TECHNICAL BULLETIN

CONNECTION SOLUTIONS FOR CANTILEVERED FLOORS

In some situations, the lower- and upper-story walls of a structure may not align as a result of cantilevered floor systems or architectural setbacks at the second story. This often occurs when wood is used as the building material for the entire structure. However, it is not uncommon for a concrete or masonry lower-story wall not to align with a wood-framed upper-story wall. Offset walls may not always be as noticeable when a structure is complete. For example, structures with brick ledge foundations or homes with concrete basement walls may have less obvious cantilevered upper-story walls. In any of these conditions, the transfer of uplift and lateral loads from level to level becomes more complicated than a single strap or clip; as a result, multiple connections may be required at several locations to create a continuous load path.

Simpson Strong-Tie has developed easy reference tables to help ensure the strength and safety of structures designed with cantilevered floors. The type of floor system used will make a difference in the connections possible, so there are multiple figures showing possible detailing and recommended connectors. Please refer to the design example, figures and tables contained within this document or contact Simpson Strong-Tie for more information.

This technical bulletin only provides connection solutions for a continuous load path at the cantilevered floor system. All other connections in the load path shall be per the Designer.

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CONNECTION SOLUTIONS FOR CANTILEVERED FLOORS – I-JOISTS

TABLE 1 – I-Joist Uplift Load Path

DF/SP Load (lbs.)	SPF/HF Load (lbs.)	❶ Fasten Stud to Rim Board[1]	❷ Fasten Rim Board to Block	❸ Fasten Block to I-Joist	❹ Fasten I-Joist to Top Plate
≤ 600	≤ 535	CS16 w/ (8) 10d nails or LTS16 strap w/ (12) 10dx1½" nails	(4) 10d	(4) 10d	H2.5A
≤ 720	≤ 565	CS16 w/ (10) 10d nails or LTS16 strap w/ (12) 10dx1½" nails	(4) 10d	(4) 10d	H8
≤ 1000	≤ 860	CS16 w/ (12) 10d nails or MTS16 strap w/ (14) 10dx1½" nails	(6) 10d	(6) 10d	TSP[4] or MTS12
≤ 1195	≤ 1065	CS16 w/ (14) 10d nails or HTS20 strap w/ (24) 10dx1½" nails	(7) 10d	(7) 10d	(2) H2.5A[2]
≤ 1365	≤ 1130	CS16 w/ (16) 10d nails or HTS20 strap w/ (24) 10dx1½" nails	(8) 10d	(8) 10d	(2) H8[2]
≤ 1450	≤ 1245	CS16 w/ (18) 10d nails or HTS20 strap w/ (24) 10dx1½" nails	(9) 10d	(9) 10d	HTS20[3]

1. Use half of the required nails in each member being connected to achieve the listed loads. Extend strap length as necessary to avoid cross-grain tension.
2. Where noted, it is acceptable to install (2) hurricane ties per the configurations shown in the "Straps & Ties" section of the current *Wood Construction Connectors* catalog.
3. Where noted, HTS20 leg shall wrap around the top plate in order to install total nails required by current *Wood Construction Connectors* catalog or a stud shall be installed in the wall to accept this nailing.
4. Where noted, (6) 10d common nails into the top plate are required.
5. Rim board must be 1" thick minimum.
6. 10dx1½" nails may be used in CS16 strap with no reduction in capacity.
7. Connectors and fasteners listed in the table include a 60% load increase for wood or earthquake.
8. **NAILS:** 10d = .148" dia. x 3" long, 10dx1½" = 0.148" dia. x 1½" long, 8d = 0.131" dia. x 2½" long, 8dx1½" = 0.131" dia. x 1½" long.

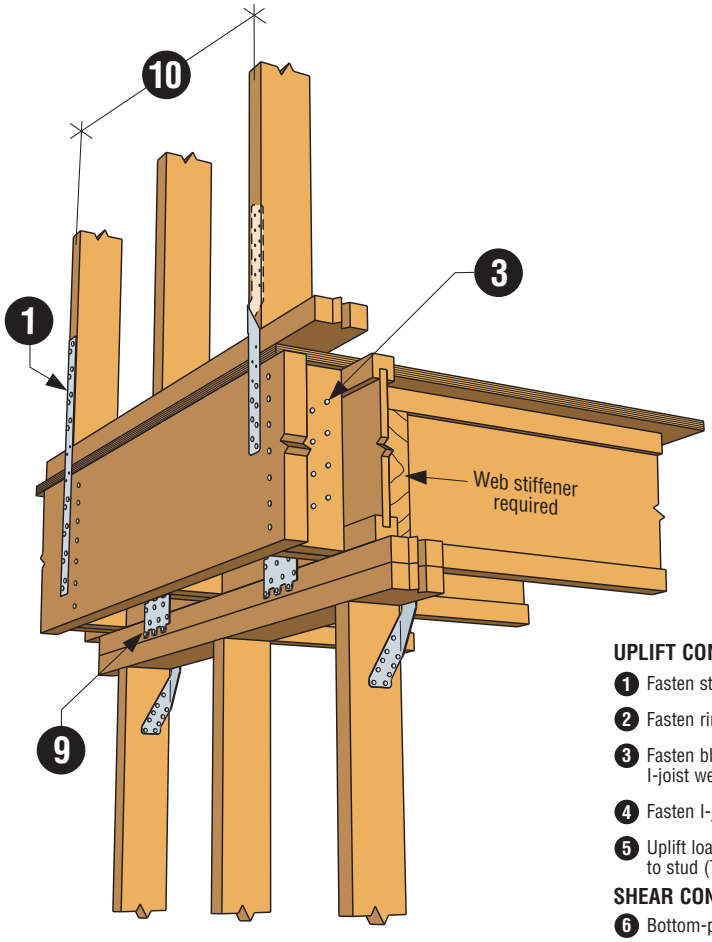
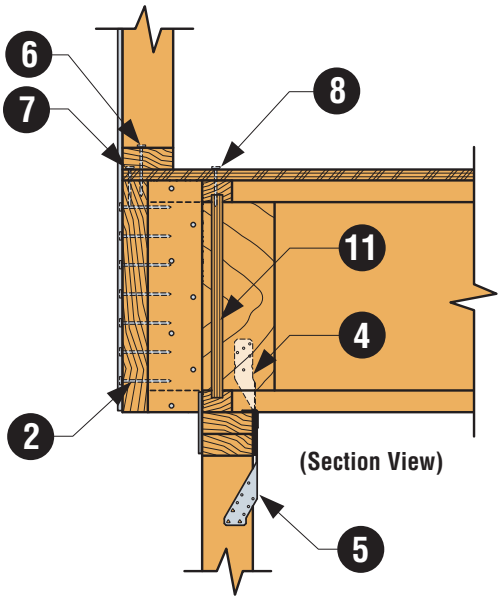


FIGURE 1
Cantilevered I-Joist
(Perspective View)



UPLIFT CONNECTIONS:

❶ Fasten stud to 1" min. rim board per Table 1 based on uplift demand per the Designer

❷ Fasten rim board to block per Table 1 based on uplift demand per the Designer

❸ Fasten block to I-joist per Table 1 based on uplift demand per the Designer. I-joist web-stiffener required

❹ Fasten I-joist to top plate per Table 1 based on uplift demand per the Designer

❺ Uplift load path to foundation shall be continuous. Designer to specify top plate to stud (TSP shown), stud to bottom plate, and bottom plate to foundation connections

SHEAR CONNECTIONS:

❻ Bottom-plate fasteners per Designer for shear

❼ Boundary fasteners per Designer for shear

❽ Fasteners must transfer shear load of both bottom-plate fasteners from ❻ and boundary fasteners per ❼ above. Designer shall specify both fasteners and spacing

❾ Fasten I-joist blocking to top plate per Table 4 based on shear load per the Designer

FRAMING NOTES:

❿ Uplift connectors may be required at each stud, joist, etc. to create uplift load path. Spacing of uplift connectors per Designer

⓫ I-joist blocking may be replaced with 1" min. wide rim board blocking

CONNECTION SOLUTIONS FOR CANTILEVERED FLOORS – SOLID SAWN

TABLE 2 – Solid Sawn Joist Uplift Load Path

DF/SP Load (lbs.)	SPF/HF Load (lbs.)	❶ Fasten Stud to Rim Board[1]	❷ Fasten Rim Board to Joist	❸ Fasten Joist to Top Plate
≤ 600	≤ 535	CS16 w/ (8) 10d nails or LTS16 strap w/ (12) 10dx1½" nails	(6)-10d[2] or (1)-A35	H2.5A
≤ 695	≤ 565	CS16 w/ (10) 10d nails or LTS16 strap w/ (12) 10dx1½" nails	(6)-10d[2] or (1)-A35	H8
≤ 1000	≤ 860	CS16 w/ (12) 10d nails or MTS16 strap w/ (14) 10dx1½" nails	(9)-10d[2] or (2)-A34	H10 or H10S or MTS12 or TSP[5]
≤ 1195	≤ 1065	CS16 w/ (14) 10d nails or HTS20 strap w/ (24) 10dx1½" nails	(2)-A35	H14 or (2)H2.5A[3]
≤ 1365	≤ 1130	CS16 w/ (16) 10d nails or HTS20 strap w/ (24) 10dx1½" nails	(2)-A35	(2) H8[3]
≤ 1450	≤ 1245	CS16 w/ (18) 10d nails or HTS20 strap w/ (24) 10dx1½" nails	(3)-A34	HTS20[4]

1. Use half of the required nails in each member being connected to achieve the listed loads. Extend strap length as necessary to avoid cross-grain tension.
2. Nails will fasten rim board into end-grain of solid sawn joist. Lateral design values include end grain factor of 0.67 per NDS Section 11.5.2.
3. Where noted, it is acceptable to install (2) hurricane ties per the configurations shown in the "Straps & Ties" section of the current *Wood Construction Connectors* catalog. Additional vertical web members will be required to accept nailing from multiple connectors.
4. Where noted, HTS20 leg shall wrap around the top plate in order to install total nails required by current *Wood Construction Connectors* catalog or a stud shall be installed in the wall to accept this nailing.
5. Where noted, (6) 10d common nails into the top plate are required.
6. Rim board must be 1" thick minimum.
7. 10dx1½" nails may be used in CS16 strap with no reduction in capacity.
8. Connectors and fasteners listed in the table include a 60% load increase for wood or earthquake.
9. **NAILS:** 10d = .148" dia. x 3" long, 10dx1½" = 0.148" dia. x 1½" long, 8d = 0.131" dia. x 2½" long, 8dx1½" = 0.131" dia. x 1½" long.

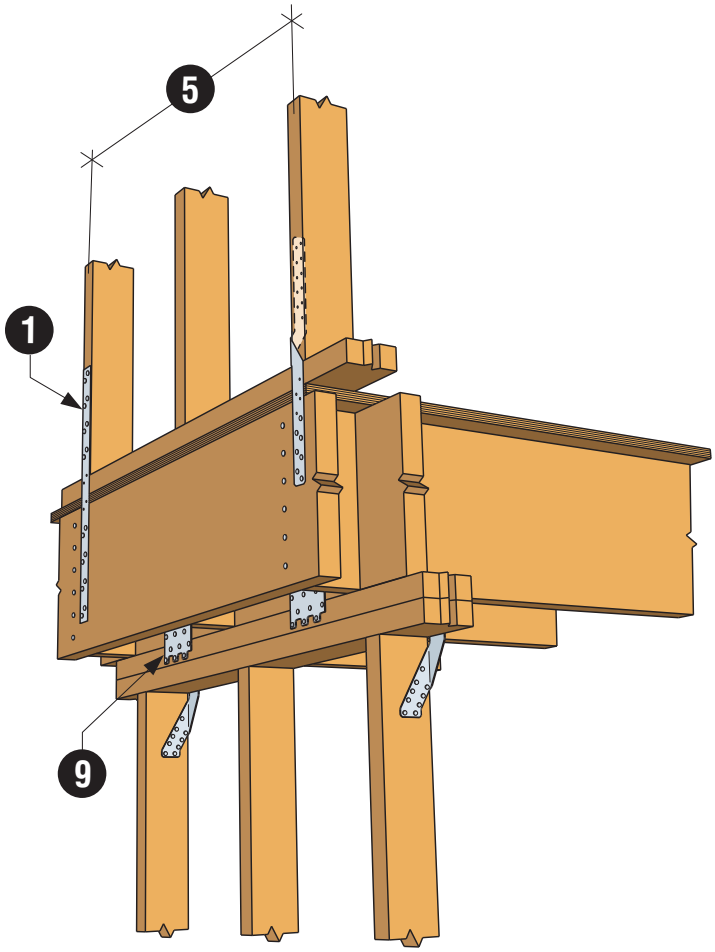
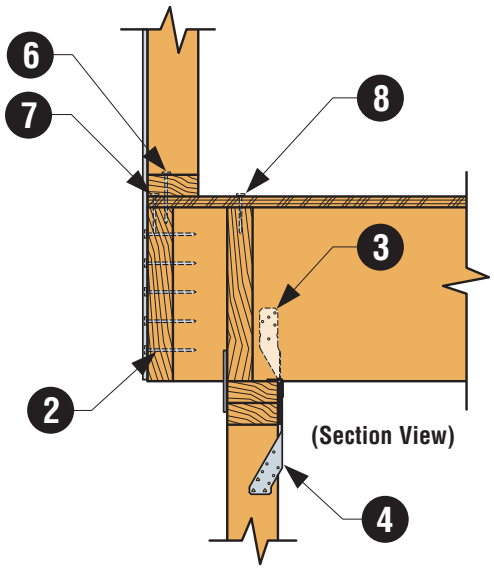


FIGURE 2
Cantilevered Solid-Sawn Joist
(Perspective View)



UPLIFT CONNECTIONS:

❶ Fasten stud to 1" min. rim board per Table 2 based on uplift demand per the Designer

❷ Fasten rim board to cantilever floor joists per Table 2 based on uplift demand per the Designer

❸ Fasten floor joist to top plate per Table 2 based on uplift demand per the Designer.

❹ Uplift load path to foundation shall be continuous. Designer to specify top plate to stud (TSP shown), stud to bottom plate, and bottom plate to foundation connections

❺ Uplift connectors may be required at each stud, joist, etc. to create uplift load path. Spacing of uplift connectors per Designer

SHEAR CONNECTIONS:

❻ Bottom-plate fasteners per Designer for shear

❼ Boundary fasteners per Designer for shear

❽ Fasteners must transfer shear load of both bottom-plate fasteners from ❻ and boundary fasteners per ❼ above. Designer shall specify both fasteners and spacing

❾ Fasten solid-sawn joist blocking to top plate per Table 4 based on shear load per the Designer

CONNECTION SOLUTIONS FOR CANTILEVERED FLOORS – TRUSSES

TABLE 3 – Truss Uplift Load Path

DF/SP Load (lbs.)	SPF/HF Load (lbs.)	❶ Fasten Stud to Rim Board[1]	❷ Fasten Rim Board to Truss	❸ Fasten Truss to Top Plate[6]
≤ 600	≤ 535	CS16 w/ (8) 10d nails or LTS16 strap w/ (12) 10dx1½" nails	(4) 10d	H2.5A
≤ 720	≤ 565	CS16 w/ (10) 10d nails or LTS16 strap w/ (12) 10dx1½" nails	(4) 10d	H8
≤ 1000	≤ 860	CS16 w/ (12) 10d nails or MTS16 strap w/ (14) 10dx1½" nails	(6) 10d	TSP[4] or MTS12
≤ 1195	≤ 1065	CS16 w/ (14) 10d nails or HTS20 strap w/ (24) 10dx1½" nails	(7) 10d	(2) H2.5A[2]
≤ 1365	≤ 1130	CS16 w/ (16) 10d nails or HTS20 strap w/ (24) 10dx1½" nails	(8) 10d	(2) H8[2]
≤ 1450	≤ 1245	CS16 w/ (18) 10d nails or HTS20 strap w/ (24) 10dx1½" nails	(9) 10d	HTS20[3]

1. Use half of the required nails in each member being connected to achieve the listed loads. Extend strap length as necessary to avoid cross-grain tension.
2. Where noted, it is acceptable to install (2) hurricane ties per the configurations shown in the "Straps & Ties" section of the current *Wood Construction Connectors* catalog. Additional vertical members are required in wood truss to accept nailing from multiple hurricane ties.
3. Where noted, HTS20 leg shall wrap around the top plate in order to install total nails required by current *Wood Construction Connectors* catalog or a stud shall be installed in the wall to accept this nailing.
4. Where noted, (6) 10d nails into the top plate are required.
5. Rim board must be 1" thick minimum.
6. Truss shall have vertical member aligned over bearing wall to accept nailing from hurricane tie.
7. 10dx1½" nails may be used in CS16 strap with no reduction in capacity.
8. Connectors and fasteners listed in the table include a 60% load increase for wood or earthquake.
9. **NAILS:** 10d = .148" dia. x 3" long, 10dx1½" = 0.148" dia. x 1½" long, 8d = 0.131" dia. x 2½" long, 8dx1½" = 0.131" dia. x 1½" long.

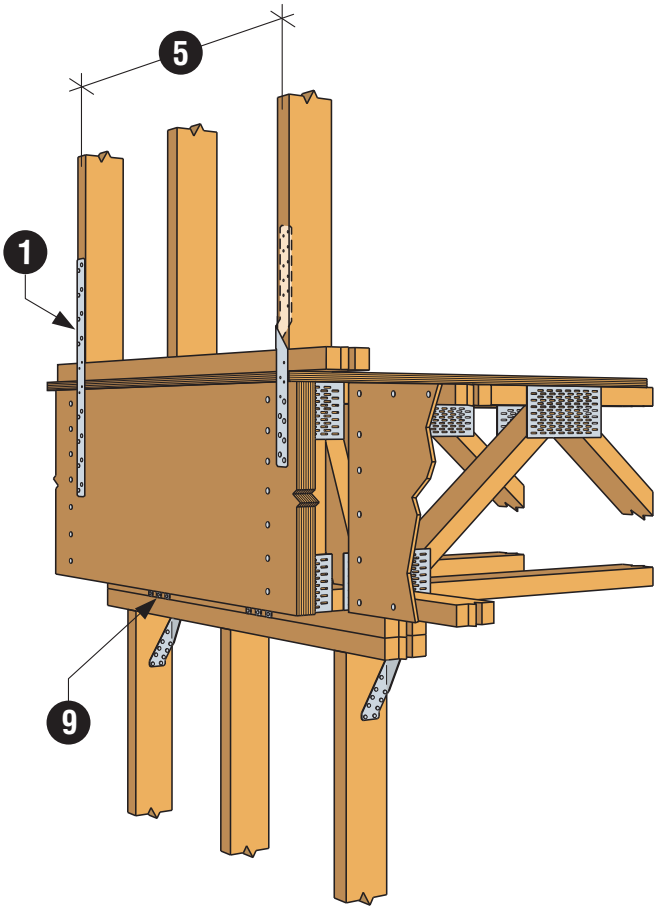
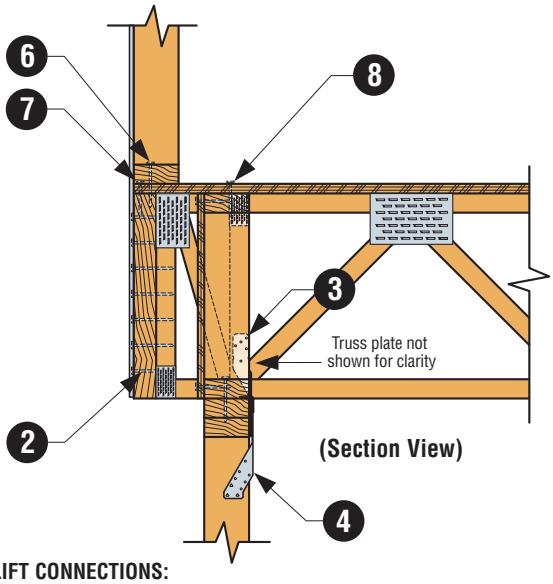


FIGURE 3
Cantilevered Floor Truss
(Perspective View)



UPLIFT CONNECTIONS:

❶ Fasten stud to 1" min. rim board per Table 3 based on uplift demand per the Designer

❷ Fasten rim board to floor trusses per Table 3 based on uplift demand per the Designer

❸ Fasten floor truss to top plate per Table 3 based on uplift demand per the Designer.

❹ Uplift load path to foundation shall be continuous. Designer to specify top plate to stud (TSP shown), stud to bottom plate, and bottom plate to foundation connections

❺ Uplift connectors may be required at each stud, joist, etc. to create uplift load path. Spacing of uplift connectors per Designer

SHEAR CONNECTIONS:

❻ Bottom-plate fasteners per Designer for shear

❼ Boundary fasteners per Designer for shear

❽ Fasteners must transfer shear load of both bottom-plate fasteners from ❻ and boundary fasteners per ❼ above. Designer shall specify both fasteners and spacing

❾ Fasten shear panel blocking to top plate per Table 4 based on shear load per the Designer

Note: Shear panel blocking shall be constructed of 2x solid framing with ⅜" min. plywood with 8d at 6" o.c. and shall be nailed to adjacent trusses with min. (2) 16d top and bottom, or shall be as specified by the Designer

CONNECTION SOLUTIONS FOR CANTILEVERED FLOORS

TABLE 4 – Shear Transfer Connections

Lateral Load Along Wall (plf)		⑨ Nail Option for Floor I-Joist[5] or Solid-Sawn Blocking	⑨ Nail Option for Floor Truss Shear Panel Blocking Only	⑨ Connector Option Acceptable for All Types of Blocking					
				LTP4[2] or A35 per Block			LTP5[2] per Block		
				Joist Spacing			Joist Spacing		
DF/SP	SPF/HF	Fasten I-Joist or Solid-Sawn Blocking to Top Plate with 10d Toe-nails[1]	Fasten Floor Truss Blocking to Top Plate with 10d commons	16" o.c.	19.2" o.c.	24" o.c.	16" o.c.	19.2" o.c.	24" o.c.
155	125	12" o.c.[4]	12" o.c.[4]	1	1	1	1	1	1
210	170	9" o.c.[4]	10" o.c.[4]	1	1	1	1	1	1
305	250	6" o.c.	7½" o.c.	1	1	1	1	1	2
370	300	5" o.c.	6" o.c.	1	1	2	1	2	2
455	370	4" o.c.	5" o.c.	1	2	2	2	2	2
540	440	3½" o.c.	4" o.c.	2	2	2	2	2	2
615	500	3" o.c.	3½" o.c.	2	2	2	2	2	3
735	600	N.S.[3]	3" o.c.	2	2	3	2	3	3
800	650	N.S.[3]	N.S.[3]	2	2	3	2	3	3

1. Toe-nails shall be installed at approximately 30 degrees and started ⅓ the length of the nail from the end of the member.
2. LTP4 and LTP5 require 8dx1½" nails. LTP4 capacity is reduced when installed over structural sheathing with 8dx1½" nails. It will achieve 100% of table load over structural sheathing up to ½" thick if installed with 8d common nails. LTP5 may be installed with 8dx1½" nails over structural sheathing up to ½" thick with no reduction in capacity. Refer to current *Wood Construction Connectors* catalog for more information.
3. N.S. = No Solution. Use LTP4, A35 or LTP5 option.
4. (2) nails required per block minimum.
5. Verify with I-joist manufacturer that toe-nailing bottom chord of I-joist is acceptable. If it is not, use rim-board blocking in place of I-joist blocking.
6. **NAILS:** 10d = .148" dia. x 3" long, 10dx1½" = 0.148" dia. x 1½" long, 8d = 0.131" dia. x 2½" long, 8dx1½" = 0.131" dia. x 1½" long.

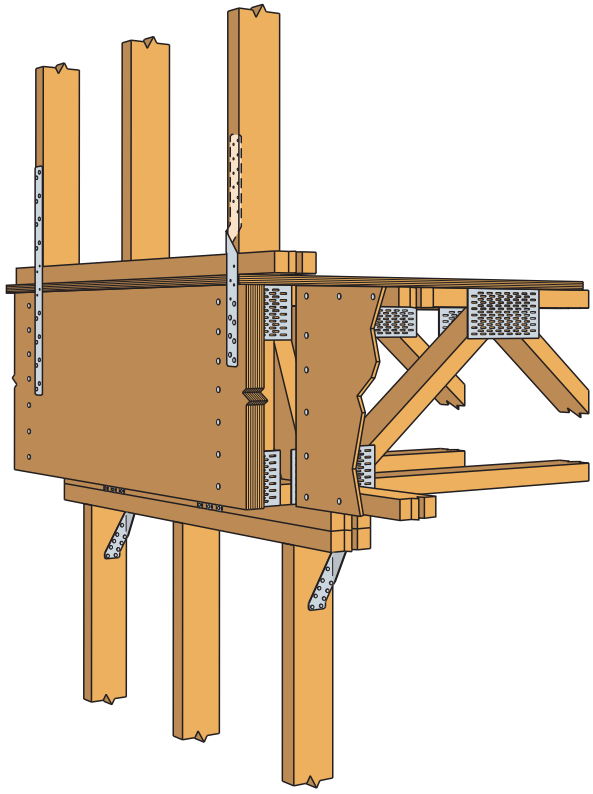
DESIGN EXAMPLE: Cantilevered Floor Trusses – Uplift and Lateral Loads

GIVEN:

- Southern Pine lumber
- 16" floor trusses spaced at 24" o.c.
- 5½" cantilever to match the edge of the brick ledge below.
- 400 plf maximum uplift at the cantilevered floor
- 250 plf shear at upper-floor shearwalls and 70 plf of shear at upper-floor diaphragm along this wall line.

Notes:

1. Uplift connections above and below the cantilevered floor section shall be specified by the Designer and are not part of this example
2. 60% of the applicable dead load may be used to reduce uplift force, so wall and floor dead load should be used – where it applies – to reduce the uplift force at each connection *(assume this has been accounted for in the uplift values given)*.



(Design example continues on following page.)

DESIGN EXAMPLE: Cantilevered Floor – Uplift and Lateral Loads *(cont.)*

CHOOSE UPLIFT CONNECTIONS: ❶ - ❺ of Figure 3 on page 4 refer to the uplift load path and Table 3.

Step 1. Connect Stud to Rim Board

Where studs are spaced at 16" o.c., 400 plf translates into 533 lbs. per stud, or 1067 lbs. of uplift every other stud.

- Top-plate bending should be checked to ensure uplift connectors can be spaced 32" o.c. *(If uplift is too high, use connectors at each stud.)*
- 1195 lbs. capacity shown under Connection ❶ in Table 3 will work using CS16 straps with (14) 10d nails to attach every other stud to the rim board.

TABLE 3 – Truss Uplift Load Path

DF/SP Load (lbs.)	SPF/HF Load (lbs.)	❶ Fasten Stud to Rim Board[1]	❷ Fasten Rim Board to Truss	❸ Fasten Truss to Top Plate[6]
≤ 1195	≤ 1065	CS16 w/ (14) 10d nails or HTS20 strap w/ (24) 10dx1½" nails	(7) 10d	(2) H2.5A[2]

Step 2. Connect Rim Board to Truss

400 plf translates into 800 lbs. per truss if the rim board is fastened to each floor truss.

- Per the column under Connection ❷ in Table 3, if the rim board is fastened to the end of each truss with (6) 10d common nails, the capacity achieved is 1000 lbs., which is greater than the 800-lb. demand load.

TABLE 3 – Truss Uplift Load Path

DF/SP Load (lbs.)	SPF/HF Load (lbs.)	❶ Fasten Stud to Rim Board[1]	❷ Fasten Rim Board to Truss	❸ Fasten Truss to Top Plate[6]
≤ 1000	≤ 860	CS16 w/ (12) 10d nails or MTS16 strap w/ (14) 10dx1½" nails	(6) 10d	TSP[4] or MTS12

Step 3. Connect Truss to Top Plates

- To transfer 800 lbs. from each truss to the top plates below, the column under Connection ❸ in Table 3 shows this can be achieved with a MTS12 twist strap or inverted TSP.

TABLE 3 – Truss Uplift Load Path

DF/SP Load (lbs.)	SPF/HF Load (lbs.)	❶ Fasten Stud to Rim Board[1]	❷ Fasten Rim Board to Truss	❸ Fasten Truss to Top Plate[6]
≤ 1000	≤ 860	CS16 w/ (12) 10d nails or MTS16 strap w/ (14) 10dx1½" nails	(6) 10d	TSP[4] or MTS12

Step 4. Continue Uplift Load Path to Foundation

- This technical bulletin only provides connection solutions to create a continuous load path at the cantilevered floor section. As noted in Connection ❹ of Figure 3, the Designer must choose the connections from the top plate to stud, stud to sill plate, and sill plate to foundation.

(Design example continues on following page.)

DESIGN EXAMPLE: Cantilevered Floor – Uplift and Lateral Loads *(cont.)*

CHOOSE SHEAR CONNECTIONS: 6 - 9 of Figure 3 on page 4 refer to the lateral load path and Table 4.

Step 1. Connect Upper-Story Bottom Plate to Rim Board
Figure 3, Connection 6 shows that the bottom-plate fasteners need to be specified by the Designer to transfer the 250 plf lateral load from the shearwall in the upper story.

Step 2. Connect Upper-Story Diaphragm to Rim Board
Figure 3, Connection 7 shows that the floor sheathing boundary fasteners need to be specified by the Designer to transfer the 70 plf lateral load from the floor level diaphragm shear. *(This is typically a general note that applies to all floor boundary edges at the specified level and can be found in the G.S.N. or Floor Framing Notes.)*

Step 3. Connect Upper-Story Diaphragm to Shear Blocking
Figure 3, Connection 8 shows that the fasteners used to transfer shear to the blocking must have the capacity to transfer the lateral load from the floor diaphragm only at non-shearwall locations, but transfer the lateral load of both the shearwall and floor diaphragm – 320 plf in this example – at shearwall locations and the fastener size and spacing should be specified by the Designer.

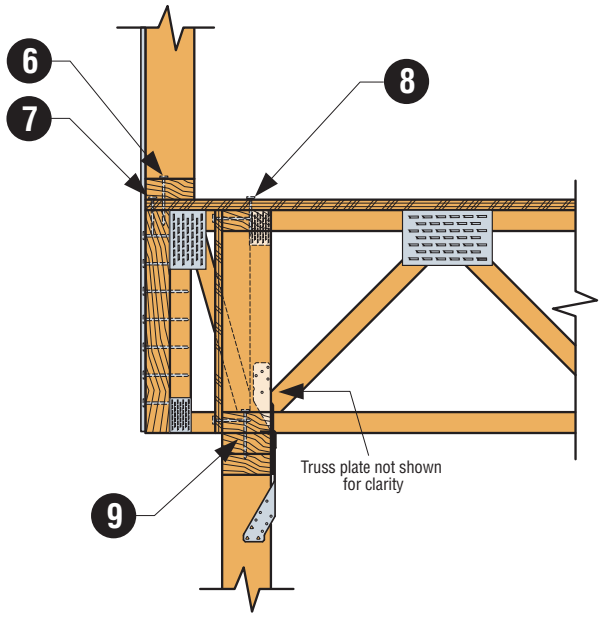


Figure 3 – Section View

Step 4. Connect Shear Blocks to Top Plate
Table 4 on page 5 specifies the attachment referenced by Connection 9 blocking to top plate below. Three options are provided in the table for different types of blocking: I-joist blocking, floor truss shear-panel blocking, and all types of blocking.

TABLE 4 – Shear Transfer Connections

Lateral Load Along Wall (plf)		9 Option for Floor I-Joist[5] or Solid-Sawn Blocking	9 Option for Floor Truss Shear Panel Blocking Only	9 Option Acceptable for All Types of Blocking					
DF/SP	SPF/HF	Fasten I-Joist or Solid-Sawn Blocking to Top Plate with 10d Toe-nails[1]	Fasten Floor Truss Blocking to Top Plate with 10d commons	LTP4 per Block			LTP5[2] per Block		
				Joist Spacing			Joist Spacing		
				16" o.c.	19.2" o.c.	24" o.c.	16" o.c.	19.2" o.c.	24" o.c.
155	125	12" o.c.[4]	12" o.c.[4]	1	1	1	1	1	1
210	170	9" o.c.[4]	10" o.c.[4]	1	1	1	1	1	1
305	250	6" o.c.	7½" o.c.	1	1	1	1	1	2
370	300	5" o.c.	6" o.c.	1	1	2	1	2	2

- This example has floor trusses, so either the "Floor Truss Shear Panel Blocking" column or the "All Types of Blocking" column applies. Lateral load demand is 320 plf. Table 4 specifies 10d common nails at 6" o.c. or using two LTP4 (or LTP5) clips per block will achieve at least 370 plf of capacity.
- LTP4 and LTP5 require 8dx1½" nails. LTP4 capacity is reduced when installed over structural sheathing with 8dx1½" nails. It will achieve 100% of table load over structural sheathing up to ½" thick if installed with 8d common nails. LTP5 may be installed with 8dx1½" nails over structural sheathing up to ½" thick with no reduction in capacity. Refer to current *Wood Construction Connectors* catalog for more information.

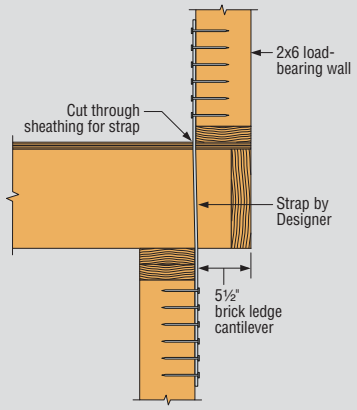
NOTE: This example does not supply a complete uplift or lateral load path. It only references the connectors required at the cantilevered wall connection. The user of this technical bulletin is responsible for designing all other connections required to complete the entire uplift and lateral load paths.

CONNECTION SOLUTIONS FOR CANTILEVERED FLOORS

Brick-Ledge-with-Cantilevered-Floor Framing Options

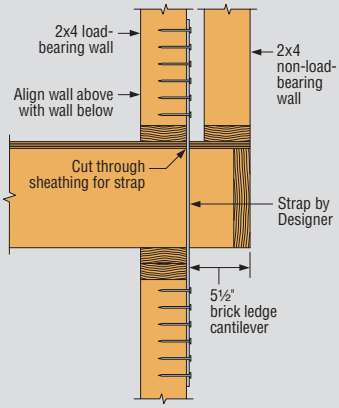
OPTION 1 – Use 2x6 wall on upper floor

**As long as studs align on both levels and are not in-line with floor joists and wall above is 2x6, framer can strap floor to floor.*

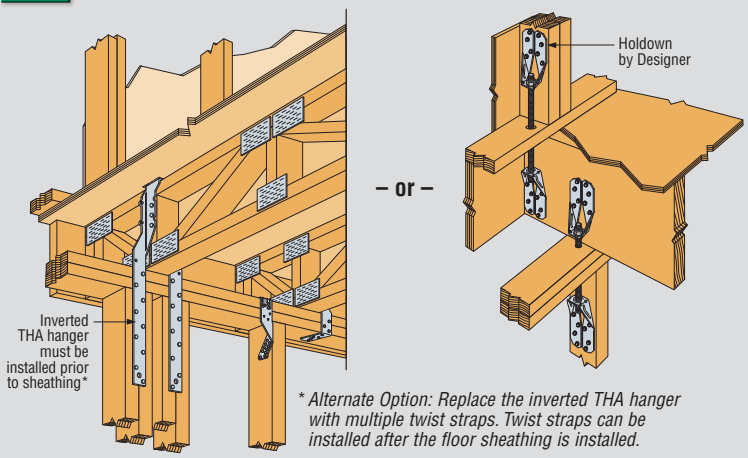


– or –

OPTION 2 – Frame double wall on second floor

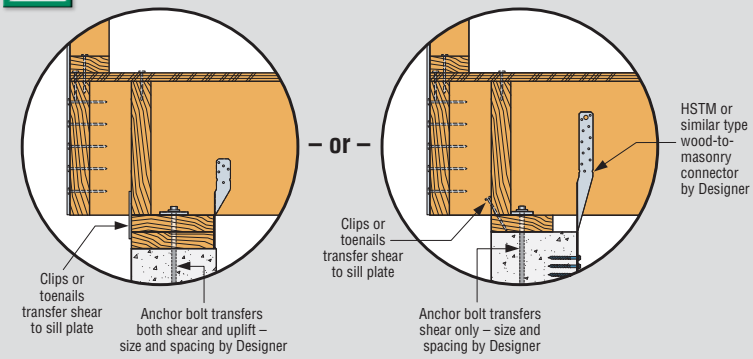


How to Transfer Greater Uplift of Girder Truss or Shearwall Overturning Loads in a Cantilevered Floor System



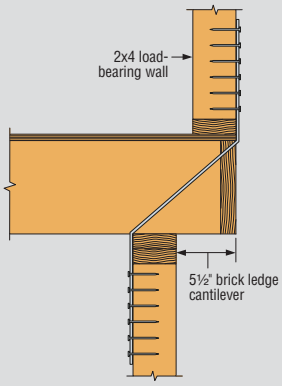
** Alternate Option: Replace the inverted THA hanger with multiple twist straps. Twist straps can be installed after the floor sheathing is installed.*

Concrete or CMU Lower-Level Wall



When a lower-level wall is concrete or CMU, the connections forming the load path from the roof to floor joist level are the same as when a wood lower wall exists. The connectors chosen to transfer shear and uplift to the concrete or CMU wall below are the only difference.

Incorrect Uplift Connection at Brick Ledge Cantilevered Floor Framing



Incorrect Rim Board

Rim board should be solid lumber matching floor joist depth. Multiple 2x members are not acceptable, see IRC section R502.7.

This technical bulletin is effective until January 31, 2013, and reflects information available as of September 1, 2010. This information is updated periodically and should not be relied upon after January 31, 2013; contact Simpson Strong-Tie for current information and limited warranty or see www.strongtie.com.

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800-999-5099
www.strongtie.com