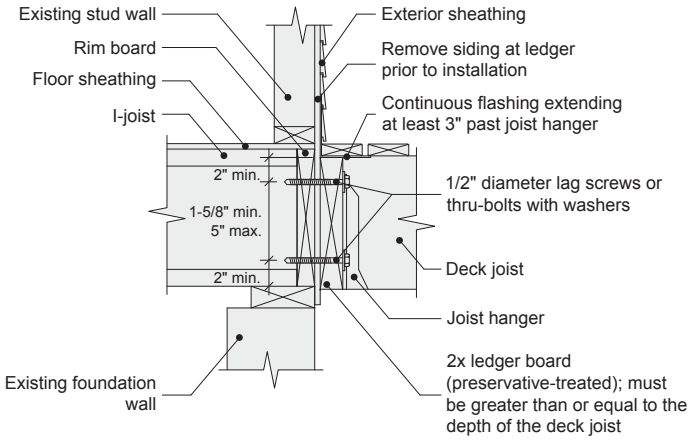
8b



Note:

1. Rim board to sill plate - Toe-nail using 8d nails (box or common) at 6 inches o.c.

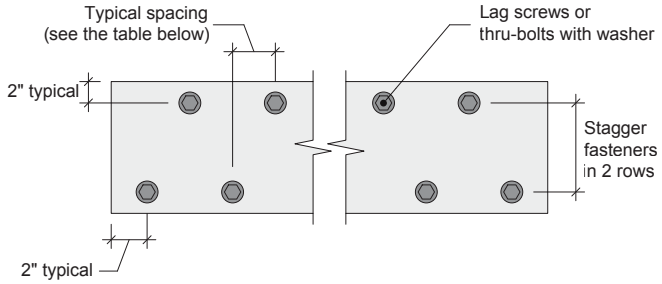
8c



Notes:

1. Attachment of 2x lumber ledgers to rim board - Use 1/2-inch-diameter lag screws (minimum nominal length of 4 inches) or 1/2-inch-diameter through-bolts with washers and nuts. In both cases, use a design value of 350 lbf per fastener (see detail 8d). ***Caution:*** *The lag screw should be inserted in a lead hole by turning with a wrench, not by driving with a hammer. Over-torquing can significantly reduce the lateral capacity of the lag screw and should therefore be avoided. See the National Design Specification (NDS) for Wood Construction published by the American Forest & Paper Association for the appropriate size of clearance and lead holes.*
2. Positively anchoring decks to the primary structure is advised and may be required by the applicable building code. The lateral connection may be in accordance with detail 8e-1 or 8e-2, as appropriate.

8d



Notes:

1. See notes in detail 8c.
2. Lateral resistance of nails applied to the faces of rim board – Calculate the lateral nail resistance based on the procedures given in the NDS, using the dowel bearing strength equivalent to Douglas-fir-Larch.

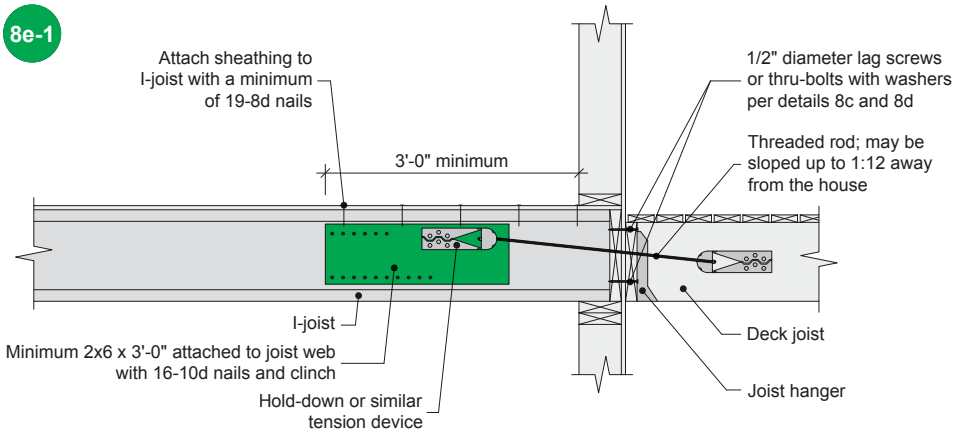
Fastener Spacing for Deck Ledger and Rim Boards using 1/2-inch-diameter Lag Screws or Thru-bolts with 15/32-inch Maximum Sheathing [a]

Deck live load of 40 psf, deck dead load of 10 psf

Rim boards	Joist span (L)			
	10' < L ≤ 12'	12' < L ≤ 14'	14' < L ≤ 16'	16' < L ≤ 18'
	On-center spacing of fasteners [b]			
1-1/8" or thicker	14"	12"	10"	9"

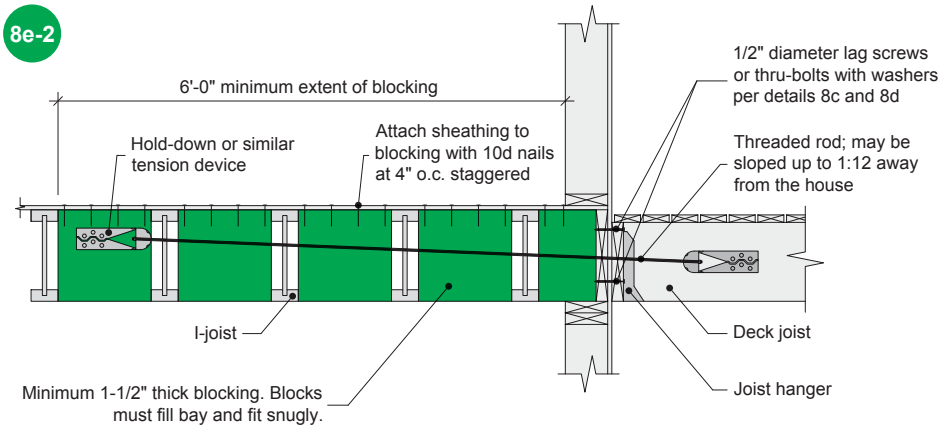
[a] See detail 8c for attachment details. Ledger shall be S-P-F or other wood species with a specific gravity of 0.42 or greater.
[b] Lag screws and thru-bolts shall be staggered in accordance with the above detail.

8e-1



Notes:
1. Decks shall be positively anchored to the primary structure, as per 2018 IRC Section R507.1.
2. Hold-down tension devices shall be provided in not less than two locations within two feet of the edge of the deck, and shall have an allowable stress design capacity of not less than 1,500 lbf, as per 2018 IRC Section R507.2.4.
3. For more details, refer to the AWC Prescriptive Residential Wood Deck Construction Guide.

8e-2



Notes:
1. Decks shall be positively anchored to the primary structure, as per 2018 IRC Section R507.1.
2. Hold-down tension devices shall be provided in not less than two locations within two feet of the edge of the deck, and shall have an allowable stress design capacity of not less than 1,500 lbf, as per 2018 IRC Section R507.2.4.
3. For more details, refer to the AWC Prescriptive Residential Wood Deck Construction Guide.

Rim Board Hole Specifications

The maximum allowable hole size for a rim board shall be 2/3 of the rim board depth, as shown in the table aside. The length of the rim board segment containing a hole shall be at least eight times the hole size.

Application Notes

1. Do not cut holes in rim board installed over openings, such as doors or windows, where the rim board is not fully supported, except that holes of 1-1/2 inch or less in size are permitted provided they are positioned at the mid-depth and in the middle one-third of the span (see note 5 for minimum hole spacing).

2. Field-cut holes should be vertically centered in the rim board and at least one hole diameter or 6 inches, whichever is less, clear distance away from the end of the wall line. Holes should never be placed such that they interfere with the attachment of the rim board to the ends of the floor joist, or any other code-required nailing.

3. While round holes are preferred, rectangle holes may be used providing the corners are not over-cut. Slightly rounding corners by pre-drilling with a 1-inch-diameter bit is recommended.

4. When concentrated loads are present on the rim board (loads not supported by any other vertical-load-carrying members such as squash blocks), holes should not be placed in the rim board within a distance equal to the depth of the rim board from the area of loading.

5. For multiple holes, the clear spacing between holes shall be at least two times the diameter of the larger hole, or twice the length of the longest side of the longest rectangular hole. This minimum hole spacing does not apply to holes of 1-1/2 inch or less in diameter, which can be placed anywhere in the rim board (see note 1 for holes over opening) except that the clear distance to the adjacent hole shall be 3 inches minimum.

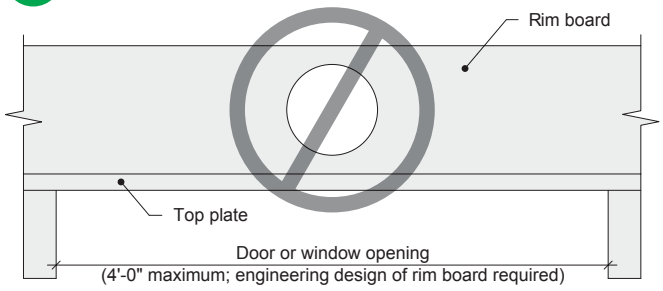
6. All holes shall be cut in accordance with the limitations listed above. See the information for cutting holes under details 6a and 6b.

Rim Board Hole Sizes and Minimum Lengths [a]

Rim board depth (in.)	Maximum allowable hole size (in.) [b]	Minimum length of rim board segment for the maximum allowable hole size (in.) [c]
9-1/2	6-1/4	50
11-7/8	7-3/4	62
14	9-1/4	74
16	10-1/2	84

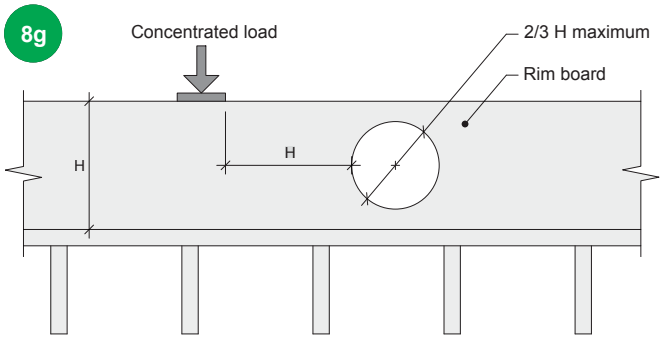
(a) These hole provisions do not apply to rim board installed over openings, such as doors or windows.
(b) The diameter of a round hole or the longer dimension of a rectangular hole.
(c) The length of rim board segment per wall line. For multiple holes, the minimum length of rim board segment shall be eight times the sum of all hole sizes.

8f

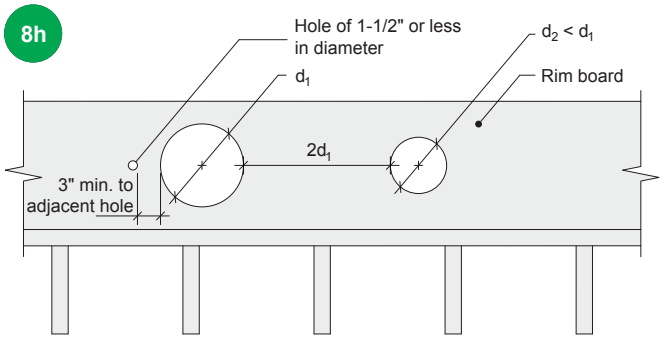


Note:
1. Do not cut holes in rim board over opening except for holes of 1-1/2" or less in size (see application note 1).

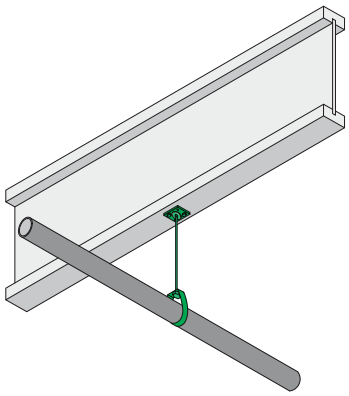
8g

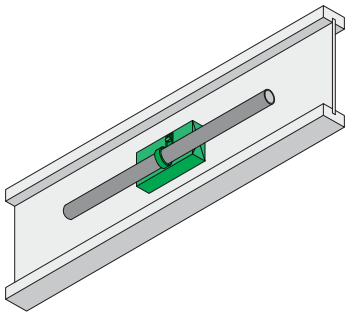


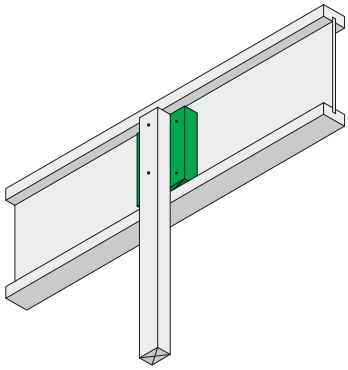
8h

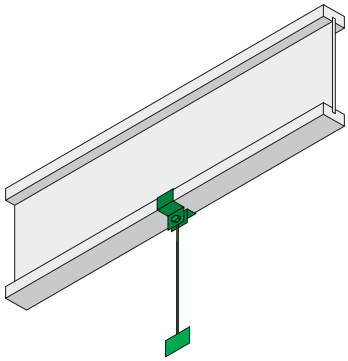


VARIOUS INSTALLATION DETAILS









9

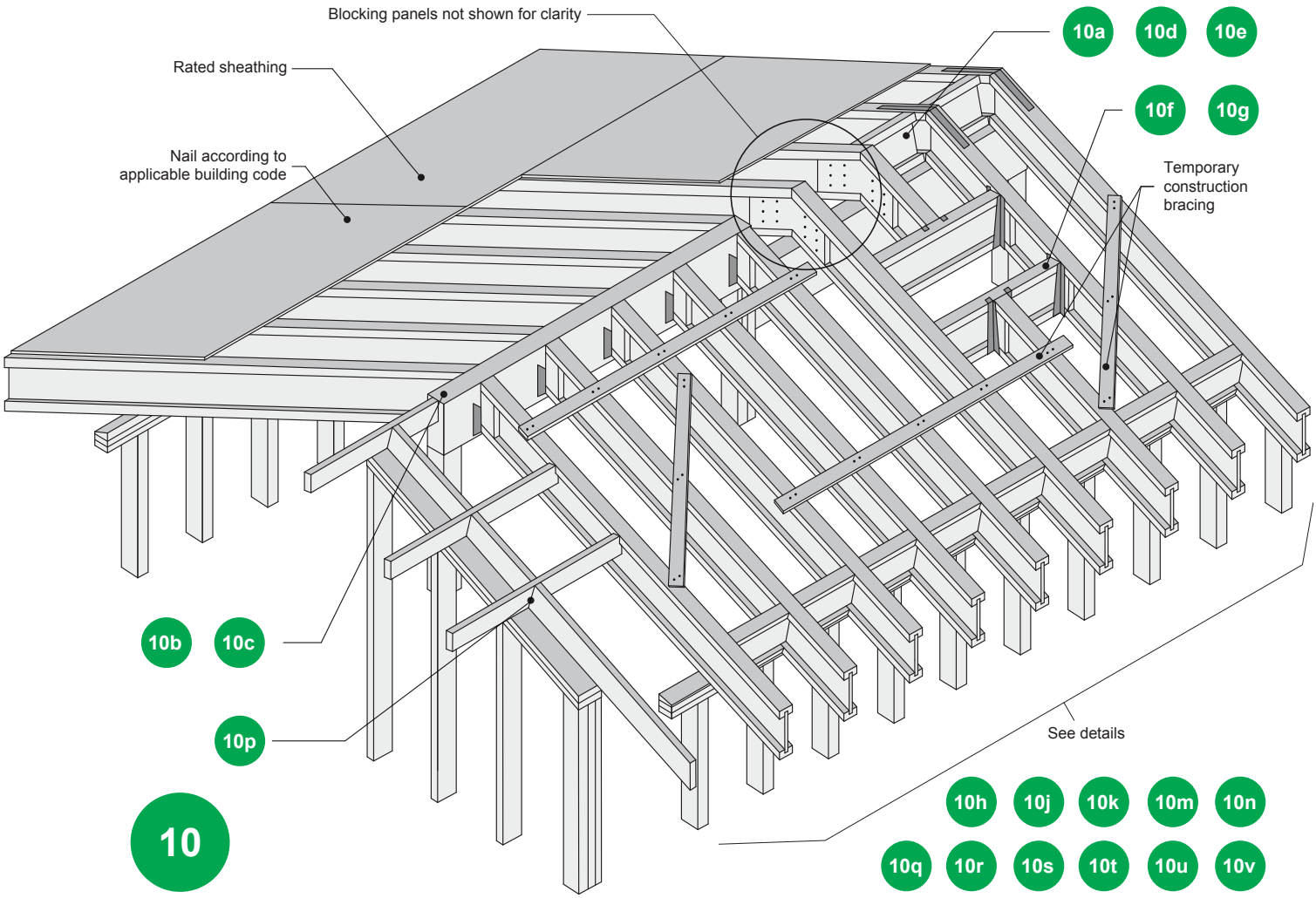
FOR VARIOUS INSTALLATION DETAILS
construction details →DC3

INSTALLATION NOTES

Roof Systems

1. Installation of Nordic I-joists shall be as shown in details 10.
2. Except for cutting to length, or for providing birdsmouth bearings, I-joist flanges should never be cut, drilled, or notched.
3. I-joists are permitted to be birdsmouth cut at the lower end of the joist only. The birdsmouth cut must have full bearing and not overhang the inside face of the plate. Bearing stiffeners are required at the birdsmouth cut on both sides of the web.
4. When beveled bearing plates are used at I-joists supports, I-joist attachment to the bevel plate must be designed to transfer lateral thrust.
5. End bearing length must be at least 1-3/4 inch. For continuous framing and roof framing with cantilevers, the intermediate support and end bearing adjacent to the cantilever must be at least 3-1/2 inches.
6. Ends of roof joists must be restrained at the bearing to prevent rollover. Rim board or I-joist blocking panels are preferred. Cantilever-end blocking must be placed at the support adjacent to the cantilever, and ends of all cantilever extensions must be laterally braced by a fascia board or other similar methods.
7. Continuous lateral support of the I-joist's compression flange is required to prevent rotation and buckling. In simple span roof applications, lateral support of the top flange is normally supplied by the roof sheathing. Bracing of the I-joist's bottom flange is also required at interior supports of multiple-span joists and at the end support next to an overhang. Lateral support of the entire bottom flange may be required in cases of load reversal such as those caused by high wind.
8. Details 10 show only I-joist specific fastener requirements. For other fastener requirements, such as wind uplift requirements or other member attachment details, see the applicable building code.
9. All roof details are valid up to a 12:12 slope unless otherwise noted.
10. Provide adequate ventilation at each joist bay as per detail 10v. Verify roof ventilation and insulation requirements with applicable building code.
11. Refer to typical floor framing installation notes and safety and construction precautions for additional information.

TYPICAL ROOF FRAMING AND CONSTRUCTION DETAILS



FOR ROOF DETAILS
construction details →DC3

Bonus Room

Design Criteria

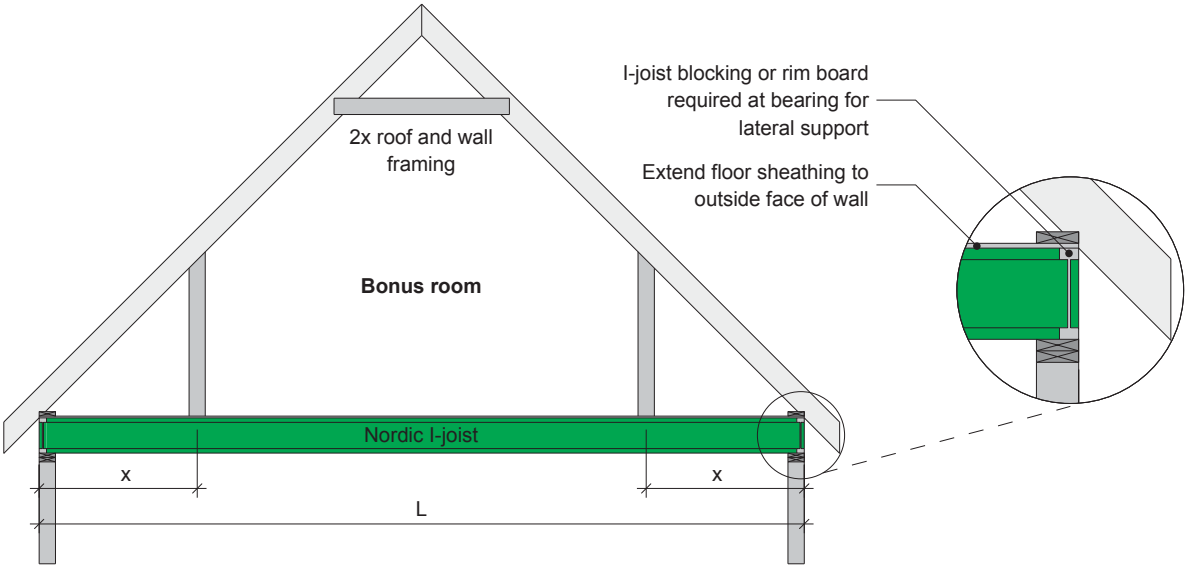
Roof load:	Dead load = 15 psf
Floor loads:	Dead load = 10 psf and live load between/behind knee walls = 40/20 psf
Knee wall load:	Dead load = 40 plf
Deflection limits:	L/480 under live load and L/240 under total load
Roof slope:	Between 8/12 and 12/12
Roof framing:	Straight gable roof

Joist Selection for Bonus Room

Knee wall location	I-joist span	Roof loading							
		Snow load = 30 psf				Snow load = 40 psf			
x	L	On center spacing				On center spacing			
(ft)	(ft)	12"	16"	19.2"	24"	12"	16"	19.2"	24"
4 or less	20	11-7/8" NI-40x	14" NI-40x 11-7/8" NI-80	14" NI-80 11-7/8" NI-80	16" NI-60 14" NI-80	11-7/8" NI-40x	14" NI-40x 11-7/8" NI-80	14" NI-80 11-7/8" NI-80	16" NI-60 14" NI-80
	22	11-7/8" NI-40x	11-7/8" NI-80	14" NI-80	14" NI-80	14" NI-40x 11-7/8" NI-80	16" NI-60 14" NI-80	16" NI-60 14" NI-80	16" NI-80
	24	14" NI-40x 11-7/8" NI-80	14" NI-80	16" NI-60 14" NI-80	16" NI-80	14" NI-40x 11-7/8" NI-80	16" NI-60 14" NI-80	16" NI-80	16" NI-80
	26	14" NI-80	16" NI-60	16" NI-80	-	16" NI-60 14" NI-80	16" NI-80	16" NI-80	-
6 or less	20	11-7/8" NI-40x	14" NI-40x 11-7/8" NI-80	14" NI-80 11-7/8" NI-80	16" NI-60 14" NI-80	11-7/8" NI-40x	11-7/8" NI-80	14" NI-80 11-7/8" NI-80	16" NI-60 14" NI-80
	22	14" NI-40x 11-7/8" NI-80	14" NI-80 11-7/8" NI-80	16" NI-60 14" NI-80	16" NI-80 14" NI-80	14" NI-40x 11-7/8" NI-80	16" NI-60 14" NI-80	16" NI-60 14" NI-80	16" NI-80
	24	14" NI-40x 11-7/8" NI-80	16" NI-60 14" NI-80	16" NI-80	16" NI-80	14" NI-80	16" NI-60 14" NI-80	16" NI-80	-
	26	16" NI-60 14" NI-80	16" NI-80	16" NI-80	-	16" NI-60 14" NI-80	16" NI-80	-	-

Notes:

1. This table is applicable to residential floor construction meeting the above design criteria.
2. Shaded I-joists require web stiffeners at joist ends.
3. Minimum bearing length shall be 3-1/2 inches for end bearings.



NORDIC

TECHNICAL GUIDE
NORDIC JOIST

NS-GT3

VERSION
2024-08-01

BUILDING SCIENCE 4

NORDIC STRUCTURES

GENERAL NOTES

1.0 General

1.1 This document supersedes all previous versions. For the latest version, consult nordic.ca or contact Nordic Structures.

1.2 While this guide emphasizes residential construction, much of the basic design information can be used for other construction applications. Review by a design professional is required for applications beyond the scope of this document.

1.3 For more information, consult nordic.ca or contact Nordic Structures.

2.0 Referenced Documents

2.1 References to Sections are to the 2024 edition of the International Building Code (IBC) or the 2024 edition of the International Residential Code (IRC).

Fire Safety

Introduction

This section provides information on fire safety and regulations for applications including Nordic I-joists. Topics include an introduction to fire safety as well as fire-resistance rated and unrated assemblies.

For more information:

- APA, I-Joist Floor Assemblies
- AWC Code Conforming Wood Design and the IBC
- International Building Code (IBC)
- International Residential Code (IRC)

Wood Construction

Important distinctions exist on different levels between light-frame wood, heavy timber, and mass timber construction, specifically regarding their fire performance behavior.

Light-frame Wood Construction

Light-frame wood construction is defined as construction whose vertical and horizontal structural elements are primarily formed by a system of repetitive wood framing members.

Light-frame wood construction relies on fire-resistant materials that are added as protective layers to the wooden studs and joists. Such layers typically consist of gypsum board, insulation, and structural wood panels.

Heavy Timber Construction

Type IV-HT (Heavy Timber) construction is that type of construction in which the exterior walls are of noncombustible materials and the interior building elements are of solid wood, laminated heavy timber or structural composite lumber (SCL), without concealed spaces or with concealed spaces complying with Section 602.4.4.3. The minimum dimensions for permitted materials including solid timber, glued-laminated timber, SCL and cross-laminated timber (CLT) and the details of Type IV construction shall comply with the provisions of Sections 602.4.4 and 2304.11. Exterior walls complying with Section 602.4.4.1 or 602.4.4.2 shall be permitted. Interior walls and partitions not less than 1-hour fire-resistance rated or heavy timber conforming with Section 2304.11.2.2 shall be permitted.

Given the prescriptive minimum dimensions and construction details, heavy timber construction inherently has a certain degree of fire resistance.

Mass Timber Construction

Mass timber is defined as structural elements of Type IV construction primarily of solid, built-up, panelized or engineered wood products that meet minimum cross-section dimensions of Type IV construction.

During a fire, exposed mass timber chars on the outside, which forms an insulating layer protecting interior wood from damage. Additionally, when the building code requires protection with gypsum board, mass timber can achieve nearly damage-free performance during a contents-fire burnout event. Mass timber is therefore recognized for its excellent fire performance.

Construction Fire Safety

Although less than 2% of building fires occur during construction, this phase presents unique risk scenarios that make any building more vulnerable regardless of material. The IBC provides extensive safety precautions for this phase, but the fires that do occur are often caused when required elements – such as fire doors, smoke alarms and sprinklers – have not been put in place. For this reason, construction site safety includes some unique challenges that are best addressed through education and increased planning. (Source: Think Wood, AWC and WoodWorks)

For more information:

- AWC Code Conforming Wood Design and the IBC (Section 8)
- Construction Fire Safety Coalition

Fire-safe Construction

Fire Resistance

Fire resistance is that property of materials or their assemblies that prevents or retards the passage of excessive heat, hot gases or flames under conditions of use.

Buildings and structures are classified in one of the construction types with limitations on building height, number of stories, and building area, as defined in the building code. Depending on the construction type, the building elements are required to have, or not, a fire-resistance rating, referred as fire-resistance-rated or unrated construction, respectively.

Fire resistance is one of the measures that ensure fire-safe construction. Other measures include fire walls, fire barriers, fire partitions, shaft enclosures, fire-stop systems, automatic sprinkler systems, fire alarm and detection systems, emergency alarm systems, smoke detection systems, and means of egress. For construction requirements, refer to the applicable building code.

Fire-resistance Ratings

Fire-resistance rating is the period of time a building element, component or assembly maintains the ability to confine a fire, continues to perform a given structural function, or both, as determined by the tests, or the methods based on the tests, prescribed in Section 703.

The fire-resistance rating of building elements, components or assemblies is determined in accordance with Section 703.2.1 (Tested assemblies) or 703.2.2 (Analytical methods) without the use of automatic sprinklers or any other fire suppression system being incorporated, or in accordance with Section 104.2.3 (Approved alternate method).

Tested Assemblies

A fire-resistance rating of building elements, components or assemblies is determined by the test procedures set forth in ASTM E119 or UL 263. The fire-resistance rating of penetrations and fire-resistant joint systems is determined in accordance with Sections 714 and 715, respectively.

The ASTM E119 and UL 263 test methods prescribe a standard fire exposure, controlled by the time-temperature curve shown in Figure 4.1, for comparing the test results of building construction assemblies.

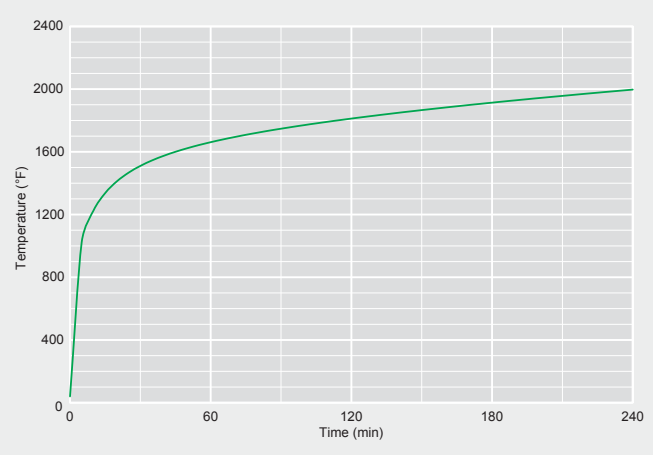


Figure 4.1 Time-temperature curve as per ASTM E119 and UL 263

In obtaining an assembly classification, the following conditions shall be met:

1. The test specimen shall have sustained the applied load during the classification period without developing unexposed surface conditions which will ignite cotton waste. [Structural resistance (a) and integrity (b) on Figure 4.2]
2. The transmission of heat through the test specimen during the classification period shall not raise the average temperature on its unexposed surface more than 250°F above its initial temperature. [Insulation (c) on Figure 4.2]

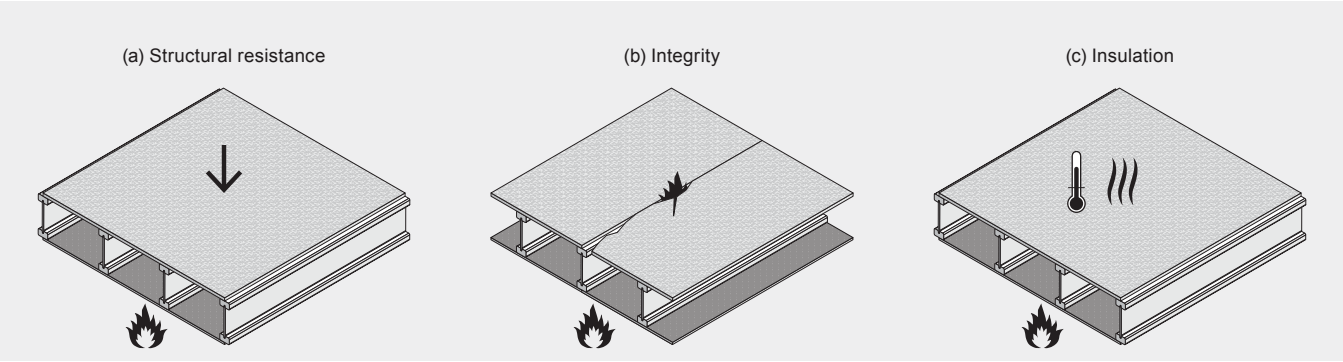


Figure 4.2 Fire resistance criteria per ASTM E119 and UL 263

Analytical Methods
The fire resistance of building elements, components or assemblies established by an analytical method shall be by any of the methods listed in this section, based on the fire exposure and acceptance criteria specified in ASTM E119 or UL 263.

1. Fire-resistance designs documented in approved sources.
2. Prescriptive designs of fire-resistance-rated building elements, components or assemblies as prescribed in Section 721.
3. Calculations in accordance with Section 722, which include:
   - Component Additive Method (CAM) [Section 722.6]
   - Exposed wood members and wood decking calculated in accordance with Chapter 16 of ANSI/AWC NDS [Section 722.1].
4. Engineering analysis based on a comparison of building element, component or assemblies designs having fire-resistance ratings as determined by the test procedures set forth in ASTM E119 or UL 263.
5. Fire-resistance designs certified by an approved agency.

Approved Alternate Method
The fire resistance of building elements, components or assemblies not complying with Section 703.2.1 (Tested assemblies) or 703.2.2 (Analytical methods) shall be permitted to be established by an alternative protection method in accordance with Section 104.2.3.

In other words, one method for code-conforming wood design and construction is to adhere to tested or prescriptive floor-ceiling or roof-ceiling assemblies that have been assigned a fire-resistance rating (see Fire Protection for prescriptive designs). Fire resistance may also be calculated in accordance with Section 722. This includes the Component Additive Method (CAM), which adds the time assigned of individual components and is further discussed in AWC DCA4. Additionally, exposed wood members and wood decking can be calculated with Chapter 16 of ANSI/AWC NDS, based on the char rate. Additional information can be found in AWC TR10 and the FDS. Lastly, a performance-based fire safety design approach may be considered (Approved alternate method).

For more information:

- AWC DCA4, Component Additive Method (CAM) for Calculating and Demonstrating Assembly Fire Resistance
- AWC FDS, Fire Design Specification
- AWC NDS, National Design Specification (NDS) for Wood Construction (Chapter 16)
- AWC TR10, Calculating the Fire Resistance of Wood Members and Assemblies

Fire Protection

Introduction

Active fire protection equipment systems perform the functions of detecting a fire, alerting the occupants or fire department of a fire emergency, mass notification, gas detection, controlling smoke and controlling or extinguishing the fire (e.g., Automatic Sprinkler Systems). Generally, the requirements are based on the occupancy, the height, and the area of the building, as these are the factors that most affect fire-fighting capabilities and the relative hazard of a specific building or portion thereof.

Passive fire protection is an integral component of building safety. Components and systems are intended to contain fires or slow the spread of fires through the use of fire-resistant building elements and open space.

Automatic Sprinkler Systems

I-joists are often used in conjunction with both steel and chlorinated polyvinyl chloride (CPVC) sprinkler systems. The documents below provide some basic guidance on appropriate methods of attachment of steel and CPVC sprinkler systems to I-joists. All designs should be checked by a design professional to assure the adequacy of not only the hangers and fasteners used but the capacity of the I-joists themselves.

- APA J745, Sprinkler Pipe Installation for APA Performance Rated I-Joists
- APA J745SUP, Sprinkler Pipe Installation Design Details
- NS-DC3, Construction Details (Details 9)

I-joists in Fire-rated Assemblies

Numerous fire-rated assemblies incorporate I-joists and wood structural panels. The references below contain prescriptive details of fire-resistance-rated building elements, components or assemblies. Nordic floor-ceiling and roof-ceiling fire-rated assemblies are illustrated in the APA Product Report PR-S274.

- 2024 IBC, Section 721, Table 721.1(3), Minimum Protection for Floor and Roof Systems (Floor or Roof Constructions 21, 23 to 28, and 30)
- AWC DCA3, Fire-Resistance-Rated Wood-Frame Wall and Floor/Ceiling Assemblies (Details WIJ-1.1 to WIJ-1.7, and WIJ-2.1)
- APA PR-S274, Fire-Rated Assemblies (Nordic Structures)

Rim Board in Fire-rated Assemblies

When fire-rated walls or floor-ceiling assemblies are required, a fire barrier over the walls is typically necessary to prevent flames from escaping the confinement provided by the wall or ceiling assembly. The barrier may be in the form of continuous rim board on top of the wall and parallel with the floor joists or as continuous rim board along the top of the wall and perpendicular to the joists. The references below provides fire-resistant rim board assemblies.

- APA D350, APA Rim Board in Fire-Rated Assemblies
- AWC DCA3, Fire-Resistance-Rated Wood-Frame Wall and Floor/Ceiling Assemblies

Flame Spread and Smoke-developed Indices

The IBC prescribes interior finish requirements based on occupancy, group, presence of sprinklers and location designated. Interior wall and ceiling finish materials are classified in accordance with ASTM E84 or UL 723, and grouped in the classes A, B, and C in accordance with their flame spread and smoke-developed indices. [Section 803.13]

The flame spread index is a comparative measure, expressed as a dimensionless number, derived from visual measurements of the spread of flame versus time for a material tested in accordance with ASTM E84 or UL 723.

The smoke-developed index is a comparative measure, expressed as a dimensionless number, derived from measurements of smoke obscuration versus time for a material tested in accordance with ASTM E84 or UL 723.

Heavy timber exception – Exposed portions of building elements complying with the requirements for buildings of heavy timber construction are not subject to interior finish requirements except in interior exit stairways, interior exit ramps, and exit passageways.

Table 4.1 shows the relevant flame spread and smoke-developed indices.

Table 4.1 – Flame Spread and Smoke-developed Indices

Product	Flame spread index	Smoke-developed index	Class	Source
Black Spruce	45	250	B	AWC DCA1
OSB 3/8”	100	95	C	AWC DCA1, APA TT-010
OSB 7/16”	115-155	75-130	C	AWC DCA1, APA TT-010
Nordic Lam, widths ≥ 3-3/8”	0-25	0-450	A	APA PR-L294
Nordic Lam, widths < 3-3/8”	26-75	0-450	B	APA PR-L294

For more information:

- AWC Code Conforming Wood Design and the IBC (Section 6)
- AWC DCA1, Flame Spread Performance of Wood Products Used for Interior Finish
- APA Technical Topics TT-010, Flame Spread Index of APA Performance-Rated Wood Structural Panels
- APA Product Report PR-L294, Nordic Lam (Section 5)

Fire Protection of Floors

The International Residential Code (IRC) include provisions to enhance the fire performance of floor systems. For example, Section R302.13 requires that all residential floor assemblies, with a few exceptions, be covered with gypsum board or have some other means of fire protection.

Code Requirements

Floor assemblies that are not required elsewhere in the IRC to be fire-resistance rated shall be provided with a 1/2-inch gypsum wallboard membrane, 5/8-inch wood structural panel membrane, or equivalent on the underside of the floor framing member. Penetrations or openings for ducts, vents, electrical outlets, lighting, devices, luminaires, wires, speakers, drainage, piping and similar openings or penetrations shall be permitted.

Exceptions:

1. Floor assemblies located directly over a space protected by an automatic sprinkler system in accordance with Section P2904, NFPA 13D, or other approved equivalent sprinkler system.
2. Floor assemblies located directly over a crawl space not intended for storage or for the installation of fuel-fired or electric-powered heating appliances.
3. Portions of floor assemblies shall be permitted to be unprotected where complying with the following:
   - 3.1 The aggregate area of the unprotected portions does not exceed 80 square feet per story.
   - 3.2 Fire-blocking in accordance with Section R302.11.1 is installed along the perimeter of the unprotected portion to separate the unprotected portion from the remainder of the floor assembly.
4. Wood floor assemblies using dimension lumber or structural composite lumber equal to or greater than 2-inch by 10-inch nominal dimension, or other approved floor assemblies demonstrating equivalent fire performance.
5. Wood floor assemblies less than 600 square feet within detached accessory structures with no habitable space above them.

Code-compliant Solutions

The AWC has published a guide regarding Exception 1 entitled *Design Guide for Installing Partial Sprinkler Protection in Unfinished Basement Areas*. Other resources are listed under Automatic Sprinkler Systems.

The APA has published code-compliant options described in APA System Report SR-405 and APA R425.

Nordic I-joists, when installed and protected as specified in APA System Report SR-405 or FP-11 in APA Product Report PR-S274, have demonstrated fire performance equivalent to 2-inch by 10-inch nominal dimension sawn lumber prescribed in Exception 4. As outlined in Section 5 of APA Product Report PR-L294, 1-1/2-inch width 13F-1.7E Nordic Lam glulam joists also meet the criteria specified in Exception 4.

For more information:

- APA R425, Fire Protective Options for I-Joist Floor Systems
- APA System Report SR-405, Fire Protection of Floors Constructed with Prefabricated Wood I-Joists for Compliance with the International Residential Code
- AWC Design Guide for Installing Partial Sprinkler Protection in Unfinished Basement Areas
- APA Product Report PR-L294, Nordic Lam
- APA Product Report PR-S274, Fire-rated Assemblies (Nordic Structures)

Fire Facts Qs & As

Can a fire-protective coating be used with Nordic I-joists?

Given the proprietary nature of almost all fire coatings, it is APA's position that the APA trademark is applicable only to the base product and does not apply after the application of the fire protective coating. Certification and inspection of such fire protective coatings are outside the scope of APA. The performance characteristics of the APA-trademarked engineered wood product after application of the proprietary fire protective coatings are the responsibility of the fire protective coating company and its certification agency.

Nordic I-joists are identified with the trademark of APA, in accordance with the APA Quality Assurance Program. APA is a not-for-profit trade association and is accredited by the ANSI National Accreditation Board (ANAB) as an inspection agency under ISO/IEC 17020 and as a testing laboratory under ISO/IEC 17025.

For more information:

- APA Technical Topics TT-126, Applicability of APA Trademarks on Engineered Wood Products Surface-Coated with Fire Protective Coating

Do adhesives used in Nordic products increase smoke toxicity?

No; testing shows that the difference in smoke toxicity between natural solid wood and engineered wood products is insignificant. However, smoke produced during the burning of most materials, wood products included, is toxic. Smoke inhalation is the leading cause of death in a fire event. The most important life-saving strategy in a fire is its containment, as well as that of smoke, for as long as possible, and a quick evacuation of the building.

Acoustics

Requirements

The IBC and the IRC provide two parameters to establish minimum acoustical requirements: Sound Transmission Class (STC) and Impact Insulation Class (IIC). Compliance with these requirements may be demonstrated either through testing or through engineering analysis based on empirical test data from other similar assemblies.

Detailed descriptions for STC and IIC ratings are provided in the following document:

- APA W460, Design/Construction Guide: Noise-Rated Systems

Floor Assemblies

The construction assemblies presented in the documents below have been tested and evaluated for their acoustic performance according to standard test methods by recognized acoustical laboratories. Some assemblies contain proprietary products, so test sponsors should be contacted for additional construction details.

- APA T230, Acoustic Performance of All-Wood Floor Systems
- AWC DCA3, Fire-Resistance-Rated Wood-Frame Wall and Floor/Ceiling Assemblies (Details WIJ-1.1 to WIJ-1.7, and WIJ-2.1)
- APA PR-S274, Fire-Rated Assemblies (Nordic Structures)

Analytical Method

AWC TR15 shows how to use an empirical model for compliance, which may be used for analysis of wood-frame floor-ceiling assemblies to estimate the code-regulated STC and IIC sound transmission parameters:

- AWC TR15, Calculation of Sound Transmission Parameters for Wood-Framed Assemblies

Weathered I-joists

Intended Use

I-joists are intended for use in dry-service conditions in which the average equilibrium moisture content of solid-sawn lumber is less than 16%.

While the products will withstand normal exposure, excessive exposure during distribution, storage or construction may lead to dimensional changes that affect serviceability. These changes include cupping, bowing or expansion to dimensions beyond the specified tolerance of the product in the as-manufactured condition. Excessive moisture exposure can cause I-joist webs to swell which can split the lumber flanges. Prolonged periods of high moisture may also support the growth of wood decay fungi, another reason for which it is important to follow proper methods of design, handling, installation and maintenance to protect wood building materials from moisture.

I-joist Components

Adhesives

Adhesives used in I-joists conform to the requirements of ASTM D2559, meaning the adhesives are suitable for the bonding of wood into structural laminated wood products (I-joists) for general construction where a high-strength, waterproof adhesive bond is required.

Flanges

Simple exposure to sun and rain causes wood to change color, usually first darkening or yellowing due to sunlight, then eventually weathering to a silver grey. In all these cases of non-biological staining, the wood has not been harmed and no action is required.

In addition, a study on the effects of limited outdoor exposure on properties of I-joists has shown that exterior exposure has no negative effect on tension properties.

Webs

I-joist webs are made from Exposure 1 OSB panels, which refers to a bond classification suitable for uses not permanently exposed to the weather. Panels classified as Exposure 1 are intended to resist the effects of moisture due to construction delays, or other conditions of similar severity.

The effects of exterior exposure on flexural properties of I-joists are significant after a prolonged period of exposure. It has been shown that swelling of the OSB webs caused by wetting is the primary cause of strength loss.

Recommendations

In conclusion, I-joists are intended for dry-use applications because water absorption can lead to swelling, deformation, and losses in material properties. However, when I-joists are exposed to normal jobsite wetting and then dried to long-term moisture conditions, the structural properties are not compromised. Furthermore, the short exposure during normal construction is not sufficient for decay.

In all other cases, such as significative swelling of the OSB, the effects of weathering on I-joists should be assessed by a designer competent in engineered wood products, and the professional will take over the responsibility and warranty for the products being evaluated.

The design and installation of Nordic I-joists should be in accordance with the recommendations and construction details published in Chapter 3. Also, it is important to minimize excessive moisture exposure with proper storage and handling as shown in Chapter 6.

For more information:

- APA A525, Build A Better Home: Controlling Mold and Mildew
- ASTM D2559, Standard Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure Conditions

NORDIC

TECHNICAL GUIDE
NORDIC JOIST

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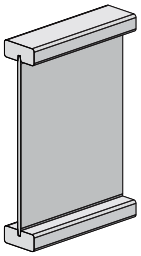
LIGHT-COMMERCIAL I-JOISTS 5

NORDIC
STRUCTURES

Nordic Joist – Design Properties

Products



NI-80x

2×4 2100f MSR
7/16 in. web

Depths
18, 20, 22 and 24 in.

23 pieces per unit

Refer to Chapter 2 for I-joists designed for residential applications.

Design Properties

Joist depth	Joist series	EI [a]	M [b]	V [c]	3-1/2" Bearing		5-1/2" Bearing		1-3/4" Bearing		4" Bearing		K [f]	Weight
					IR [d]	IR [d] w/ BS	IR [d]	IR [d] w/ BS	ER [e]	ER [e] w/ BS	ER [e]	ER [e] w/ BS		
		(10^6 lbf-in.^{2})	(lbf-ft)	(lbf)	(lbf)	(lbf)	(lbf)	(lbf)	(lbf)	(lbf)	(lbf)	(lbf)	(10^6 lbf)	(plf)
18"	NI-80x	1,399	10,990	2,360	3,115	3,820	3,280	4,420	1,300	1,900	1,850	2,360	9.36	4.45
20"	NI-80x	1,771	12,315	2,450	3,190	4,120	3,410	4,575	1,320	2,045	1,900	2,450	10.40	4.75
22"	NI-80x	2,191	13,645	2,530	3,265	4,425	3,535	4,730	1,340	2,195	1,950	2,530	11.44	5.05
24"	NI-80x	2,660	14,975	2,600	3,340	4,725	3,665	4,885	1,360	2,340	2,000	2,600	12.48	5.25

a) Bending stiffness, EI, of the I-joist.

b) Bending moment capacity, M, of the I-joist.

c) Shear capacity, V, of the I-joist.

d) Intermediate reaction capacity, IR, of the I-joist with and without bearing stiffeners (BS). Minimum bearing length shall be 3-1/2 inches for intermediate bearings. Interpolation of the resistance between 3-1/2-inch and 5-1/2-inch bearing is permitted.

e) End reaction capacity, ER, of the I-joist with and without bearing stiffeners (BS). Minimum bearing length shall be 1-3/4 inch for end bearings. Interpolation of the resistance between 1-3/4-inch and 4-inch bearing is permitted.

f) Coefficient of shear deflection, K. For calculating uniform load and center-point load deflections of the I-joist in a simple-span application, use equations (1) and (2).

(1) Uniform load: $$\delta = \frac{5w\ell^4}{384EI} + \frac{w\ell^2}{K}$$

(2) Center-point load: $$\delta = \frac{P\ell^3}{48EI} + \frac{2P\ell}{K}$$

Where:

δ = calculated deflection (in.)
ℓ = design span (in.)
EI = bending stiffness of the I-joist (lbf-in.^{2})
K = coefficient of shear deflection (lbf)
w = uniform load (lbf/in.)
P = concentrated load (lbf)

Notes:

1. The tabulated design values are for normal duration of loading (C_D = 1.0).
2. The vertical (bearing) linear load capacity without bearing stiffeners is 1,275 lbf/ft for NI-80x up to 24 inches.
3. Design of I-joists shall be in accordance with the NDS.

Allowable Floor Spans

Design Criteria

Load:	Live load = 40 psf
Deflection limits:	L/480 under live load and L/240 under total load
Sheathing:	APA Rated Sheathing or APA Rated Sturd-I-Floor, nailed-glued

Allowable Floor Spans

Dead load = 15 psf

Joist depth	Joist series	Simple span On center spacing				Multiple spans On center spacing			
		12"	16"	19.2"	24"	12"	16"	19.2"	24"
18"	NI-80x	34'-0"	31'-0"	29'-2"	27'-2"	37'-1"	33'-9"	31'-5"	28'-1"
20"	NI-80x	36'-10"	33'-6"	31'-7"	29'-5"	40'-2"	36'-5"	33'-3"	29'-9"
22"	NI-80x	39'-6"	36'-0"	33'-11"	31'-4"	43'-1"	38'-4"	25'-0"	31'-3"
24"	NI-80x	42'-2"	38'-5"	36'-2"	32'-10"	46'-0"	40'-2"	36'-8"	32'-9"

Dead load = 25 psf

Joist depth	Joist series	Simple span On center spacing				Multiple spans On center spacing			
		12"	16"	19.2"	24"	12"	16"	19.2"	24"
18"	NI-80x	34'-0"	31'-0"	28'-11"	25'-10"	36'-7"	31'-8"	28'-10"	25'-9"
20"	NI-80x	36'-10"	33'-6"	30'-8"	27'-5"	38'-9"	33'-6"	30'-7"	27'-4"
22"	NI-80x	39'-6"	35'-4"	32'-3"	28'-10"	40'-9"	35'-3"	32'-2"	28'-9"
24"	NI-80x	42'-2"	37'-0"	33'-10"	30'-3"	42'-9"	37'-0"	33'-9"	29'-10"

Dead load = 35 psf

Joist depth	Joist series	Simple span On center spacing				Multiple spans On center spacing			
		12"	16"	19.2"	24"	12"	16"	19.2"	24"
18"	NI-80x	34'-0"	29'-6"	26'-11"	24'-1"	34'-0"	29'-5"	26'-10"	23'-4"
20"	NI-80x	36'-1"	31'-3"	28'-6"	25'-6"	36'-0"	31'-2"	28'-5"	24'-2"
22"	NI-80x	38'-0"	32'-11"	30'-0"	26'-10"	37'-11"	32'-10"	29'-11"	25'-0"
24"	NI-80x	39'-10"	34'-6"	31'-5"	28'-1"	39'-9"	34'-5"	31'-5"	25'-10"

Notes:

1. The tabulated clear spans are applicable to floor construction meeting the above design criteria and are based on a sheathing thickness of 19/32 inch (40/20 or 20 oc) for a joist spacing of 19.2 inches or less, or 23/32 inch (48/24 or 24 oc) for a joist spacing of 24 inches.
2. For multiple-span applications, the end spans shall be 40% or more of the adjacent span.
3. Minimum bearing length shall be 1-3/4 inch for end bearings and 3-1/2 inches for intermediate bearings, except for shaded areas, which shall be 3-1/2 inches for end bearings and 5-1/2 inches for intermediate bearings.
4. Bearing stiffeners are not required when I-joists are used in accordance with this table, except for underlined clear spans and as required for hangers.

Design Criteria

Load:	Live load = 50 psf
Deflection limits:	L/480 under live load and L/240 under total load
Sheathing:	APA Rated Sheathing or APA Rated Sturd-I-Floor, nailed-glued

Allowable Floor Spans

Dead load = 15 psf

Joist depth	Joist series	Simple span On center spacing				Multiple spans On center spacing			
		12"	16"	19.2"	24"	12"	16"	19.2"	24"
18"	NI-80x	31'-5"	28'-7"	26'-11"	25'-1"	34'-3"	31'-2"	28'-10"	25'-9"
20"	NI-80x	34'-0"	31'-0"	29'-2"	27'-1"	37'-1"	33'-6"	30'-7"	27'-4"
22"	NI-80x	36'-7"	33'-3"	31'-4"	28'-10"	39'-10"	35'-3"	32'-2"	28'-9"
24"	NI-80x	39'-0"	35'-6"	33'-5"	30'-3"	42'-6"	37'-0"	33'-9"	29'-10"

Dead load = 25 psf

Joist depth	Joist series	Simple span On center spacing				Multiple spans On center spacing			
		12"	16"	19.2"	24"	12"	16"	19.2"	24"
18"	NI-80x	31'-5"	28'-7"	26'-11"	24'-1"	34'-0"	29'-5"	26'-10"	23'-4"
20"	NI-80x	34'-0"	31'-0"	28'-6"	25'-6"	36'-0"	31'-2"	28'-5"	24'-2"
22"	NI-80x	36'-7"	32'-11"	30'-0"	26'-10"	37'-11"	32'-10"	29'-11"	25'-0"
24"	NI-80x	39'-0"	34'-6"	31'-5"	28'-1"	39'-9"	34'-5"	31'-5"	25'-10"

Dead load = 35 psf

Joist depth	Joist series	Simple span On center spacing				Multiple spans On center spacing			
		12"	16"	19.2"	24"	12"	16"	19.2"	24"
18"	NI-80x	31'-5"	27'-8"	25'-3"	22'-2"	31'-11"	27'-8"	25'-2"	20'-7"
20"	NI-80x	33'-11"	29'-4"	26'-9"	23'-11"	33'-10"	29'-3"	26'-8"	21'-4"
22"	NI-80x	35'-8"	30'-11"	28'-2"	25'-2"	35'-7"	30'-10"	27'-7"	22'-0"
24"	NI-80x	37'-5"	32'-4"	29'-6"	26'-5"	37'-4"	32'-4"	28'-6"	22'-9"

Notes:

1. The tabulated clear spans are applicable to floor construction meeting the above design criteria and are based on a sheathing thickness of 19/32 inch (40/20 or 20 oc) for a joist spacing of 19.2 inches or less, or 23/32 inch (48/24 or 24 oc) for a joist spacing of 24 inches.
2. For multiple-span applications, the end spans shall be 40% or more of the adjacent span.
3. Minimum bearing length shall be 1-3/4 inch for end bearings and 3-1/2 inches for intermediate bearings, except for shaded areas, which shall be 3-1/2 inches for end bearings and 5-1/2 inches for intermediate bearings.
4. Bearing stiffeners are not required when I-joists are used in accordance with this table, except for underlined clear spans and as required for hangers.

Allowable Roof Spans

Design Criteria

Span:	Simple
Load:	Dead load = 20 psf
Deflection limits:	L/240 under snow load
	L/180 under total load

Allowable Roof Spans

Snow load = 30 psf

Joist depth	Joist series	Slope of 1/4:12 to 4:12 On center spacing			Slope of >4:12 to 8:12 On center spacing			Slope of >8:12 to 12:12 On center spacing		
		12"	16"	24"	12"	16"	24"	12"	16"	24"
18"	NI-80x	37'-9"	34'-2"	29'-8"	35'-7"	32'-2"	27'-11"	32'-11"	29'-9"	25'-10"
20"	NI-80x	40'-11"	37'-0"	32'-1"	38'-6"	34'-10"	30'-3"	35'-7"	32'-3"	28'-0"
22"	NI-80x	43'-11"	39'-9"	34'-6"	41'-4"	37'-5"	32'-6"	38'-3"	34'-8"	30'-1"
24"	NI-80x	46'-11"	42'-6"	36'-6"	44'-2"	40'-0"	34'-9"	40'-10"	37'-0"	32'-2"

Snow load = 40 psf

Joist depth	Joist series	Slope of 1/4:12 to 4:12 On center spacing			Slope of >4:12 to 8:12 On center spacing			Slope of >8:12 to 12:12 On center spacing		
		12"	16"	24"	12"	16"	24"	12"	16"	24"
18"	NI-80x	35'-6"	32'-1"	27'-10"	33'-6"	30'-4"	26'-4"	31'-2"	28'-2"	24'-6"
20"	NI-80x	38'-5"	34'-9"	30'-2"	36'-4"	32'-10"	28'-6"	33'-9"	30'-6"	26'-6"
22"	NI-80x	41'-4"	37'-4"	31'-10"	39'-0"	35'-4"	30'-8"	36'-3"	32'-10"	28'-6"
24"	NI-80x	44'-1"	39'-11"	33'-4"	41'-8"	37'-8"	32'-7"	38'-8"	35'-0"	30'-5"

Snow load = 50 psf

Joist depth	Joist series	Slope of 1/4:12 to 4:12 On center spacing			Slope of >4:12 to 8:12 On center spacing			Slope of >8:12 to 12:12 On center spacing		
		12"	16"	24"	12"	16"	24"	12"	16"	24"
18"	NI-80x	33'-1"	29'-10"	25'-10"	31'-9"	28'-8"	24'-10"	29'-8"	26'-11"	23'-4"
20"	NI-80x	35'-10"	32'-4"	28'-0"	34'-4"	31'-1"	26'-11"	32'-2"	29'-1"	25'-3"
22"	NI-80x	38'-6"	34'-9"	29'-6"	36'-11"	33'-5"	28'-10"	34'-7"	31'-3"	27'-2"
24"	NI-80x	41'-1"	37'-2"	30'-11"	39'-5"	35'-8"	30'-3"	36'-11"	33'-5"	29'-0"

Notes:

1. The tabulated spans are based on the horizontal distance between inside face of supports and are applicable to roof construction meeting the above design criteria.
2. Minimum bearing length shall be 1-3/4 inch for end bearings and 3-1/2 inches for intermediate bearings.
3. Bearing stiffeners are not required when I-joists are used in accordance with this table, except for underlined spans and as required for hangers.

Allowable Uniform Loads

Allowable Uniform Floor Loads (plf)

Joist depth	Joist series	Criteria	Clear span (ft)											
			8	10	12	14	16	18	20	22	24	26	28	30
18"	NI-80x	Live load (L/480)									97	77	63	52
		Total load (L/240)	303	243	203	175	153	136	123	112	102	95	88	82
20"	NI-80x	Live load (L/480)											79	65
		Total load (L/240)	310	249	208	179	157	140	126	114	105	97	90	84
22"	NI-80x	Live load (L/480)												79
		Total load (L/240)	317	255	213	183	161	143	129	117	107	99	92	86
24"	NI-80x	Live load (L/480)												
		Total load (L/240)	325	261	218	187	164	146	132	120	110	101	94	88

Allowable Uniform Roof Loads (plf)

Joist depth	Joist series	Criteria	Clear span (ft)											
			8	10	12	14	16	18	20	22	24	26	28	30
18"	NI-80x	Snow load (L/240)												
		Total load (L/180)	348	280	234	201	176	157	141	128	118	109	101	94
20"	NI-80x	Snow load (L/240)												
		Total load (L/180)	357	287	240	206	180	161	145	132	121	111	104	97
22"	NI-80x	Snow load (L/240)												
		Total load (L/180)	365	293	245	211	185	164	148	135	124	114	106	99
24"	NI-80x	Snow load (L/240)												
		Total load (L/180)	373	300	251	216	189	168	151	138	126	117	108	101

Notes:

1. The tabulated values may be used for simple or multiple spans.
2. For multiple-span applications, the end spans shall be 40% or more of the adjacent span.
3. I-joist shall satisfy both live or snow load and total load. Where the live or snow load is blank, the total load governs the design.
4. I-joist shall be laterally supported at points of bearing and along all compression edges.
5. Minimum bearing length shall be 1-3/4 inch for end bearings and 3-1/2 inches for intermediate bearings.
6. Bearing stiffeners are not required when I-joists are used in accordance with these tables, except as required for hangers.
7. Allowable uniform floor loads take into account a live load deflection limit of L/480 and a total load deflection limit of L/240. Allowable uniform roof loads take into account a snow load deflection limit of L/240 and a total load deflection limit of L/180. Final design shall include a complete analysis including the verification of the bending moment and shear capacities.
8. For a live load deflection limit of L/360, multiply live load values by 1.33. For a snow load deflection limit of L/360, multiply snow load values by 0.67.
9. For double joists, double the table values and nail joists together per detail 1p.

Bonus Room

Design Criteria

Roof load:	Dead load = 15 psf
Floor loads:	Dead load = 10 psf and live load between/behind knee walls = 40/20 psf
Knee wall load:	Dead load = 40 plf
Deflection limits:	L/480 under live load and L/240 or 3/4 in. under total load, whichever is worse
Roof slope:	Between 8/12 and 12/12
Roof framing:	Straight gable roof

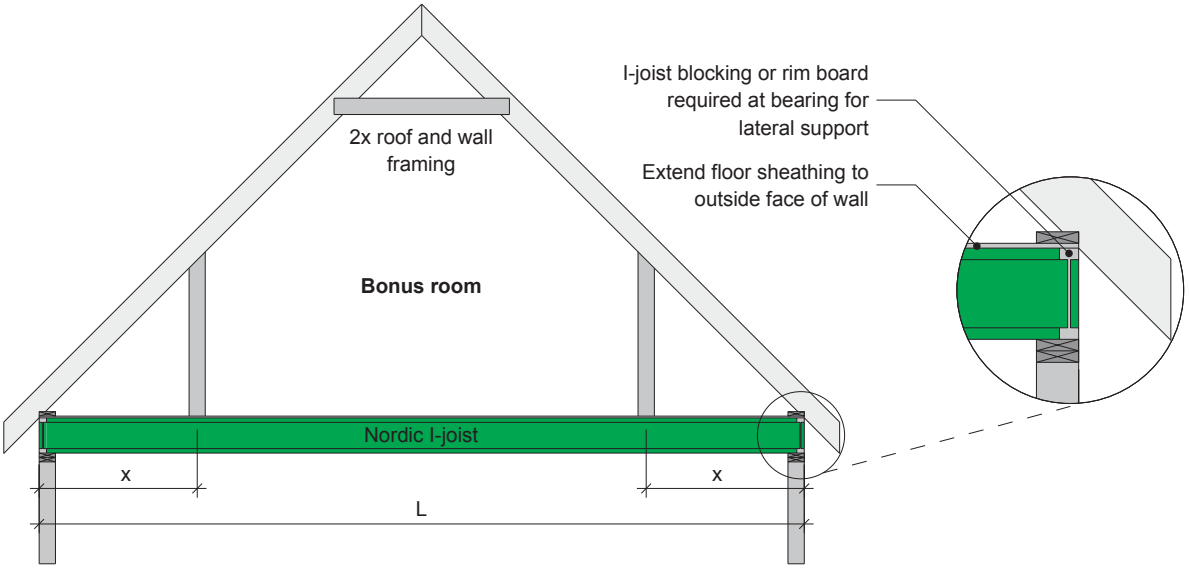
Joist Selection for Bonus Room

Knee wall location	I-joist span	Roof loading							
		Snow load = 30 psf				Snow load = 40 psf			
x	L	On center spacing				On center spacing			
(ft)	(ft)	12"	16"	19.2"	24"	12"	16"	19.2"	24"
4 or less	28	18" NI-80x	18" NI-80x	18" NI-80x	22" NI-80x	18" NI-80x	18" NI-80x	18" NI-80x	22" NI-80x [a]
	30	18" NI-80x	18" NI-80x	20" NI-80x	24" NI-80x	18" NI-80x	18" NI-80x	20" NI-80x	-
	32	18" NI-80x	20" NI-80x	22" NI-80x	-	18" NI-80x	20" NI-80x	22" NI-80x	-
	34	18" NI-80x	22" NI-80x	24" NI-80x	-	20" NI-80x	22" NI-80x	24" NI-80x [a]	-
	36	20" NI-80x	22" NI-80x	-	-	20" NI-80x	24" NI-80x	-	-
6 or less	28	18" NI-80x	18" NI-80x	18" NI-80x	22" NI-80x	18" NI-80x	18" NI-80x	20" NI-80x	22" NI-80x [a]
	30	18" NI-80x	18" NI-80x	20" NI-80x	24" NI-80x	18" NI-80x	20" NI-80x	22" NI-80x	24" NI-80x [a]
	32	18" NI-80x	20" NI-80x	22" NI-80x	-	18" NI-80x	22" NI-80x	22" NI-80x	-
	34	20" NI-80x	22" NI-80x	-	-	20" NI-80x	22" NI-80x	-	-
	36	20" NI-80x	24" NI-80x	-	-	22" NI-80x	24" NI-80x	-	-

a) Web stiffeners are required underneath knee walls.

Notes:

1. This table is applicable to floor construction meeting the above design criteria.
2. Shaded I-joists require web stiffeners at joist ends.
3. Minimum bearing length shall be 3-1/2 inches for end bearings.



Web Hole and Duct Chase Opening Specifications

Location of Web Holes

Design Criteria	
Span:	Simple or multiple
Joist spacing:	Up to 24 inches
Loads:	Live load = 40 psf and dead load = 10 psf
Deflection limits:	L/480 under live load and L/240 under total load

Minimum distance from inside face of any support to center of hole (ft-in.)

Joist depth	Joist series	Round hole diameter (in.)														
		2	4	6	8	10	12	14	14-3/4	16	16-3/4	18	18-3/4	20	20-3/4	22
18"	NI-80x	0'-9"	2'-6"	4'-4"	6'-3"	8'-9"	12'-0"	16'-0"	18'-0"	-	-	-	-	-	-	-
20"	NI-80x	0'-8"	2'-3"	4'-0"	5'-10"	8'-0"	10'-9"	14'-3"	15'-10"	18'-9"	20'-10"	-	-	-	-	-
22"	NI-80x	0'-7"	2'-0"	3'-6"	5'-6"	7'-8"	10'-0"	12'-8"	14'-0"	16'-5"	18'-0"	21'-5"	23'-9"	-	-	-
24"	NI-80x	0'-7"	1'-10"	3'-6"	5'-5"	7'-5"	9'-5"	11'-9"	12'-9"	14'-9"	16'-2"	19'-0"	21'-0"	24'-5"	26'-8"	-

Notes:

1. Tabulated values are applicable to floor construction meeting the above design criteria.
2. Refer to Chapter 3 for rules related to cutting holes in I-joists.

Location of Duct Chase Openings

Design Criteria	
Span:	Simple
Joist spacing:	Up to 24 inches
Loads:	Live load = 40 psf and dead load = 10 psf
Deflection limits:	L/480 under live load and L/240 under total load

Minimum distance from inside face of any support to center of opening (ft-in.)

Joist depth	Joist series	Duct chase length (in.)				
		8	12	16	20	24
18"	NI-80x	13'-1"	14'-0"	15'-1"	16'-1"	17'-0"
20"	NI-80x	14'-3"	15'-3"	16'-2"	17'-3"	18'-4"
22"	NI-80x	15'-4"	16'-4"	17'-5"	18'-6"	20'-0"
24"	NI-80x	16'-6"	17'-5"	18'-8"	20'-2"	21'-9"

Notes:

1. Tabulated values are applicable to floor construction meeting the above design criteria.
2. The maximum depth of a duct chase opening that can be cut into an I-joist web shall equal the clear distance between the flanges of the I-joist minus 1/4 inch (maintain a minimum of 1/8 inch between the top or bottom of the opening and the adjacent I-joist flange).
3. Refer to Chapter 3 for rules related to cutting duct chase openings in I-joists.

NORDIC

TECHNICAL GUIDE
NORDIC JOIST

NS-GT3

VERSION
2024-08-01

ADDITIONAL INFORMATION 6

NORDIC STRUCTURES

Safety and Construction Precautions

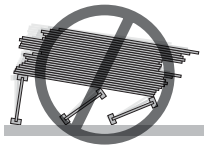
I-joists are not stable until completely installed, and will not carry any load until fully braced and sheathed.

Avoid Accidents by Following these Important Guidelines:

1. Brace and nail each I-joist as it is installed, using hangers, blocking panels, rim board, and/or cross-bridging at joist ends. When I-joists are applied continuous over interior supports and a load-bearing wall is planned at that location, blocking will be required at the interior support.
2. When the building is completed, the floor sheathing will provide lateral support for the top flanges of the I-joists. Until this sheathing is applied, temporary bracing, often called struts, or temporary sheathing must be applied to prevent I-joist rollover or buckling.
   - Temporary bracing or struts must be 1x4 inch minimum, at least 8 feet long and spaced no more than 8 feet on center, and must be secured with a minimum of two 8d nails fastened to the top surface of each I-joist. Nail the bracing to a lateral restraint at the end of each bay. Lap ends of adjoining bracing over at least two I-joists.
   - Or, sheathing (temporary or permanent) can be nailed to the top flange of the first 4 feet of I-joists at the end of the bay.
3. For cantilevered I-joists, brace top and bottom flanges, and brace ends with closure panels, rim board, or cross-bridging.
4. Install and fully nail permanent sheathing to each I-joist before placing loads on the floor system. Then, stack building materials over beams or walls only.
5. *Never* install a damaged I-joist.

Improper storage or installation, failure to follow applicable building codes, failure to follow span ratings for Nordic I-joists, failure to follow allowable hole sizes and locations, or failure to use web stiffeners when required can result in serious accidents. Follow these installation guidelines carefully.

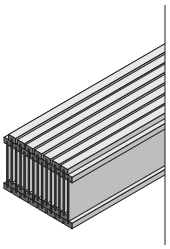
Do not walk on I-joists until fully fastened and braced, or serious injuries can result.

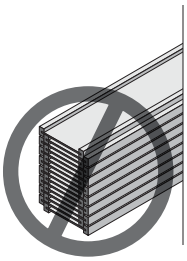


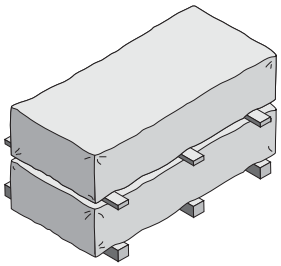
Never stack building materials over unsheathed I-joists. Once sheathed, do not overstress I-joist with concentrated loads from building materials.

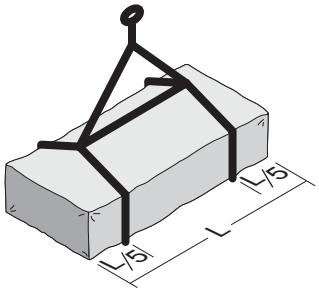
Storage and Handling Guidelines

1. Bundle wrap can be slippery when wet. Avoid walking on wrapped bundles.
2. Store, stack, and handle I-joists vertically and level only.
3. Always stack and handle I-joists in the upright position only.
4. Do not store I-joists in direct contact with the ground and/or flatwise.
5. Protect I-joists from weather, and use spacers to separate bundles.
6. Bundled units should be kept intact until time of installation.
7. When handling I-joists with a crane on the job site, take a few simple precautions to prevent damage to the I-joists and injury to your work crew.
   - Pick I-joists in bundles as shipped by the supplier.
   - Orient the bundles so that the webs of the I-joists are vertical.
   - Pick the bundles at the 5th points, using a spreader bar if necessary.
8. Do not handle I-joists in a horizontal orientation.
9. Never use or try to repair a damaged I-joist.









Software

Nordic Sizer

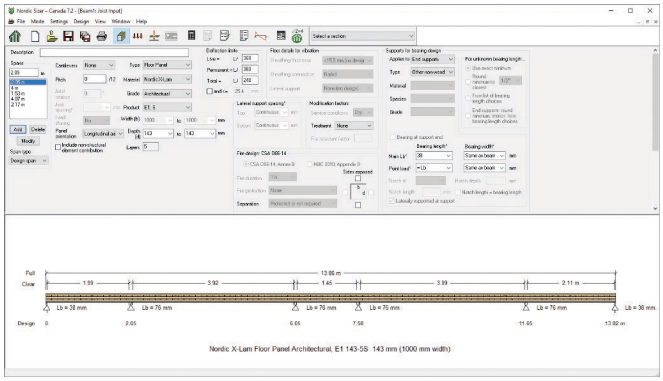
Nordic Sizer is a software program built to design individual structural elements (joists, beams, columns, studs, slabs, and panels) using the full range of Nordic engineered wood products.

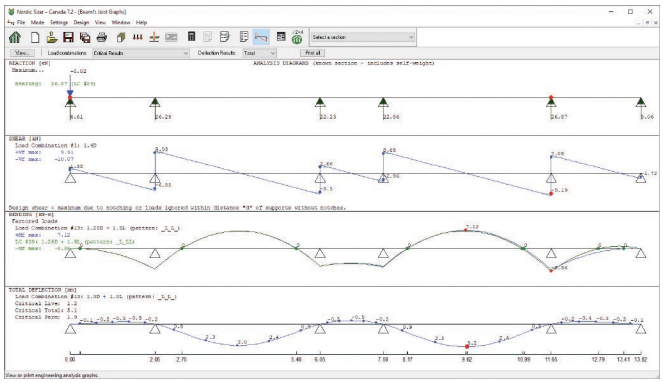
Nordic Sizer software application analyzes and designs members for specified loads in accordance with CSA O86 (Canada) or NDS (United States) standard, and automatically checks load cases and load combinations in accordance with NBC (Canada) or IBC (United States). Features include floor vibration checks and fire resistance calculations.

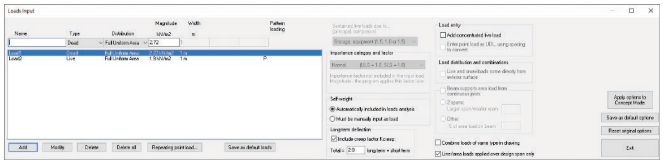
For more information: http://woodworks-software.com

DOWNLOAD & INSTALL
Fill in the form (contact.nordic.ca/en/nordic-sizer-software-request/) to receive instructions by email within the next business day.
For assistance, please contact the technical support at 514-871-8526, ext. 2 or tech@nordic.ca.

WOODWORKS SOFTWARE TUTORIALS
US Training Videos and User Guide
woodworks-software.com/support/support-us-edition/







NORDIC STRUCTURES

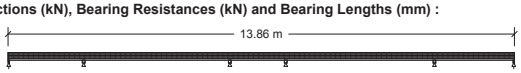
COMPANY	PROJECT
Aug. 12, 2020 15:47	Beam1

Design Check Calculation Sheet
Nordic Sizer – Canada 7.2

Loads:

Load	Type	Distribution	Pat-tern	Location [m] Start	End	Magnitude Start	End	Unit
Load1	Dead	Full Area	No			2.72(1.00m)		kN/m2
Load2	Live	Full Area	Yes			1.90(1.00m)		kN/m2
Self-weight	Dead	Full UDL	No			0.72		kN/m

Maximum Reactions (kN), Bearing Resistances (kN) and Bearing Lengths (mm) :



Unfactored:								
Dead	1.54	12.59		9.22	9.56		12.87	1.79
Live	1.79	7.04		7.14	7.28		7.19	1.88
Factored:								
Uplift	0.02							
Total	4.61	26.29		22.23	22.86		26.87	5.06
Bearing:								
Capacity								
Beam	161.54	282.46		305.35	304.13		282.38	161.54
Des ratio								
Beam	0.03	0.08		0.06	0.07		0.08	0.03
Load case	#24	#14		#25	#16		#29	#24
Length	38*	76		76	76		76	38*
Min req'd	38*	76*		76*	76*		76*	38*
KB	1.00	1.00		1.00	1.00		1.00	1.00
KB min	1.00	1.00		1.00	1.00		1.00	1.00
KD	1.00	0.87		0.94	0.94		0.87	1.00

*Minimum bearing length for panels is 38 mm for exterior supports and 76 mm for intermediate supports

Nordic X-Lam Floor Panel Architectural, E1 143-5S 143 mm (1000 mm width)
Supports: All - Non-wood
Total length: 13.858 m; Clear span: 2, 3.9, 1.5, 4, 2.1 m; Volume = 1.982 m^3; Panel orientation: Longitudinal axis
This section PASSES the design code check.

Limit States Design using CSA O86-14:

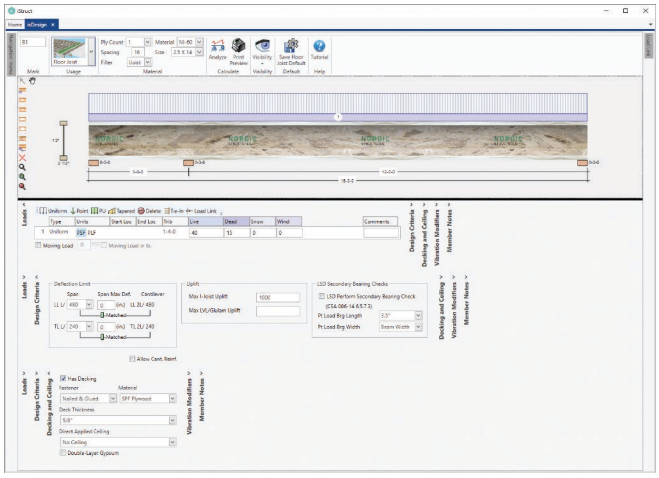
Criterion	Analysis Value	Design Value	Unit	Analysis/Design
Shear	Vf @d = 9.19	Vr = 27.95	kN	Vf/Vr = 0.33
Moment(+)	Mf = 7.12	Mr = 58.05	kN-m	Mf/Mr = 0.12
Moment(-)	Mf = 8.86	Mr = 56.95	kN-m	Mf/Mr = 0.16
Perm. Defl'n	1.9 = < L/999	11.3 = L/360	mm	0.17
Live Defl'n	1.2 = < L/999	11.3 = L/360	mm	0.11
Total Defl'n	5.1 = L/798	17.0 = L/240	mm	0.30
Vibration	Lmax = 4.070	Lv = 5.186	m	Lmax/Lv = 0.78

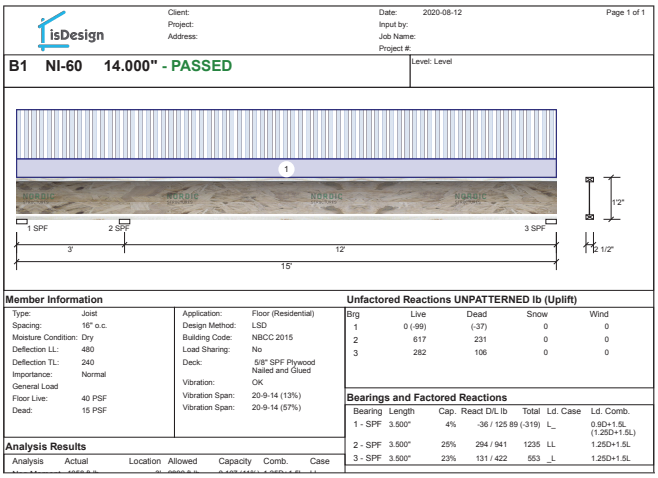
CSD – iStruct™

iStruct™ is a state-of-the-art enterprise solution for layout, design, and structural analysis that combines layout/drafting, single member design, reporting, and an incredible real time 3D experience. It supports a selection of products, including I-joists, SCL lumber, solid sawn lumber, walls, rim board, hangers, and more.

isDesign™ is a single member sizing solution that allows users to size floor and roof joists, beams, and posts by inputting span and load information. Innovative tools allow selection of the most cost-effective solution.

isPlan™ is a 3D layout and design solution that allows users to model an entire structure with 2D and 3D views. isPlan™ develops and transfers gravity loads through the entire structure and designs the structural members. Robust import and export of pdf, dxf, and dwg files combined with intuitive modeling and design tools ensure efficient and cost-effective designs.

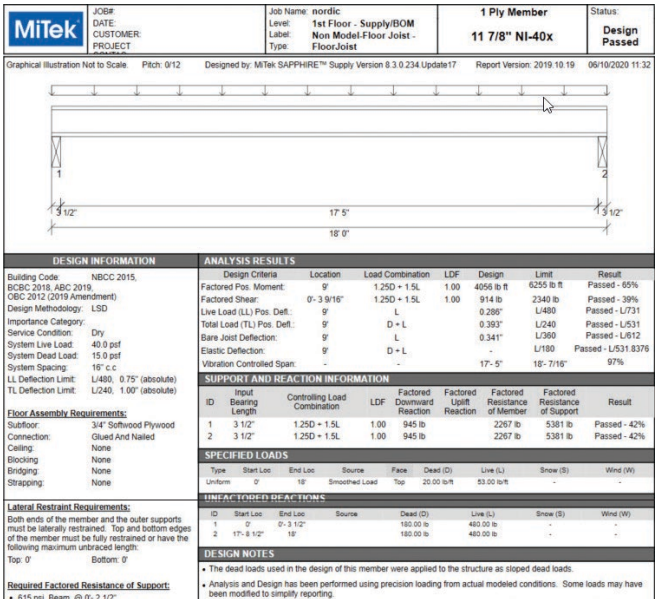




MiTek – SAPPHIRE™ Structure

Built exclusively for component manufacturers, this software delivers the most powerful structural modeling, editing, and estimating functionality available anywhere.

The Formula Builder feature enables designers to create or store customized formulas, group formulas into sets, scheme and apply to jobs or individual objects. Create estimates by applying formulas to modeled objects. For options management, you can create and customize plan options directly from within a job file. You can include all member types in your options, from accessories to walls, and utilize option customization, such as special junction considerations for site-specific creation.



Dead Load

Material Weights

Material	(psf)	Material	(psf)
Sheathing and decking		Floor fill	
OSB, 3/8-in.	1.4	Gypsum concrete, 3/4-in.	6.9
OSB, 7/16-in.	1.6	Lightweight concrete, 1-1/2-in.	12
OSB, 1/2-in.	1.9	Stone concrete, 1-1/2-in.	18
OSB, 19/32-in.	2.2		
OSB, 23/32-in.	2.7	Floor finishes	
Plywood, 11/32-in.	1.1	Carpet and pad	2.0
Plywood, 15/32-in.	1.5	Ceramic or quarry tile (3/4-in.) on 1/2-in. mortar bed	16
Plywood, 19/32-in.	1.9	Ceramic or quarry tile (3/4-in.) on 1-in. mortar bed	23
Plywood, 23/32-in.	2.3	Hardwood flooring, nominal 1-in.	4.0
Plywood, 1-1/8-in.	3.6	Linoleum or asphalt tile, 1/4-in.	1.0
Metal deck, 20 gage	2.5	Marble and mortar on stone-concrete fill	33
Metal deck, 18 gage	3.0	Slate (per inch thickness)	15
Wood decking, 1-in.	3.0	Subflooring, 3/4-in.	3.0
Wood decking, 2-in.	5.0		
Wood decking, 3-in.	8.0	Floors (12-in. spacing)	
		2 x 6	2.1
Ceilings		2 x 8	2.8
Gypsum board, 1/2-in.	2.2	2 x 10	3.6
Gypsum board, 5/8-in.	2.8	2 x 12	4.3
Mechanical duct allowance	4.0	Nordic I-joists [a]	2.55 - 5.25
Plaster on wood lath	8.0		
Suspended steel channel system	2.0	Partitions	
Wood furring suspension system	2.5	Wood or steel studs, 1/2-in. gypsum board each side	8.0
		Wood studs, 2 x 4, unplastered	4.0
Coverings		Wood studs, 2 x 4, plastered one side	12
Asbestos-cement shingles	4.0	Wood studs, 2 x 4, plastered two sides	20
Asphalt shingles	2.0		
Wood shingles	3.0	Walls [b]	
Cement tile	16	Exterior stud walls	
Clay tile (for mortar add 10 psf)		5/8-in. gypsum, insulated, 3/8-in. siding	
Minimum	10	2 x 4 at 16-in. o.c.	11
Spanish	19	2 x 6 at 16-in. o.c.	12
Composition		With brick veneer	48
Three-ply ready roofing	1.0	Windows, glass, frame and sash	8.0
Four-ply felt and gravel	5.5		
Five-ply felt and gravel	6.0	Insulation (per inch thickness)	
Gypsum sheathing, 1/2-in.	2.0	Cellular glass	0.7
Skylight, metal frame, 3/8-in. wire glass	8.0	Fibrous glass	1.1
Waterproofing membranes		Fiberboard	1.5
Bituminous, gravel-covered	5.5	Perlite	0.8
Bituminous, smooth surface	1.5	Polystyrene foam	0.2
Liquid applied	1.0	Rigid insulation	1.5
Single-ply, sheet	0.7	Urethane foam with skin	0.5

a) See pages 2.3 and 5.2 for residential and commercial I-joist weight, respectively.

b) Wall weights in pounds per square foot of wall. Multiply weight times wall height for pounds per linear foot (plf).

Notes:

1. Estimated material weights in pounds per square foot (psf).
2. Adding 1.0 to 2.0 psf is recommended for miscellaneous dead loads.
3. Wood decking and 2x lumber weight based on Douglas Fir.
4. For additional information, refer to *Minimum Design Loads for Buildings and Other Structures*, Standard ASCE 7, Tables C3-1 and C3-2.

Conversion Factors

Conversion Factors

Item	Imperial to metric			Metric to imperial		
Length	1 in.	=	25.4 mm	1 mm	=	0.0393701 in.
		=	0.0254 m	1 m	=	39.3701 in.
	1 ft	=	0.3048 m		=	3.28084 ft
	1 yd	=	0.9144 m		=	1.09361 yd
	1 mile	=	1.60934 km	1 km	=	0.621371 mile
Length / time	1 ft/s	=	0.3048 m/s	1 m/s	=	3.28084 ft/s
	1 mph	=	1.60934 km/h	1 km/h	=	0.621371 mph
Area	1 in.²	=	645.16 mm²	1 mm²	=	0.001550 in.²
	1 ft²	=	0.0929030 m²	1 m²	=	10.7639 ft²
	1 acre	=	0.404686 ha	1 ha	=	2.47105 acres
	1 mi²	=	2.58999 km²	1 km²	=	0.386102 mi²
Volume	1 in.³	=	16,387.1 mm³	1 mm³	=	0.0000610237 in.³
	1 ft³	=	0.0283168 m³	1 m³	=	35.3147 ft³
	1 yd³	=	0.764555 m³		=	1.30795 yd³
	1 fl oz (US)	=	29.5735 mL	1 mL	=	0.0338141 fl oz (US)
	1 gal (US)	=	3.78541 L	1 L	=	0.264172 gal (US)
Mass	1 oz	=	28.3495 g	1 g	=	0.0352740 oz
	1 lb	=	0.453592 kg	1 kg	=	2.20462 lb
	1 short ton (2000 lb)	=	0.907185 tons	1 ton	=	1.10231 short tons
Mass / volume	1 lb/ft³	=	16.0185 kg/m³	1 kg/m³	=	0.0624280 lbf/ft³
Force	1 lbf	=	4.44822 N	1 N	=	0.224809 lbf
Stress	1 lbf/in.² (psi)	=	0.00689476 N/mm² (MPa)	1 N/mm² (MPa)	=	145.038 lbf/in.² (psi)
Loading	1 lbf/ft² (psf)	=	0.0478803 kN/m² (kPa)	1 kN/m² (kPa)	=	20.8854 lbf/ft² (psf)
	1 lbf/ft (plf)	=	0.0145939 kN/m	1 kN/m	=	68.5218 lbf/ft (plf)
Bending moment	1 lbf-ft	=	0.00135582 kN-m	1 kN-m	=	737.561 lbf-ft
Temperature	1 °F	=	(°F - 32) / 1.8 °C	1 °C	=	32 + 1.8 (°C) °F

Notes:

1. 9.80665 N = 1.0 kg x 9.80665 m/s²
2. 1.0 Pa = 1.0 N/m²

+ construction details →**DC3**

+ installation guide →**GI31**

+ product warranty →**NS-DI002**

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