

TECHNICAL NOTES



Attachment of Residential Deck Ledger to Metal Plate Connected Wood Truss Floor System

September 18, 2007

Applicability:

The purpose of this *Technical Note* is to suggest construction details for residential deck ledger attachment to metal plate connected wood truss (MPCWT) floor systems.

Issue:

Numerous field observations of existing decks revealed that a major source of failures are attributable to inadequate connection between the deck ledger and house rim joist, related wood decay and/or corrosion of fasteners, and a failure of single and/or various elements of the guardrail system.

Residential decks are usually supported on one side by a ledger attached to the house. This ledger attachment is critical for ensuring that the deck is safely and securely supported at this location. Deck ledger connection problems are often aggravated by lack of structural redundancy, namely, when the ledger to rim board connection fails, the deck typically collapses catastrophically.

Recommendations:

When the floor system for the house uses MPCWT, the deck ledger shall not be connected to the house by nails alone. In the absence of a lateral bracing system installed on the deck, lag screws or bolts and/or other mechanical connectors must be used, i.e., the deck ledger must be lagged or bolted to the rim joist and/or other structural components of the house which in turn must be securely attached to the framing of the structure and supported on the foundation and/or wall below.

A MPCWT is an engineered, prefabricated structural component designed for each specific application. MPCWT used in residential floors are often installed with a 2x4 lumber “ribbon” at the ends of the trusses (see Figure 1), the purpose of which is to tie the ends of the trusses together. The ribbon board, by itself, is not intended to support the Deck Ledger and deck. Installing residential decks when the floor system for the house uses MPCWT requires a standard detail provided by the truss designer, a free-standing deck, or a full plan submission.

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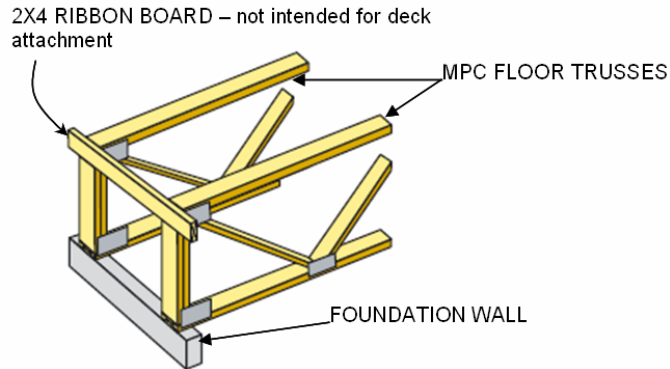


Figure 1: Metal plate connected wood floor trusses with a 2x4 lumber "ribbon" at the ends of the trusses

Any of the five recommended details for connecting deck ledgers to common wood truss floor system configurations (as described in Appendices A - E) can be used for making the connection.

Key Definitions:

Truss: An individual metal plate connected wood component manufactured for the construction of a building.

Deck Ledger: When building a deck that juts out from a house, the deck is usually tied into the house structurally. To achieve this, a header board or "ledger" is connected to the house. The header board is one end of the deck, and the deck at this end derives support from the house.

Background:

The *2007 Supplement* to the 2006 *International Residential Code (IRC)* has prescriptive provisions for deck ledger connections. *IRC* Table R502.2.2.1 specifies fastener spacing for ½" diameter bolts or lag screws. AF&PA's American Wood Council, in cooperation with the International Code Council, has also developed *Design for Code Acceptance No. 6 (DCA6)* – *Prescriptive Residential Deck Construction Guide*, available at www.awc.org.

The deck ledger shall not be connected to the house by nails alone. Therefore, in the absence of a lateral bracing system installed on the deck, lag screws or bolts and/or other mechanical connectors for "positive anchorage" are required to design and construct a code-conforming deck. In other words, the deck ledger must be lagged or bolted to the rim joist and/or other structural components of the house which in turn must be securely attached to the framing of the structure and supported on the foundation and/or wall below.

Analysis:

The technical reference for the engineering design of connections in wood construction is the *2005 National Design Specification® (NDS®) for Wood Construction*¹ However, due to commonly accepted methods of connecting deck ledgers to rim boards, the *NDS* requirements are

¹ American Forest & Paper Association (AF&PA). 2005 National Design Specification (NDS) for Wood Construction. AF&PA, 1111 19th Street, NW, Suite 800, Washington, DC 20036

not applicable. Table 11J of the *NDS* provides reference lateral design values for lag screws in single shear connections based on the assumption of 8D penetration in the main member or 4 inches for a ½-inch diameter lag screw. Additionally, the minimum penetration depth of four diameters (4D) into the main member when using ½-inch diameter lag screws is not met, when a solid-sawn rim board, which is only 1½ -inches thick, is used.

Because of the specific requirements for deck ledger and rim board connections, an alternative design was needed. An alternative design method is supported in Section 104.11.2 of the 2006 *IBC* which allows using alternative materials and methods including load testing to derive design values.

2006 IBC 104.11.2 Tests. Whenever there is insufficient evidence of compliance with the provisions of this code, or evidence that a material or method does not conform to the requirements of this code, or in order to substantiate claims for alternative materials or methods, the building official shall have the authority to require tests as evidence of compliance to be made at no expense to the jurisdiction. Test methods shall be as specified in this code or by other recognized test standards. In the absence of recognized and accepted test methods, the building official shall approve the testing procedures. Tests shall be performed by an approved agency. Reports of such tests shall be retained by the building official for the period required for retention of public records.

Recent research and testing of deck-ledger-to-rim-board connection details at Virginia Tech and Washington State University

The latest research and testing conducted on the deck ledger connection by the Virginia Tech Department of Wood Science and Forest Products and Washington State University Wood Materials and Engineering Laboratory², provided ultimate capacities for lag screws and bolts much higher than allowable capacities derived using the *NDS* equations. (*References 3, 4, and 5*) Initially, the researchers used the 2005 *NDS* to calculate the required on-center spacing of lag screws and bolts for deck ledger to rim board connections for various deck widths. Although the calculated spacing was “per code,” it was impractical. The tight spacing limitation for allowable capacities for lag screws and bolts in *NDS* is based on small allowable deformations at the design loads.

Three common deck-ledger-to-rim-board connection details were tested, which is allowed and recognized by the code. Test results for this specific application revealed that the “ultimate” loads for lag screws are two to three times higher than the values obtained using the *NDS* equations. In addition, bolts tested for this specific application proved to be even stronger compared to *NDS* equations.

The recommended details for attachment of deck ledgers to MPCWT floor systems in IRC Table R502.2.2.1 are based on the latest research and testing conducted jointly by the Virginia Tech Department of Wood Science and Forest Products and Washington State University Wood Materials and Engineering Laboratory. Below is the summary of the minimum requirements and limitations:

² Anderson, C.A., F.E. Woeste, and J.R. Loferski. 2003. Manual for the Inspection of Residential Wood Decks and Balconies. Forest Products Society, 2801 Marshall Ct., Madison, WI 53705

- Loferski, J., F. Woeste, R. Cudill, T. Platt, and Q.. Smith.2004. Load-tested deck ledger connections, Journal of Light Construction. 22(6):71-78

- D.M. Carradine, D. Bender, J. R. Loferski, and F.E. Woeste.2006. Residential Deck Ledger Connection Testing and Design. Wood Design Focus, AF&PA/AWC: (9-12)

- D.M. Carradine, D. Bender, J. R. Loferski, and F.E. Woeste. 2005. Residential Deck Ledger Design. Building Safety Journal, December, 2005: (4-7)

Three common residential deck ledger construction details using ½-inch diameter lag screws or bolts were tested. The 2006 *IRC* specified live load of 40 psf and dead load of 10 psf are used. Note that other loads may control residential deck ledger design such as snow, seismic, wind, and concentrated loads such as planters or tubs.

Solid-sawn lumber rim board with specific gravity of $G \geq 0.42$ (includes spruce-pine-fir (SPF), hem-fir, Douglas-fir-larch, and southern pine) or structural composite lumber (SCL) rim board with thickness ≥ 1 " and equivalent specific gravity of $G \geq 0.50$.

All floor truss members used to connect deck ledger to the floor truss system shall be of minimum specific gravity of $G \geq 0.42$ (includes SPF, hem-fir, Douglas-fir-larch and southern pine)

Preservative pressure treated (PPT) deck ledger lumber with $G \geq 0.42$ (includes hem-fir, Douglas-fir-larch and southern pine). Deck ledger can be incised and wet. PPT deck ledger should be treated to a retention level of 0.40 lbs/ft³ of ACQ-B, C and D (Alcaline Copper Quat), which is suitable for ground contact. Other approved preservative treatments per American Wood Preservers' Association such as CC (Micronized Copper) may be used as well. No wood decay present is allowed.

No fastener corrosion is allowed. All fasteners should be hot-dip galvanized per *ASTM A153* or "316 stainless steel series," as determined by the deck designer and approved by the building official.

Lag screws and bolts shall be installed according to 2005 *NDS* requirements. Lead holes for the lag screws should be equal to the root diameter (or slightly less) of the threaded portion and the clearance holes should be ½" in diameter. For a particular box of ½" diameter lag screws, a "test" installation into the house is recommended before drilling the lead holes to ensure that the lead holes are neither too small nor too large. Bolts shall be installed with 9/16" or at least 17/32" diameter clearance holes.

Squash and/or blocking panels between the trusses, sill plate, and ribbon board should be cut to fit tightly (i.e., snug-tight) and be attached using deformed shank 8d nails spaced at max. 4" on center.

Each of the five recommended details for connecting deck ledgers to common wood truss floor system configurations are described in Appendices A – E.

Conclusion:

From the above discussion it can be concluded that nailing deck ledgers to MPCWT floor systems is not sufficient. The deck ledger must be lagged or bolted to the rim joist and/or other structural components of the house. Various options and connection details for achieving the connection of the deck ledger to the MPCWT floor system are provided in this *Technical Note*, which may be referred to by the building designer to achieve a code-conforming deck ledger connection.

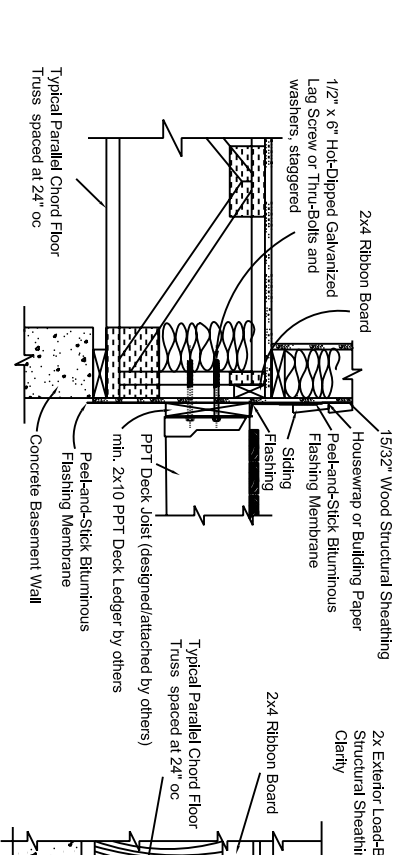
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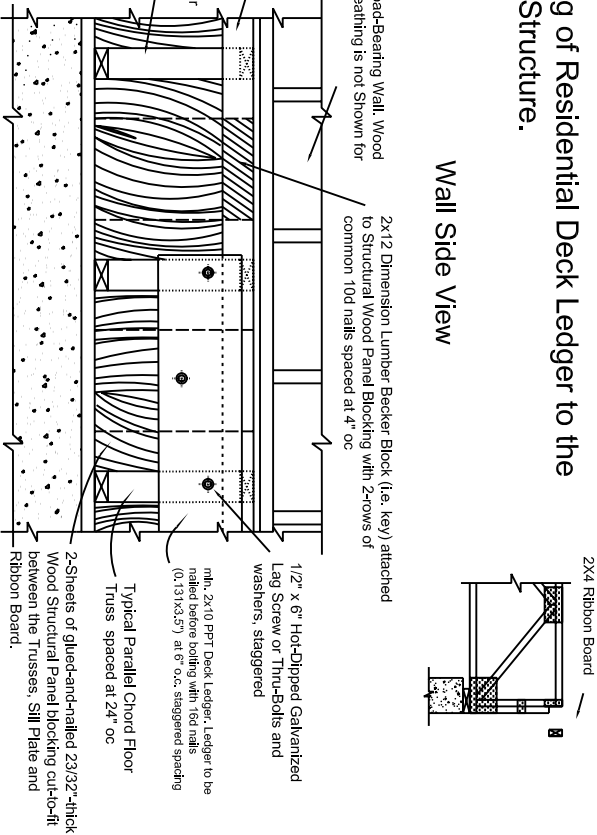
APPENDIX A

DETAIL 1. Attaching and/or Retrofitting of Residential Deck Ledger to the MPCWT Floor System of the Existing Structure.

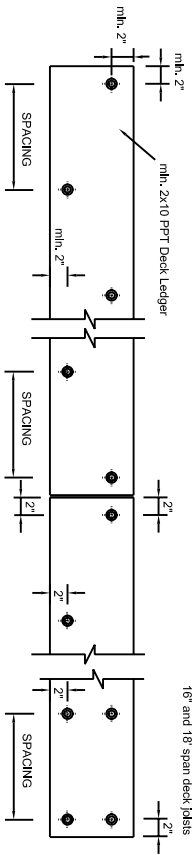
Wall Section



Wall Side View



Deck Ledger fastening schedule



Method for installing 1/2"-diameter lag screws or bolts for use with Table 1. Fasteners should be staggered and installed with min. edge spacing of 2" as shown in the figure. For 16" and 18" deck joist spans use 2-rows of 1/2"-diam. fasteners as shown in Table 1 and figure.

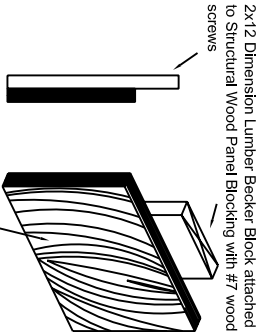
Table 1. Fastener on-center spacing for PPT Hem-Fir or Southern Pine Residential Deck Ledgers attached to Parallel Chord Floor Truss System of the Existing Structure

CONNECTION DETAIL	RESIDENTIAL DECK JOIST SPAN CONNECTION DETAIL		
	6 to 8 feet	10 to 14 feet	16 to 18 feet
1/2"-Diameter Lag Screws with 15/32"-thick Wood Structural Panel Sheathing	24 " oc	12 " oc	2-rows of 1/2"-Diam. screws @ 12" oc
1/2"-Diameter Bolts with 15/32"-thick Wood Structural Panel Sheathing	24 " oc	24 " oc	2-rows of 1/2"-Diam. bolts @ 24" oc

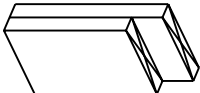
* Ledger to be nailed before bolting with 16d nails (0.131x3.5") at 6" o.c. staggered spacing.
** Ledger-to-house connection design load for Hem-Fir Ledger, 15/32" Wood Structural Sheathing and 2X SPF Dimensional Lumber Rimboard is 450 lbs if 1/2"-diameter lag screw is used and 880 lbs if 1/2"-diameter bolt is used. For the same configuration except using LVL Rimboard (SCL with G-50.50), the connection design load is 460 lbs if 1/2"-diameter lag screw is used and 850 lbs if 1/2"-diameter bolt is used.

GENERAL NOTES

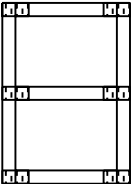
- All floor truss members used to connect deck ledger shall be of min. specific gravity of G ≥ 0.42 (includes SPF, Hem-Fir, Douglas-Fir-Larch and Southern Pine)
- Rim board lumber with specific gravity of G ≥ 0.42 (includes SPF, Hem-Fir, Douglas-Fir-Larch and Southern Pine)
- Structural Composite Lumber (SCL) rim board with thickness ≥ 1" and equivalent specific gravity of G ≥ 0.50.
- Presservative Pressure Treated (PPT) deck ledger lumber with G ≥ 0.43 (includes Hem-Fir, Douglas-Fir-Larch and Southern Pine). Deck ledger can be incized and wet.
- PPT deck ledger should be treated to a retention level of 0.40 lbs/ft³ of ACQ (suitable for ground contact). No wood decay present is allowed.
- No fastener corrosion is allowed. All fasteners should be hot-dip galvanized per ASTM A153 or "316 stainless steel series", as determined by deck designer and approved by building official.
- Lag screws and bolts shall be installed according to 2005 NDS requirements. Lead holes for the lag screws should be equal to the root diameter (or slightly less) of the threaded portion and the clearance holes should be 1/2" in diameter.
- For a particular box of 1/2" diameter lag screws, a "test" installation into the house is recommended before drilling the lead holes to ensure that the lead holes are neither too small nor too large.
- Bolts shall be installed with 9/16" or at least 17/32" diameter clearance holes.
- Squash and/or blocking panels between the trusses, sill plate and ribbon board should be cut to fit tightly (i.e.. snug-tight) and be attached using deformed shank 8d nails spaced at max. 4" oc.



2-Sheets of glued-and-nailed 3/4"-thick plywood panels cut-to-fit tightly between the trusses and sill plate and ribbon board. Attach plywood sheets using 8d deformed shank (i.e., screw shank) toe-nails spaced at max. 4" oc.



NOTE: For 16" deep trusses and less, Structural Composite Lumber and/or 2X12 Dimension Lumber cut-to-fit tight between the floor trusses and sill plate and ribbon board can also be used.

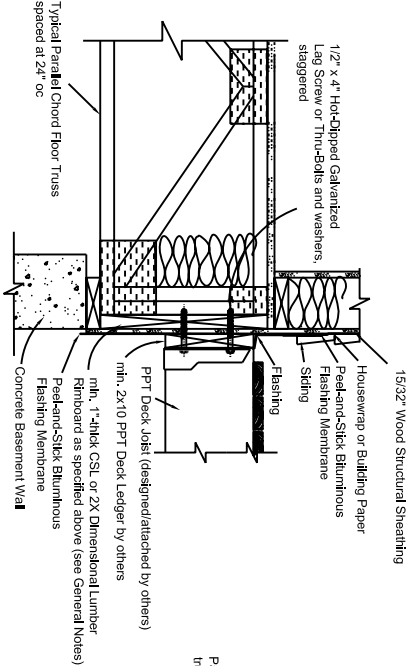


Ladder Truss Frames with middle vertical spaced at 9-1/2" oc, installed snug-tight between the floor trusses, sill plate and ribbon board. For 14 to 18" deck spans use truss frames with 4x4 middle vertical.

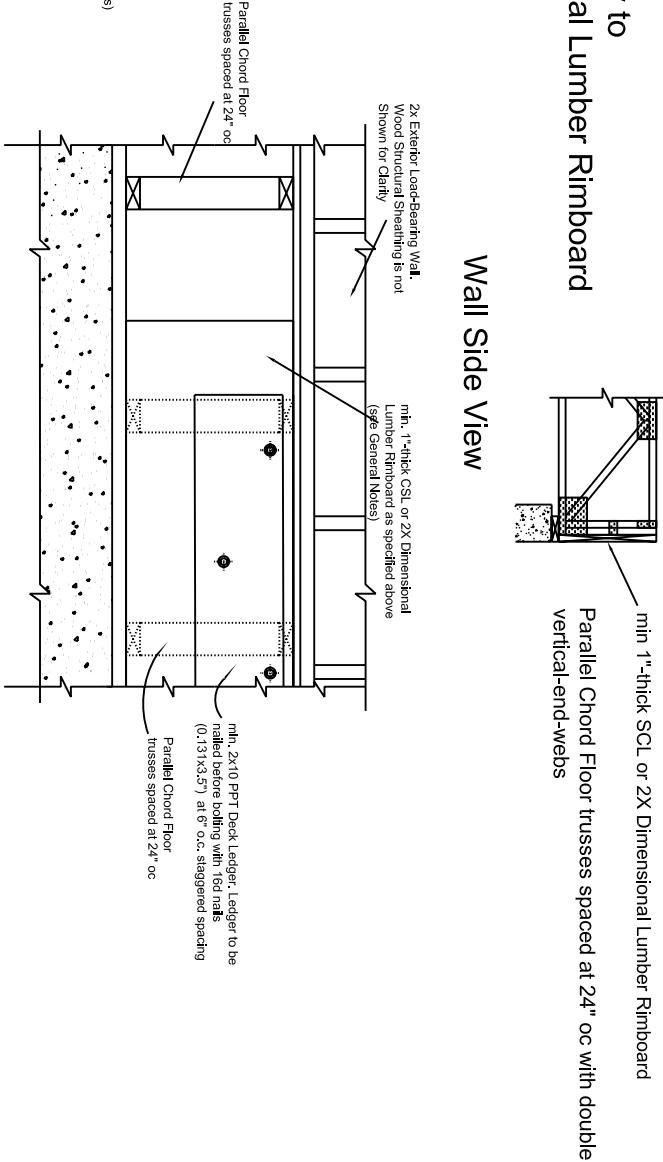
APPENDIX B

DETAIL 2. Attaching Residential Deck Ledger directly to Structural Composite Lumber (SCL) or 2X Dimensional Lumber Rimboard

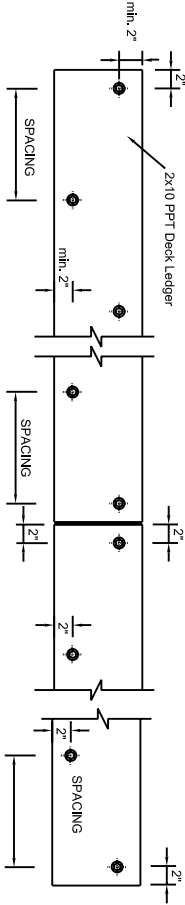
Wall Section



Wall Side View



Deck Ledger Fastening Schedule



Method for installing 1/2"-diameter lag screws or bolts for use with Table 2. Fasteners should be staggered and installed with min. edge spacing of 2" as shown in the above figure.

GENERAL NOTES

- All floor truss members used to connect deck ledger shall be of min. specific gravity of $G \geq 0.42$ (includes SPF, Hem-Fir, Douglas-Fir-Larch and Southern Pine)
- Rim board lumber with specific gravity of $G \geq 0.42$ (includes SPF, Hem-Fir, Douglas-Fir-Larch and Southern Pine)
- Structural Composite Lumber (SCL) rim board with thickness $\geq 1"$ and equivalent specific gravity of $G \geq 0.50$.
- Presservative Pressure Treated (PPT) deck ledger lumber with $G \geq 0.43$ (includes Hem-Fir, Douglas-Fir-Larch and Southern Pine).
- PPT deck ledger should be treated to a retention level of 0.40 lbs/ft³ of ACQ (suitable for ground contact). No wood decay present is allowed.
- No fastener corrosion is allowed. All fasteners should be hot-dip galvanized per ASTM A153 or "316 stainless steel series", as determined by deck designer and approved by building official.
- Lag screws and bolts shall be installed according to 2005 NDS requirements. Lead holes for the lag screws should be equal to the root diameter (or slightly less) of the threaded portion and the clearance holes should be 1/2" in diameter.
- For a particular box of 1/2" diameter lag screws, a "test" installation into the house is recommended before drilling the lead holes to ensure that the lead holes are neither too small nor too large.
- Bolts shall be installed with 9/16" or at least 17/32" diameter clearance holes.
- The Rimboard should be adequately anchored to the house framing to resist deck horizontal loads normal to the wall. Design and connection of Rimboard to the house is the Building Designers Responsibility.

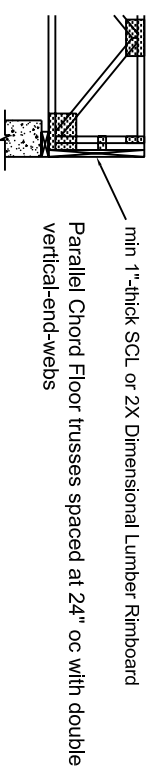
Table 2. Fastener on-center spacing for PPT Hem-Fir or Southern Pine Residential Deck Ledgers attached to Structural Composite Rimboard or 2x Lumber Rimboard

CONNECTION DETAIL	RESIDENTIAL DECK JOIST SPAN CONNECTION DETAIL						
	6 feet	8 feet	10 feet	12 feet	14 feet	16 feet	18 feet
1/2"-Diameter Lag Screws with 15/32"-thick Wood Structural Panel Sheathing *	30" oc	23" oc	18" oc	15" oc	13" oc	11" oc	10" oc
1/2"-Diameter Bolts with 15/32"-thick Wood Structural Panel Sheathing *	36" oc	36" oc	34" oc	29" oc	24" oc	21" oc	19" oc

* Ledger to be nailed before bolting with 16d nails (0.131x3.5") at 6" o.c. staggered spacing.

** Ledger-to-house connection design load for Hem-Fir Ledger, 15/32" Wood Structural Sheathing and 2X SPF Dimensional Lumber Rimboard is 450 lbs for 1/2"-diameter lag screw and 880 lbs for 1/2"-diameter bolts. For the same configuration except using LVL Rimboard (SCL with $G \geq 0.50$), the connection design load is 460 lbs if 1/2"-diameter lag screw is used and 850 lbs if 1/2"-diameter bolt is used.

DETAIL 3. Attaching Residential Deck Ledger directly to Structural Composite Lumber (SCL) Rimboard or 2X Dimensional Lumber Rimboard when Foam Wall Sheathing is used

[illegible]

2x Exterior Load-Bearing Wall
Foil-Faced Foam Sheathing is not shown for clarity

mfr. 1" thick CSL or 2X Dimensional Lumber
Rimboard as specified above (see General Notes)

1x6"x2" PPT Lumber Spacers
at each bolt and/or screw locations.
Install spacers to rimboard with 5/8" d nails
staggered.

mfr. 2x10 PPT Deck Ledger. Ledger to be
nailed before bolting with 16d nails
(0.131x3.5") at 6" o.c. staggered spacing

Parallel Chord Floor
trusses spaced at 24" oc

Parallel Chord Floor
trusses spaced at 24" oc

PPT Sill Plate

Concrete Basement Wall

Method for installing 1/2"-diameter lag screws or bolts for use with Table 2. Fasteners should be staggered and installed with min. edge spacing of 2" and 2-1/2" as shown in the above figure:

- All floor truss members used to connect deck ledger shall be of min. specific gravity of $G \geq 0.42$ (includes SPF, Hem-Fir, Douglas-Fir-Larch and Southern Pine)
- Rim board lumber with specific gravity of $G \geq 0.42$ (includes SPF, Hem-Fir, Douglas-Fir-Larch and Southern Pine)
- Structural Composite Lumber (SCL) rim board with thickness $\geq 1"$ and equivalent specific gravity of $G \geq 0.50$.
- Preservative Pressure Treated (PPT) deck ledger lumber with $G \geq 0.43$ (includes Hem-Fir, Douglas-Fir-Larch and Southern Pine). Deck ledger can be incized and wet.
- PPT deck ledger should be treated to a retention level of 0.40 lbs/ft³ of ACQ (suitable for ground contact). No wood decay present is allowed.
- No faster corrosion is allowed. All fasteners should be hot-dip galvanized per ASTM A153 or "316 stainless steel series", as determined by deck designer and approved by building official.
- Lag screws and bolts shall be installed according to 2005 NDS requirements. Lead holes for the lag screws should be equal to the root diameter (or slightly less) of the threaded portion and the clearance holes should be 1/2" in diameter.
- For a particular box of 1/2" diameter lag screws, a "test" installation into the house is recommended before drilling the lead holes to ensure that the lead holes are neither too small nor too large.
- Bolts shall be installed with 9/16" or at least 17/32" diameter clearance holes.

The Rimboard should be adequately anchored to the house framing to resist deck horizontal loads normal to the wall. Design and connection of Rimboard to the house is the Building Designers Responsibility.

DETAIL 4. Attaching Residential Deck Ledger directly to Structural Composite Lumber (SCL) or 2X Dimensional Lumber Rimboard when Floor Trusses are parallel to deck ledger

min 1"-thick SCL or 2X Dimensional Lumber Rimboard

Parallel Chord Floor trusses spaced at 24" oc and perpendicular to deck ledger

Method for installing 1/2"-diameter lag screws or bolts for use with Table 2. Fasteners should be staggered and installed with min. edge spacing of 2" and and 2-1/2" as shown in the above figure

- All floor truss members used to connect deck ledger shall be of min. specific gravity of $G \geq 0.42$ (includes SPF, Hem-Fir, Douglas-Fir-Larch and Southern Pine)
- Rim board Lumber with specific gravity of $G \geq 0.42$ (includes SPF, Hem-Fir, Douglas-Fir-Larch and Southern Pine)
- Structural Composite Lumber (SCL) rim board with thickness $\geq 1"$ and equivalent specific gravity of $G \geq 0.50$.
- Preservative Pressure Treated (PPT) deck ledger lumber with $G \geq 0.43$ (includes Hem-Fir, Douglas-Fir-Larch and Southern Pine). Deck ledger can be incized and wet.
- PPT deck ledger should be treated to a retention level of 0.40 lbs/ft³ of ACO (suitable for ground contact). No wood decay present is allowed.
- No fastener corrosion is allowed. All fasteners should be hot-dip galvanized per ASTM A153 or "316 stainless steel series", as determined by deck designer and approved by building official.
- Lag screws and bolts shall be installed according to 2005 NDS requirements. Lead holes for the lag screws should be equal to the root diameter (or slightly less) of the threaded portion and the clearance holes should be 1/2" in diameter.

For a particular box of 1/2" diameter lag screws, a "test" installation into the house is recommended before drilling the lead holes to ensure that the lead holes are neither too small nor too large.

Bolts shall be installed with 9/16" or at least 17/32" diameter clearance holes.

Table 4. Fastener on-center spacing for PPT Hem-Fir or Southern Pine Residential Deck Ledgers attached to Structural Composite Rimboard or 2x Lumber Rimboard

CONNECTION DETAIL	RESIDENTIAL DECK JOIST SPAN CONNECTION DETAIL						
	6 feet	8 feet	10 feet	12 feet	14 feet	16 feet	18 feet
1/2"-Diameter Lag Screws with 1/32"-thick Wood Structural Panel Sheathing *	30" oc	23" oc	18" oc	15" oc	13" oc	11" oc	10" oc
1/2"-Diameter Bolts with 1/32"-thick Wood Structural Panel Sheathing *	36 " oc	36 " oc	34" oc	29" oc	24" oc	21" oc	19" oc

Ledger to be nailed before bolting with 16d nails (0.131x3.5") at 6" o.c. staggered spacing

¹ Ledger-to-house connection design load for Hem-Fir: Ledger, 15/32" Wood Structural Sheathing and 2X SPF Dimensional Lumber Rimboard is 450 lbs for 1/2"-diameter lag screw and 880 lbs for 1/2"-diameter bolts. For the same configuration except using LVL Rimboard (SCL with G \geq 50), 1/2"-diameter lag screw and 880 lbs for 1/2"-diameter lag screw is used and 850 lbs if 1/2"-diameter bolt is used.

F, Hem-Fir, Douglas-Fir-Larch and Southern Pine)
(pine)

- **Preservative Pressure Treated (PPT)** deck ledger lumber with $G \geq 0.43$ (includes Hem-Fir, Douglas-Fir-Larch and Southern Pine). Deck ledger can be incized and wet.
- **PPT deck ledger** should be treated to a retention level of 0.40 lbs/ft³ of ACQ (suitable for ground contact). No wood decay present is allowed.

No fastener corrosion is allowed. All fasteners should be hot-dip galvanized per ASTM A153 or "316 stainless steel series", as determined by deck designer and approved by building official.

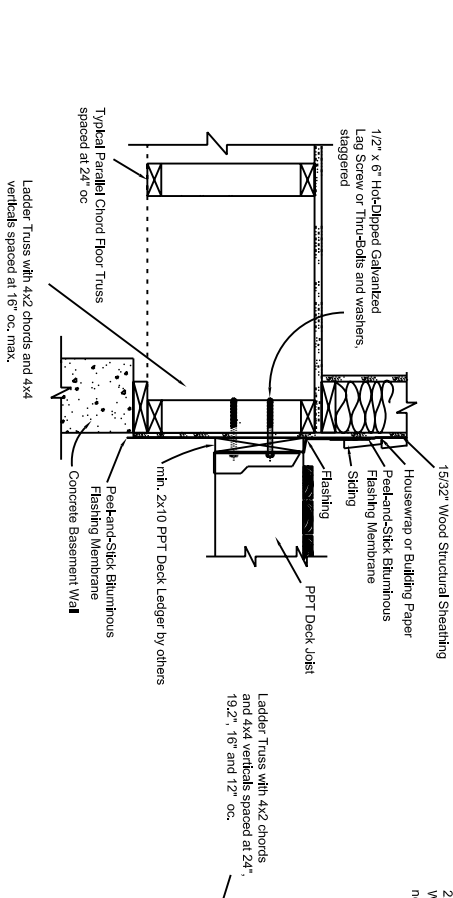
-lag screws and bolts shall be installed according to 2005 NDS requirements. Lead holes for the lag screws should be equal to the root diameter (or slightly less) of the threaded portion and the clearance holes should be 1/2" in diameter. For a particular box of 1/2" diameter lag screws, a "test" installation into the house is recommended before drilling the lead holes to ensure that the lead holes are neither too small nor too large.

- The Rimboard should be adequately anchored to the house framing to resist deck horizontal loads normal to the wall. Design and connection of Rimboard to the house is the Building Designers Responsibility

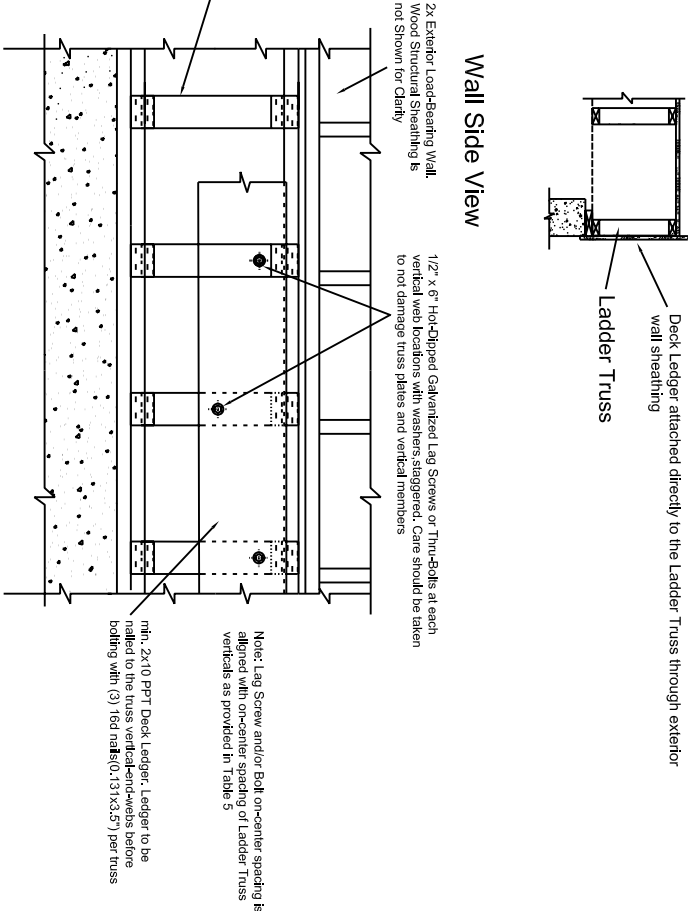
APPENDIX E

DETAIL 5. Attaching Residential Deck Ledger directly to Ladder Truss installed parallel to the deck ledger.

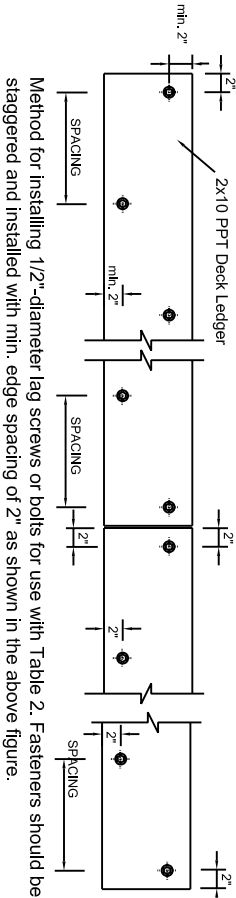
Wall Section



Wall Side View



Deck Ledger fastening schedule



GENERAL NOTES

- All floor truss members used to connect deck ledger shall be of min. specific gravity of G ≥0.42 (includes SPF, Hem-Fir, Douglas-Fir-Larch and Southern Pine)
- Rim board lumber with specific gravity of G ≥0.42 (includes SPF, Hem-Fir, Douglas-Fir-Larch and Southern Pine)
- Structural Composite Lumber (SCL) rim board with thickness ≥ 1" and equivalent specific gravity of G ≥ 0.50.
- Preservative Pressure Treated (PPT) deck ledger lumber with G ≥0.43 (includes Hem-Fir, Douglas-Fir-Larch and Southern Pine). Deck ledger can be incized and wet.
- PPT deck ledger should be treated to a retention level of 0.40 lbs/ft³ of ACQ (suitable for ground contact). No wood decay present is allowed.
- No fastener corrosion is allowed. All fasteners should be hot-dip galvanized per ASTM A153 or "316 stainless steel series", as determined by deck designer and approved by building official.
- Lag screws and bolts shall be installed according to 2005 NDS requirements. Lead holes for the lag screws should be equal to the root diameter (or slightly less) of the threaded portion and the clearance holes should be 1/2" in diameter.
- For a particular box of 1/2" diameter lag screws, a "vest" installation into the house is recommended before drilling the lead holes to ensure that the lead holes are neither too small nor too large.
- Bolts shall be installed with 9/16" or at least 17/32" diameter clearance holes.

Table 5. Fastener on-center spacing for PPT Hem-Fir or Southern Pine Residential Deck Ledgers attached directly to Ladder Truss

CONNECTION DETAIL	RESIDENTIAL DECK JOIST SPAN CONNECTION DETAIL						
	6 feet	8 feet	10 feet	12 feet	14 feet	16 feet	18 feet
1/2"-Diameter Lag Screws with 15/32"-thick Wood Structural Panel Sheathing *	24" oc	24" oc	19.2" oc	16" oc	12" oc	12" oc	10" oc*
1/2"-Diameter Bolts with 15/32"-thick Wood Structural Panel Sheathing *	24" oc	24" oc	24" oc	24" oc	24" oc	24" oc	19" oc

* Use of 1/2"-Diameter Lag Screws for deck joist span of 18 feet is not recommended. However, 1/2"- Diameter Lag Screws can still be used if the Ladder Truss vertical webs are spaced at 10" o.c.

** Ledger to be nailed to the truss vertical-end-webs before bolting with three (3) common 16d nails per truss.

*** Ledger-to-house connection design load for Hem-Fir Ledger, 15/32" Wood Structural Sheathing and 2X SPF Dimensional Lumber Rimboard is 450 lbs for 1/2"-diameter lag screw and 850 lbs for 1/2"-diameter bolts . For the same configuration except using LVL Rimboard (SCL with G ≥0.50), the connection design load is 460 lbs if 1/2"-diameter lag screw is used and 850 lbs if 1/2"-diameter bolt is used.