Structural Training - Part 1:

Structural Training

Residential Wood-Framed Construction

Presented by:
City of Santa Clarita
Building & Safety Division

February, 2014

The information provided in this presentation is for training purposes only. For any structure, you should consult a qualified architect or engineer for all structural issues. It is the sole responsibility of the project designer(s) owner(s), and/or contractor(s) to build structures in compliance with the applicable codes, laws, ordinances and other regulations.

Training Goals

With every new edition of the Building Code, the structural regulations change and become more complex. However, the physics of structures will never change.

The key to understanding the structural provisions of the Building Code is understanding structural behavior. Discussing the changes to the structural provisions of the Building Code is meaningless without a context and understanding of why the provisions are there in the first place. Once you understand "why," the "how" is easy.

Today's training will cover the basic science behind the most common structural elements, and how these elements are designed and built in compliance with the Building Code.

Training Goals

A typical two-story wood-framed house in Santa Clarita will serve as the example project for this training. The structural concepts discussed today will apply (in general) to any structure.

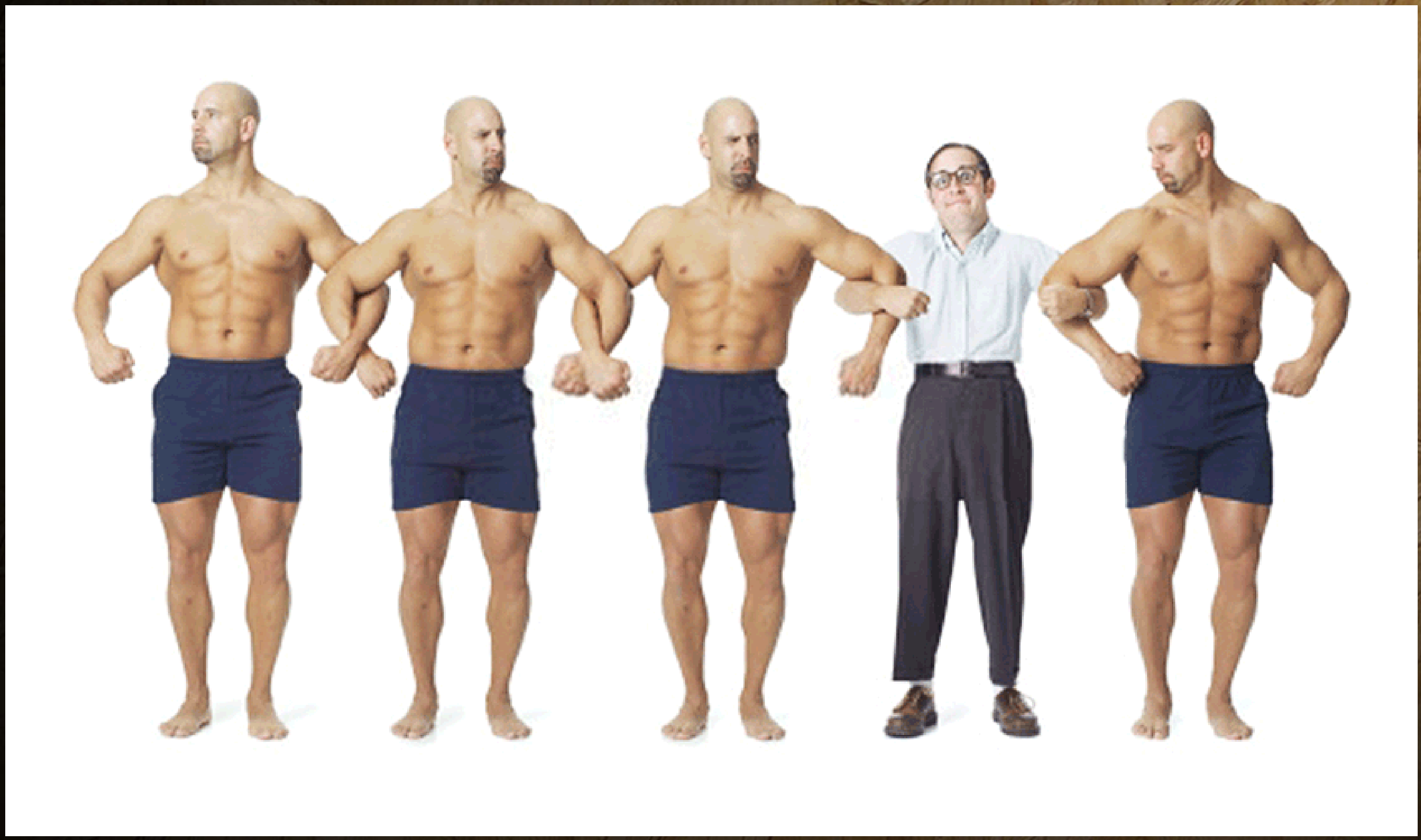
We will not be covering highly technical structural engineering calculations or topics (unless requested, and time permits).

We will also briefly review the following:

- Major structural changes from the 2010 CBC to 2013 CBC
- City structural amendments to the 2013 CBC

Feel free to ask questions during the training.

A structural load path is like a chain...



It´s only as strong as its weakest link!

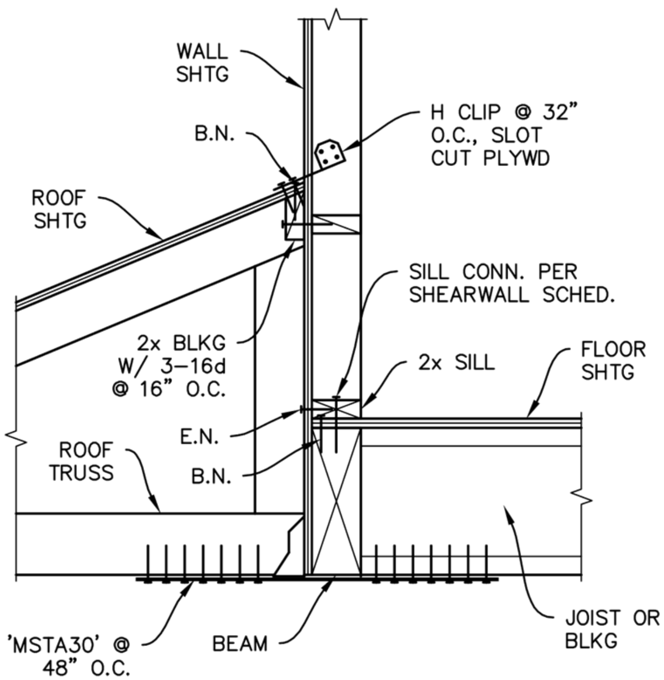
If one structural element or connection is weak or missing, the performance of that entire load path is compromised.

This is why it is so important that we understand how and where structural loads are generated, and how to safely transfer those loads to their supporting elements.

Making sure the structure "is all there" is just as important as making sure "it's strong enough."

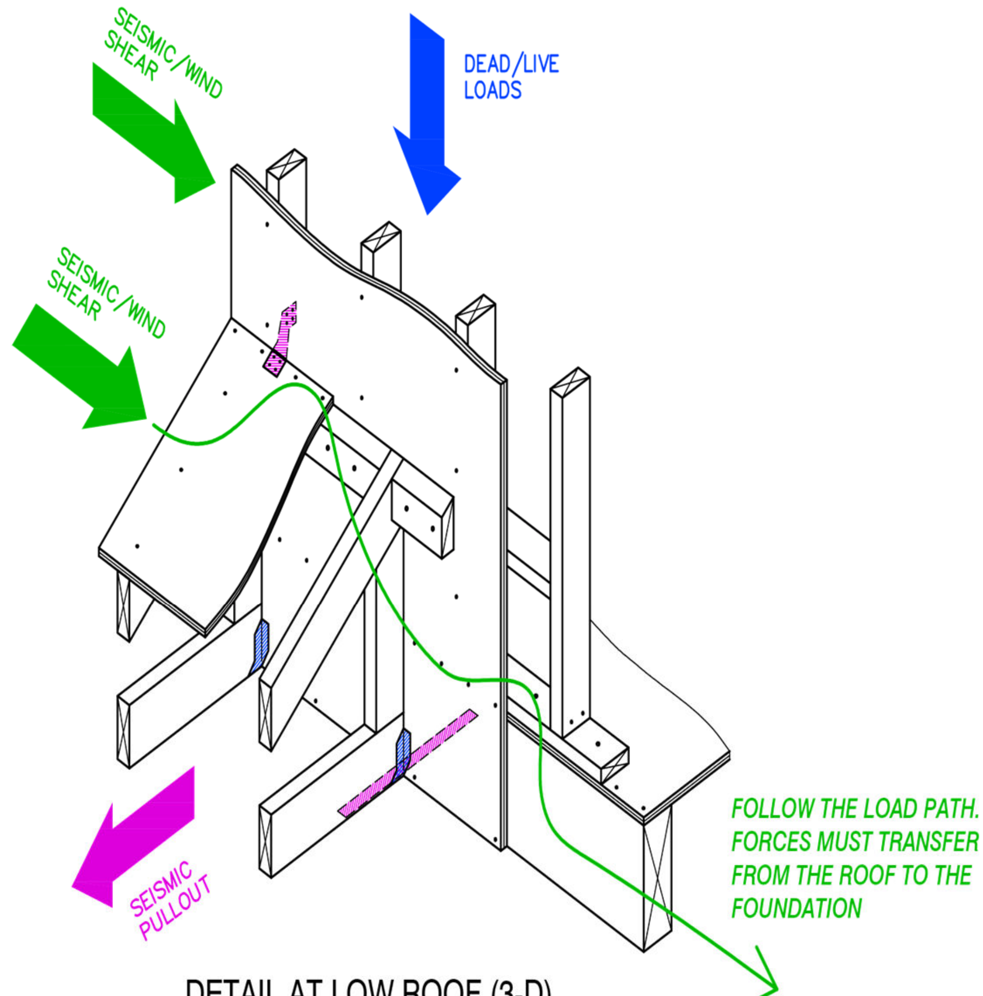
It is also important to understand how the various structural elements perform under different types of loads. A connection that performs well under static loads (dead and live) may not perform well for wind and/or seismic loads, and vice versa.

Thinking in Three Dimensions



DETAIL AT LOW ROOF (2-D)

WHEN LOOKING AT TWO-DIMENSIONAL DETAILS, IT'S EASY TO THINK IN ONLY TWO DIMENSIONS.



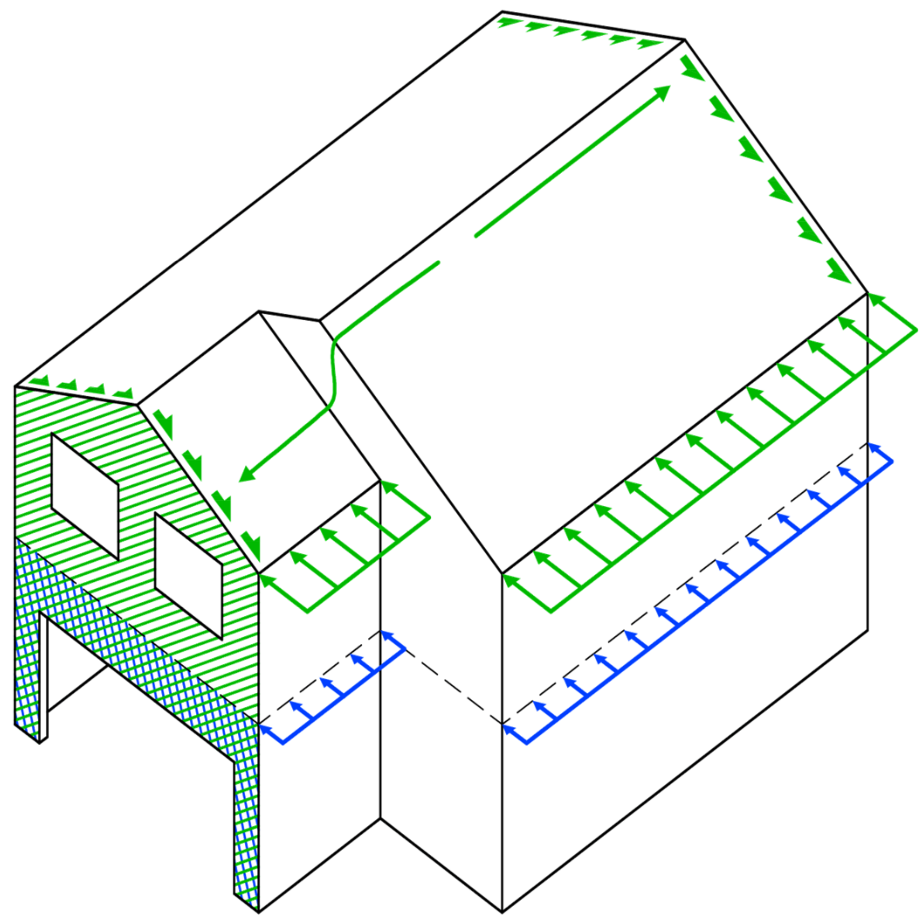
DETAIL AT LOW ROOF (3-D)

EARTHQUAKE FORCES CAN ACT IN ANY DIRECTION. FOR MOST DETAILS, THERE ARE FORCES ACTING IN ALL THREE DIRECTIONS. STRUCTURAL ASSEMBLIES MUST PROVIDE COMPLETE LOAD PATHS IN ALL DIRECTIONS.

Example Project - "A Typical House in Santa Clarita"

DATA ABOUT OUR "TYPICAL HOUSE IN SANTA CLARITA":

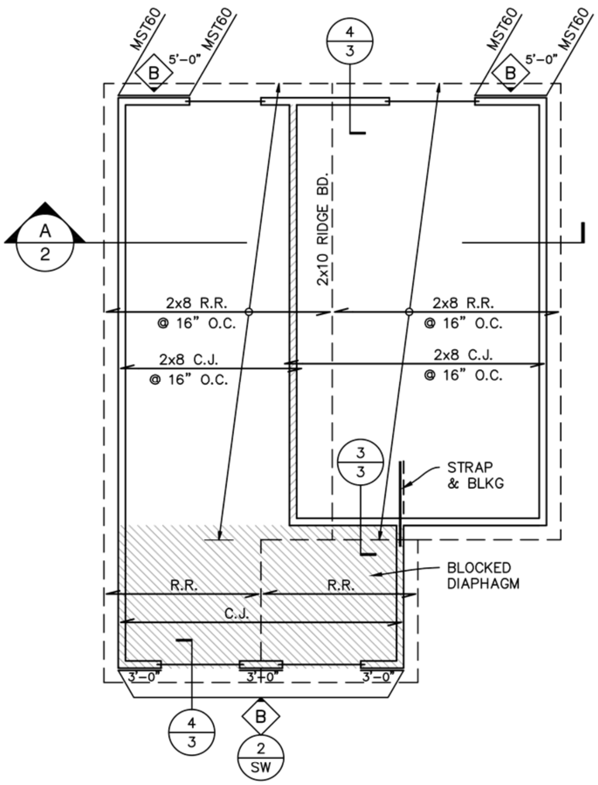
- STRUCTURE IS TWO STORIES, WOOD-FRAMED, ± 2,000 SQ. FT.
- HAS A LIGHTWEIGHT CONCRETE TILE ROOF AND STUCCO WALLS.
- SEISMIC GROUND ACCELERATION, Ss = 2.75 (THE AVERAGE IN SANTA CLARITA UNDER THE 2013 CBC). THE TOTAL SEISMIC FORCE ON THE HOUSE (BASE SHEAR) IS 20% OF THE DEAD WEIGHT (Cs = 0.20 W)
- SEISMIC LOADS GOVERN THE LATERAL DESIGN (TYPICAL IN SANTA CLARITA).
- FOR THIS TRAINING WE WILL BE STUDYING THE LATERAL SYSTEM IN THE TRANSVERSE DIRECTION ONLY.



You should have an 11x17 packet which includes structural drawings, diagrams, and other information for our "typical house."

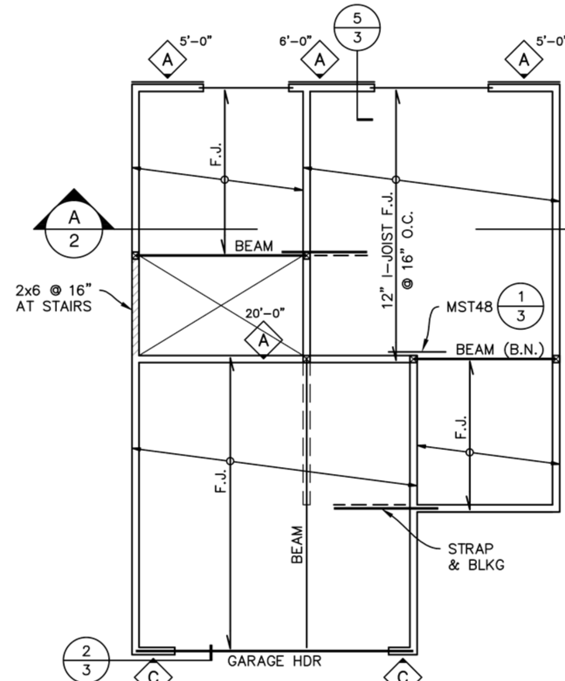
Let's take a minute to look at the framing plans for our "typical" house...

“A Typical House in Santa Clarita” – FRAMING PLANS



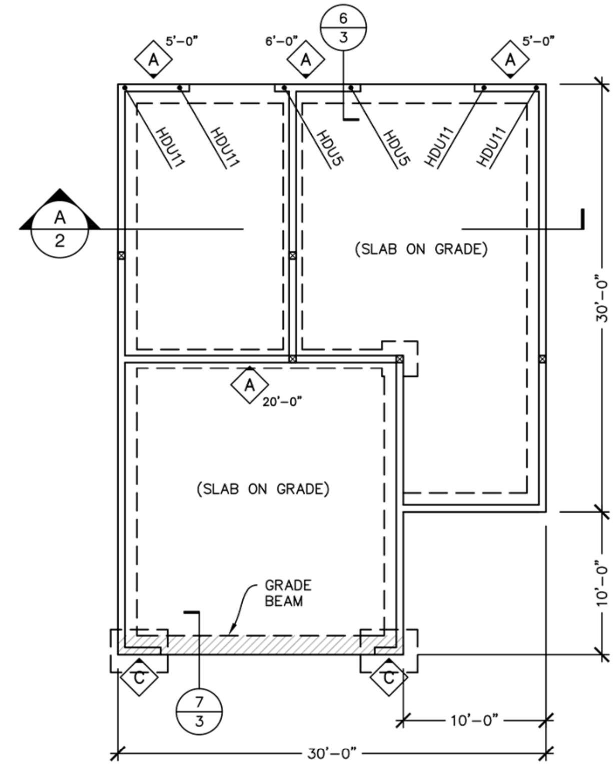
ROOF FRAMING PLAN

ROOF AREA = 1,250 SQ. FT.
ROOF LEVEL MASS (DEAD LOAD, INCLUDING INTERIOR AND EXTERIOR WALLS) = 40,000 LB.



FLOOR FRAMING PLAN

FLOOR AREA = 1,080 SQ. FT.
FLOOR LEVEL MASS (DEAD LOAD, INCLUDING INTERIOR AND EXTERIOR WALLS) = 40,000 LB.



FOUNDATION PLAN

SCALE 1/8" = 1'-0"

HOUSE INFORMATION:
ROUGHLY 2,000 SQ. FT., TILE ROOF, STUCCO,
Ss = 2.73, BASE SHEAR Cs = 0.20 W (AVERAGE IN THE CITY)

SHEARWALL SCHEDULE

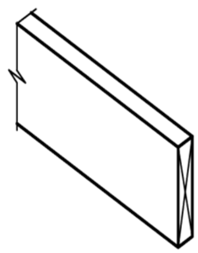
MARK	SHEATHING (PLYWOOD OR OSB)	STUDS AT PANEL EDGES (1)	E.N. / F.N. (2)	FOUNDATION SILL PL	FOUNDATION ANCHOR BOLTS (3)	UPPER FLOORS SILL PL	UPPER FLOORS SILL CONN (4)	ALLOW SHEAR (PLF)
A	1/2" STRUCT. 1	3x	10d @ 4"/12"	2x	5/8" DIA. @ 34"	2x	16d @ 3"	510
B	1/2" STRUCT. 1	3x	10d @ 3"/12"	2x	5/8" DIA. @ 26"	2x	SDS @ 6"	665
C	MANUFACTURED SHEARWALL				(2) 1-1/8" F1554 GRADE 36			3300

SHEARWALL SCHEDULE NOTES:
1. THICKNESS OF STUDS AND BLOCKING RECEIVING EDGE NAILING FROM ADJOINING PANELS.
2. NAILS SHALL BE COMMON NAILS WITH FULL HEADS.
3. ANCHOR BOLTS SHALL BE INSTALLED WITH 3" SQ x 1/4" PLATE WASHERS.
4. 'SDS' INDICATES SIMPSON 'STRONG DRIVE' 1/4" x 5" S-SERIES WOOD SCREW (ICC-ES# 5268).

Structural Parts for Our "Typical House in Santa Clarita"

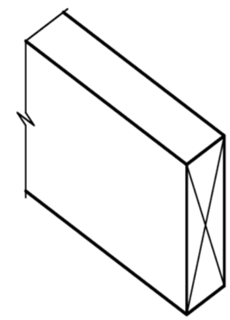
(ACTUAL CAPACITIES UNDER THE 2013 CBC. SOME LARGER VALUES ARE ROUNDED DOWN TO THE NEAREST 100 LB.)

Horizontal Framing Members



2x8 DFL#2 @ 16" O.C.
CAN SUPPORT:

- TILE ROOF UP TO 15' SPAN.
- CEILING UP TO 23' SPAN.
- CEILING W/ATTIC STORAGE UP TO 16' SPAN.



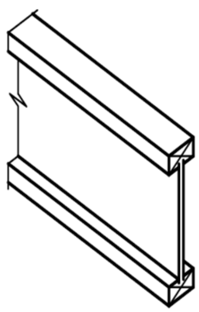
4x DFL#1 BEAMS

ALLOWABLE STRESSES:

- BENDING = 1,000 PSI
- SHEAR = 180 PSI

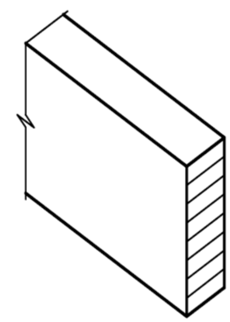
STIFFNESS:

- 1,700 KSI



12" WOOD I-JOIST @ 16" O.C.
CAN SUPPORT:

- RESIDENTIAL FLOOR UP TO 26' SPAN.



GLULAM/PARALLAM BEAMS

ALLOWABLE STRESSES:

- BENDING = 2,400/2,900 PSI
- SHEAR = 265/290 PSI

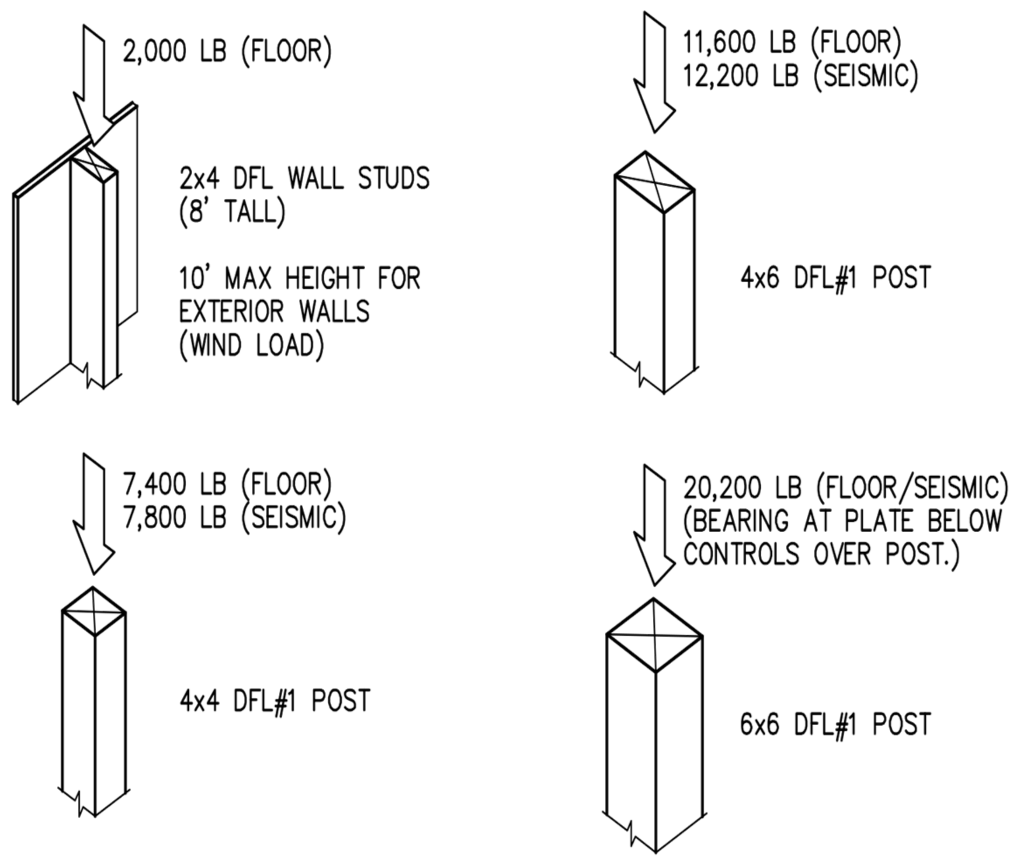
STIFFNESS:

- 1,800/2,000 KSI

Structural Parts for Our "Typical House in Santa Clarita"

(ACTUAL CAPACITIES UNDER THE 2013 CBC. SOME LARGER VALUES ARE ROUNDED DOWN TO THE NEAREST 100 LB.)

Vertical Framing Members (8′ height)



Structural Parts for Our "Typical House in Santa Clarita"

(ACTUAL CAPACITIES UNDER THE 2013 CBC. SOME LARGER VALUES ARE ROUNDED DOWN TO THE NEAREST 100 LB.)

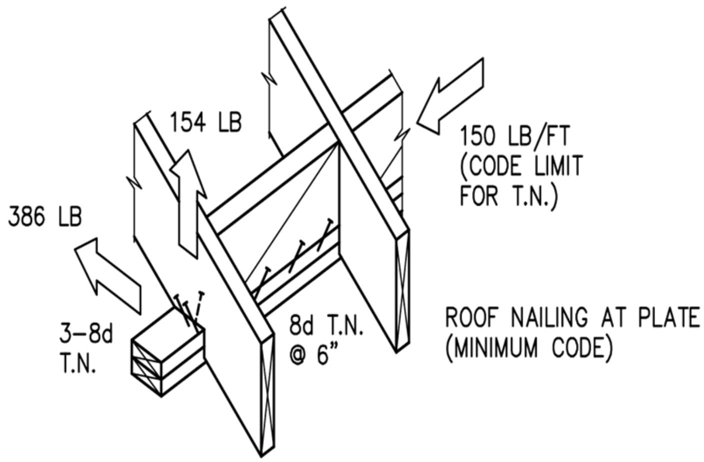
Nails and Code Minimum Nailing

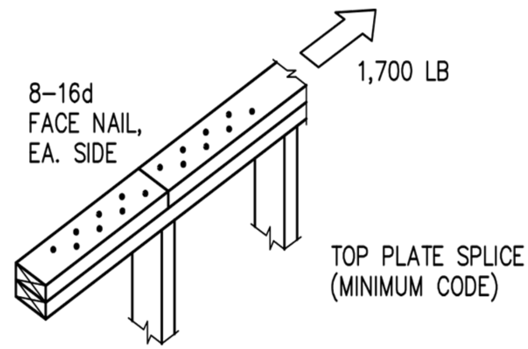
8d COMMON NAIL, SHEAR:
97 LB FLOOR / 155 LB WIND/SEISMIC

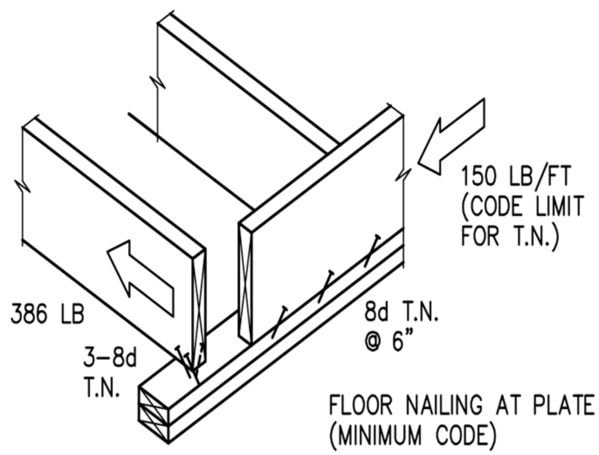
10d COMMON NAIL, SHEAR:
118 LB FLOOR / 188 LB WIND/SEISMIC

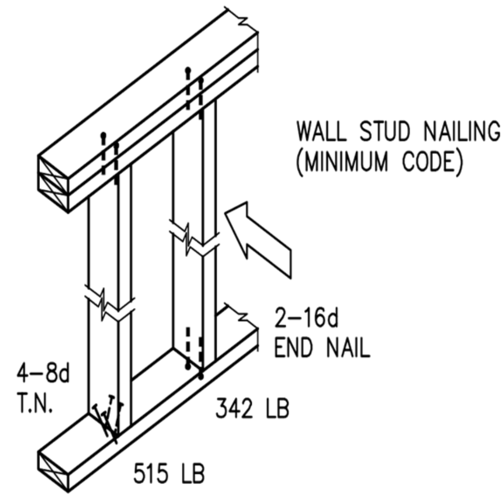
16d COMMON NAIL, SHEAR:
141 LB FLOOR / 225 LB WIND/SEISMIC

The use of nails in withdraw to support structural loads is prohibited by the code in certain instances. Nails have very low withdraw capacity. Wood can shrink over time, reducing this capacity further. Use of nails in pure withdraw for anything other than very small loads (less than 20 lb) is considered bad practice. We have a city amendment which expands and clarifies the prohibition against using nails in withdraw.





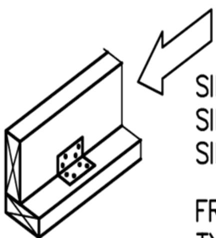




Structural Parts for Our "Typical House in Santa Clarita"

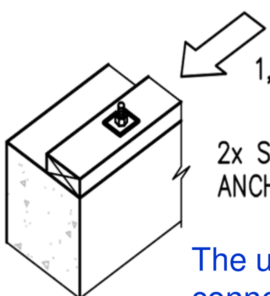
(ACTUAL CAPACITIES UNDER THE 2013 CBC. SOME LARGER VALUES ARE ROUNDED DOWN TO THE NEAREST 100 LB.)

Hardware



SIMPSON 'A34': 455 LB
SIMPSON 'A35': 695 LB
SIMPSON 'LTP4': 670 LB

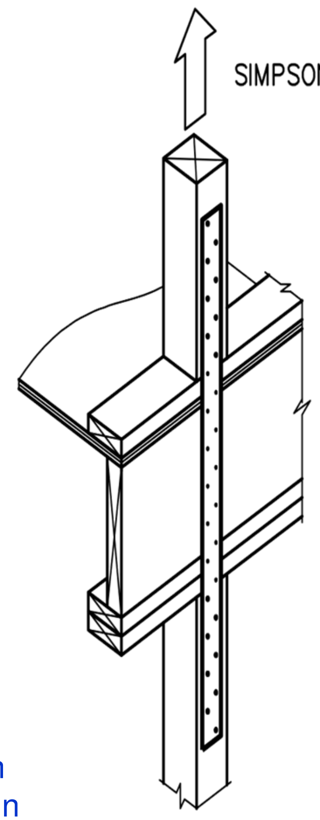
FRAMING CLIPS TYPICALLY USED IN LIEU OF T.N. AT BLOCKING



1,450 LB

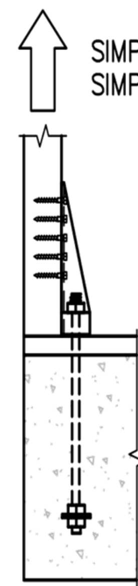
2x SILL W/ 5/8" ANCHOR BOLT

The use of field-bent sill plate connectors (such as Simpson 'MASA') is prohibited for use in shearwalls (city amendments).



SIMPSON 'MST60': 4,830 LB

FLOOR–FLOOR HOLDOWN STRAP



SIMPSON 'HDU5': 5,645 LB
SIMPSON 'HDU11': 9,535 LB

HOLDOWN SIMPSON 'HDU5':

Santa Clarita allows full holdown values to be used for design.
L.A. City and L.A. County amendments require a 25% reduction.

Light-gage, field-bent sill plate connectors (such as Simpson 'MASA')
have shown poor performance in the field…

Field-bent sill plate connectors are prohibited for shear walls (city amendments).

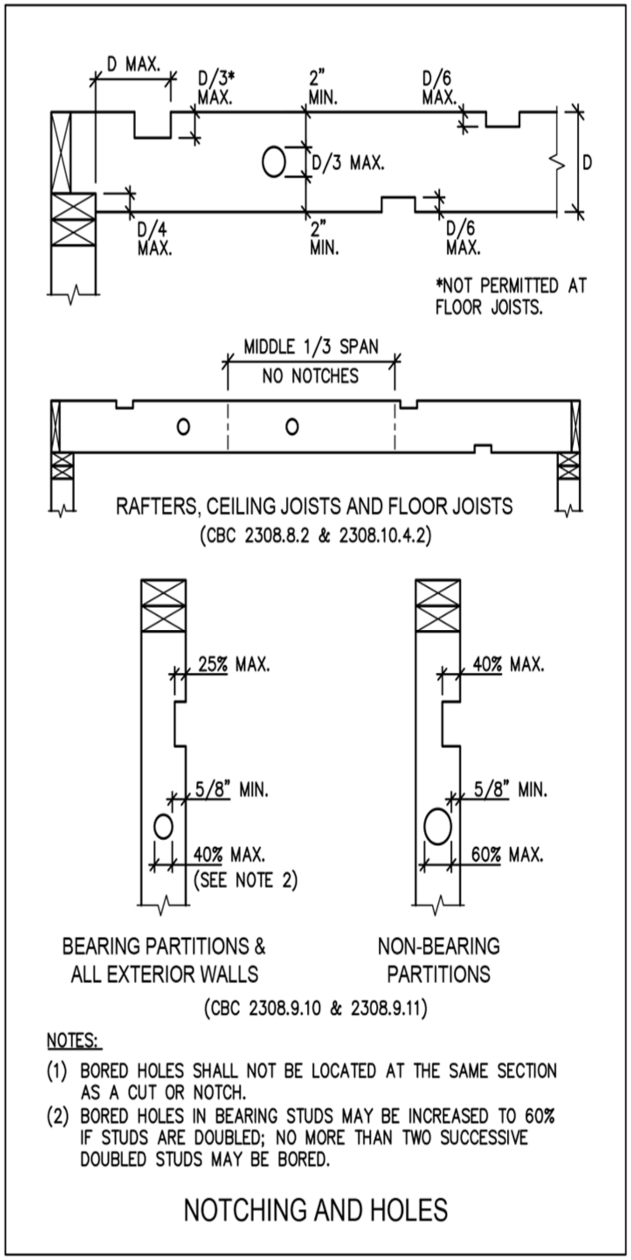
When installed improperly at non-shear walls, an epoxy anchor bolt may serve as a field fix.

Structural Training - Part 2:

CITY OF SANTA CLARITA

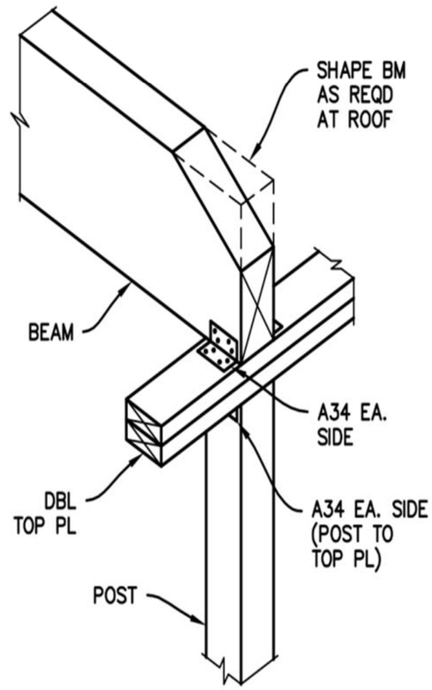
FOUNDED 15 DECEMBER 1987™

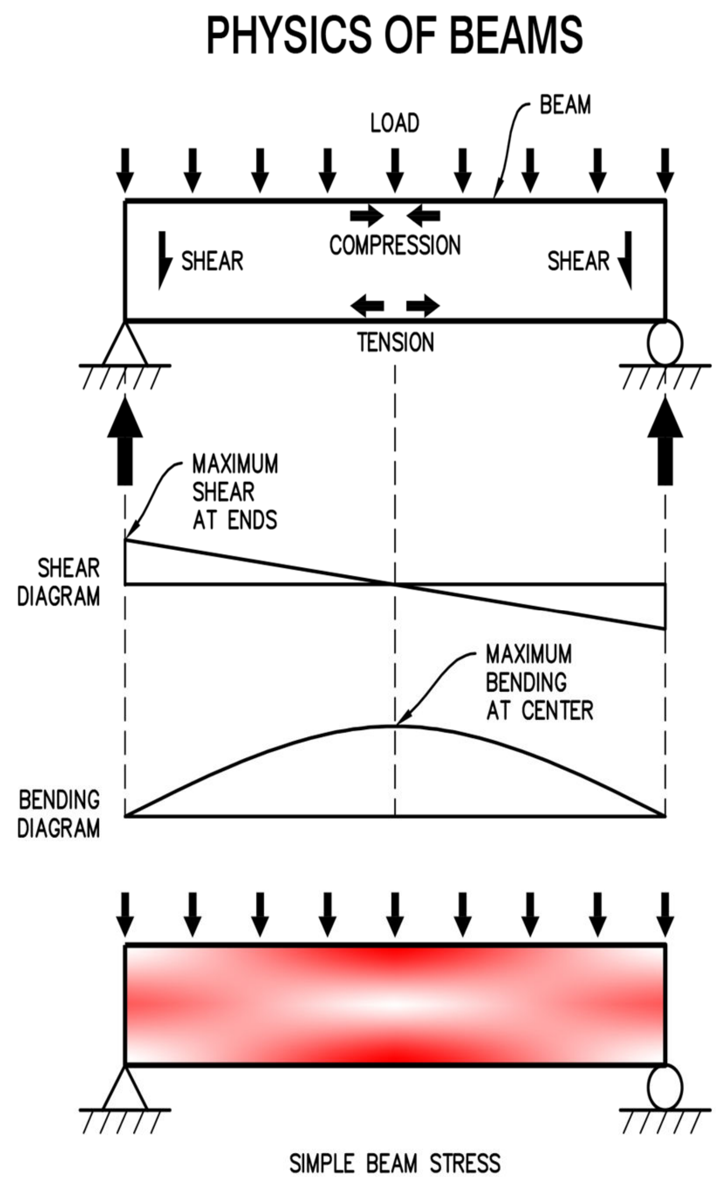
“A Typical House in Santa Clarita” - BEAMS



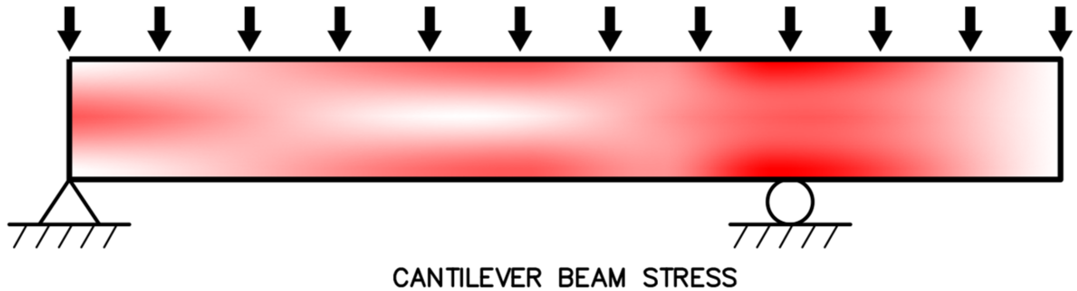
Wood beams are typically governed by bending which causes compression/tension on the top/bottom of the beam.

Notching the top or bottom of beams in the middle third, or the flanges of I-joists is prohibited without engineering justification.





“A Typical House in Santa Clarita” - BEAMS



Cantilevered and continuous beams create a reversal of bending where the beams are continuous over the supports. This creates tension on the top of the beam. Notching or boring is not permitted near the support where the beam is continuous (unless justified by engineering calculations).

Glulam beams have higher grade lumber on the outer laminations.

‘V4’ glulams have higher stress lumber on the tension side only (used for simple span beams).

‘V8’ glulams have higher stress lumber on both sides (used for cantilever beams).

“A Typical House in Santa Clarita” - BEAMS

Over-cut beam. Notice how the saw was run past the notch. This severely compromises the structural integrity. If loaded to its design live load, this beam could easily fail.
Fix: Replace or engineered retrofit.

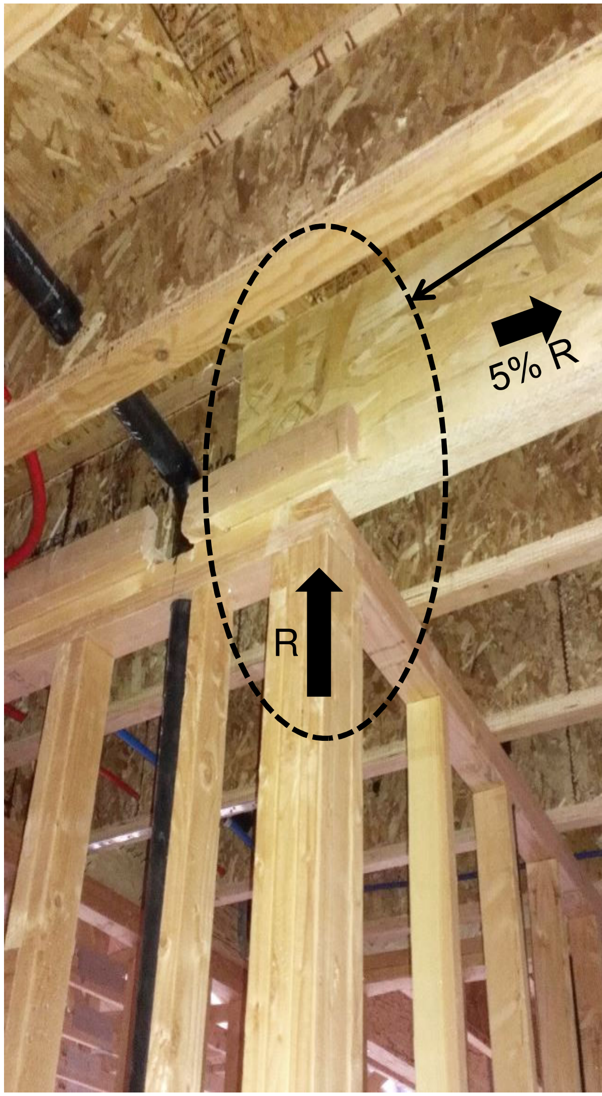
Over-bored joists. Holes are well within the zone of maximum tensile stress.
Fix: Replace or engineered retrofit.

“A Typical House in Santa Clarita” - BEAMS

Is this strap capable of transferring vertical shear? No, the small piece along the bottom of the header will fail.
Fix: Replace or engineered retrofit.

This beam is installed upside-down. The lumber of the “top” lamination is a lower grade than the bottom lamination.
Fix: If the beam is over-designed, it may still work (engineer must justify).
Otherwise, replace or retrofit.

“A Typical House in Santa Clarita” - BEAMS



This beam (which carries vertical loads only) is missing a connection to its support.

The building code requires all beams (including those which support only vertical loads) to be connected to their supporting elements (ASCE 7 section 1.4.4). The connection shall support a minimum load of 5% of the beam vertical reaction acting parallel to the beam axis.

If the beam reaction were 5,000 lb, the connection must support 250 lb. A small post cap or framing clip would be acceptable.

If this beam were along a shear line, it would have a much higher connection (drag) force.

“A Typical House in Santa Clarita” - DIAPHRAGMS

“Diaphragm” is the structural term used for floor or roof structures when they are carrying in-plane loads (loads in the plane of the floor or roof).

How Diaphragms Work:

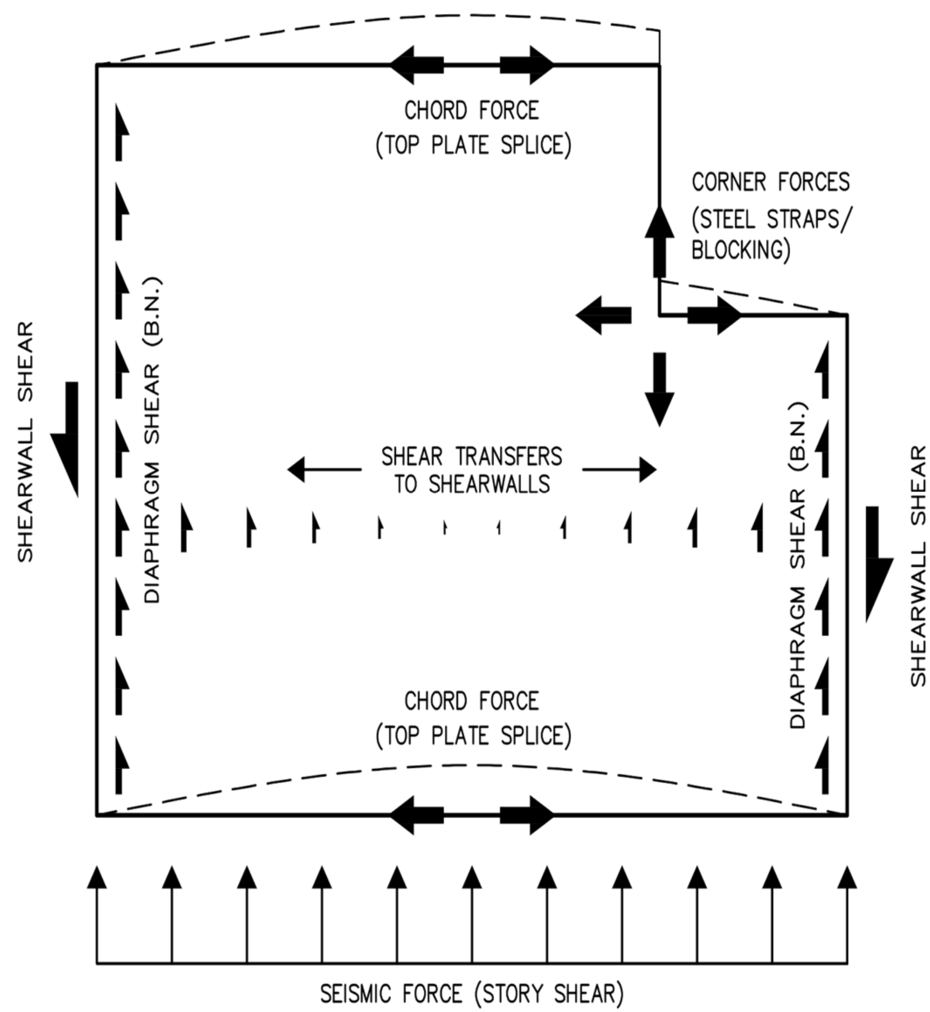
The seismic force generated in a building comes from the mass of the diaphragm itself and the walls pushing on the diaphragm.

The diaphragm transfers the loads to the shearwalls. The parts of the diaphragm closest to the shearwalls have the highest shear.

Like beams, diaphragms have tension and compression forces (“chord forces”).

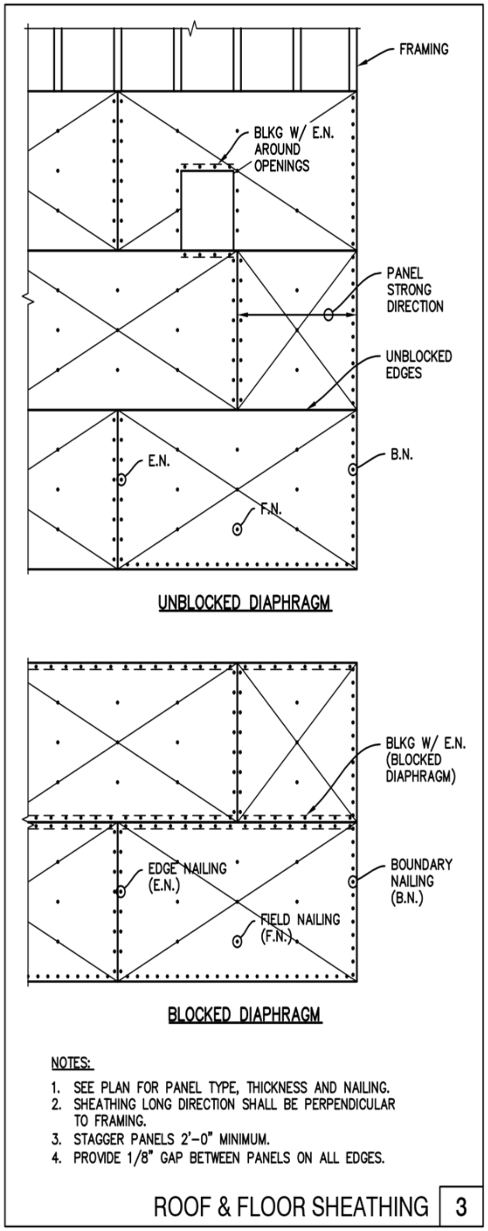
Stress concentrations also occur at discontinuities (corners, openings).

PHYSICS OF DIAPHRAGMS



FLOOR/ROOF DIAPHRAGM PLAN

"A Typical House in Santa Clarita" - DIAPHRAGMS



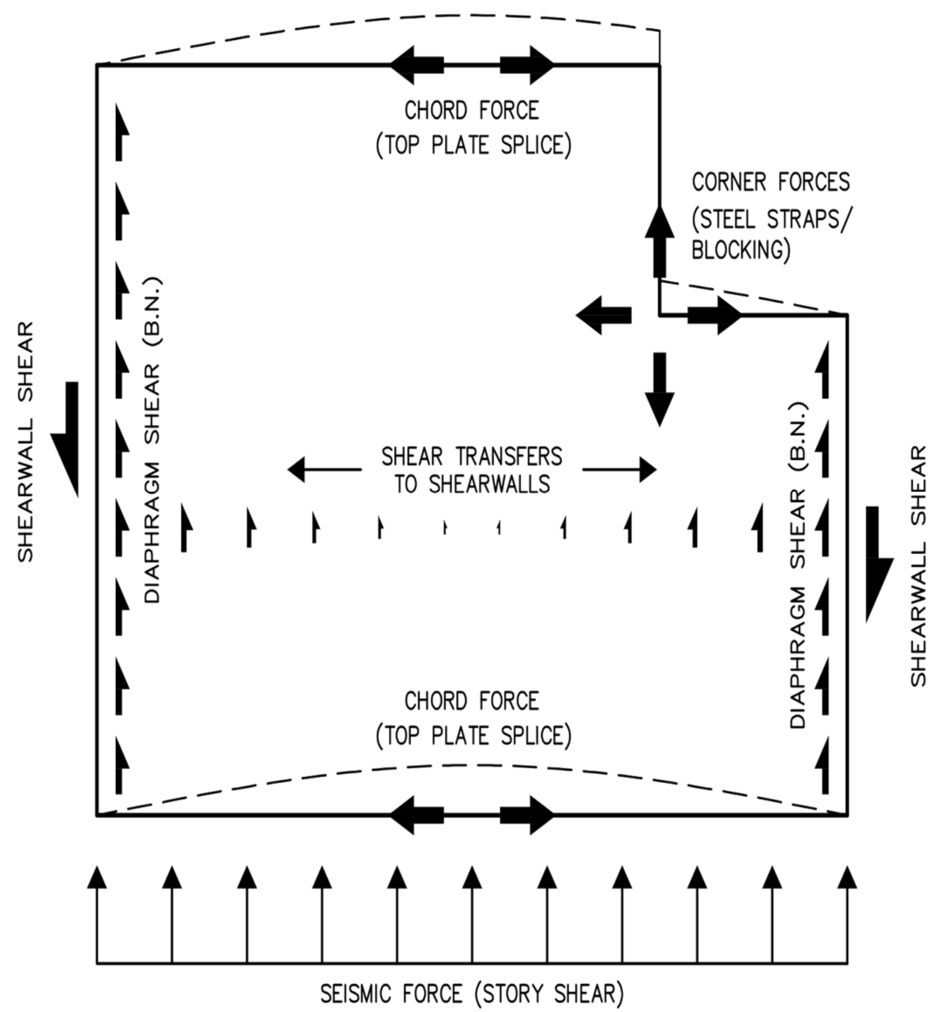
PLYWD/OSB DIAPHRAGMS:

UNBLOCKED DIAPHRAGMS SHEAR CAPACITY:
125 LB/FT - 320 LB/FT

BLOCKED DIAPHRAGMS SHEAR CAPACITY:
185 LB/FT - 820 LB/FT

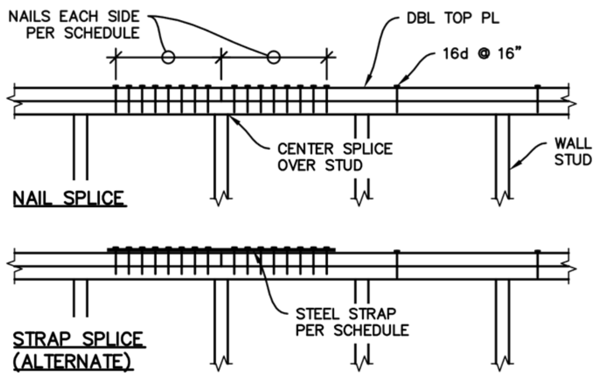
THE BUILDING CODE ALSO HAS "HIGH LOAD" DIAPHRAGMS (WHICH USE MULTIPLE ROWS OF FASTENERS) FOR EVEN HIGHER SHEAR CAPACITIES.

PHYSICS OF DIAPHRAGMS



FLOOR/ROOF DIAPHRAGM PLAN

"A Typical House in Santa Clarita" - DIAPHRAGMS



PLAN MARK	NAIL SPLICE	STRAP SPLICE
A	8–16d	CS16 x 30"
B	12–16d	(2) CS16
C	16–16d	(2) CS16
D	20–16d	MST60

NOTE:
MINIMUM 24" LAP LENGTH EACH SIDE OF END JOINT.

TOP PLATE SPLICE 1

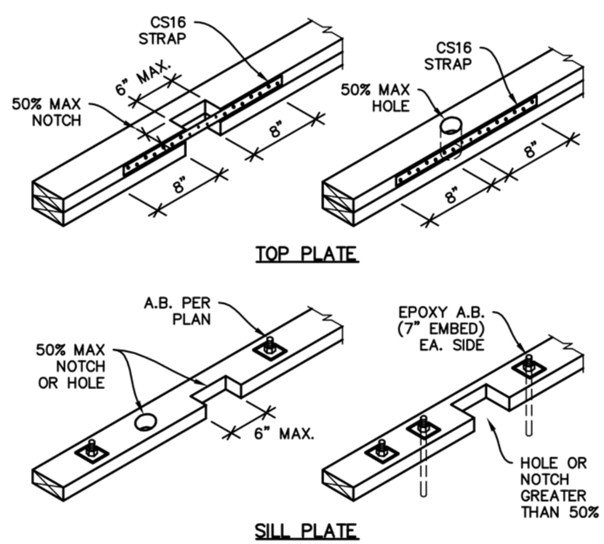
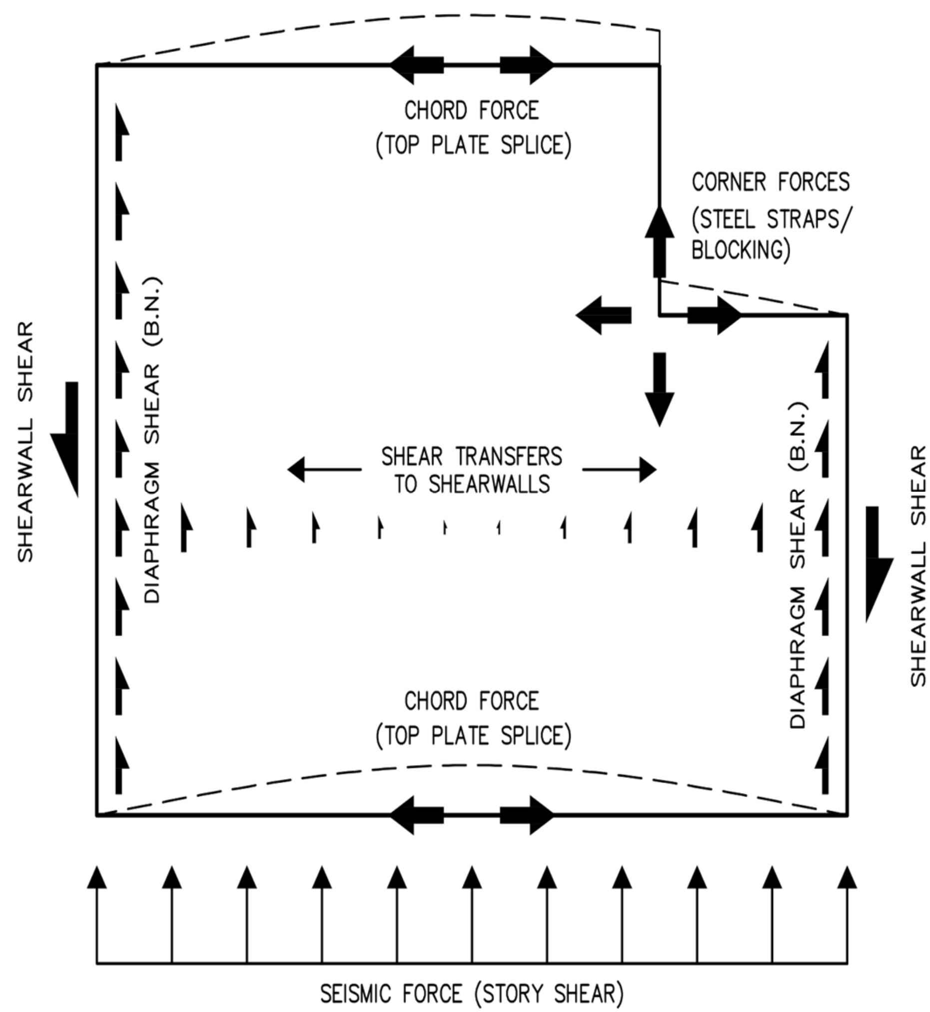


PLATE NOTCHING & BORING 2

PHYSICS OF DIAPHRAGMS



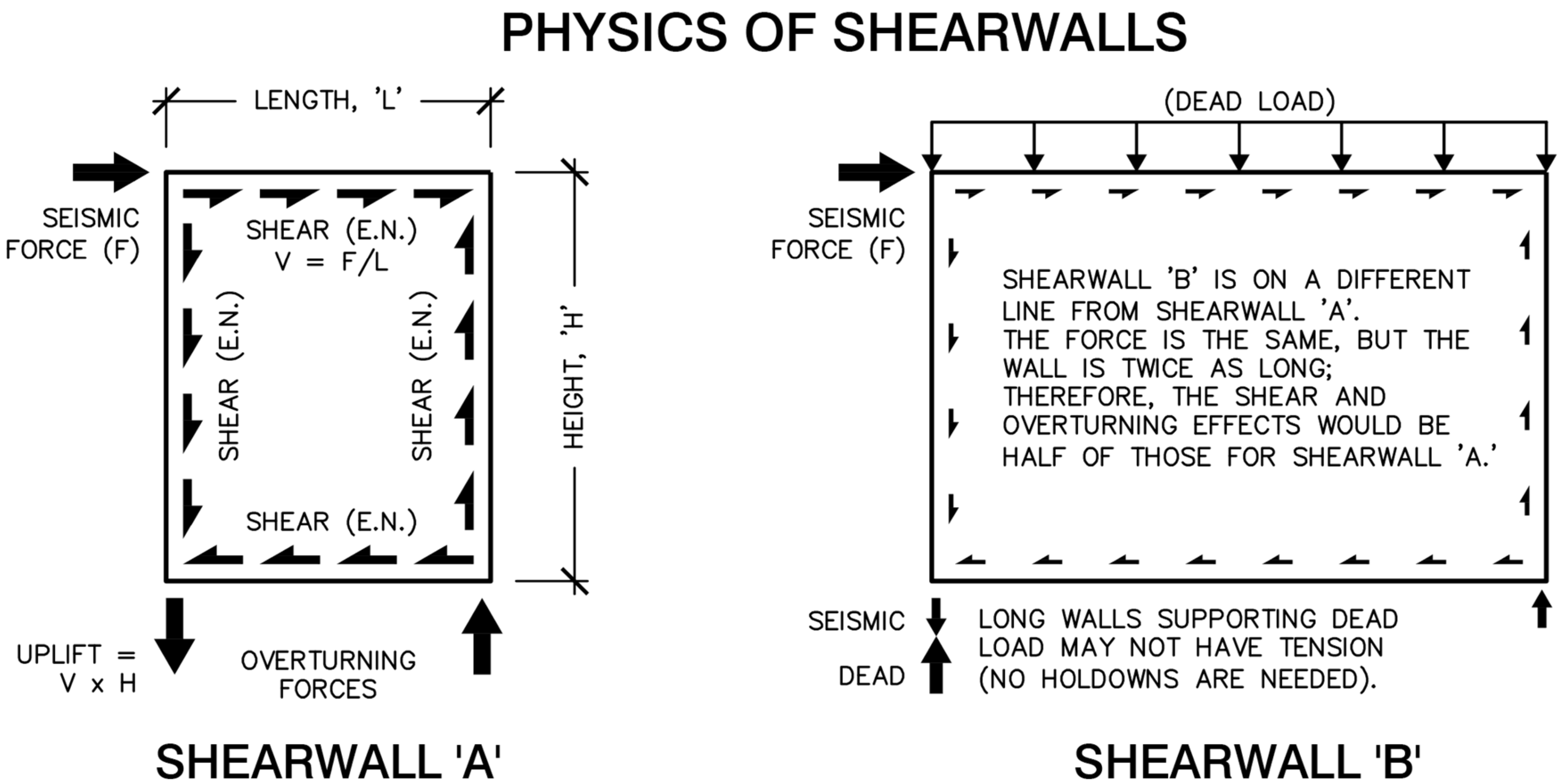
FLOOR/ROOF DIAPHRAGM PLAN

“A Typical House in Santa Clarita” - DIAPHRAGMS

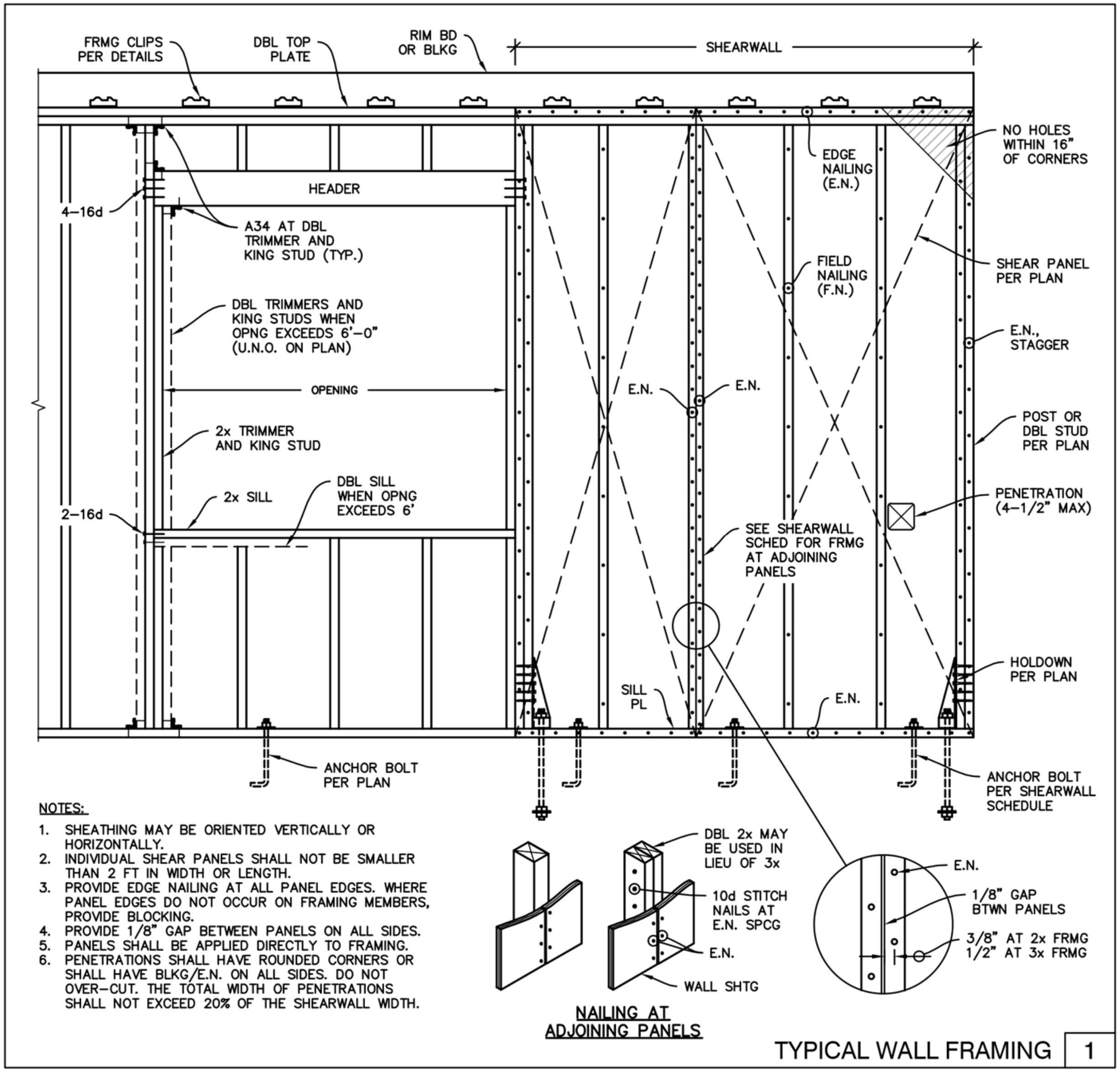
Blocked diaphragm will transfer shear from the upper shearwalls to the lower shearwalls.

Structural Training - Part 3:

“A Typical House in Santa Clarita” - SHEARWALLS



“A Typical House in Santa Clarita” - SHEARWALLS



PLYWD/OSB SHEARWALLS:

SHEAR CAPACITY =
140 LB/FT – 870 LB/FT

PLYWOOD MAY BE PLACED ON BOTH SIDES FOR DOUBLE THE CAPACITY.

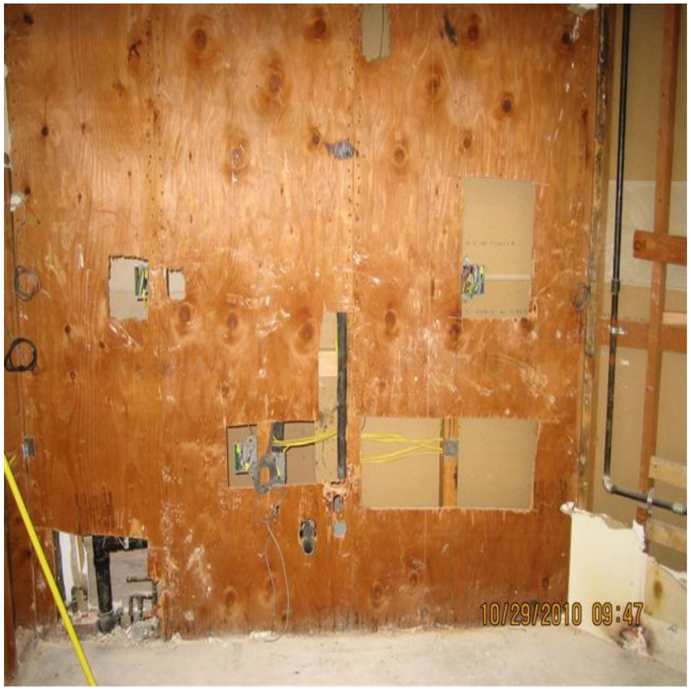
MAXIMUM HEIGHT:WIDTH RATIO = 3.5:1.

THE TOP PLATE IS A CRITICAL PART OF THE LOAD PATH. NOTICE THAT THE TOP PLATE DRAGS THE LOAD TO THE SHEARWALL.

COULD THE RIM BOARD BE USED TO DRAG LOAD TO THE SHEARWALL? YES, BUT ONLY IF THE PLYWOOD IS NAILED TO THE RIM BOARD (WE WILL SEE THESE DETAILS LATER).

“A Typical House in Santa Clarita” - SHEARWALLS

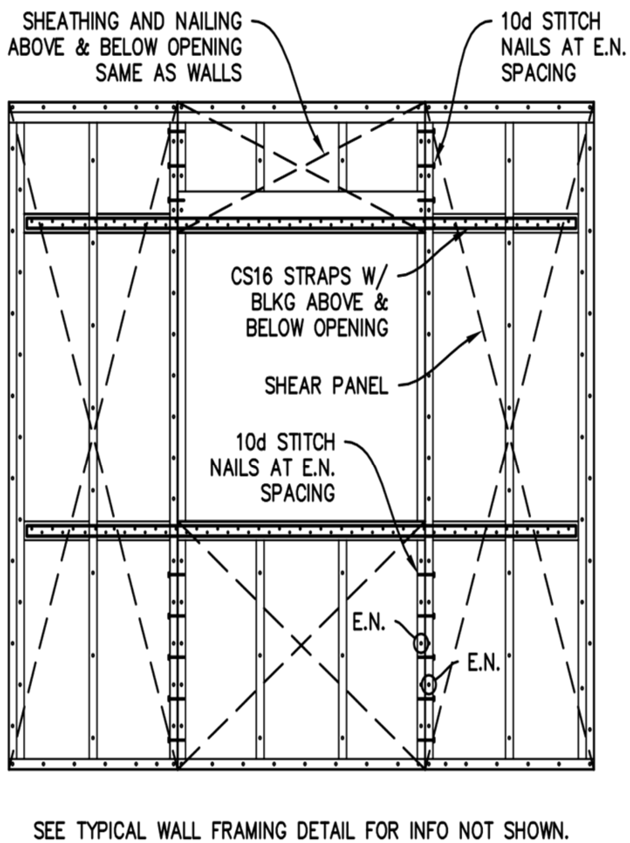
Load path: diaphragm B.N. > blocking > framing clips > top plate > shearwall E.N. > shearwall sheathing > shearwall E.N. > sill plate > anchor bolts/holdowns > foundation.



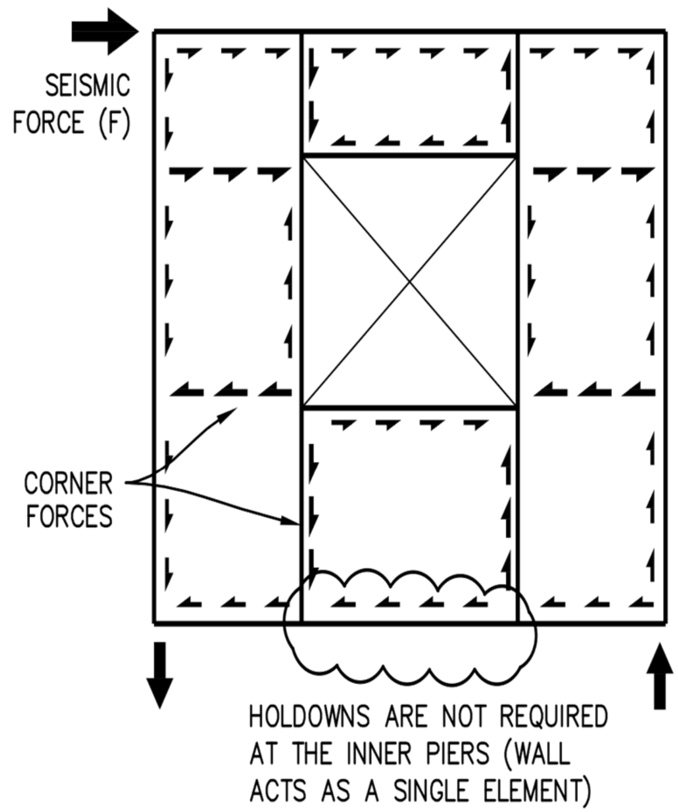
The structural integrity of this shearwall has been severely compromised by excessive openings. Fix: Replace the wall sheathing (patching openings is not effective for multiple/large openings).

"A Typical House in Santa Clarita" - SHEARWALLS

Shearwalls which are detailed for force transfer around openings may exceed the 3:5 height:width ratio. The minimum wall length is 2 ft (SDPWS 4.3.5.2).

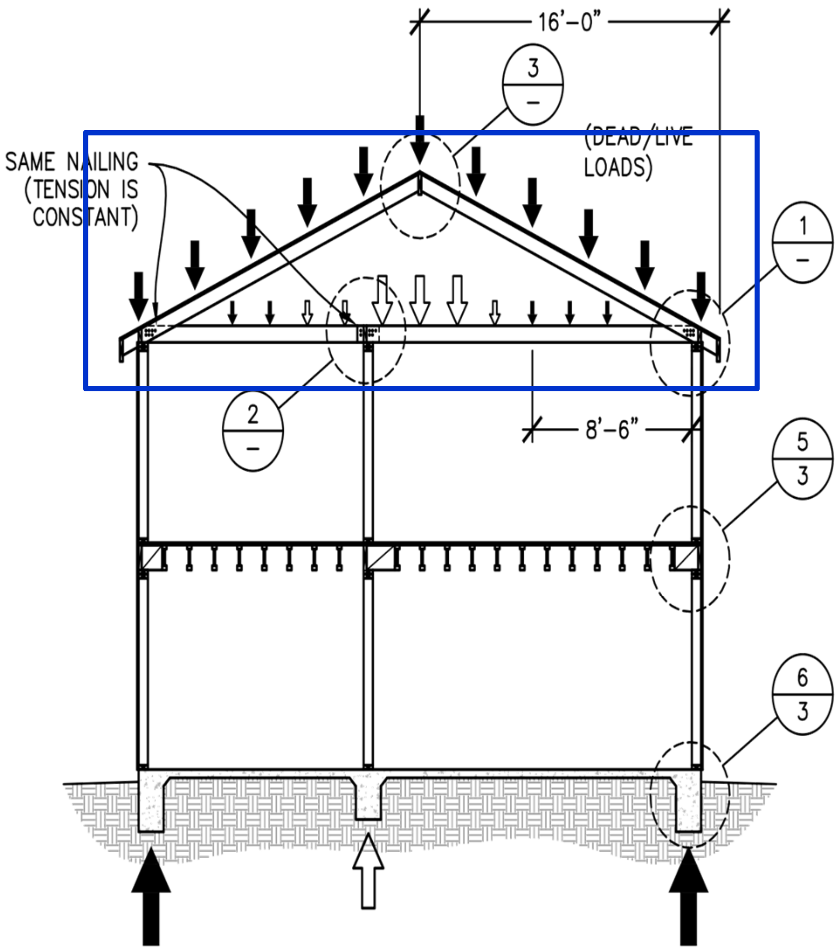


SHEARWALL AROUND OPENING | 2



SHEARWALL 'C'
(DETAIL 2/–)

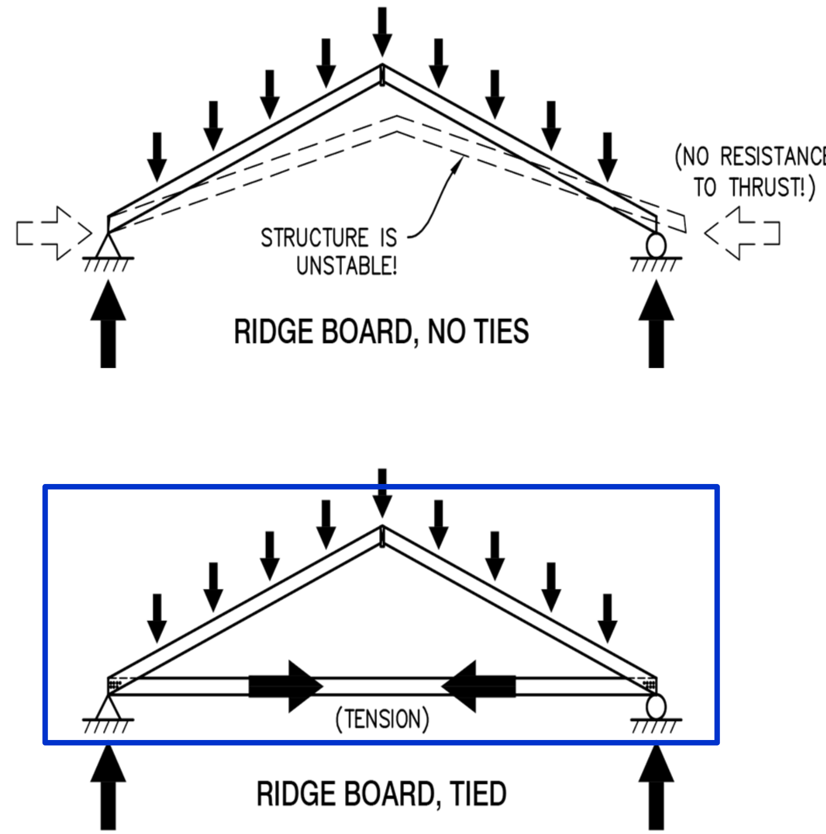
"A Typical House in Santa Clarita" – GRAVITY LOADS



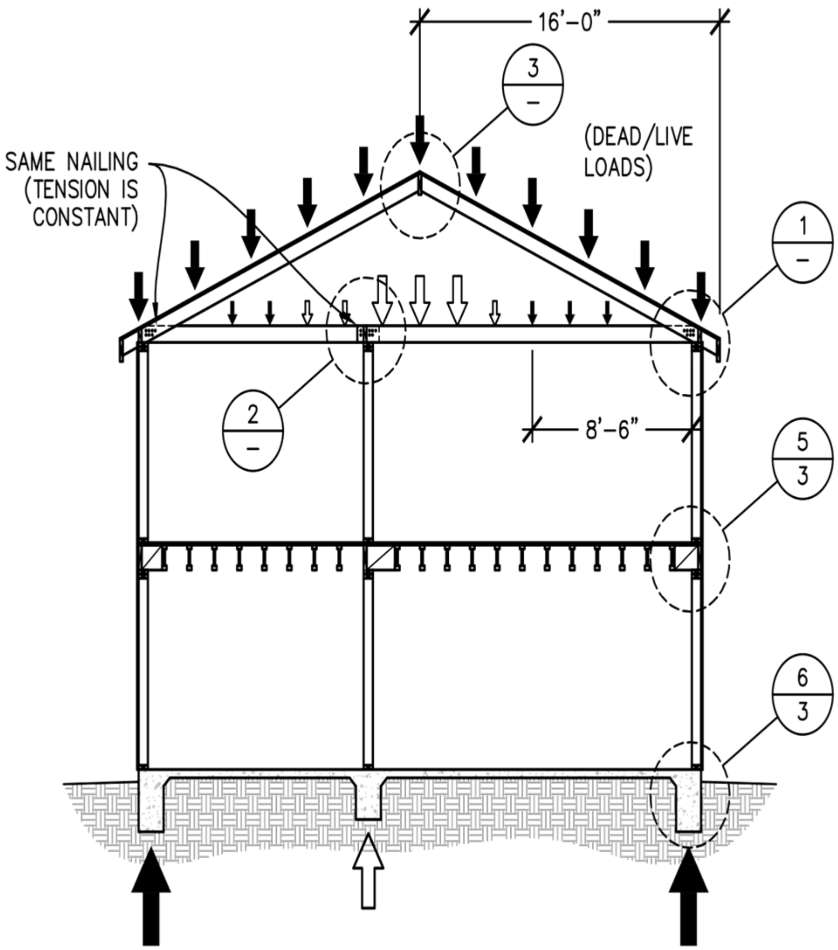
SECTION 'A'

CHECK EXTERIOR BEARING WALLS AT THE FIRST FLOOR:
16' ROOF x 35 PSF = 560 PLF
+ 8.5' CEILING x 15 PSF = 128 PLF
+ 8' WALL x 16 PSF = 128 PLF
TOTAL = 816 x (16"/12") = 1,088 LB < 2,000 LB. 2x4 @ 16" O.K.

PHYSICS OF ROOF STRUCTURES



“A Typical House in Santa Clarita” – GRAVITY LOADS



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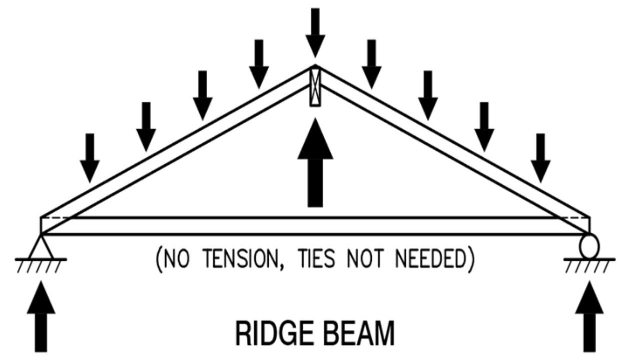
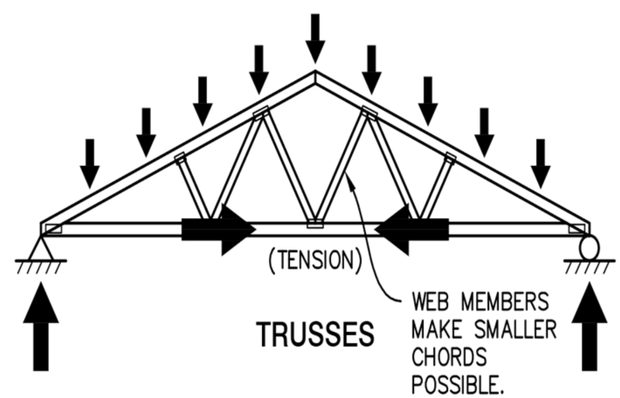
16' ROOF x 35 PSF = 560 PLF
+ 8.5' CEILING x 15 PSF = 128 PLF
+ 8' WALL x 16 PSF = 128 PLF
TOTAL = 816 x (16"/12") = 1,088 LB < 2,000 LB. 2x4 @ 16" O.K.

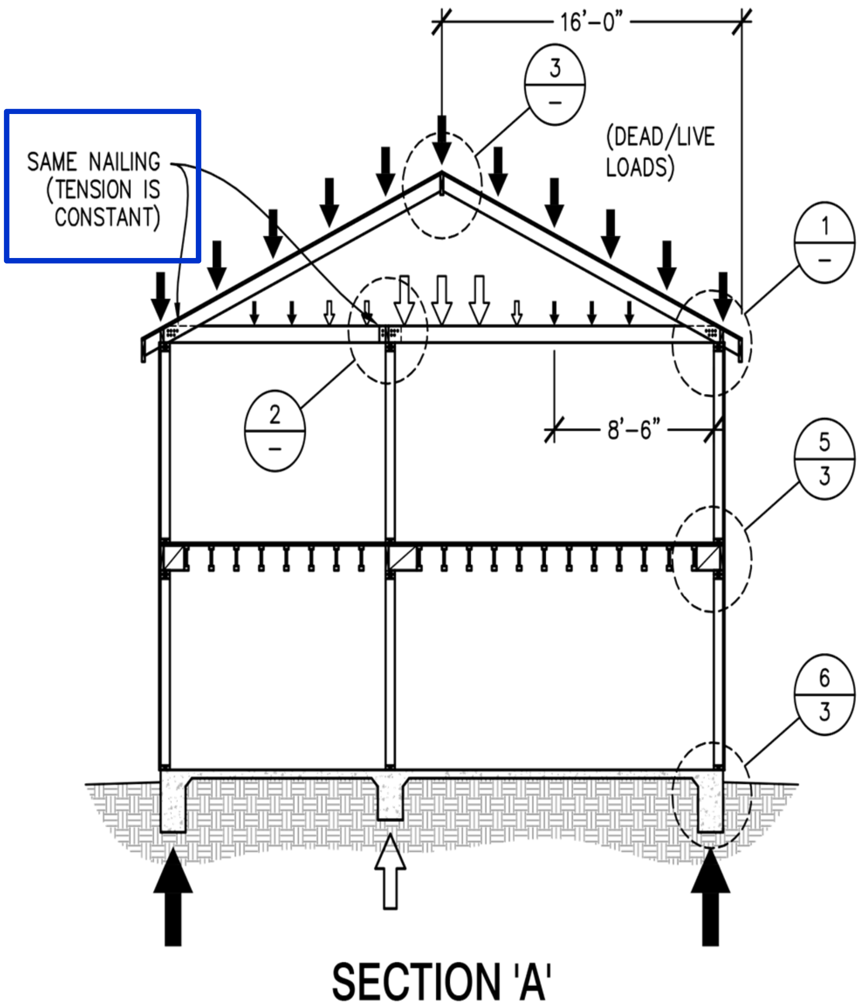


RIDGE BEAM



TRUSSES

"A Typical House in Santa Clarita" – GRAVITY LOADS



CHECK EXTERIOR BEARING WALLS AT THE FIRST FLOOR:
16' ROOF x 35 PSF = 560 PLF
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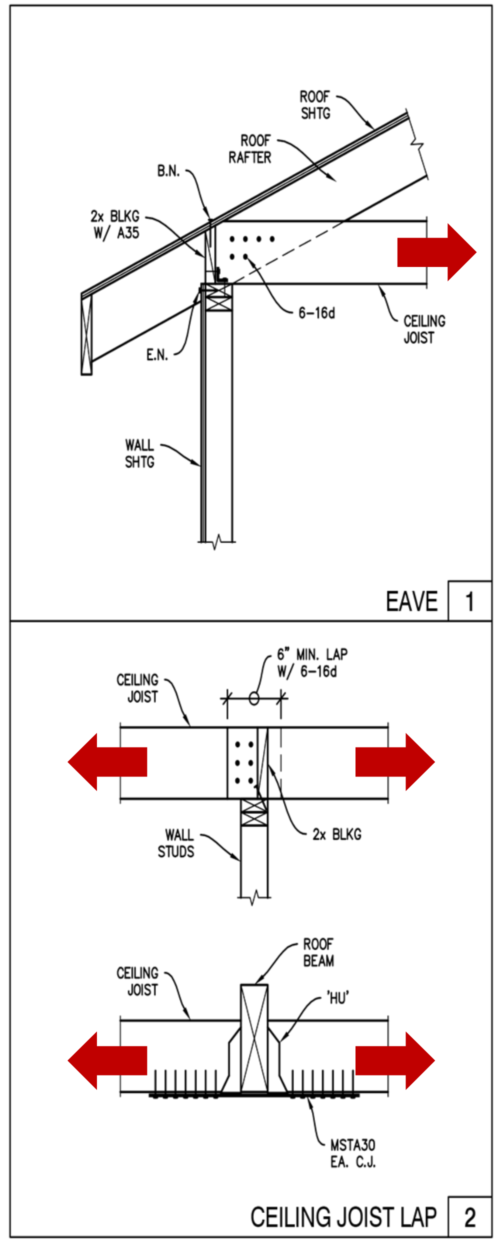
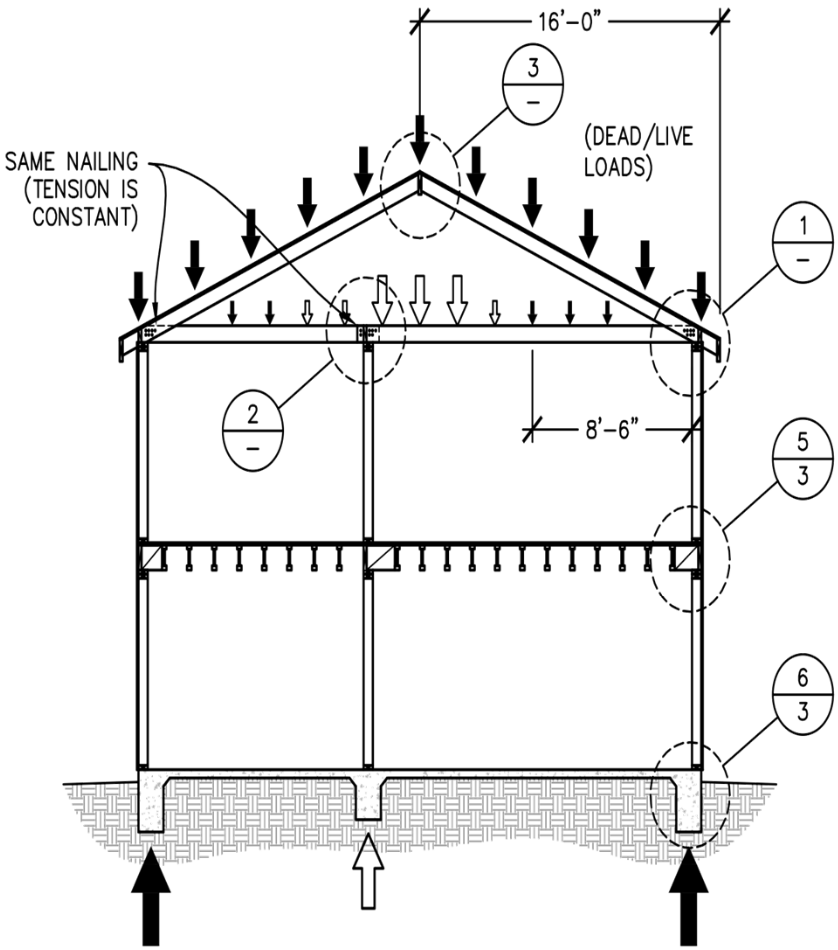


Loads are transferred in all three directions.

Q: Why are the steel straps needed in detail 2?

A: The joist hanger can't adequately transfer the tension in the ceiling joist (nails in withdraw).

“A Typical House in Santa Clarita” – GRAVITY LOADS



SECTION 'A'

CHECK EXTERIOR BEARING WALLS AT THE FIRST FLOOR:
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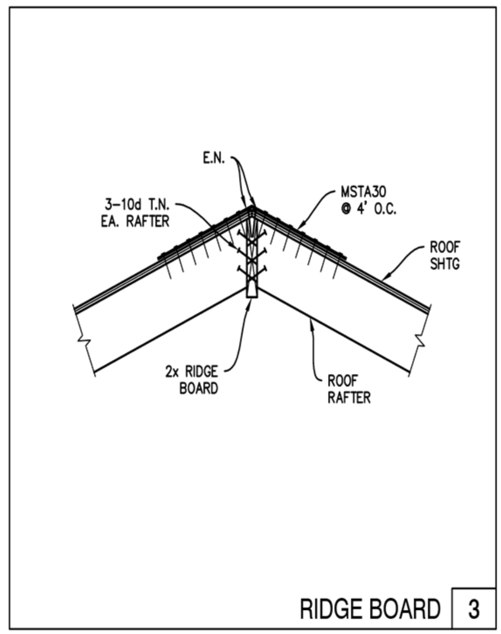


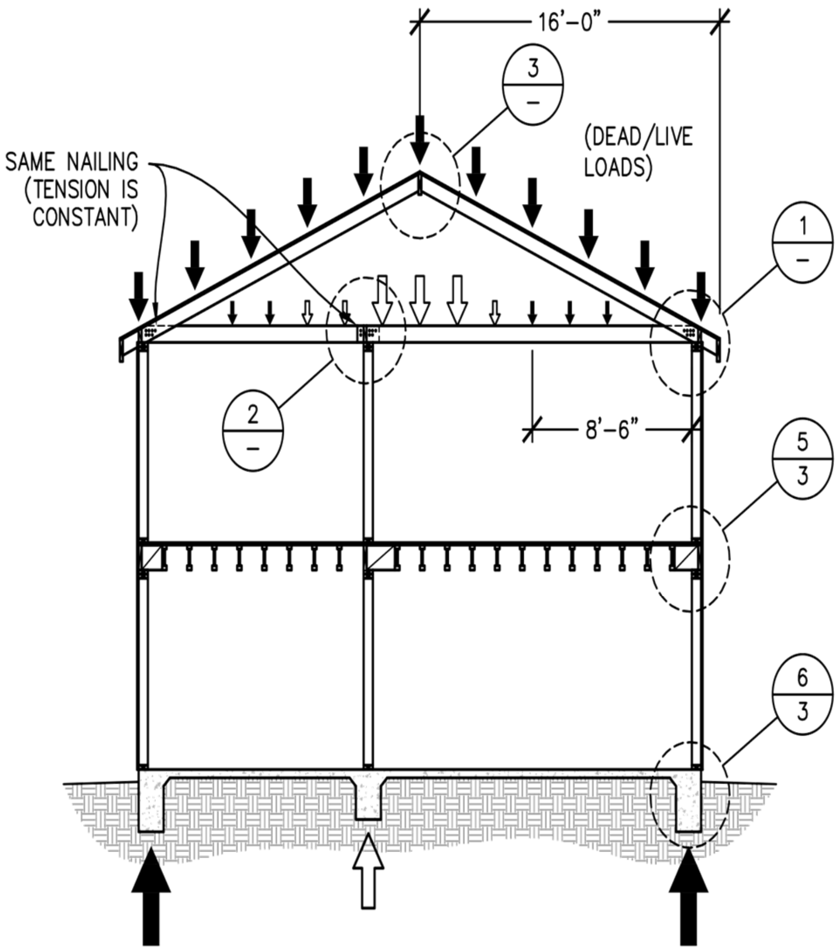
Q: Are the rafters in tension or compression?

A: Compression.

Q: Why are the steel straps needed at the ridge?

A: Since the roof sheathing can’t lap at the ridge, the straps and edge nailing are needed for diaphragm continuity.

“A Typical House in Santa Clarita” – GRAVITY LOADS



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Q: Does the exterior bearing wall carry any floor loads?

A: No. The floor joists are running parallel to the wall. (technically 8")

Q: Does the interior bearing wall carry any roof dead or live load?

A: No, it only carries ceiling loads.

Q: Is it acceptable to anchor the interior bearing wall with shot pins?

A: No, the CRC clearly states that anchor bolts are required at bearing walls (CRC R403.1.6.1). This is clarified in the building code by a city amendment.

"A Typical House in Santa Clarita" – GRAVITY LOADS

Bearing walls shall have anchor bolts, or an anchor approved for Seismic Design Category 'E' (Simpson 'Titen HD' shown above). Shot pins alone are not acceptable to anchor bearing walls.

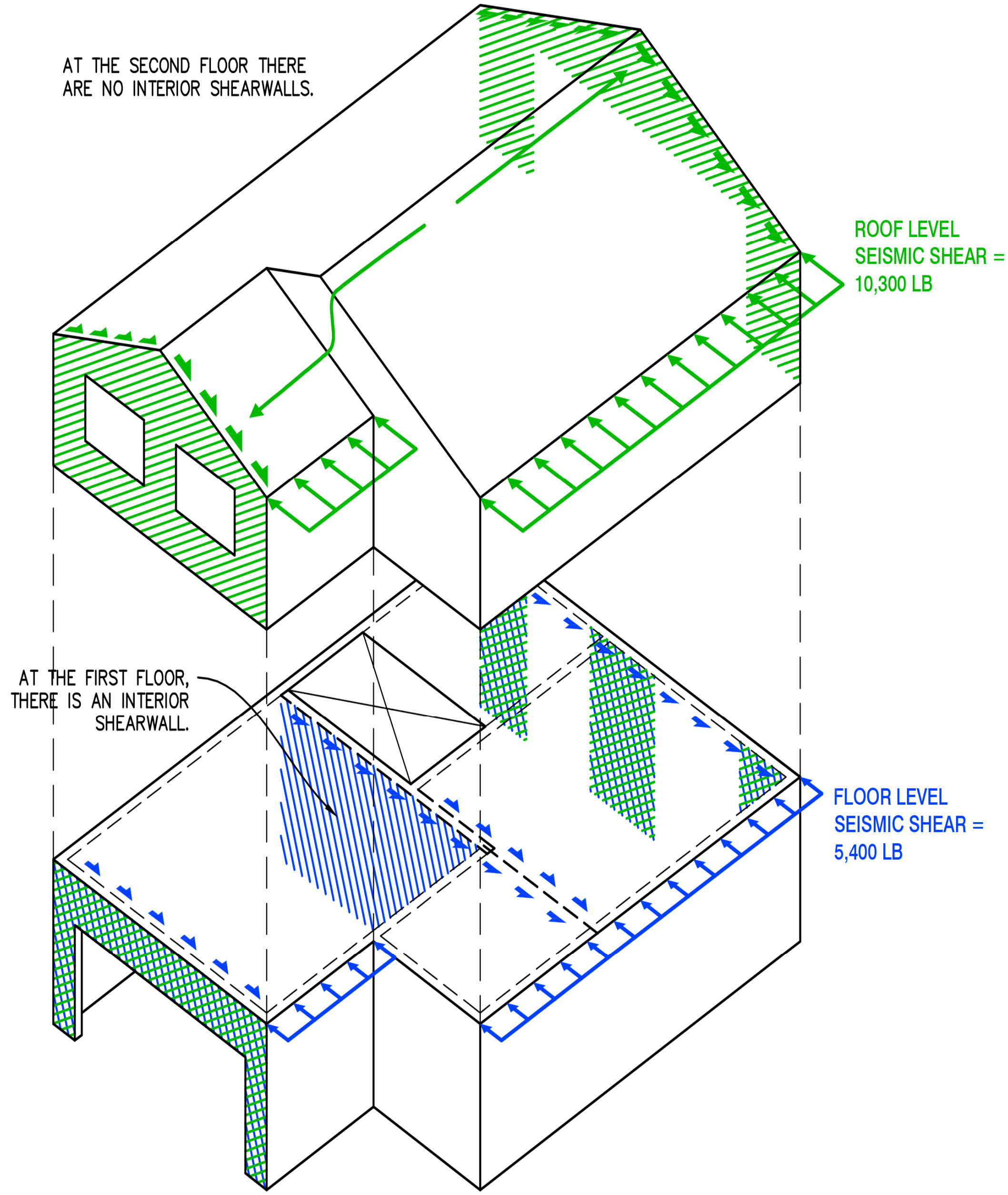
Posts shall be anchored laterally at their base for a minimum of 2% of their vertical load. Toe nails will work for smaller posts (4x4). Larger posts will require hardware.

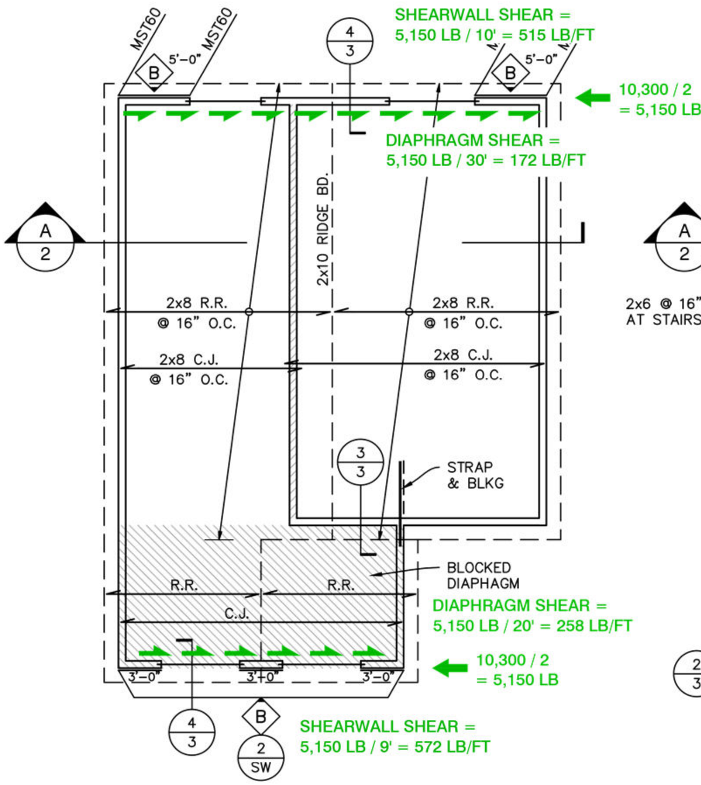
Structural Training - Part 4:

"A Typical House in Santa Clarita" – SEISMIC LOADS

In the 2007 CBC, seismic forces were reduced from the 2001 CBC.
In the 2013 CBC, seismic forces have been increased to basically where they were under the 2001 CBC.

"A load path to the foundation shall be provided for uplift, shear, and compression forces. Elements resisting shear wall forces contributed by multiple stories shall be designed for the sum of forces contributed by each story."
(SDPWS 4.3.6.4.4)

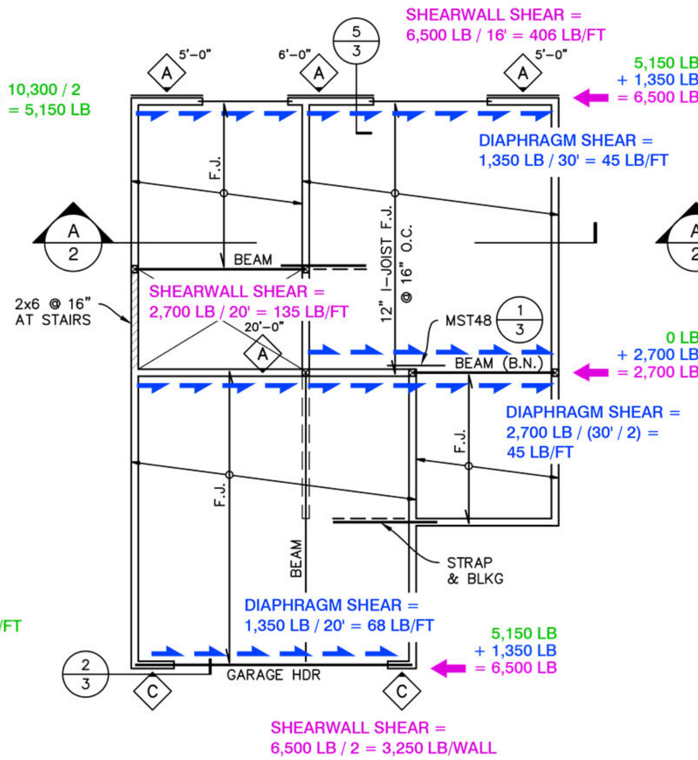




ROOF FRAMING PLAN

ROOF AREA = 1,250 SQ. FT.
ROOF LEVEL MASS (DEAD LOAD, INCLUDING INTERIOR AND EXTERIOR WALLS) = 40,000 LB.

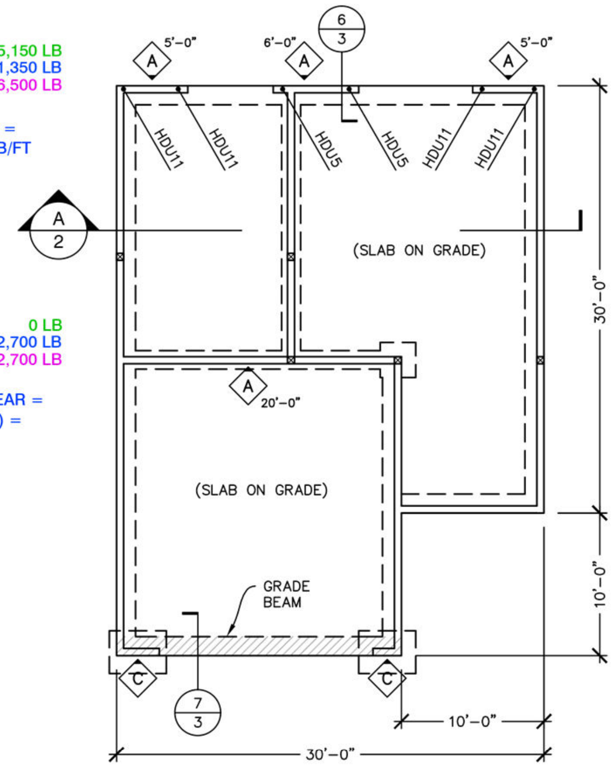
ROOF LEVEL SEISMIC SHEAR = 10,300 LB



FLOOR FRAMING PLAN

FLOOR AREA = 1,080 SQ. FT.
FLOOR LEVEL MASS (DEAD LOAD, INCLUDING INTERIOR AND EXTERIOR WALLS) = 40,000 LB.

FLOOR LEVEL SEISMIC SHEAR = 5,400 LB
TOTAL ROOF + FLOOR SHEAR = 15,700 LB



FOUNDATION PLAN

SCALE 1/8" = 1'-0"

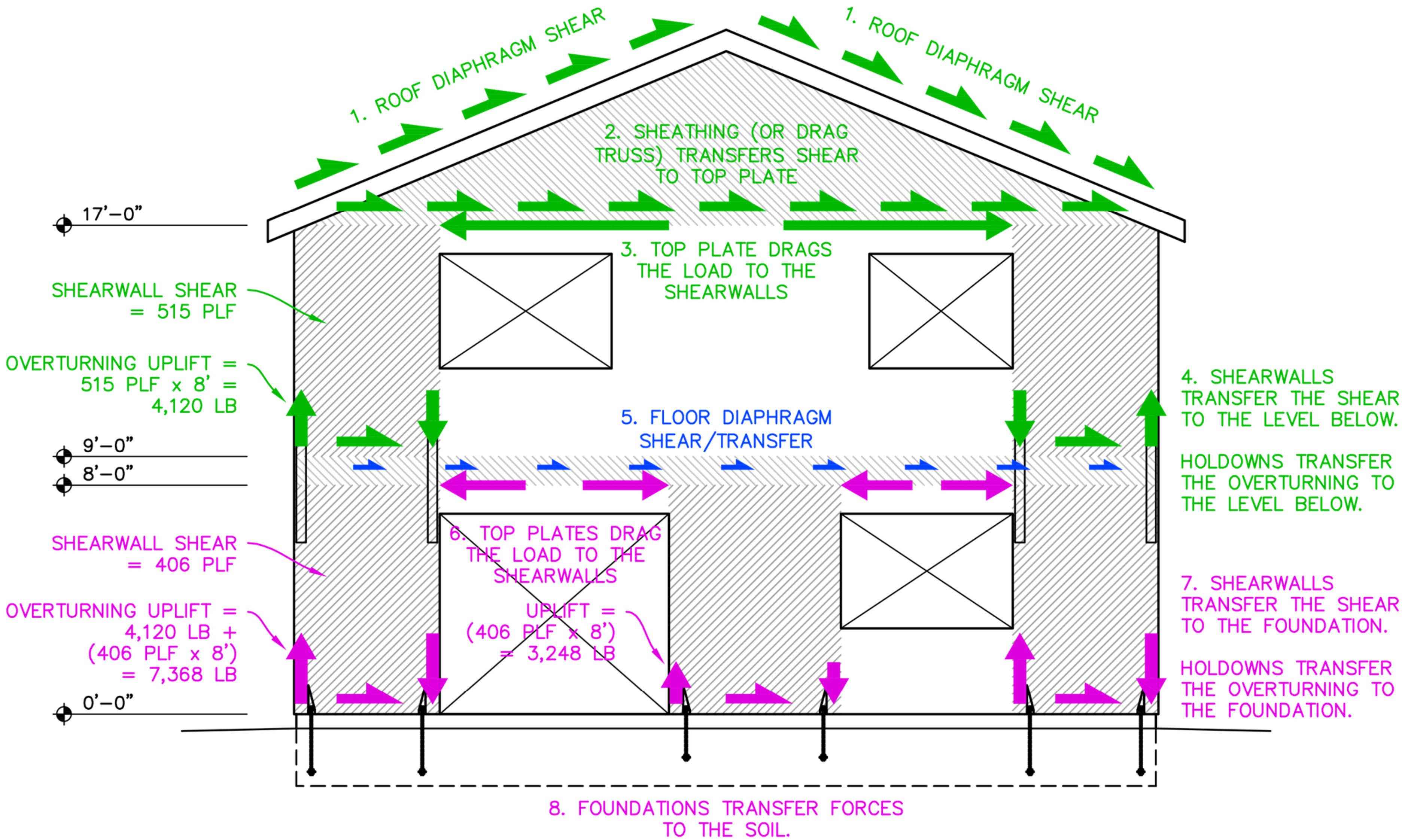
HOUSE INFORMATION:
ROUGHLY 2,000 SQ. FT., TILE ROOF, STUCCO,
Ss = 2.73, BASE SHEAR Cs = 0.20 W (AVERAGE IN THE CITY)

SHEARWALL SCHEDULE

MARK	SHEATHING (PLYWOOD OR OSB)	STUDS AT PANEL EDGES (1)	E.N. / F.N. (2)	FOUNDATION		UPPER FLOORS		ALLOW SHEAR (PLF)
				SILL PL	ANCHOR BOLTS (3)	SILL PL	SILL CONN (4)	
A	1/2" STRUCT. 1	3x	10d @ 4"/12"	2x	5/8" DIA. @ 34"	2x	16d @ 3"	510
B	1/2" STRUCT. 1	3x	10d @ 3"/12"	2x	5/8" DIA. @ 26"	2x	SDS @ 6"	665
C	MANUFACTURED SHEARWALL				(2) 1-1/8" F1554 GRADE 36			3300

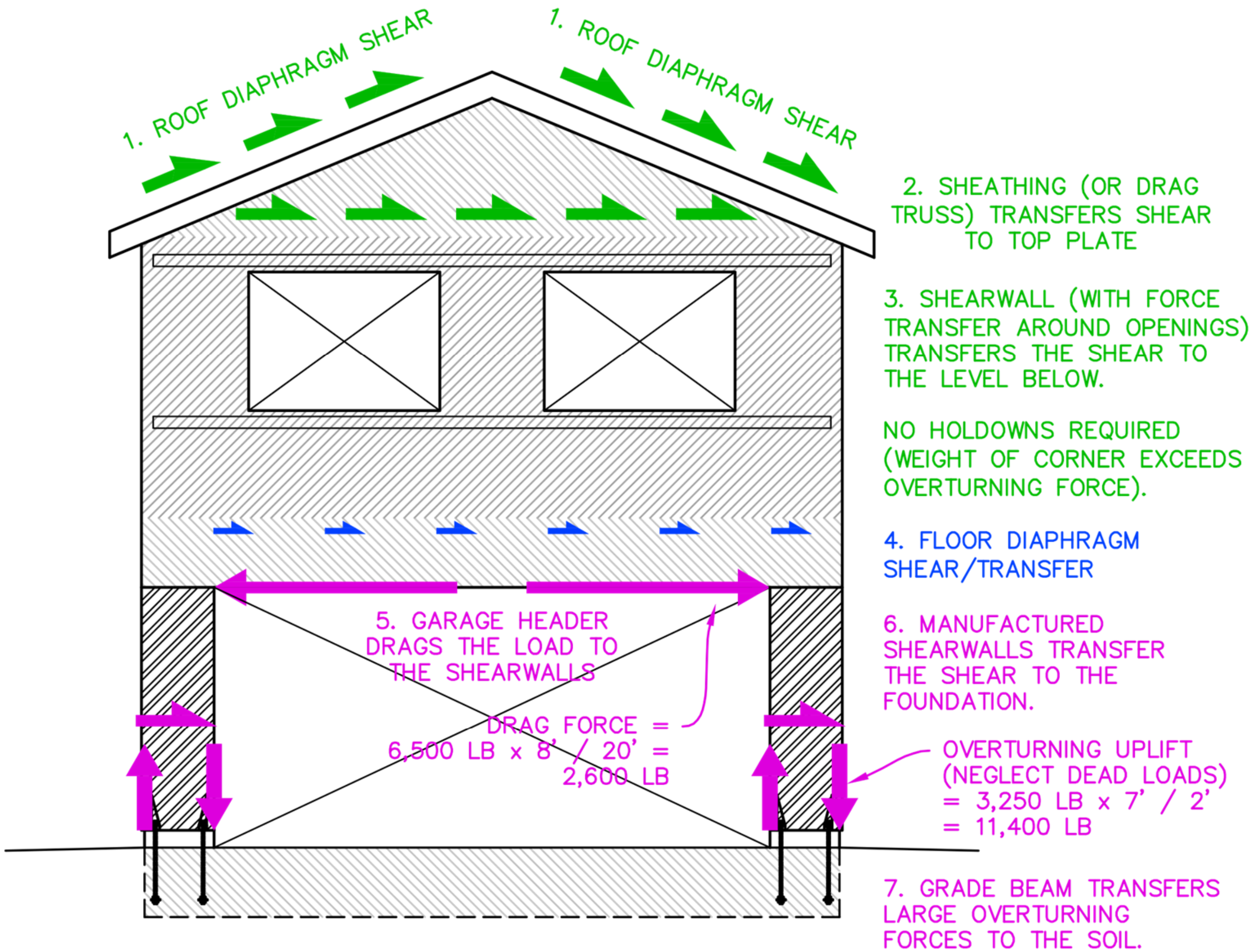
SHEARWALL SCHEDULE NOTES:
1. THICKNESS OF STUDS AND BLOCKING RECEIVING EDGE NAILING FROM ADJOINING PANELS.
2. NAILS SHALL BE COMMON NAILS WITH FULL HEADS.
3. ANCHOR BOLTS SHALL BE INSTALLED WITH 3" SQ x 1/4" PLATE WASHERS.
4. 'SDS' INDICATES SIMPSON 'STRONG DRIVE' 1/4" x 5" S-SERIES WOOD SCREW (ICC-ES# 5268).

"A Typical House in Santa Clarita" – SEISMIC LOADS



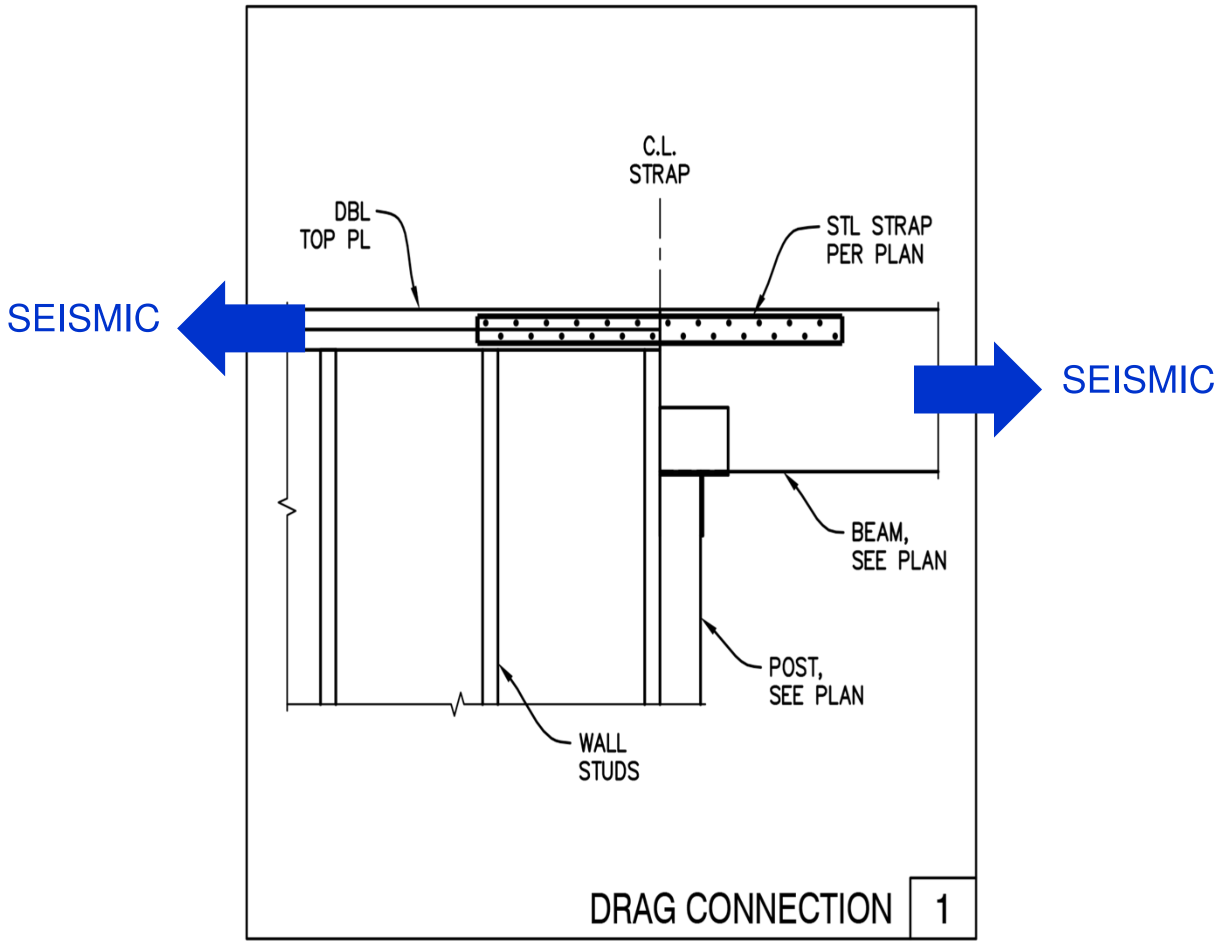
REAR ELEVATION

“A Typical House in Santa Clarita” – SEISMIC LOADS



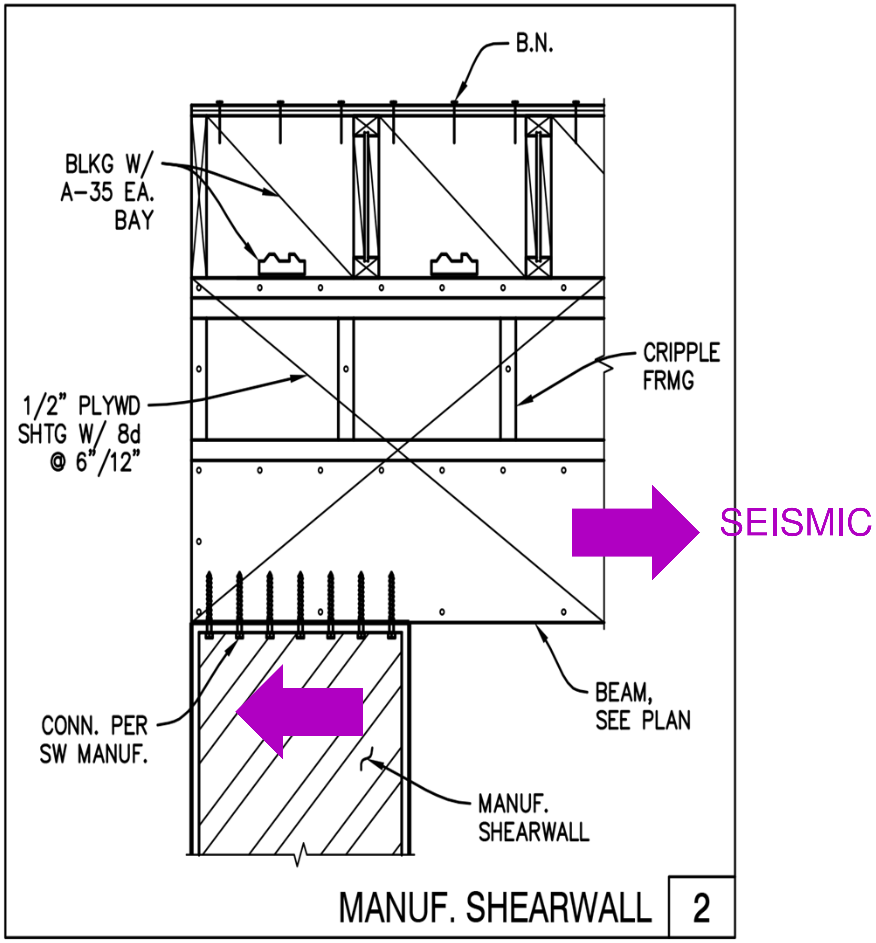
FRONT ELEVATION

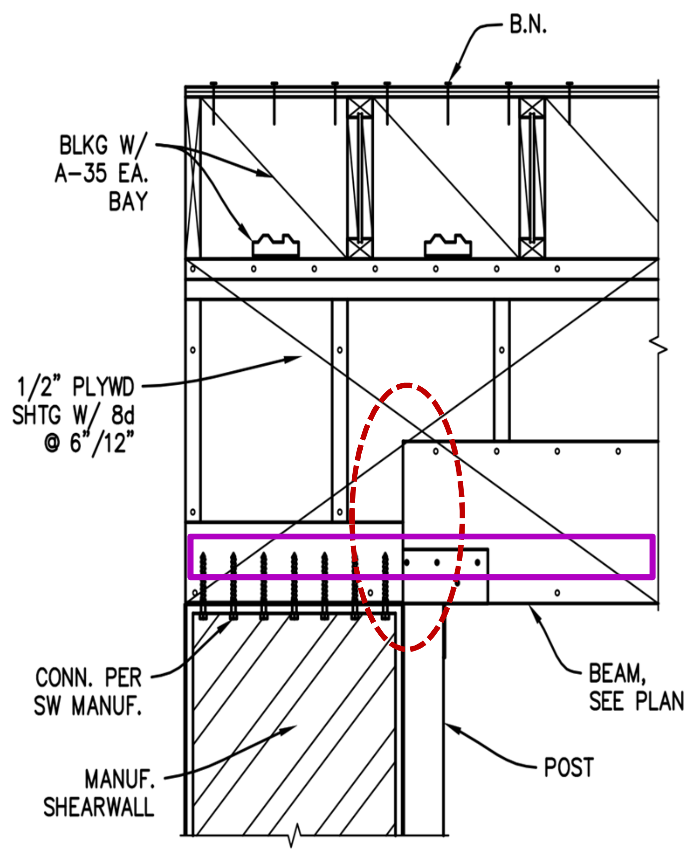
"A Typical House in Santa Clarita" – DETAILS



"A Typical House in Santa Clarita" – DETAILS

What about this detail…?





It has a break in the load path!

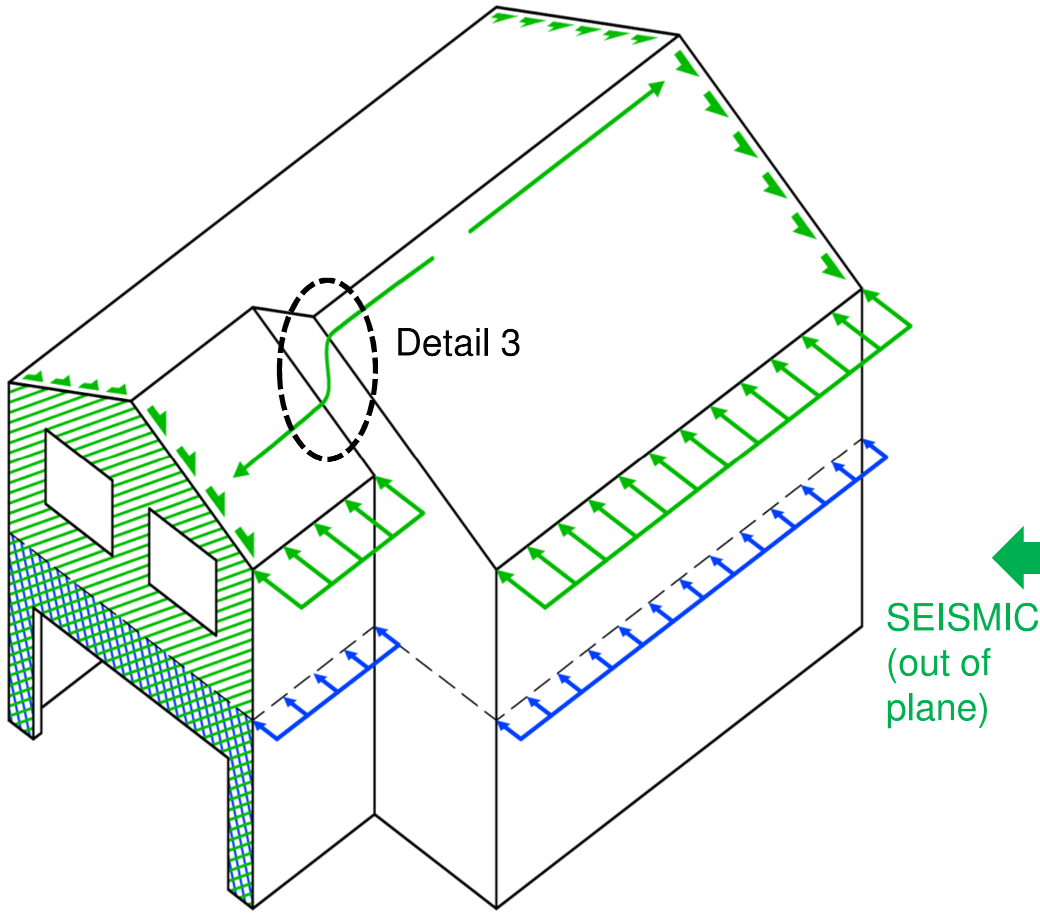
Possibly add a heavy strap (engineered fix required).

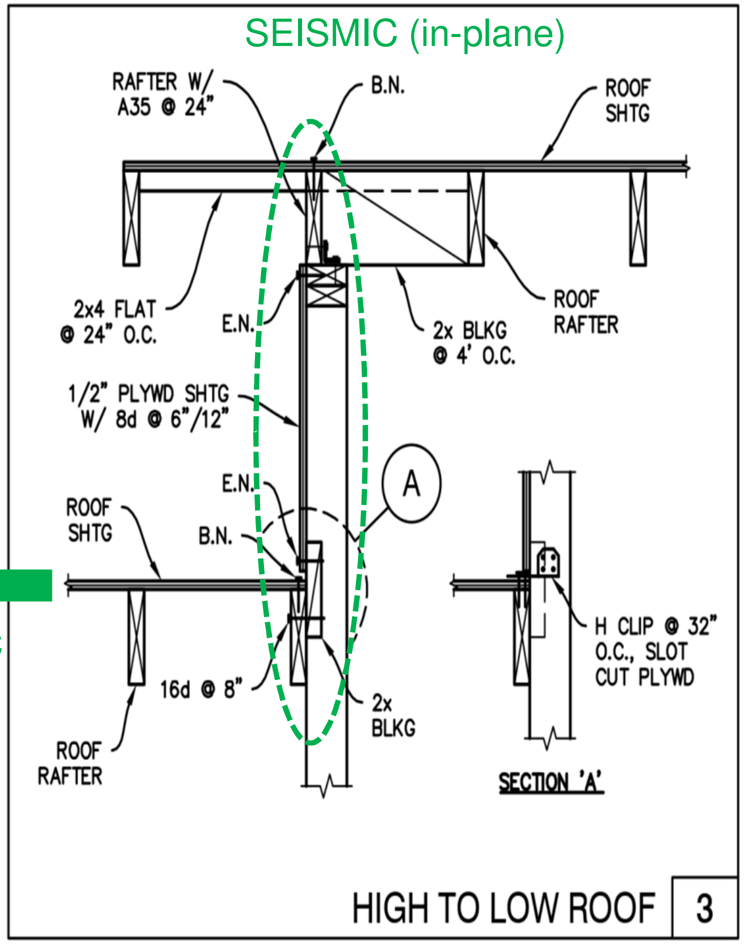
“A Typical House in Santa Clarita” – DETAILS

Another possible load path to an engineered shearwall.

… and another instance where the top plate splices are very important!

“A Typical House in Santa Clarita” – DETAILS



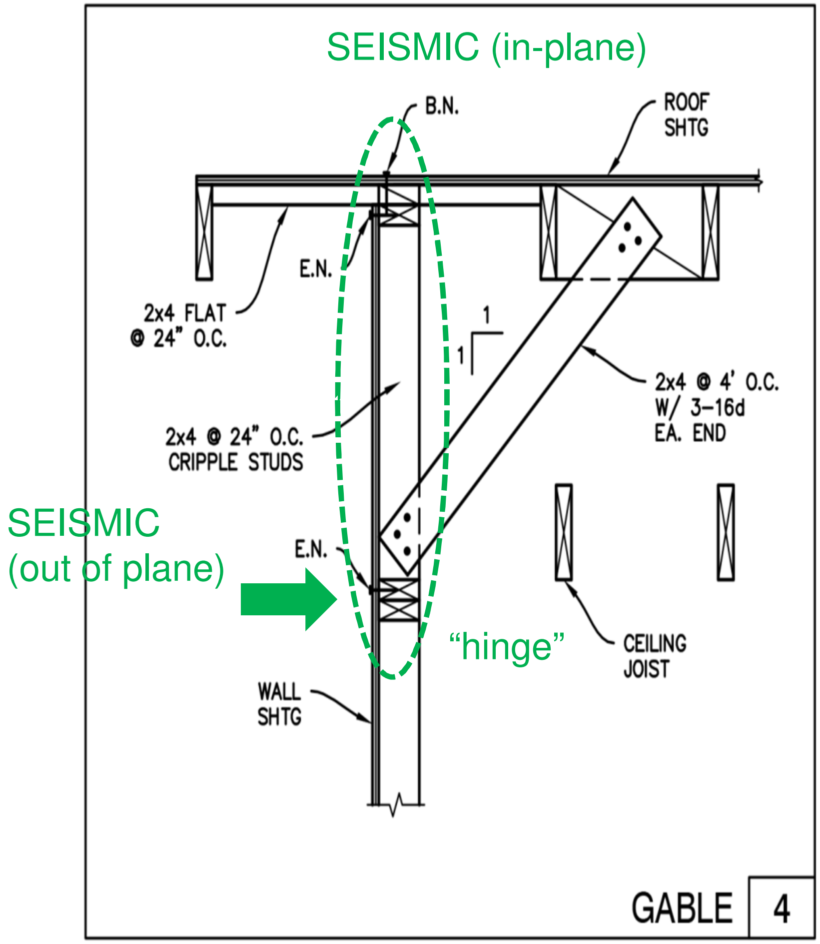


"A Typical House in Santa Clarita" – DETAILS

Roof clips prevent the low roof from pulling away from the rest of the structure (out-of-plane seismic loads).

Nailing from the inside to the shear transfer blocking at the low roof. This type of nailing is acceptable for in-plane (shear) loads, but should not be used to support out-of-plane (pullout) or vertical loads.

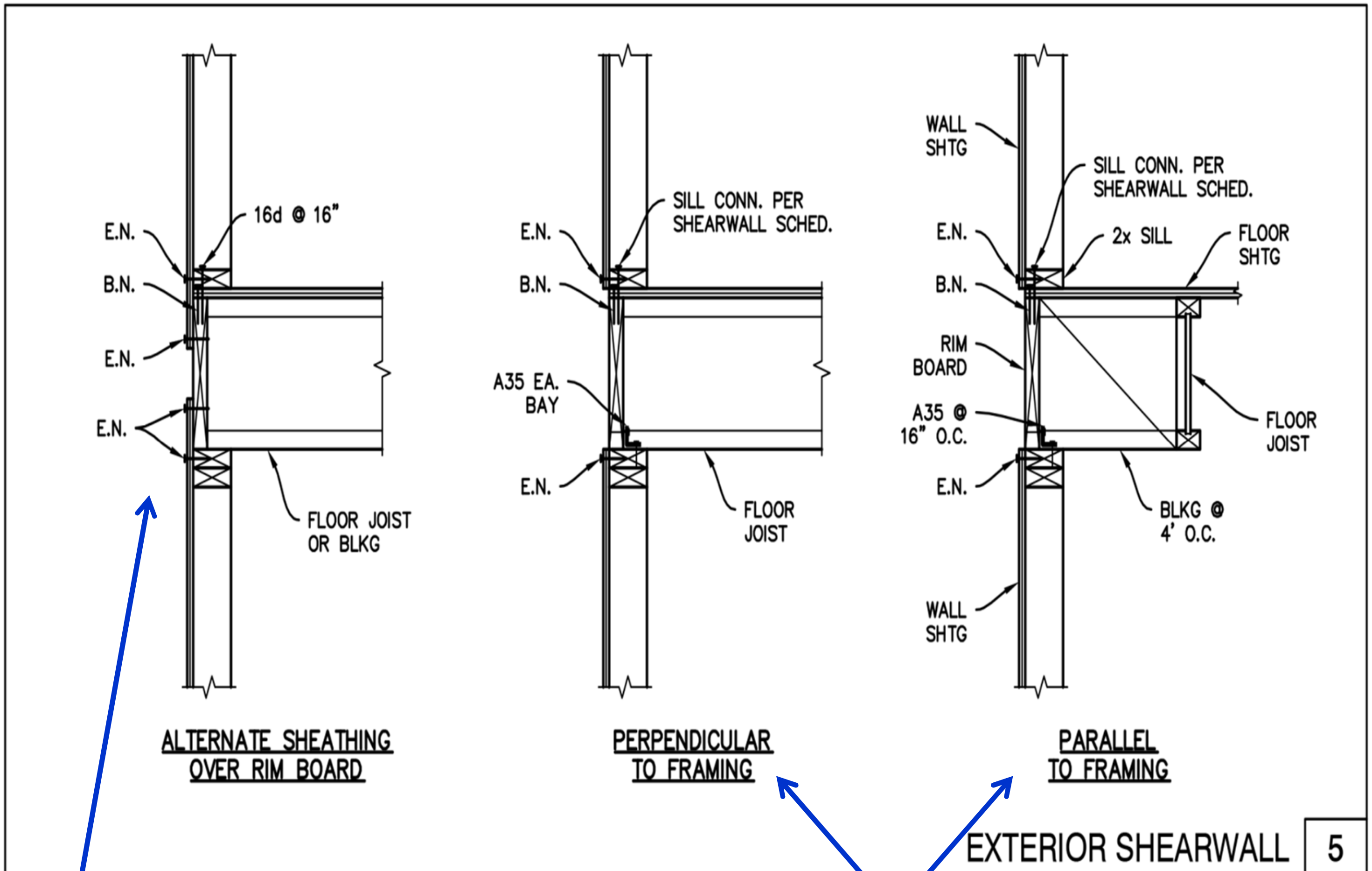
“A Typical House in Santa Clarita” – DETAILS



Kickers support the wall out-of-plane. Kickers are also required at truss roofs (for the same reason).

Can the gyp board ceiling brace the wall? Gyp board is typically considered non-structural. Unless specifically detailed, do not rely on gyp board for anything structural.

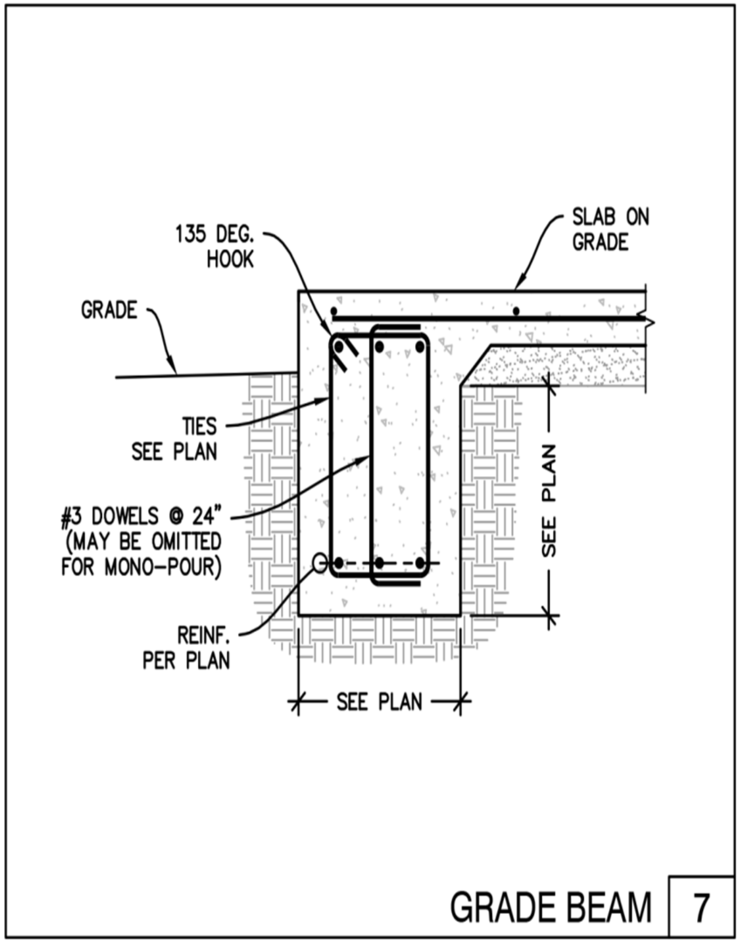
“A Typical House in Santa Clarita” – DETAILS



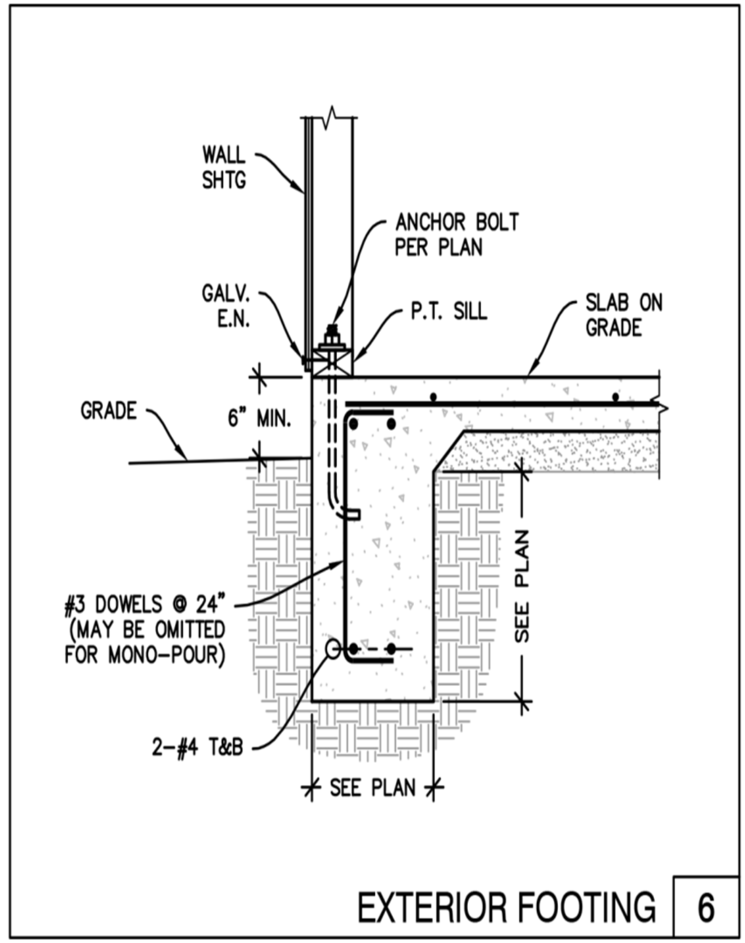
Alternate condition (rim board acts as drag element). This only works if the rim board is continuous.

Typical condition (top plate acts as drag element.

“A Typical House in Santa Clarita” – DETAILS



Grade beams provide more bending capacity than standard footings. This is needed when overturning forces are very large.



Bottom E.N. is very important (all of the shear goes through these nails). Nails must be corrosion-resistant for most types of treated lumber.

Roof Drag Struts

Our example project did not have interior drag struts at the roof, but they are common in residential construction:

In the photos above, truss blocking transfers diaphragm shear to the steel coil strap, which then transfers to the shearwall top plate.

What happens when structures are designed or built improperly?

The loads we design structures for (dead, live, wind, seismic, etc.) are based on probabilities. These probabilities, combined with the limits on allowable stresses, represent the "factor of safety" of the structure.

During most of the life of a structure, many of the loads are not present. For example, roof live load only occurs during re-roofing. The maximum earthquake and wind loads only occur for a few seconds.

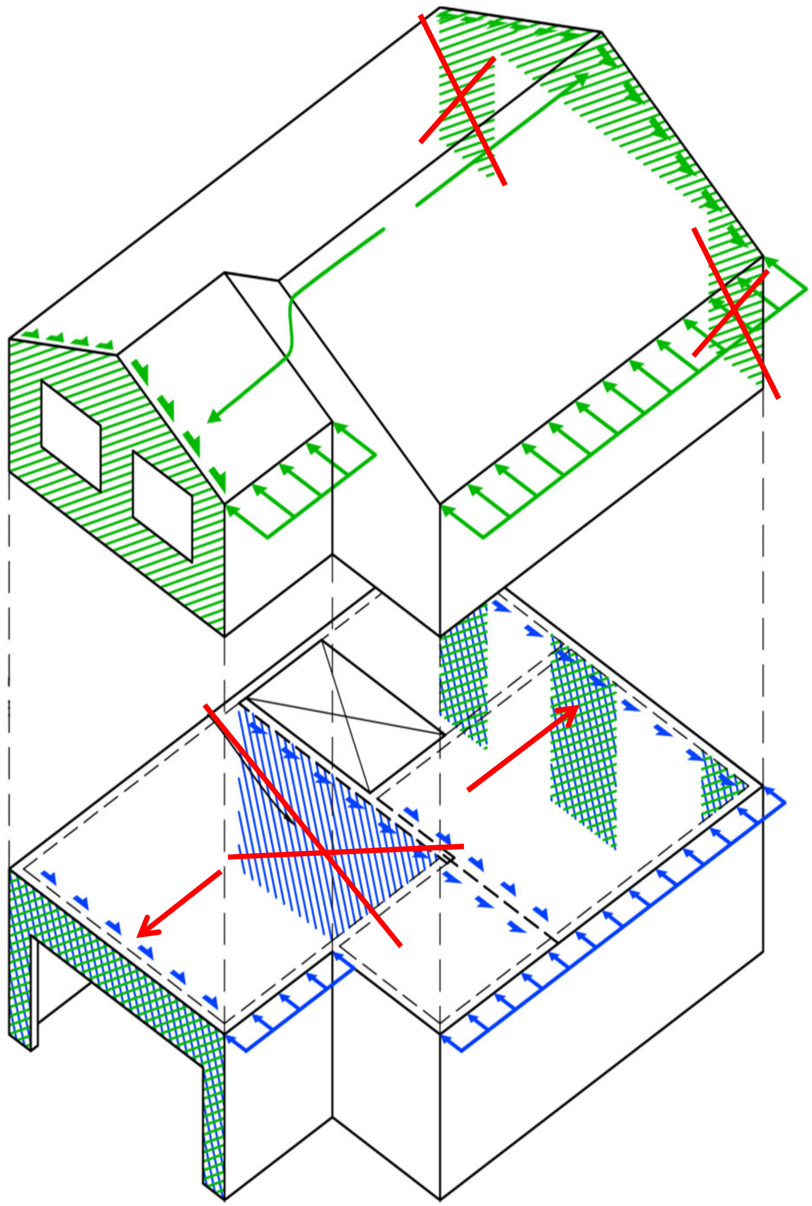
An improperly built structure might be able to support its own weight (dead load) and limited live loads for years. Still, these structures are a hazard and will not perform when subjected to the expected loads.

It has been 20 years since the last major earthquake in our area!

(No lateral load path. Undersized beam.)

A structure like this might stand for years, but will not perform under the code-mandated live loads or lateral loads.

What happens when structures are designed or built improperly?



If the exterior shearwalls at the rear of the second floor were removed, the seismic load at the roof would have nowhere to go (no redundancy). Failure would occur.

Santa Clarita does not permit “three-sided” diaphragms for anything other than ‘U’ occupancies.

If the interior shearwall at the first floor were removed, the load would try to transfer to the exterior shearwalls. However, the diaphragm and exterior shearwalls were not designed to carry this additional load. Failure would occur.

The information provided in this presentation is for training purposes only. For any structure, you should consult a qualified architect or engineer for all structural issues. It is the sole responsibility of the project designer(s) owner(s), and/or contractor(s) to build structures in compliance with the applicable codes, laws, ordinances and other regulations.