STRUCTURAL SYSTEM OF WOOD BUILDING IN AMERICA

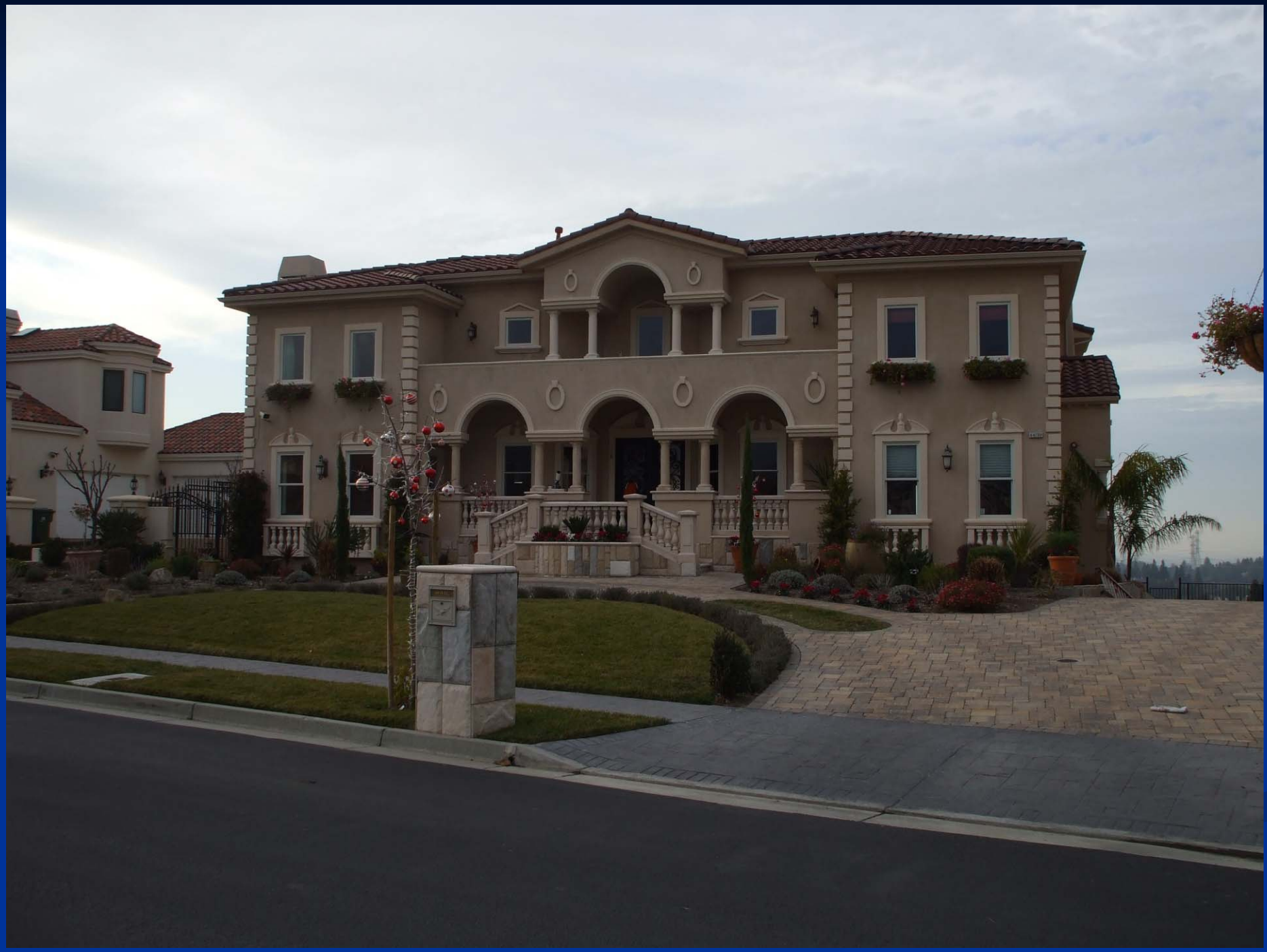
What is American Style Wood House?

Majority of houses in US is “SINGLE FAMILY RESIDENCE”


PLAN
3312
PIENZA


1757


The Strathmore II



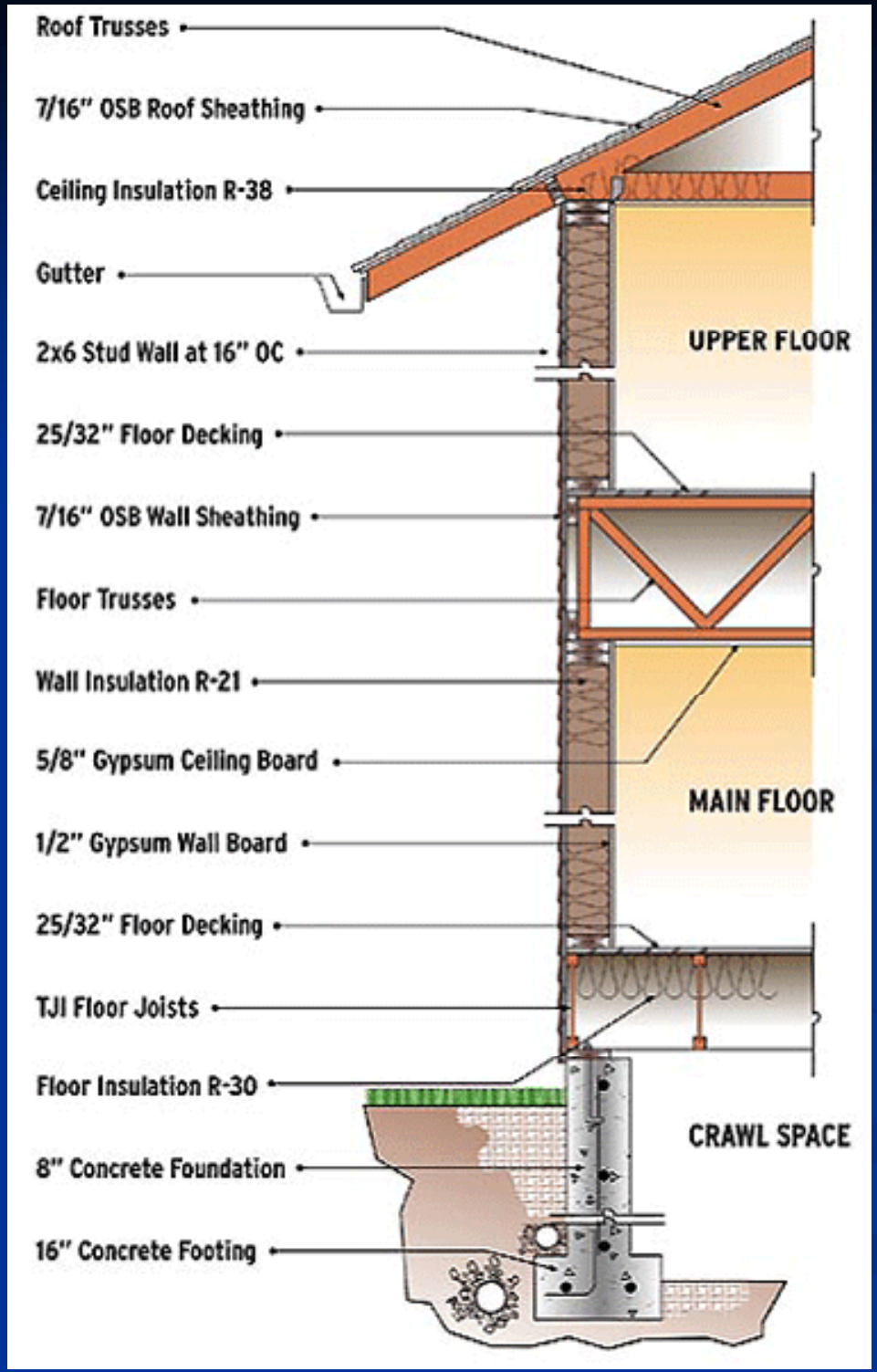
- The majority of residential buildings such as Single Family Residence, Town Home, Town House, Duplex, Multiplex, Apartment, Condos in US are constructed with Wood Framing enclosed by

(1) Stucco, stone veneer over exterior face of walls and by gypsum board on interior face;

(2) Concrete tile or composite shingle on top of inclined roof and with gypsum board at underside of roof ceiling;

(3) Hardwood or tile or stone on top of floor and with gypsum board at underside of floor ceiling;

(4) Concrete slab on grade or raised wood floor with continuous strap concrete footing along the perimeter and interior concrete pad footing


Roof Trusses
7/16" OSB Roof Sheathing
Ceiling Insulation R-38
Gutter
2x6 Stud Wall at 16" OC
25/32" Floor Decking
7/16" OSB Wall Sheathing
Floor Trusses
Wall Insulation R-21
5/8" Gypsum Ceiling Board
1/2" Gypsum Wall Board
25/32" Floor Decking
TJI Floor Joists
Floor Insulation R-30
8" Concrete Foundation
16" Concrete Footing
UPPER FLOOR
MAIN FLOOR
CRAWL SPACE

ANATOMY

- Wood Framing

  (1) **Roof**

  (a) Diaphragm (b) Rafter (c) Ridge

  (d) Ceiling Joist (e) Kicker & Purlin

  (2) **Floor**

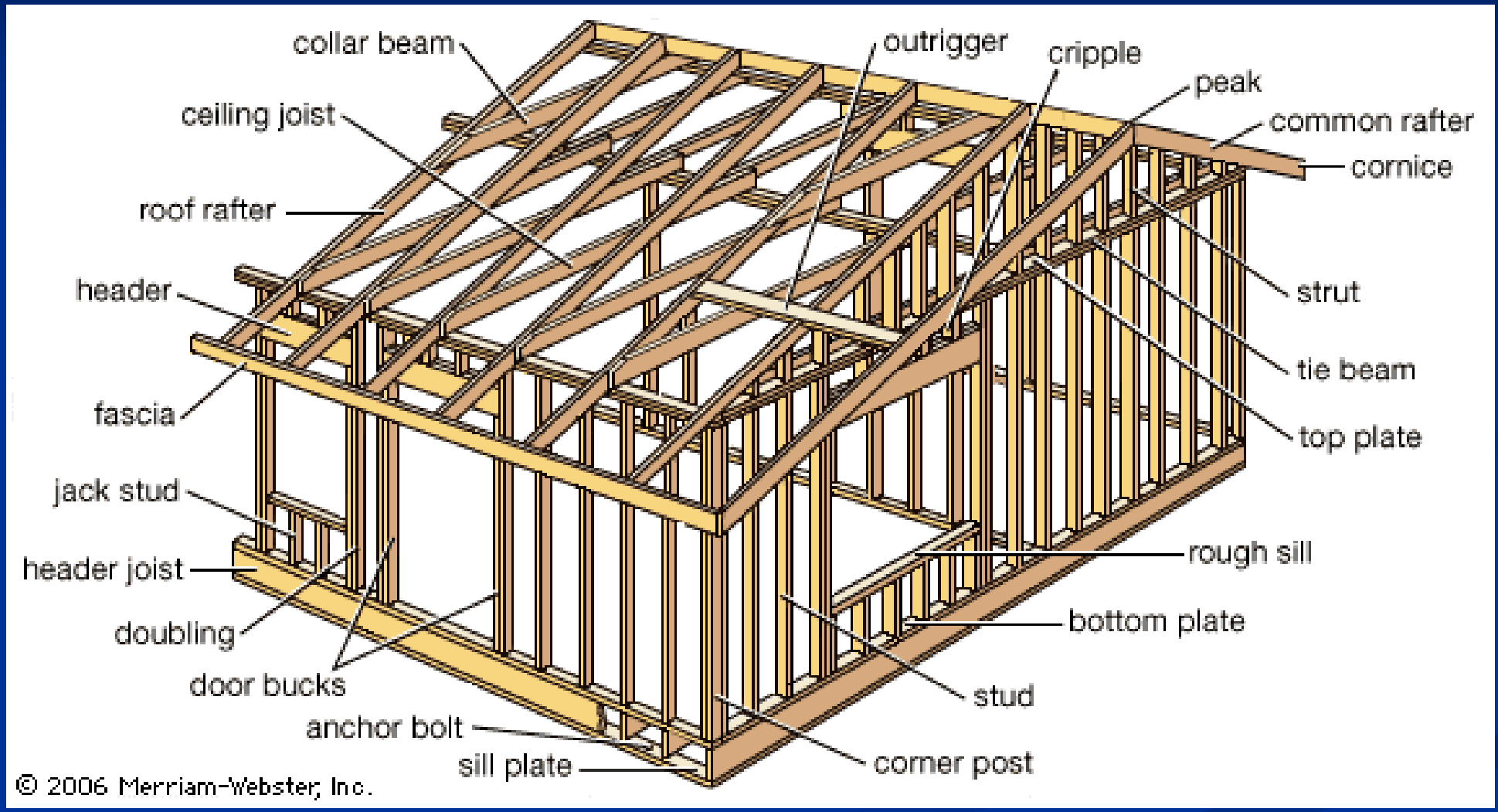
  (a) Floor Joist (b) Floor Beam

  (3) **Wall**

  (a) Double Top Plates (b)Stud

  (c)Sole plate

- Concrete Foundation & Basement Wall


collar beam
ceiling joist
roof rafter
header
fascia
jack stud
header joist
doubling
door bucks
anchor bolt
sill plate
outrigger
cripple
peak
common rafter
cornice
strut
tie beam
top plate
rough sill
bottom plate
stud
corner post
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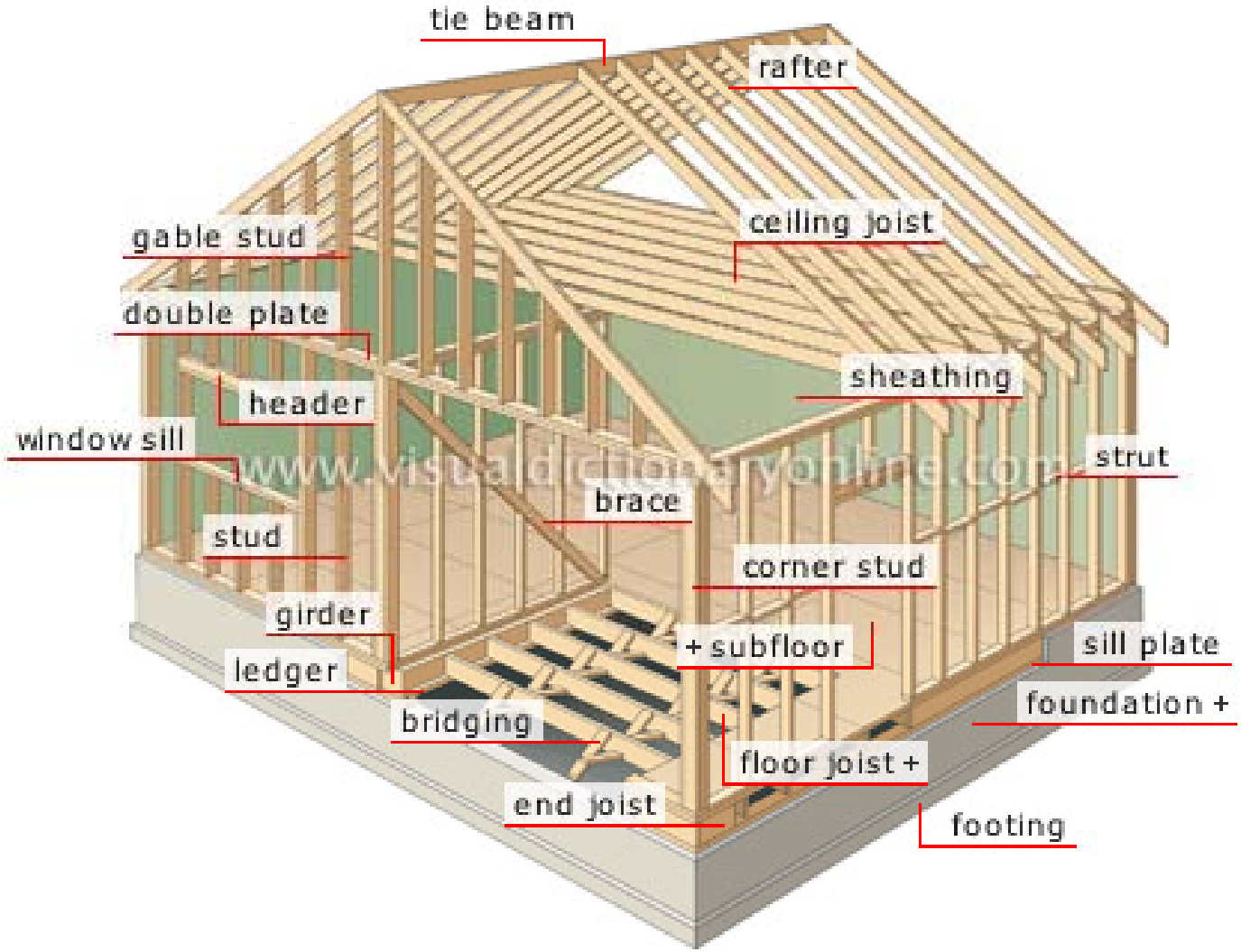
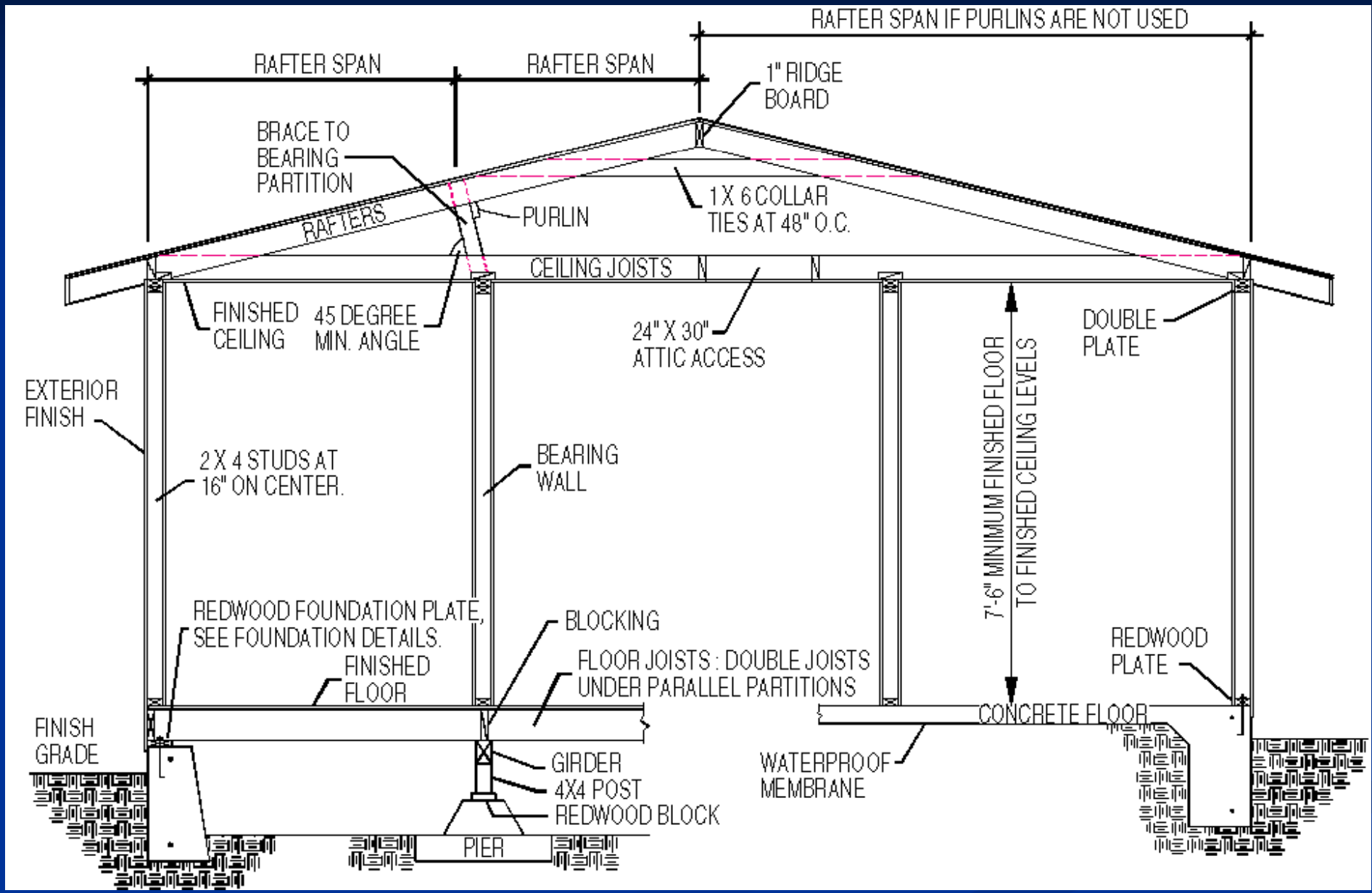
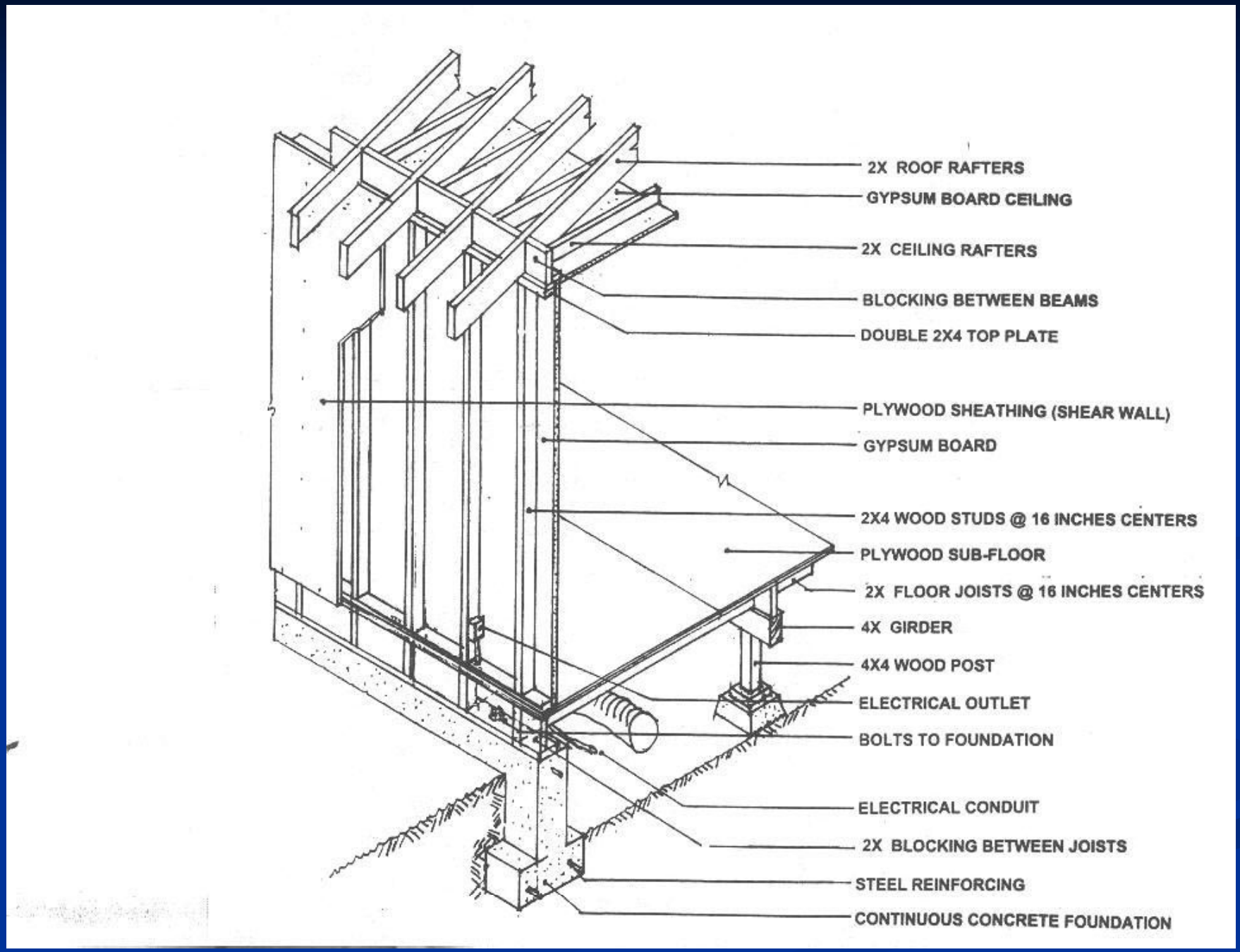
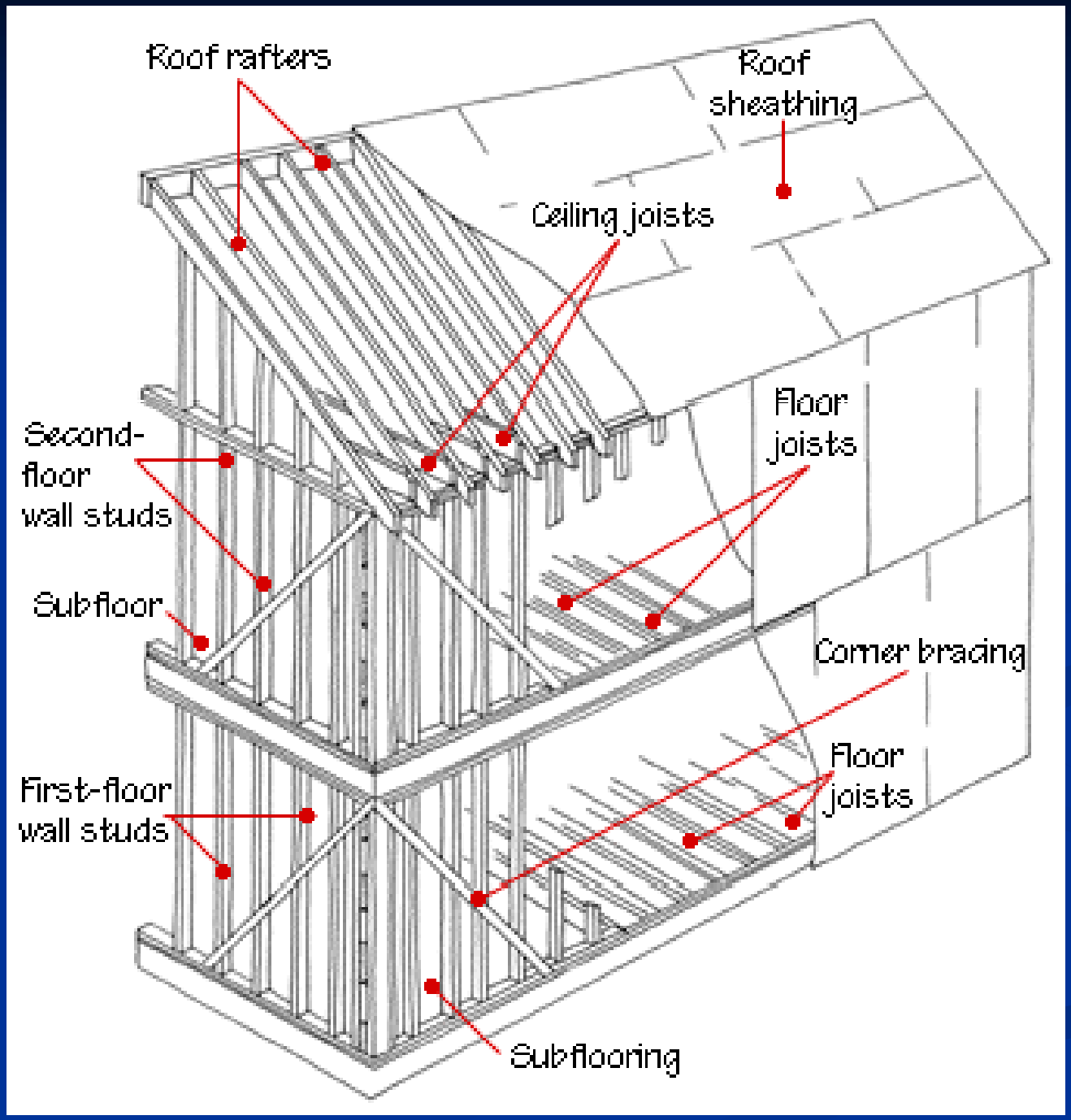
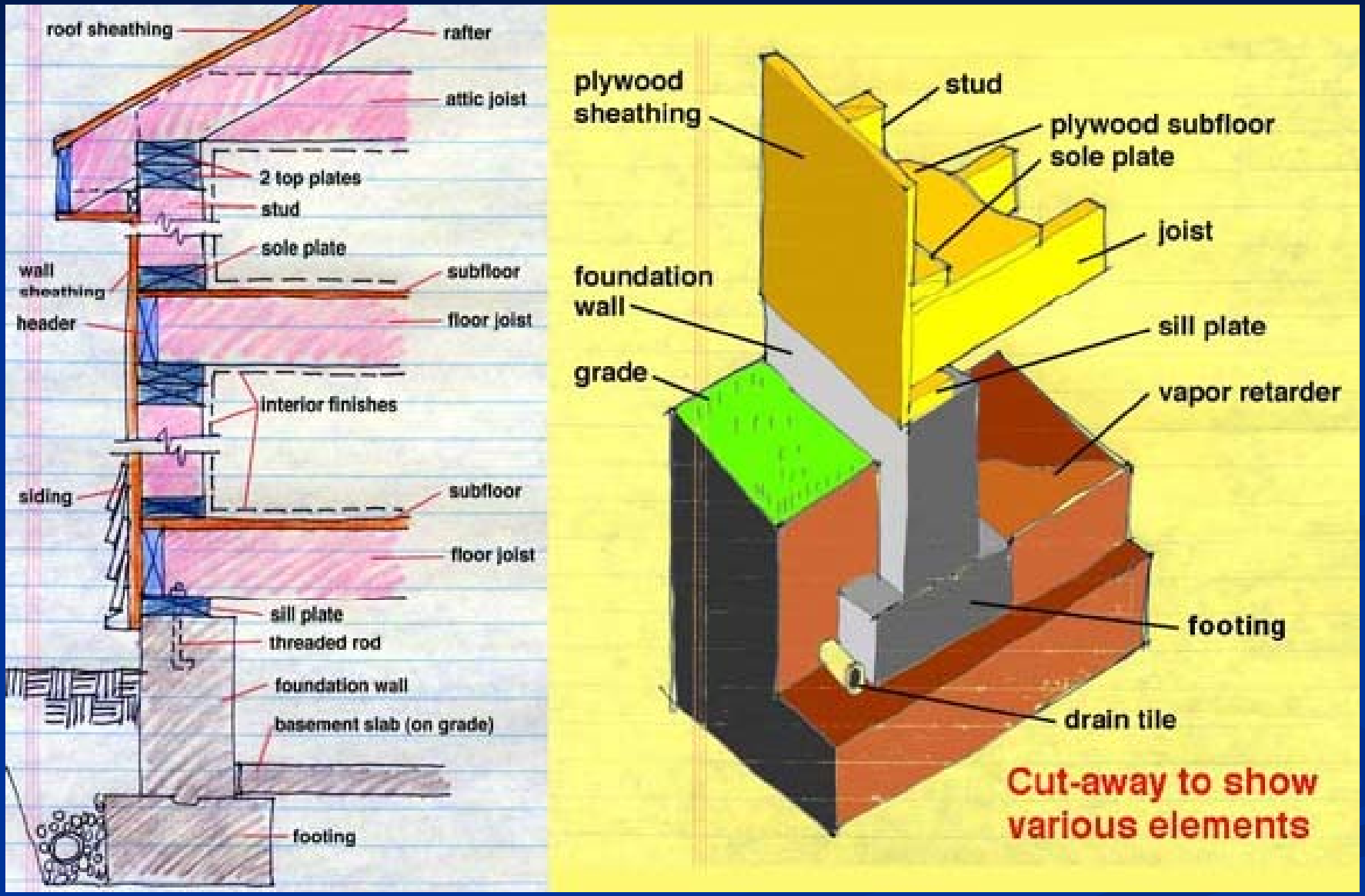
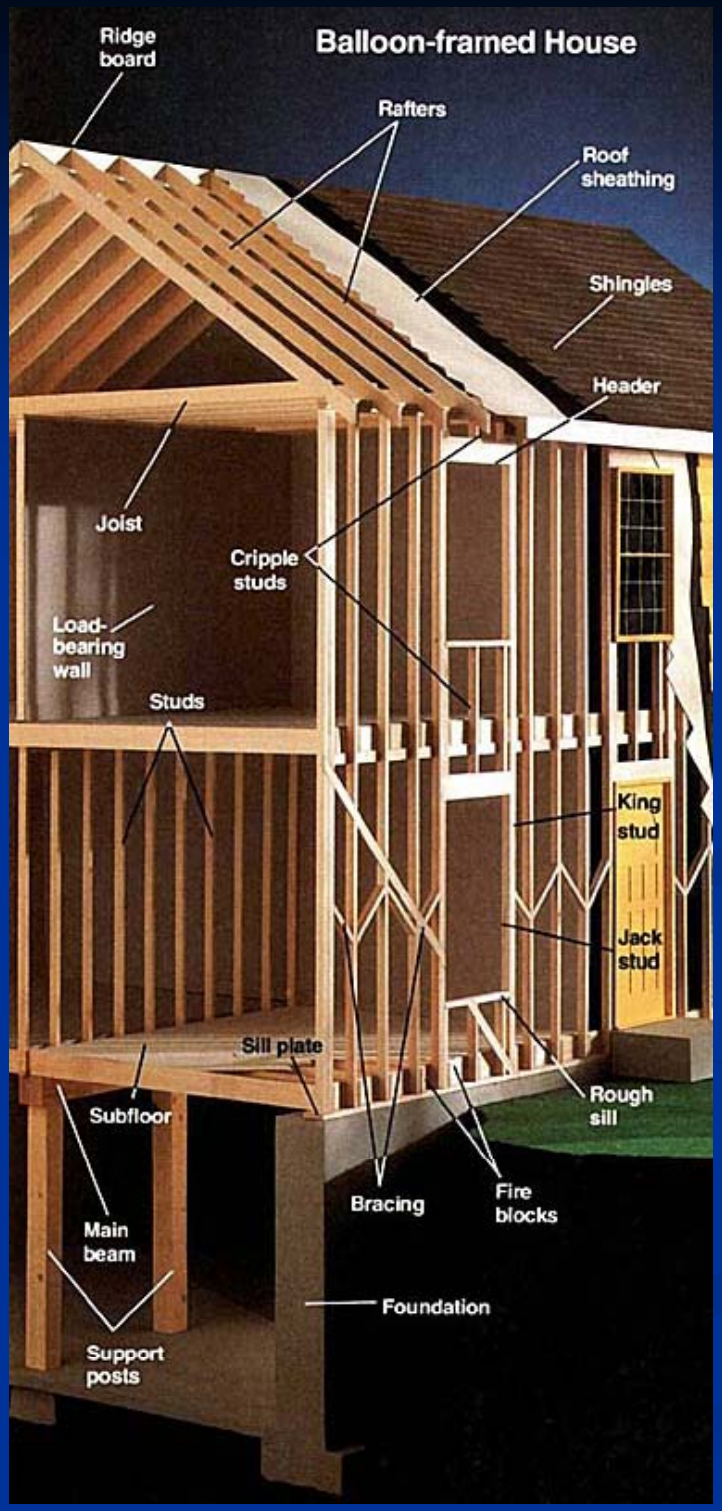

tie beam
rafter
ceiling joist
gable stud
double plate
sheathing
header
window sill
strut
brace
stud
corner stud
girder
+ subfloor
sill plate
ledger
foundation +
bridging
floor joist +
end joist
footing


RAFTER SPAN IF PURLINS ARE NOT USED
RAFTER SPAN
RAFTER SPAN
1" RIDGE BOARD
BRACE TO BEARING PARTITION
RAFTERS
PURLIN
1 X 6 COLLAR TIES AT 48" O.C.
CEILING JOISTS
FINISHED CEILING
45 DEGREE MIN. ANGLE
24" X 30" ATTIC ACCESS
DOUBLE PLATE
EXTERIOR FINISH
2 X 4 STUDS AT 16" ON CENTER.
BEARING WALL
7'-6" MINIMUM FINISHED FLOOR TO FINISHED CEILING LEVELS
REDWOOD FOUNDATION PLATE, SEE FOUNDATION DETAILS.
BLOCKING
FINISHED FLOOR
FLOOR JOISTS : DOUBLE JOISTS UNDER PARALLEL PARTITIONS
REDWOOD PLATE
CONCRETE FLOOR
FINISH GRADE
GIRDER
4X4 POST
REDWOOD BLOCK
WATERPROOF MEMBRANE
PIER


2X ROOF RAFTERS
GYPSUM BOARD CEILING
2X CEILING RAFTERS
BLOCKING BETWEEN BEAMS
DOUBLE 2X4 TOP PLATE
PLYWOOD SHEATHING (SHEAR WALL)
GYPSUM BOARD
2X4 WOOD STUDS @ 16 INCHES CENTERS
PLYWOOD SUB-FLOOR
2X FLOOR JOISTS @ 16 INCHES CENTERS
4X GIRDER
4X4 WOOD POST
ELECTRICAL OUTLET
BOLTS TO FOUNDATION
ELECTRICAL CONDUIT
2X BLOCKING BETWEEN JOISTS
STEEL REINFORCING
CONTINUOUS CONCRETE FOUNDATION


Roof rafters
Roof sheathing
Ceiling joists
Floor joists
Second-floor wall studs
Subfloor
Corner bracing
Floor joists
First-floor wall studs
Subflooring


roof sheathing
rafter
attic joist
2 top plates
stud
sole plate
wall sheathing
subfloor
header
floor joist
interior finishes
siding
subfloor
floor joist
sill plate
threaded rod
foundation wall
basement slab (on grade)
footing
plywood sheathing
stud
plywood subfloor
sole plate
joist
foundation wall
sill plate
grade
vapor retarder
footing
drain tile
Cut-away to show various elements


Balloon-framed House
Ridge board
Rafters
Roof sheathing
Shingles
Header
Joist
Cripple studs
Load-bearing wall
Studs
King stud
Jack stud
Sill plate
Subfloor
Rough sill
Bracing
Fire blocks
Main beam
Foundation
Support posts


NO
TRESPASSING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Advantages of Using Wood as Structural Members

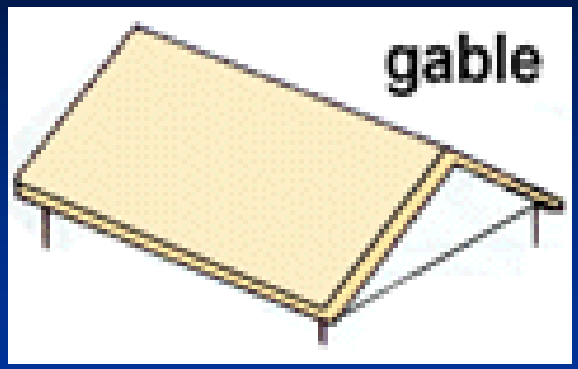
- High Ratio of Strength to Weight
- Low Earthquake-Induced Inertia Load
- High Energy Absorption (for Seismic and/or Wind)
- Low Cost per Pound
- Good Electrical Insulation, Low Thermal Conductance
- Warmth, Beauty, Versatility, Durability, Workability
- Wide Ranges of Finishes Can be Used
- Wide Ranges of Wood Species Can be Used
- Reusable, Recyclable, Green, and more

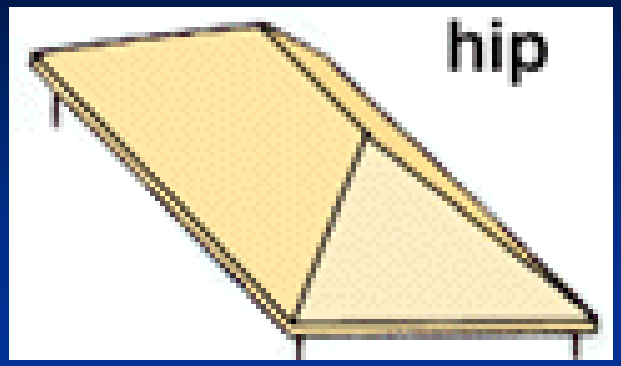
Disadvantages of Wood Frame Construction

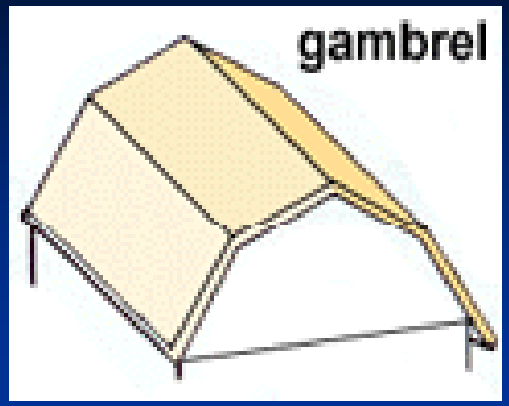
- Sound Noise
- Fire Resistivity
- Moisture Control
- Non-Homogeneous, Not Isotropic, Orthotropic (3 axis)
- Variation of Strength Under Different Situations
- Wood Degrading Organisms (Biodeterioration): Fungi (cause molds), Insects (termites), Bacteria, Marine Borers

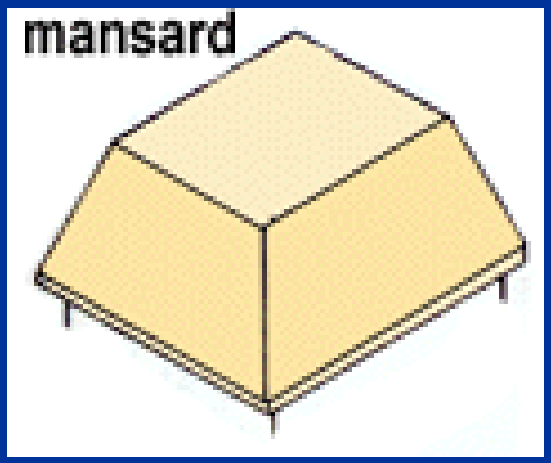
Roof System

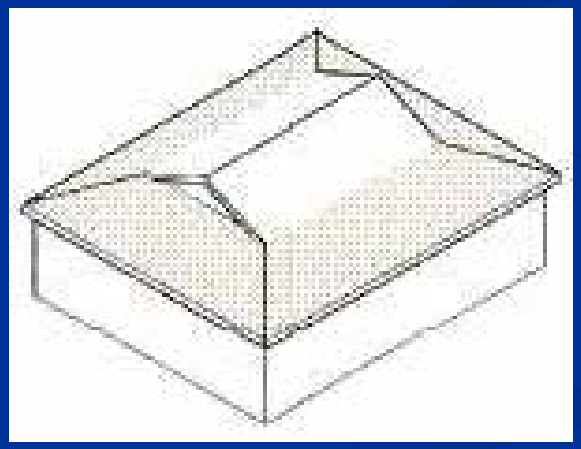
- Gable Roof (2 rafters & one ceiling joist)
- Hipped Roof (2 rafters & one ceiling inclined)
- Dutch Roof (Gable-on-Hip)
- Clipped Roof (Hip-on-Gale)
- Sloped Roof
- Others such as Flat Roof, Gambrel Roof, Mansard Roof

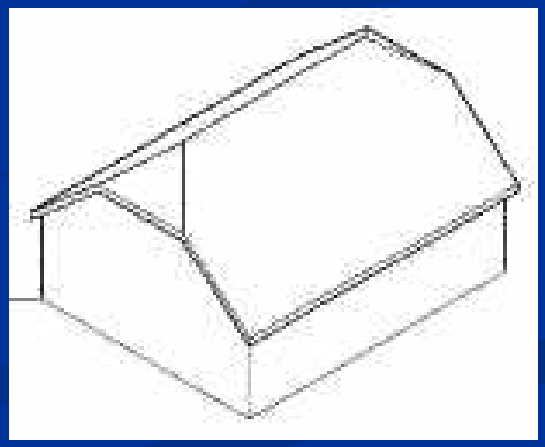

gable


hip


gambrel


mansard





How to Construct Roof

- Triangle (Flat Ceiling)

  (1) Home-Made Trusses (2) Pre-manufactured Trusses
- Vaulted Ceiling

  Inverted V, Letter A, Kicker & Purlin, Ridge Beam & Post
- Recessed Ceiling
- Scissor Roof

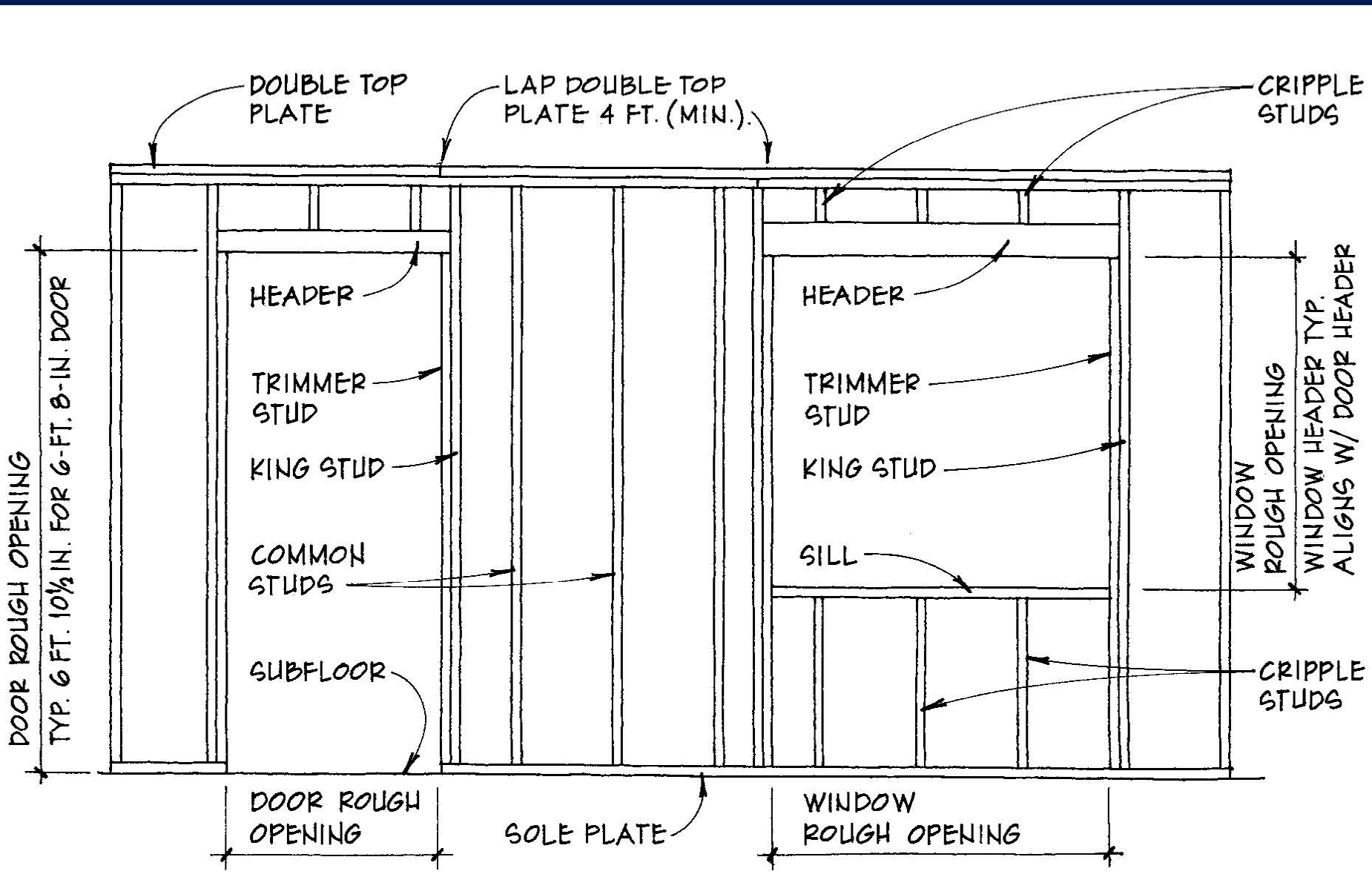
Wall Frame System

- The wall is constructed with

  (1) Double Top Plats (2) 2x Studs @16” O.C.

  (3) Sole Plat (4) With or Without Structural Panel

  (5) *The Gypsum Board on the Interior Side and the Exterior Weather Cover such as Stucco, Siding Usually Are Not Considered Structurally*


DOUBLE TOP PLATE
LAP DOUBLE TOP PLATE 4 FT. (MIN.)
CRIPPLE STUDS
HEADER
HEADER
TRIMMER STUD
TRIMMER STUD
KING STUD
KING STUD
COMMON STUDS
SILL
SUBFLOOR
CRIPPLE STUDS
DOOR ROUGH OPENING
TYP. 6 FT. 10½ IN. FOR 6-FT. 8-IN. DOOR
WINDOW ROUGH OPENING
WINDOW HEADER TYP. ALIGNS W/ DOOR HEADER
DOOR ROUGH OPENING
SOLE PLATE
WINDOW ROUGH OPENING

Wood Frame Wall

- Shear Wall
- Non-Shear Wall

  (1) Bearing Wall

  (2) Non-Bearing Wall

How to make a frame wall to be Shear Wall ???

To be Bearing Wall ??? To be Non-Bearing Wall ???

Floor Frame System

- FLOOR DIAPHRAGM

  ¾” THK STRUCT II PLYWOOD T&G GPI, 5 PLY 48/24 GLUE W/ 10d@6” O.C. ALL EDGES & 10” O.C. IN FIELD
- 2x10, 2x12, 2x14 FL JOISTS@16” O.C.
- PRE-MANUFACTURED FL JOISTS

  TJI, TJL, TJW, TJS, TJM, TJH, OPEN-WEB JOISTS, OTHERS
- FLOOR BEAMS

  SWAN LUMBER 4x10, 4x12, 4x14

  ENGINEERING TIMBER: GL BM, MICRO LAM, VERSALAM, PARALLAM, POWERBEAM, ETC.

Ground Raised Floor

- 2x6 FL JOISTS@16” O.C. W/ 7’-6” SPAN
- 4x8 FL W/ 7’-6” SPAN SUPPORTING 2x6S
- 4x4 POST SUPPORTING 4x8S
- 18” TO 24” x12” THK CONC. PAD FTG
- FL DIAPHRAGM

  ¾” THK STRUCT II PLYWOOD T&G GPI, 5 PLY 48/24
  GLUE W/ 10d@6” O.C. ALL EDGES & 10” O.C. IN FIELD

Foundation

- On Flat to Minor Slope Ground

  (1) Continuous Strap Inverted T shape Footing along Perimeter

  (2) Interior Pad Footing or Slab On Grade

- On Hill Slope

  (1) Continuous Grade Beam With Piers along Perimeter and Interior

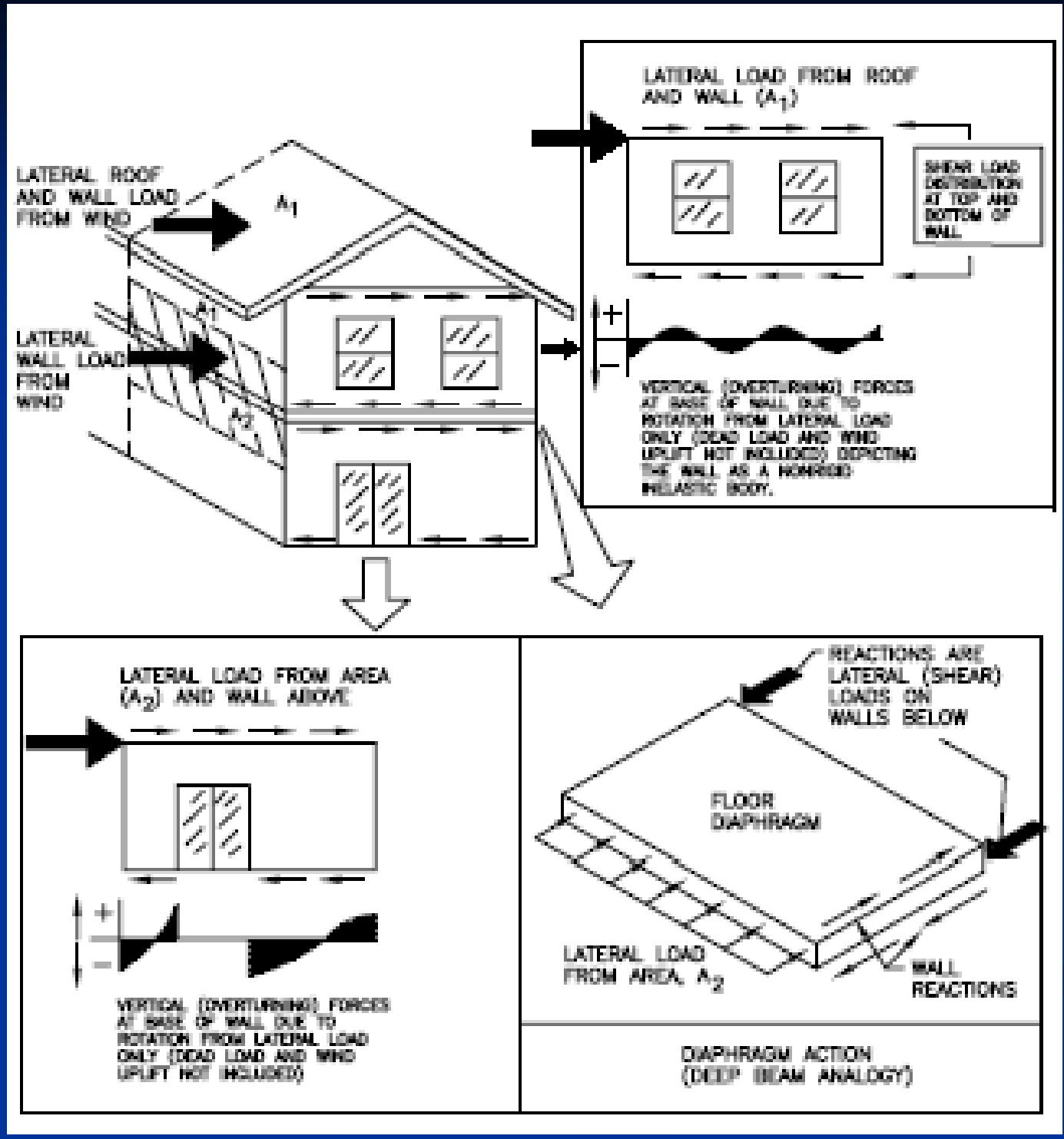
LATERAL FORCE RESISTING SYSTEM

HORIZONTAL DIAPHRAGM
SHEAR WALL

A continuous load path should be designed to carry the lateral force due to natural loadings such as earthquake and wind from the roof and floors down to the foundations

Continuous Load Path

- A continuous load path should be designed to carry the lateral forces due to natural loadings such as earthquake and wind from the roof and floors down to the foundations to safeguard the life of residents
- To ensure this all the members, elements, and connections should be designed with adequate strength and stiffness to achieve above purpose


LATERAL ROOF AND WALL LOAD FROM WIND
A_1
LATERAL WALL LOAD FROM WIND
A_2
LATERAL LOAD FROM ROOF AND WALL (A_1)
SHEAR LOAD DISTRIBUTION AT TOP AND BOTTOM OF WALL
+
−
VERTICAL (OVERTURNING) FORCES AT BASE OF WALL DUE TO ROTATION FROM LATERAL LOAD ONLY (DEAD LOAD AND WIND UPLIFT NOT INCLUDED) DEPICTING THE WALL AS A NONRIGID INELASTIC BODY.
LATERAL LOAD FROM AREA (A_2) AND WALL ABOVE
+
−
VERTICAL (OVERTURNING) FORCES AT BASE OF WALL DUE TO ROTATION FROM LATERAL LOAD ONLY (DEAD LOAD AND WIND UPLIFT NOT INCLUDED)
REACTIONS ARE LATERAL (SHEAR) LOADS ON WALLS BELOW
FLOOR DIAPHRAGM
LATERAL LOAD FROM AREA, A_2
WALL REACTIONS
DIAPHRAGM ACTION (DEEP BEAM ANALOGY)

Basic Concepts

- Box Idea:

  Treat the wood building as a pseudo box composed of

  (1) Horizontal diaphragm (roof or floor wood platform laid horizontally), and

  (2) Vertical diaphragm (Wood shear wall per code, Simpson Strong Wall, Simpson Steel Strong Wall, Hardy Frame, TJI Shear Wall, Cantilevel free standing column, Steel moment frame, Simpson Moment Frame)

  (2) Collectors (drag strut) in line with Vertical Lateral Elements

  (3) Base foundation of concrete and rebars

Horizontal Diaphragm

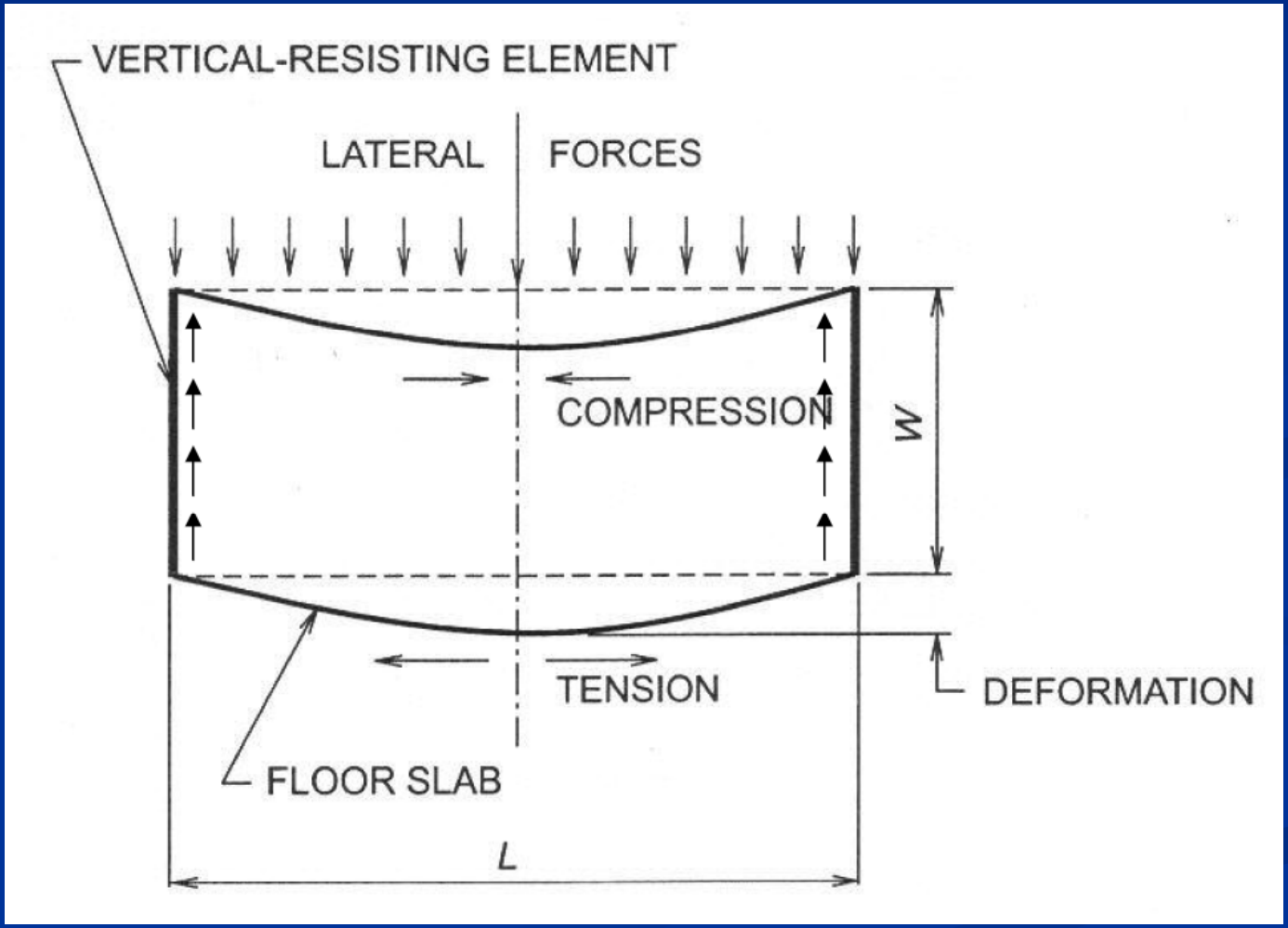
- Roof framing clad with structural panels with specified nailing schedule

  1/2" PLYWOOD STRUCT II W/ 10d NAILS @6"O.C. ALL SUPPORTED EDGES, 12" O.C. IN FIELD LAYOUT THE LONG DIMENSION OF DIAPHRAGM PERPENDICULAR TO FRAMING MEMBER BEL

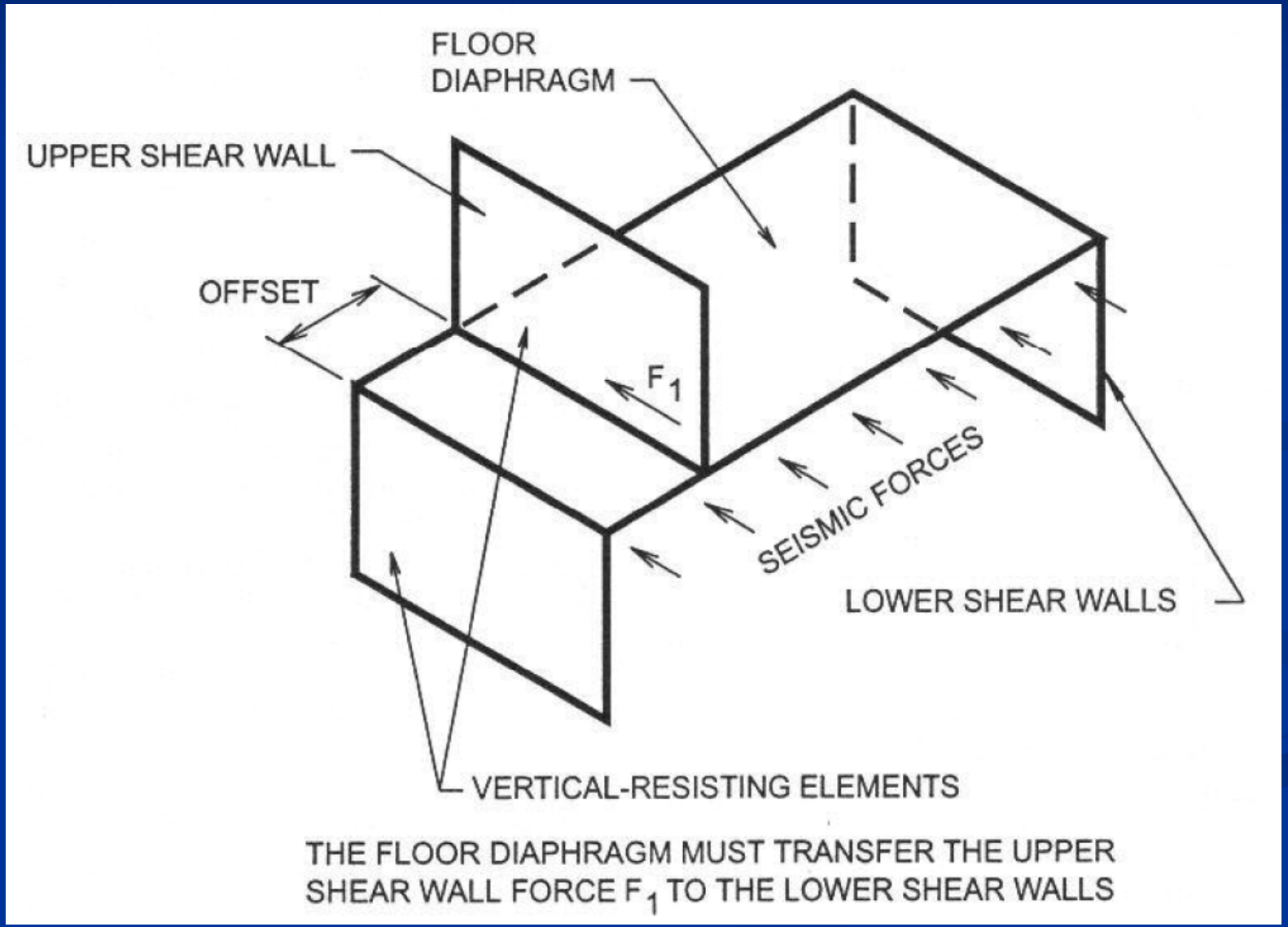
- Floor framing clad with structural panels with specified nailing schedule

  3/4" PLYWOOD STRUCT II T&G GP I, 5 PLY 48/24 GLUE W/ 10d NAILS @6“ O.C. ALL SUPPORTED EDGES, 10" O.C. IN FIELD

Horizontal Diaphragm



Horizontal Diaphragm



THE FLOOR DIAPHRAGM MUST TRANSFER THE UPPER SHEAR WALL FORCE F_1 TO THE LOWER SHEAR WALLS

Shear Wall

- Ordinary Wood Shear Wall
- Perforated Wood Shear Wall
- Wood Shear Wall with Opening reinforcement
- Engineering Shear Wall

  (1) Simpson's Strong Wall

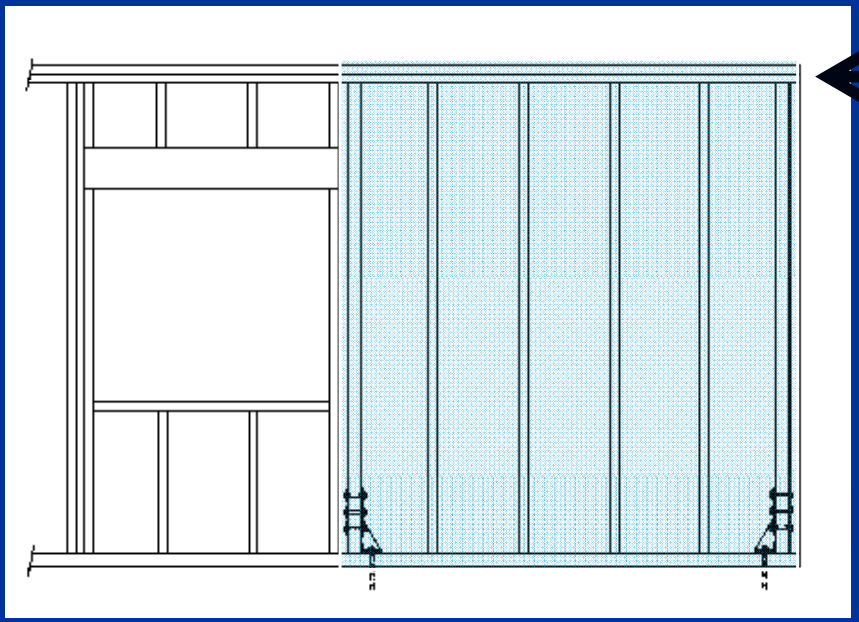
  (2) Simpson's Steel Strong Wall

  (3) Hardy Frame

  (4) Others

Ordinary Wood Shear Wall

- Wood framing wall with structural panel on one or both side with specified nailing per code to resisting lateral force and with or without hold-downs to resisting overturning



V=Q*W

Q=0.21

H/B = 2:1

Ordinary Wood Shear Wall

- 2x4 (or 2x6)@16” O.C. W/ double top plates on top and sole plate (and sill plate) at bottom W/ ½” thk Struct II plywood W/10d @6” O.C. all edges and 12” O.C. in field

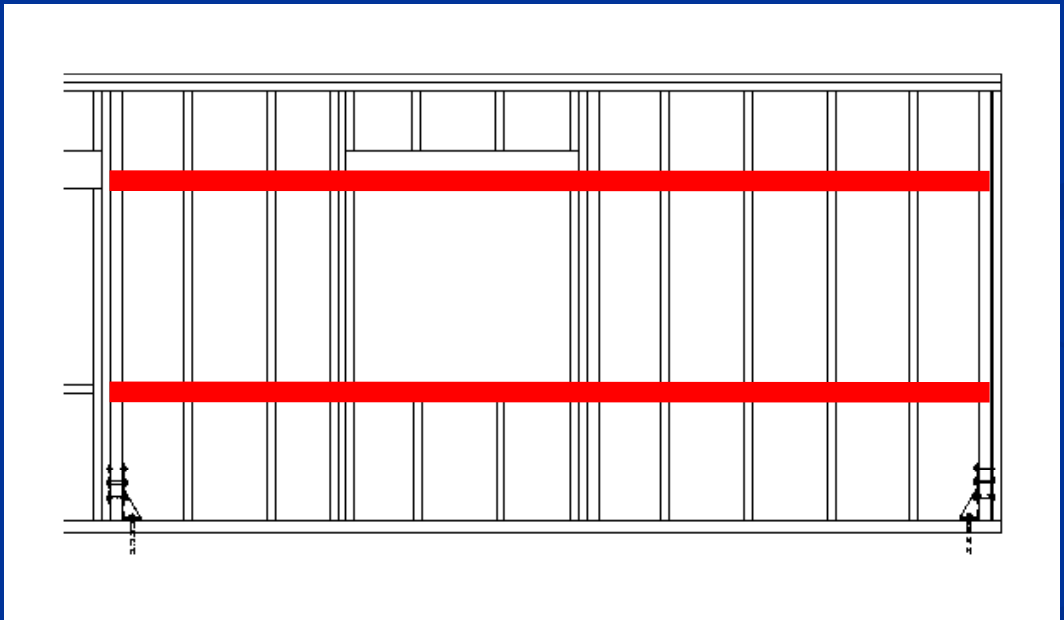
SHEAR WALL TYPE

TYPE	DESCRIPTION	SILL PLATE & ANCHOR BOLTS	SOLE PLATE NAILING	CLIP ANGLE @ TOP PLATE	SHEAR CAPACITY
1	1/2” STR II PLYWD W/ 10d @6” O.C. @PNL EDGES, 12” O.C. INFIELD	2X SILL PLATE W/ 5/8” A.B. @ 48” O.C.	16d @ 6” O.C.	LS50 @ 16” O.C.	310 #/FT
2	1/2” STR II PLYWD W/ 10d @4” O.C. @PNL EDGES, 12” O.C. INFIELD	3X SILL PLATE W/ 5/8” A.B. @ 32” O.C.	SDS 1/4”X3” WOOD SCREW @ 8” O.C.	LS50 @ 12” O.C.	460 #/FT
3	1/2” STR II PLYWD W/ 10d @3” O.C. @PNL EDGES, 12” O.C. INFIELD	3X SILL PLATE W/ 5/8” A.B. @ 16” O.C.	SDS 1/4”X3” WOOD SCREW @ 6” O.C.	LS50 @ 12” O.C.	600 #/FT
4	1/2” STR II PLYWD W/ 10d @2” O.C. @PNL EDGES, 12” O.C. INFIELD	3X SILL PLATE W/ 5/8” A.B. @ 16” O.C.	SDS 1/4”X3” WOOD SCREW @ 4” O.C.	2–LS50 @ 16” O.C.	700 #/FT

Wood Shear Wall with Opening Reinforcement

- For shear walls with openings, where framing members, blocking, and connections around the openings are designed for force transfer around the openings (force-transfer shear walls) the following provisions shall apply.
- Design for force transfer shall be based on a rational analysis.

Wood Shear Wall with Opening Reinforcement



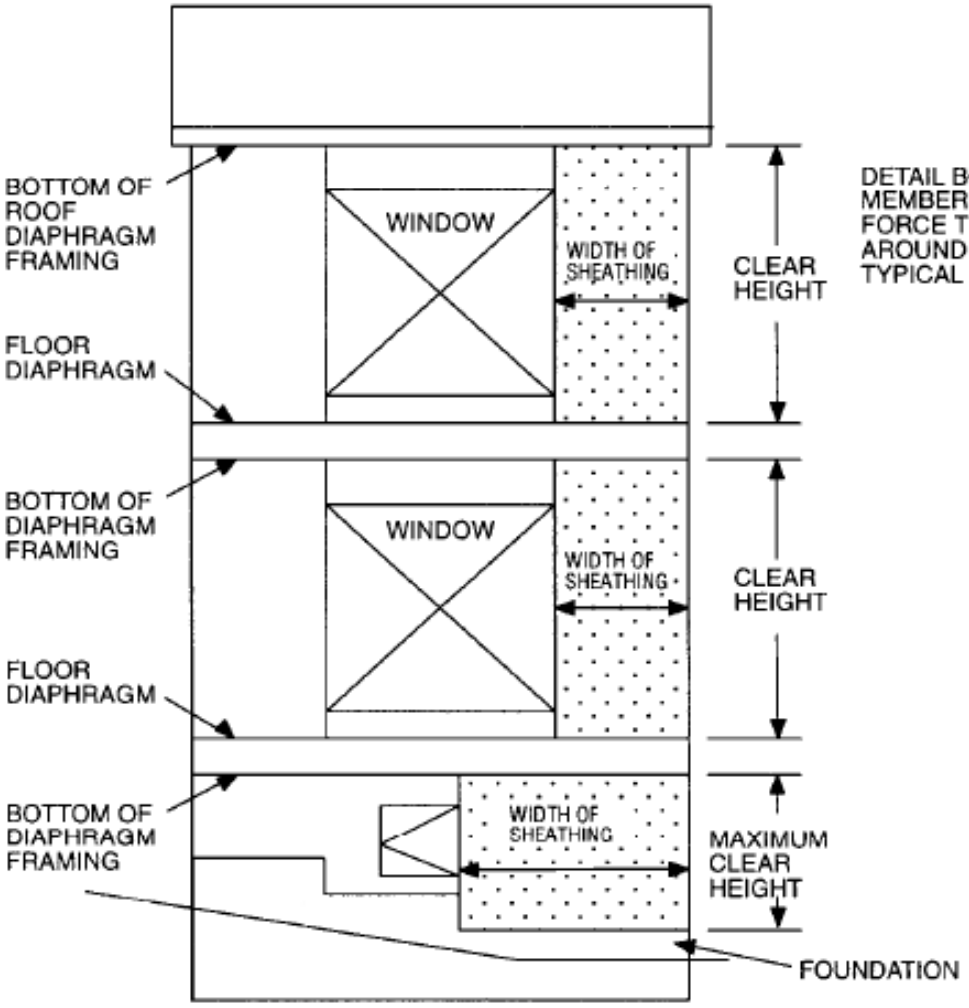
2CS14, MST60

HDU2,
HDU5, HDU6

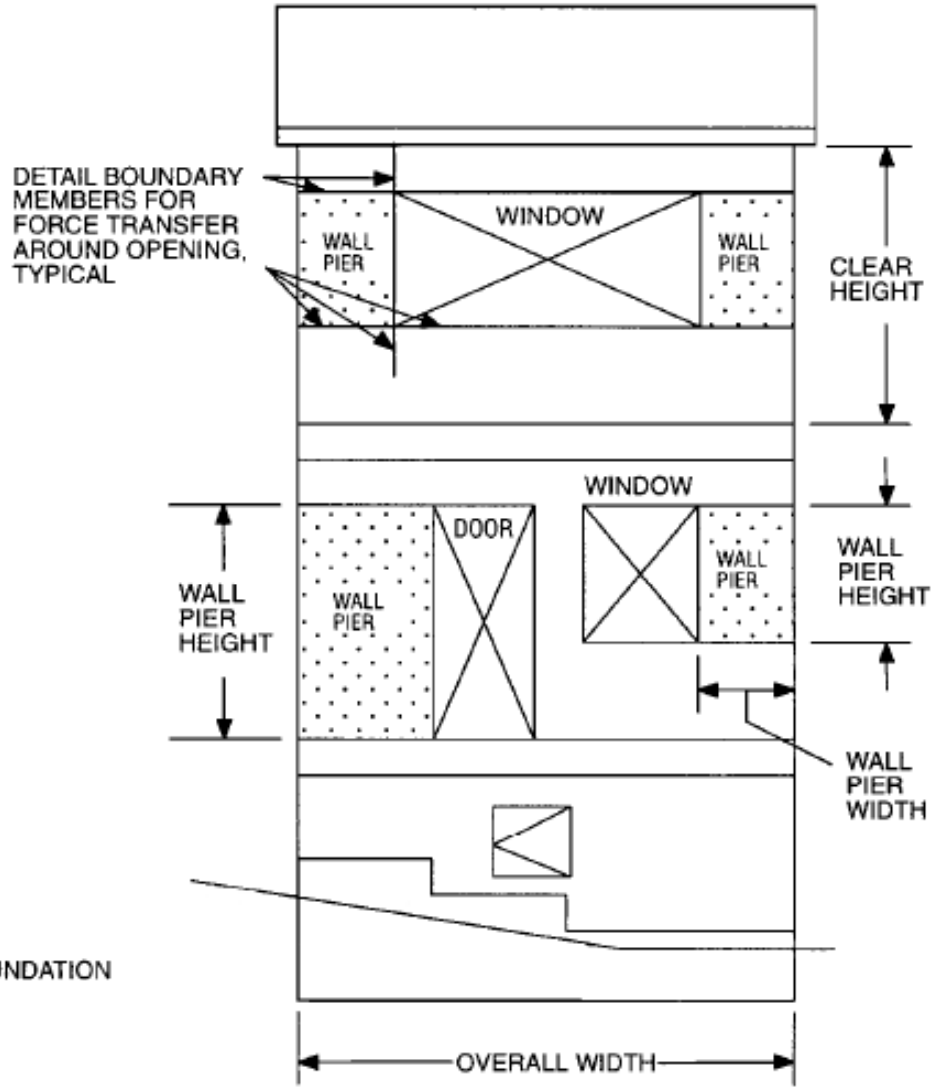
Wood Shear Wall with Opening Reinforcement

- The following limitations shall apply:

1. The length of each wall pier shall not be less than 2'.
2. A full-height wall segment shall be located at each end of a force-transfer shear wall.
3. Where out-of-plane offsets occur, portions of the wall on each side of the offset shall be considered as separate force-transfer shear walls.
4. Collectors for shear transfer shall be provided through the full length of the force-transfer shear wall.



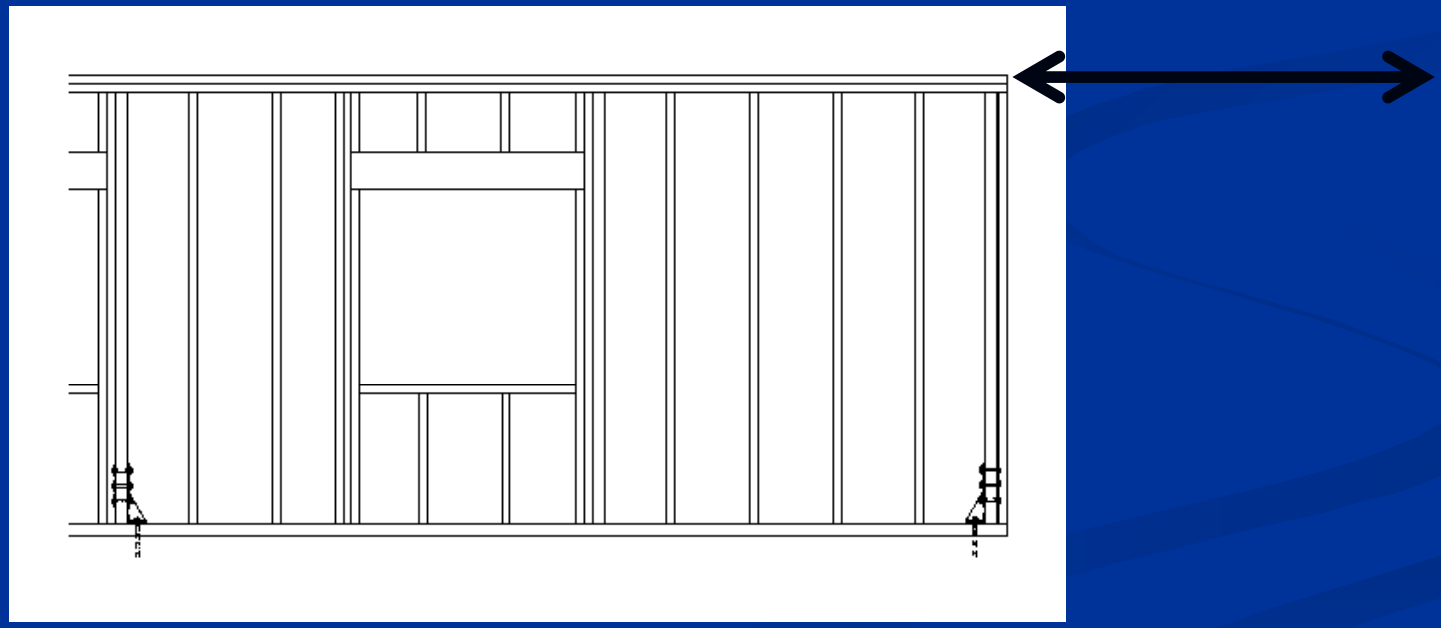
(a) HEIGHT-TO-WIDTH RATIO FOR SHEAR WALLS AND PERFORATED SHEAR WALLS



(b) HEIGHT-TO-WIDTH RATIO WITH DESIGN FOR FORCE TRANSFER AROUND OPENINGS

Perforated Wood Shear Wall

- Where wood structural panel shear walls with openings are not designed for force transfer around the openings, they shall be designed as perforated shear walls.



Perforated Wood Shear Wall

- Where wood structural panel shear walls with openings are not designed for force transfer around the openings, they shall be designed as perforated shear walls.

$$v = \frac{V}{C_o \Sigma L_i}$$ **(Equation 23-4)**

where:

v = Unit shear force, pounds per lineal feet (N/m).

V = Shear force in perforated shear wall, pounds (N).

C_o = Shear resistance adjustment factor from Table 2305.3.8.2.

$\sum L_i$ = Sum of widths of perforated shear wall segments, feet (mm).

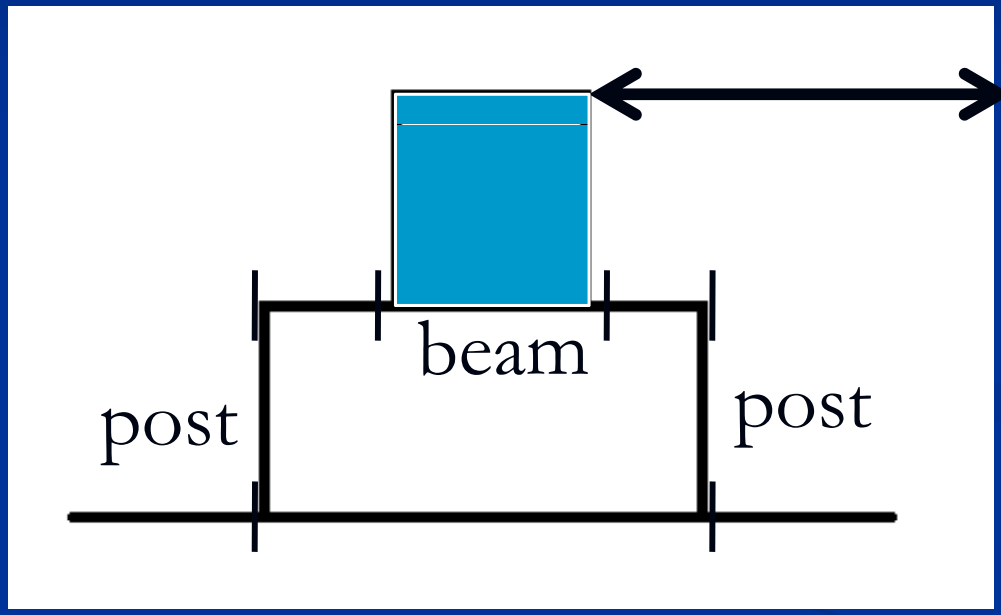
Shear Load Path of Shear Wall

- Two story Building

  (1) Shear Wall above 2nd floor supported by beam and shear transfer through 2nd floor diaphragm

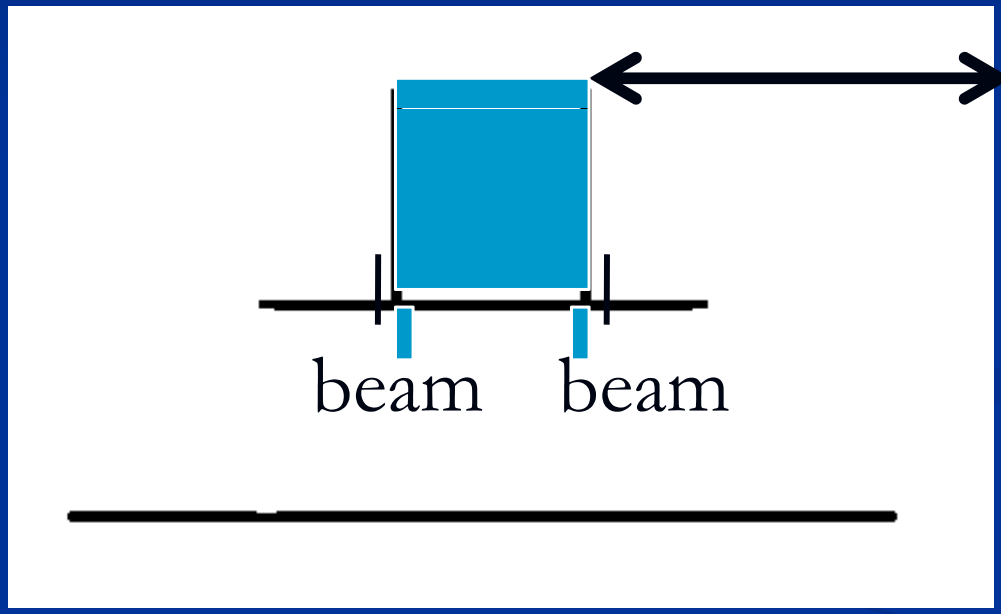
  (2) Shear Wall above 2nd floor supported by floor joisted and blockings, and shear transfer through 2nd floor diaphragm

Shear Wall Supported by Beam



- Special Load Combination for design the shear wall supported by the floor beam due to the C & T

Shear Wall Supported by Beam



- Special Load Combination for design the shear wall supported by the floor beam due to the C & T

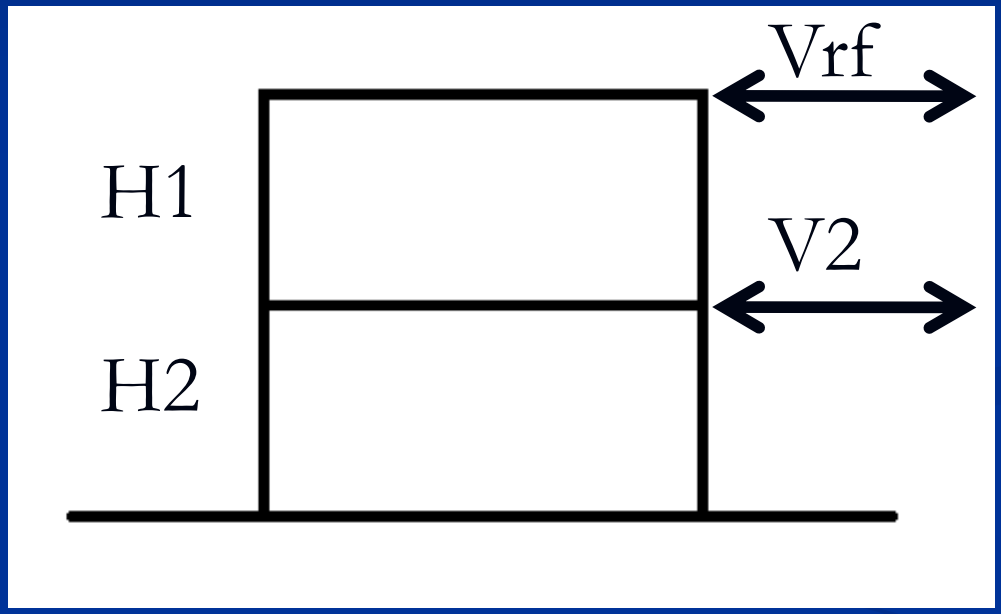
Shear Load Path of Shear Wall

- Two story Building

  (3) Stack up two story Shear Wall with same length

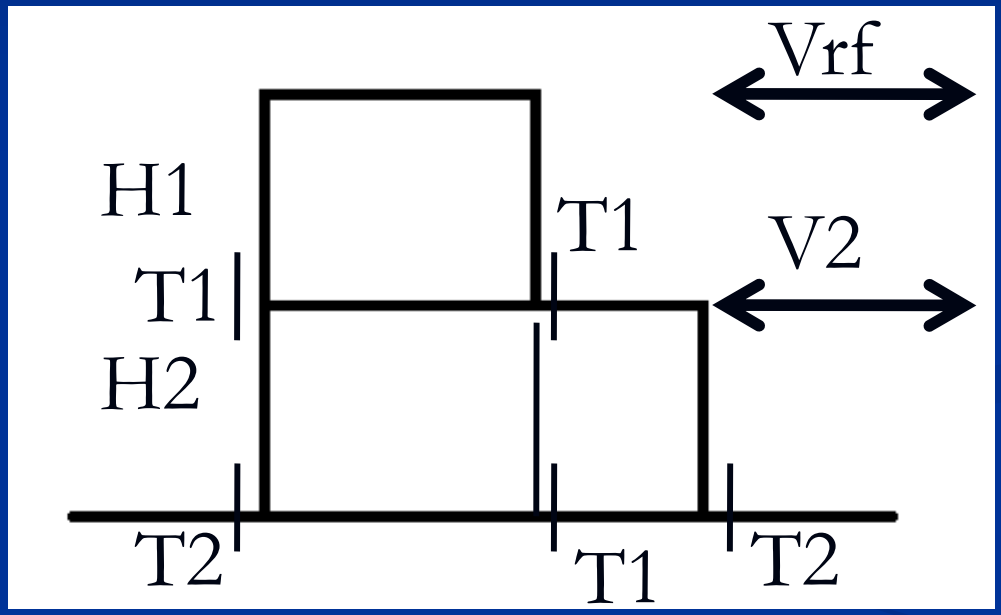
  (4) Stack up two story Shear Wall with different length

Shear Load Path of Shear Wall



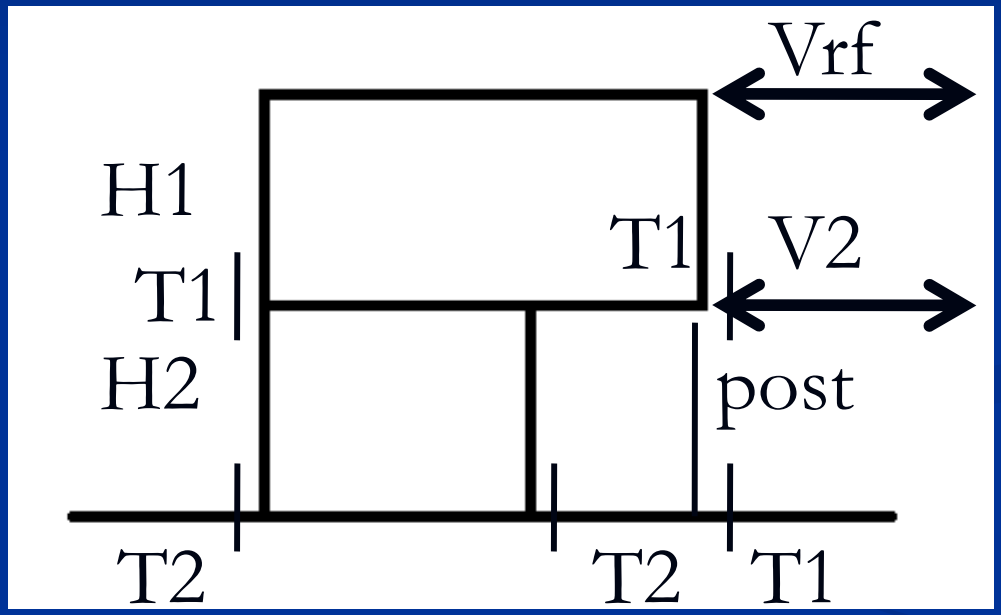
- T & C @ 2nd FL = Vrf*H1/L
- T & C @ 1st or Ground FL = (Vrf*(H1+H2)+V2*H2)/L

Shear Load Path of Shear Wall



- T & C @ 2nd FL T1=C1= Vrf*H1/L1
- T & C @ 1st or Ground FL T2 = Vrf*H1/L1+(Vrf+V2)*H2/L2

Shear Load Path of Shear Wall



- T & C @ 2nd FL = Vrf*H1/L1
- T & C @ 1st or Ground FL = Vrf*H1/L1+(Vrf+V2)*H2/L2

Engineering Shear Wall

- Simpson Strong Wall
- Simpson Steel Strong Wall
- Hardy Frame
- Others (other manufacturers)

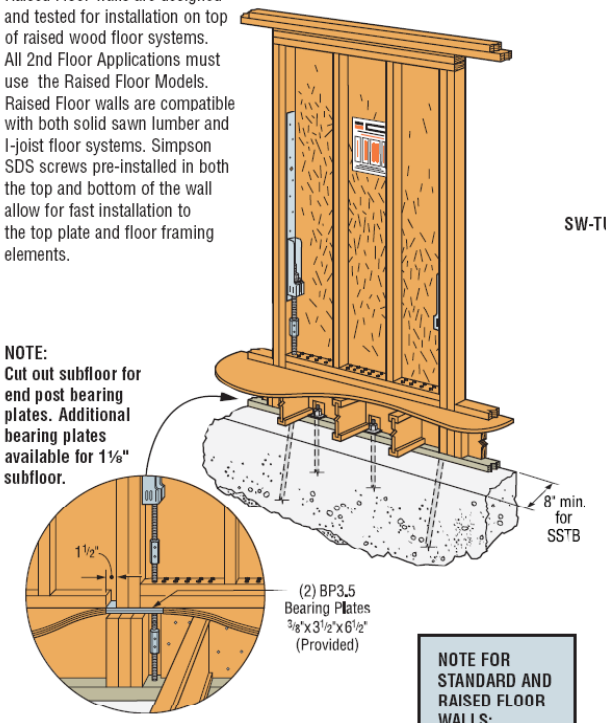
Simpson Strong-Wall

SIMPSON Strong-Tie

STRONG-WALL® SHEARWALL

RAISED FLOOR (-RF)

Raised Floor walls are designed and tested for installation on top of raised wood floor systems. All 2nd Floor Applications must use the Raised Floor Models. Raised Floor walls are compatible with both solid sawn lumber and I-joist floor systems. Simpson SDS screws pre-installed in both the top and bottom of the wall allow for fast installation to the top plate and floor framing elements.



NOTE:
Cut out subfloor for end post bearing plates. Additional bearing plates available for 1⅛" subfloor.

Naming Scheme:

SW24x8-RF

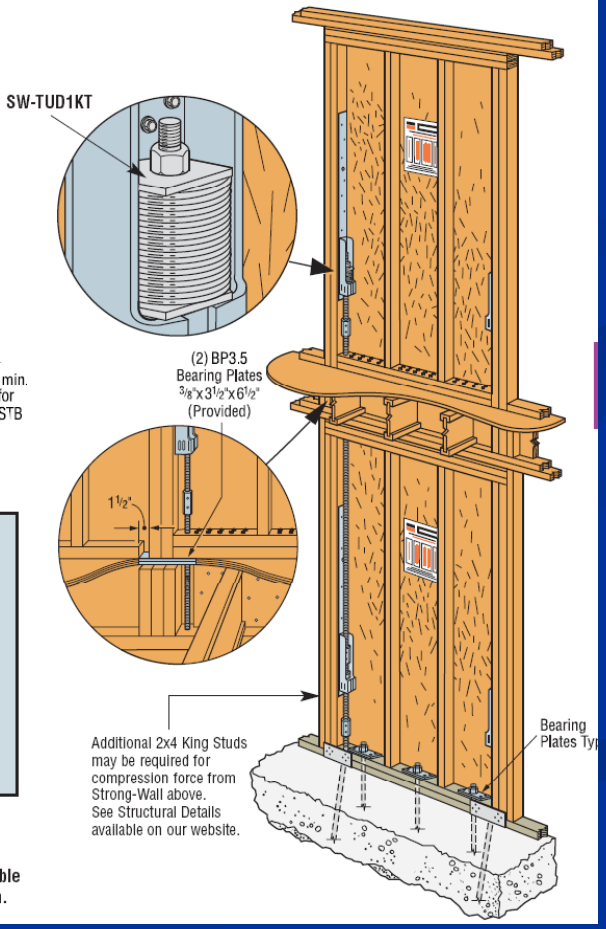
- Strong-Wall
- Width (in.)
- Nominal Height (ft.)
- Raised Floor

NOTE FOR STANDARD AND RAISED FLOOR WALLS:
Walls may also be used in 2x6 wall framing. Install sheathing side at exterior wall line and add furring to interior framing side.

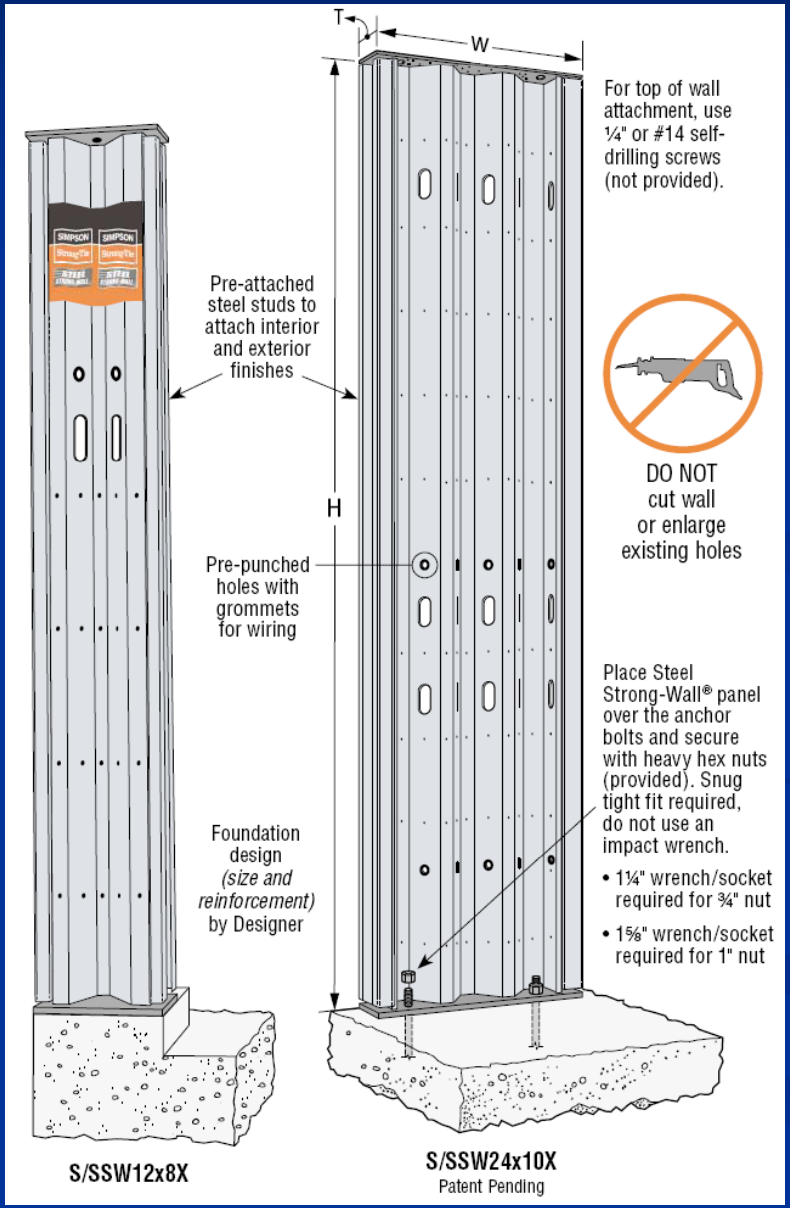
NOTE:
The Engineer of Record is responsible for concrete design.

STRONG-WALL® SHEARWALL FOR 2nd FLOOR APPLICATIONS!

Raised Floor (-RF) walls are code listed for use on the second floor of two-story wood light-frame construction. Simpson Strong-Tie recommends the Simpson Takeup Device, (SW-TUD1KT), be used at the 2nd floor to compensate for wood shrinkage and settlement due to dead load.



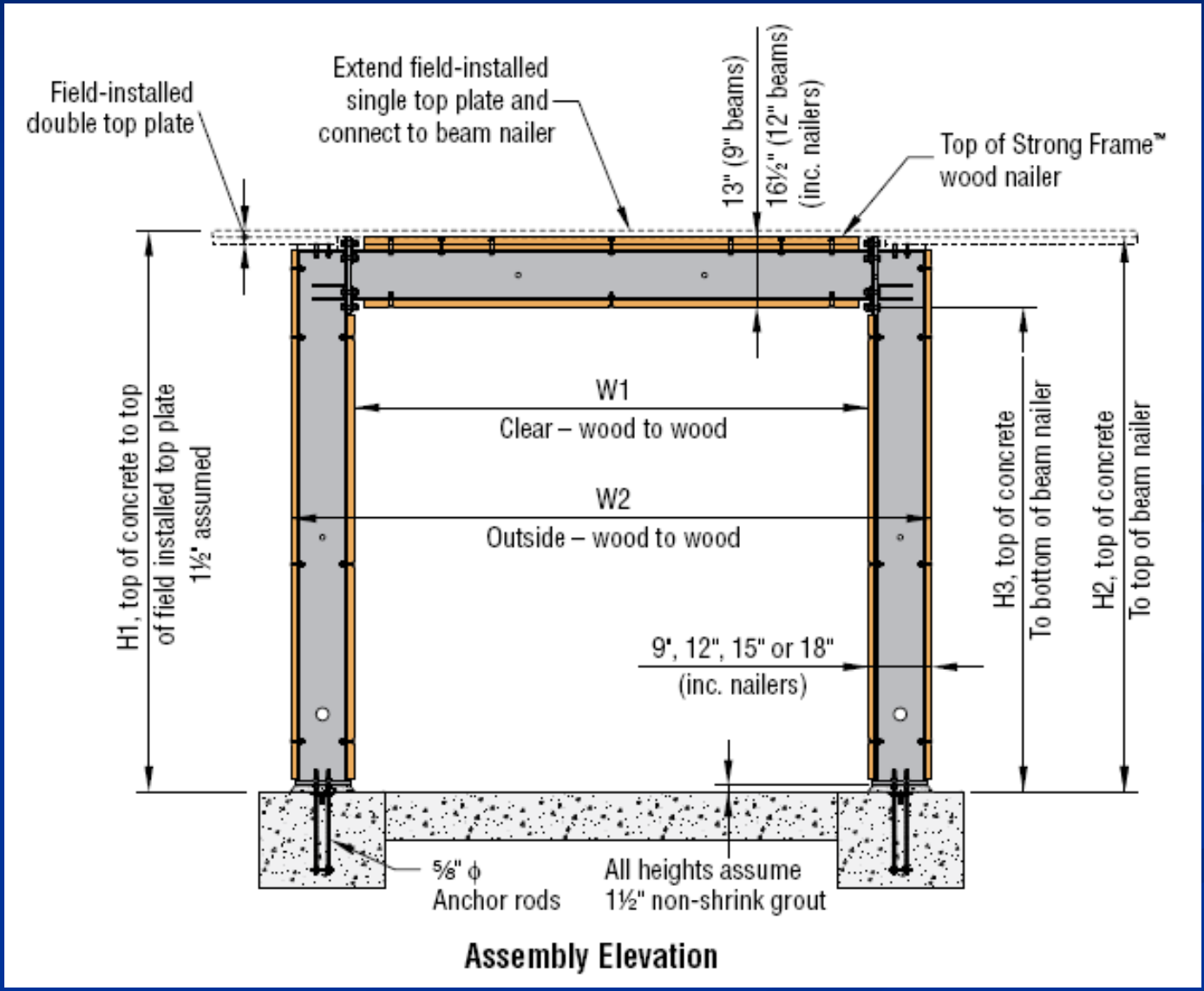
Simpson Steel Strong Wall



Steel Moment Frame

- Ordinary Steel Moment Frame
- Simpson Moment Frame
- Not used in Wood buildings as possible unless necessary

Simpson Strong Frame

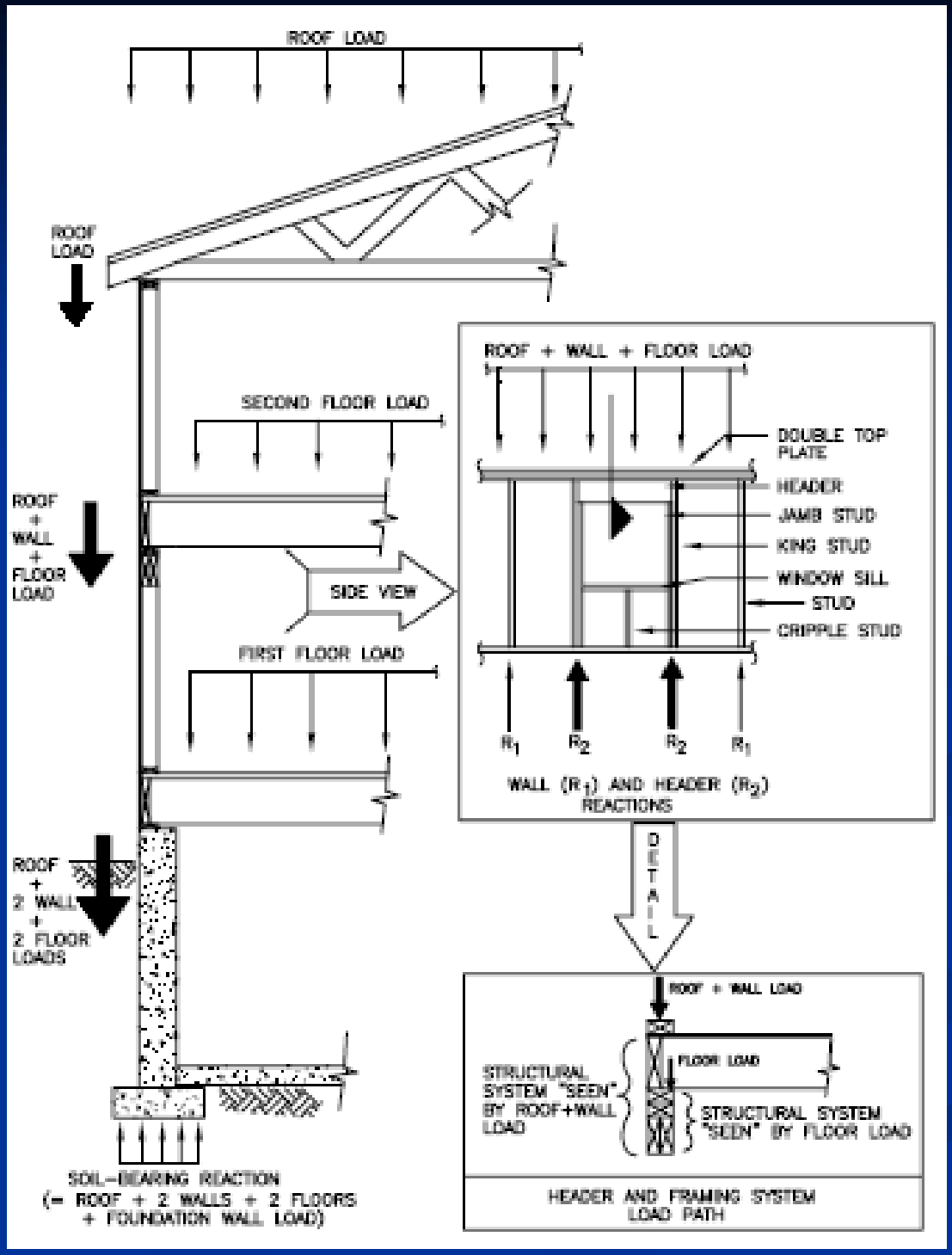


Cantilevel Column

- Wood Cantilevel Column
- Steel Cantilevel Column
- TS Tube , Pipe, etc.
- Not used in Wood Buildings as possible as necessary

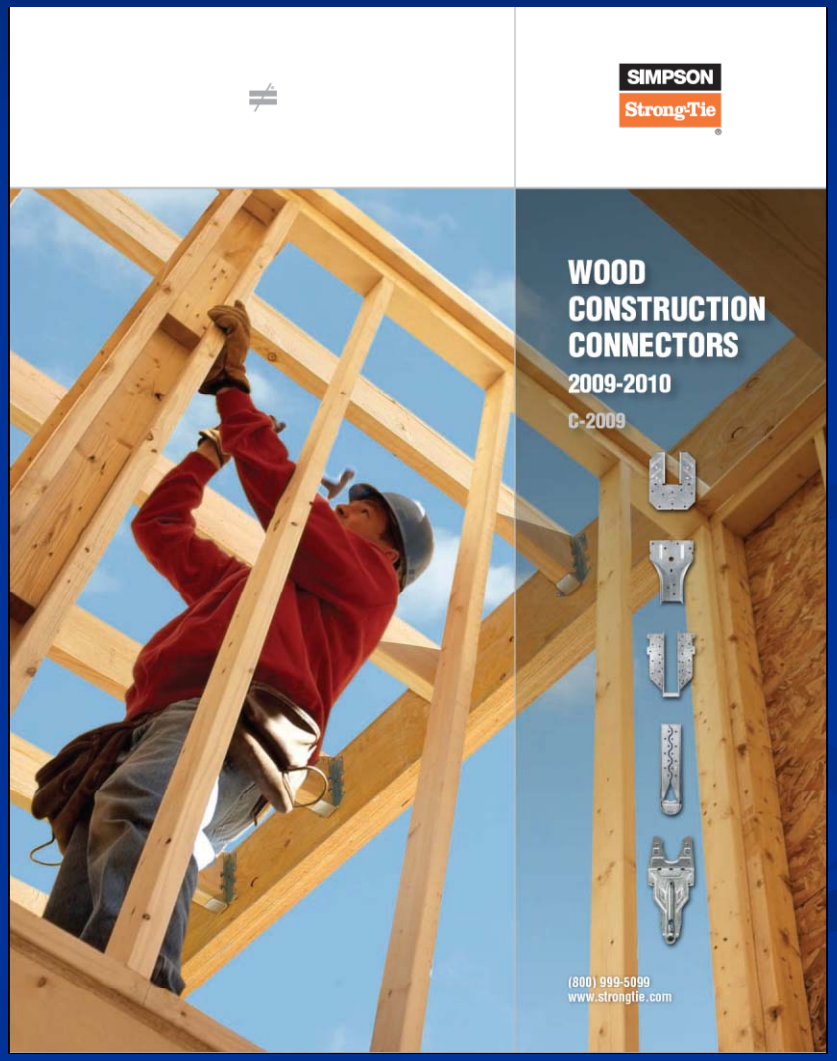
GRAVITY LOAD SYSTEM

- Gravity Loads include
  (1) Self Weight (2) Live Load (3) Snow Load
- Diaphragm & Joist
- Purlin & Kicker
- Beam & Post
- Roof & Floor Trusses
- From Top to Bottom through Continuous Load Path to Foundation to Bearing Soil Simple Mechanics


ROOF LOAD
ROOF LOAD
SECOND FLOOR LOAD
ROOF + WALL + FLOOR LOAD
SIDE VIEW
FIRST FLOOR LOAD
ROOF + 2 WALL + 2 FLOOR LOADS
SOIL-BEARING REACTION
(= ROOF + 2 WALLS + 2 FLOORS + FOUNDATION WALL LOAD)
ROOF + WALL + FLOOR LOAD
DOUBLE TOP PLATE
HEADER
JAMB STUD
KING STUD
WINDOW SILL
STUD
CRIPPLE STUD
R1 R2 R2 R1
WALL (R1) AND HEADER (R2) REACTIONS
DETAIL
ROOF + WALL LOAD
FLOOR LOAD
STRUCTURAL SYSTEM "SEEN" BY ROOF+WALL LOAD
STRUCTURAL SYSTEM "SEEN" BY FLOOR LOAD
HEADER AND FRAMING SYSTEM LOAD PATH

CONNECTORS

- Nails
- Lag Screws
- Anchor Bolts
- Hangers
- Metal Straps
- Hold-downs
- Beam to Post Seats
- Shear Transfer Clips
- Etc.



Nails

Fasteners & Quik Drive® Systems

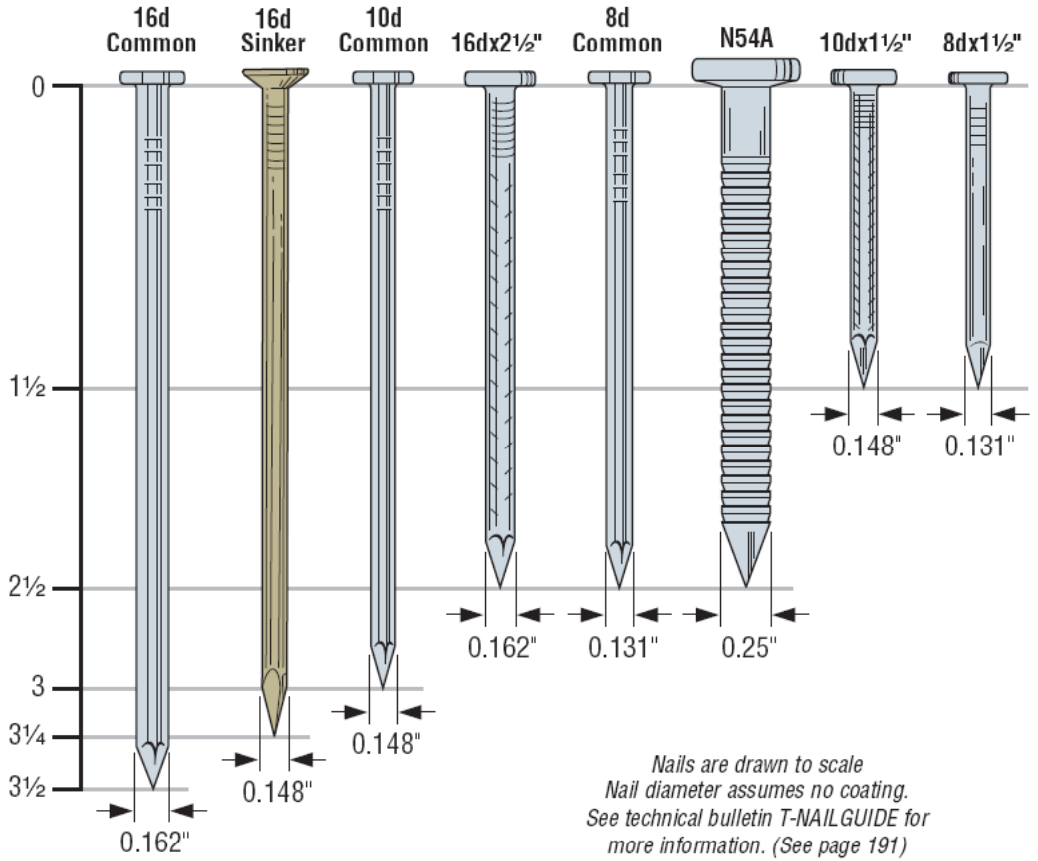
NAIL TYPES

SIMPSON Strong-Tie®

Nail Types and Sizes Specified for Simpson Strong-Tie® connectors

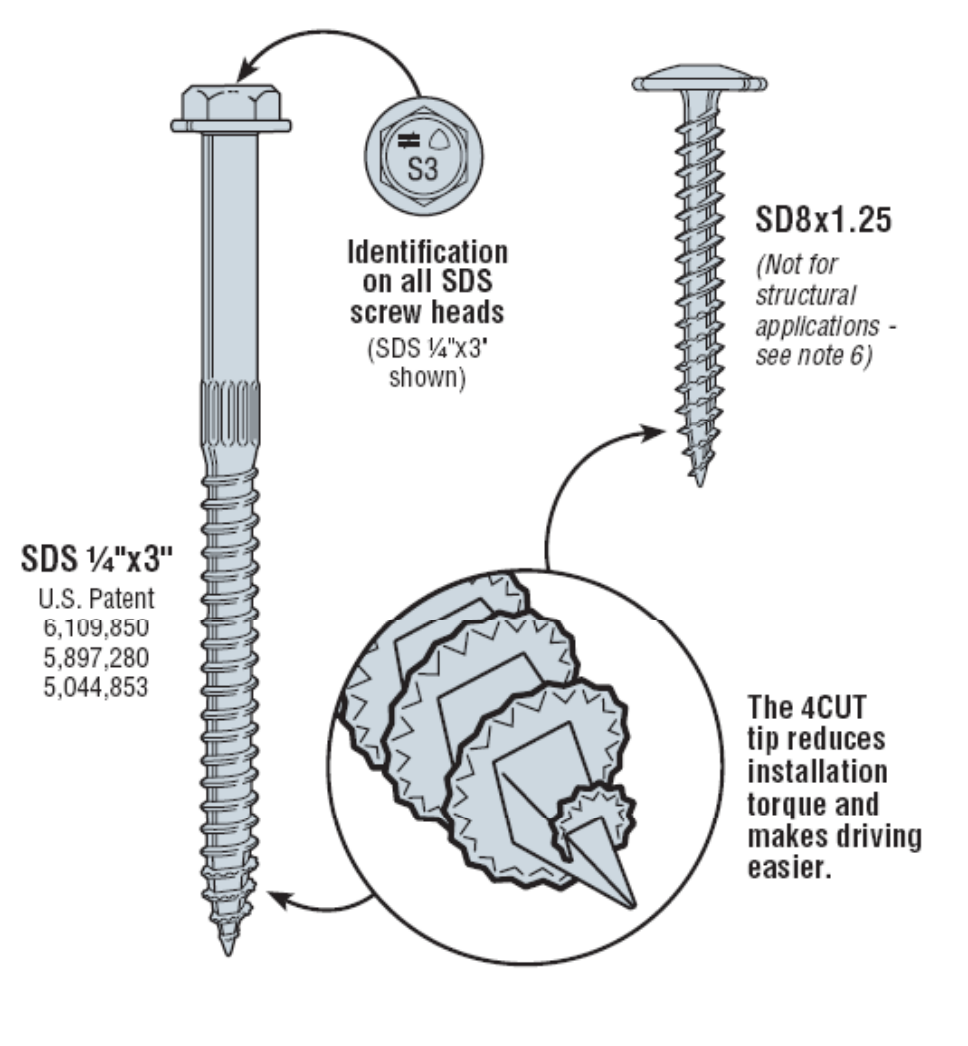
Many Simpson Strong-Tie connectors have been designed and tested for use with specific types and sizes of nails. The specified quantity, type and size of nail must be installed in the correct holes on the connector to achieve published loads. Other factors such as nail material and finish are also important. Incorrect fastener selection or installation can compromise connector performance and could lead to failure.

Simpson Strong-Tie does not offer all of these nails, see page 17 for more information.



Nails are drawn to scale
Nail diameter assumes no coating.
See technical bulletin T-NAILGUIDE for more information. (See page 191)

Lag Screws

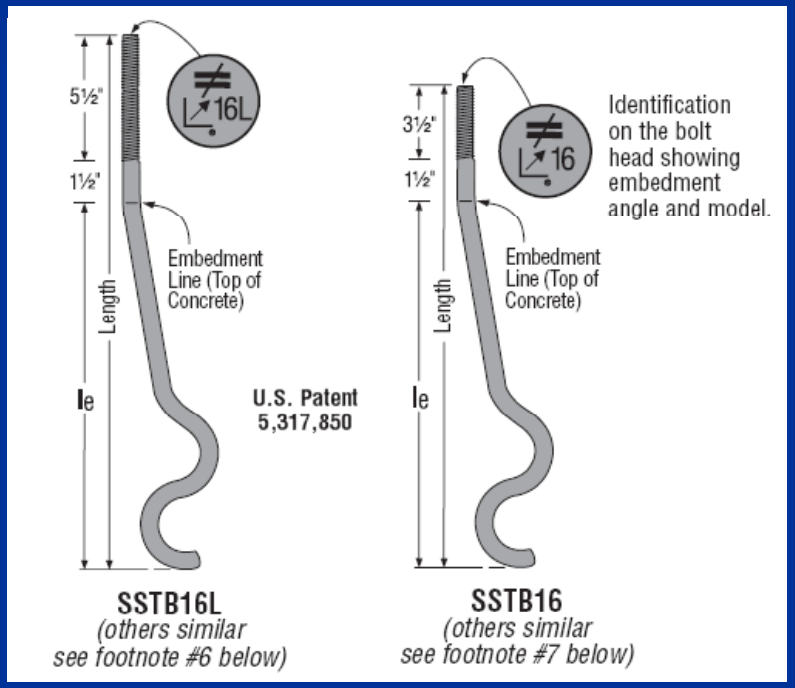

S3
Identification on all SDS screw heads
(SDS ¼"x3" shown)
SD8x1.25
(Not for structural applications - see note 6)
SDS ¼"x3"
U.S. Patent
6,109,850
5,897,280
5,044,853
The 4CUT tip reduces installation torque and makes driving easier.

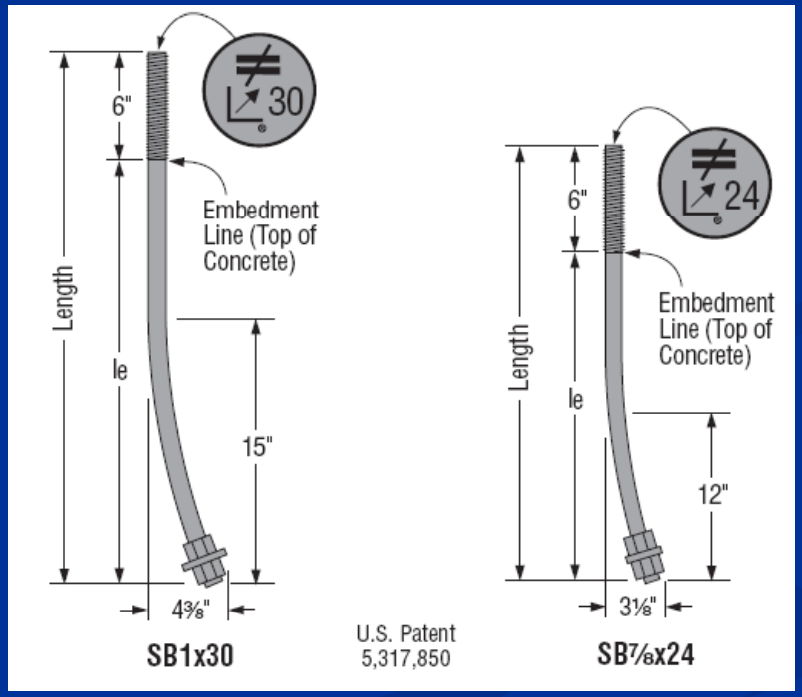
Lag Screws

SDS and SD Wood Screws

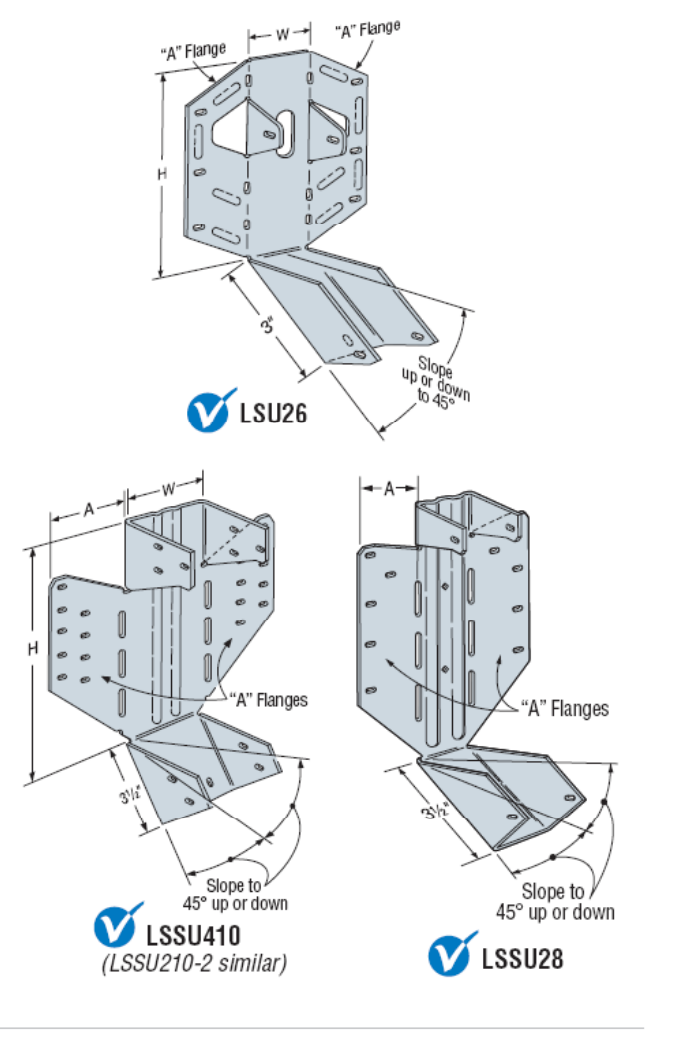
Size (in.)	Model No.	Thread Length (in.)	Fasteners per Carton[8]	DF/SP Allowable Loads[4]						SPF/HF Allowable Loads[4]						Code Ref.
				Shear (100)[1]					Withdrawal[5] (100)	Shear (100)					Withdrawal[5] (100)	
				Wood Side Plate[3]		Steel Side Plate				Wood Side Plate[3]		Steel Side Plate				
				1½"	1¾" SCL	16 ga	14 ga & 12 ga	10 ga or Greater	Wood or Steel Side Plate	1½"	1¾" SPF LVL	16 ga	14 ga & 12 ga	10 ga or Greater	Wood or Steel Side Plate	
	5/32 x 1¼	SD8x1.25[6,7]	—	—	—	—	50	50	50	—	—	—	45	45	45	—	170
	¼ x 1½	SDS25112	1	1500	—	—	250	250	250	170	—	—	180	180	180	120	I5, L17, F20
	¼ x 2	SDS25200	1¼	1300	—	—	—	290	290	215	—	—	—	210	210	150	
	¼ x 2½	SDS25212	1½	1100	190	—	—	390	420	255	135	—	—	280	300	180	
	¼ x 3	SDS25300	2	950	280	—	—	420	420	345	200	—	—	300	300	240	
	¼ x 3½	SDS25312	2¼	900	340	340	—	420	420	385	245	245	—	300	300	270	
	¼ x 4½	SDS25412	2¾	800	350	340	—	420	420	475	250	245	—	300	300	330	
	¼ x 6	SDS25600	3¼	600	350	340	—	420	420	560	250	245	—	300	300	395	

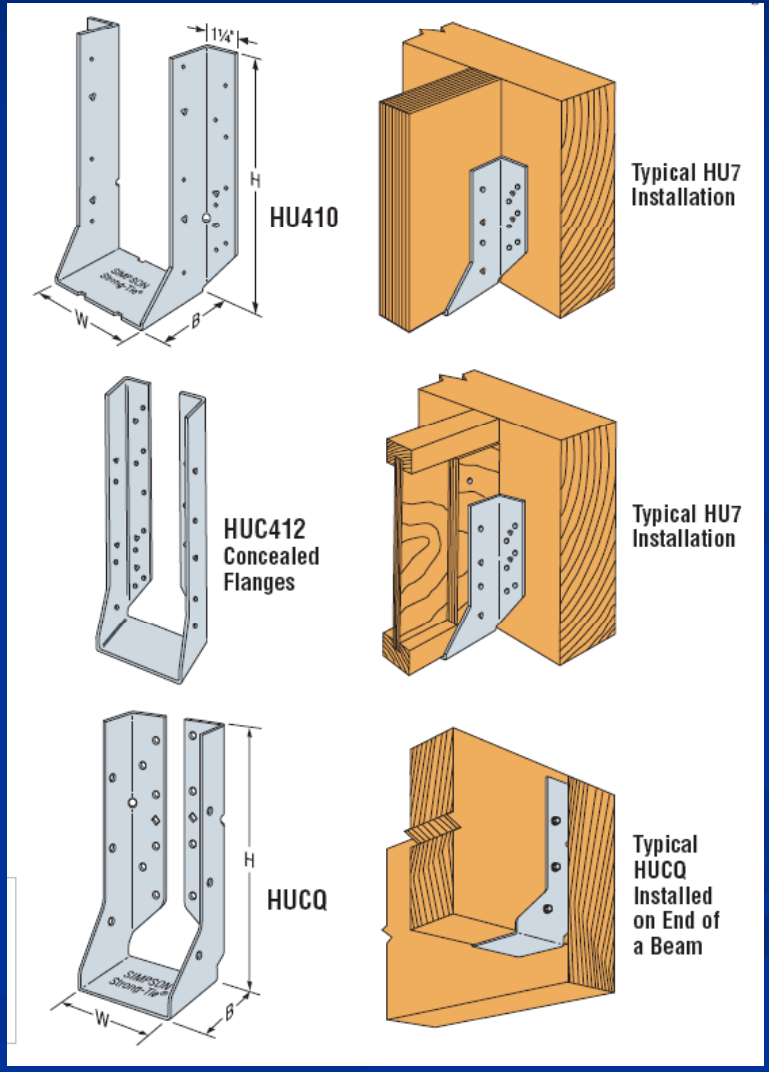
Anchor Bolts



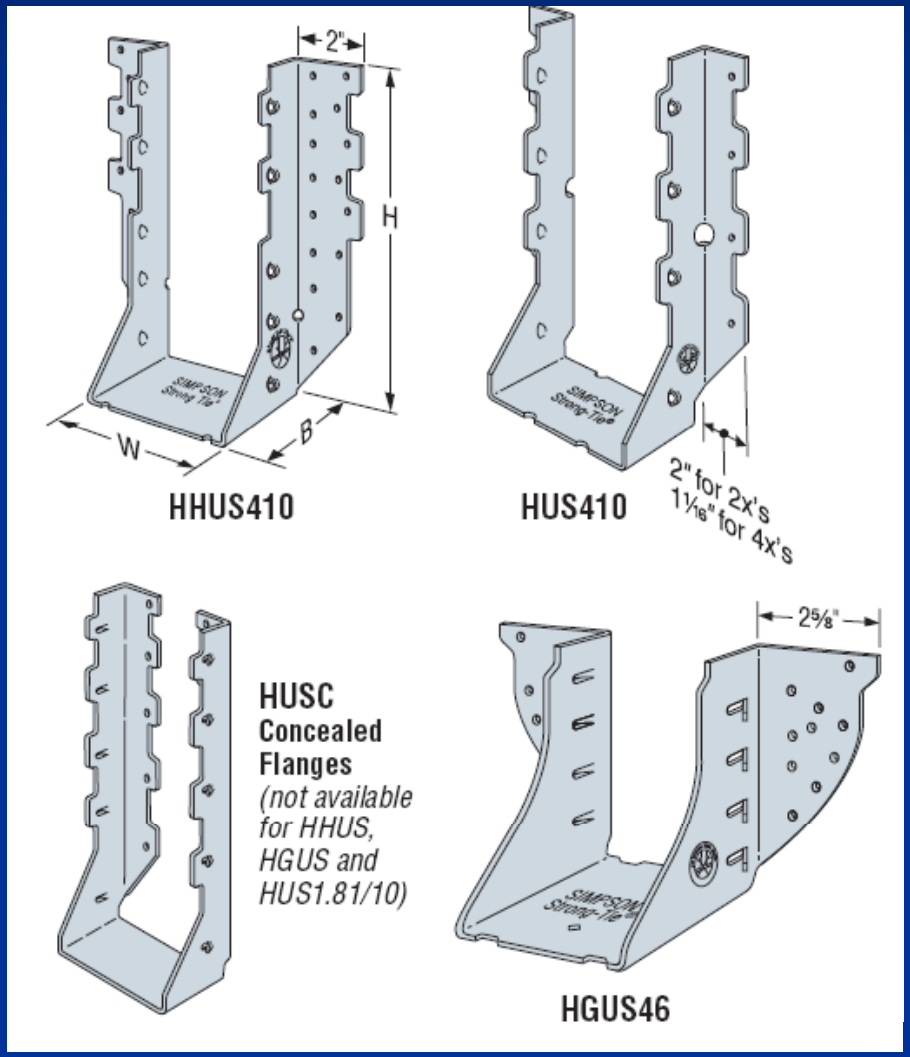


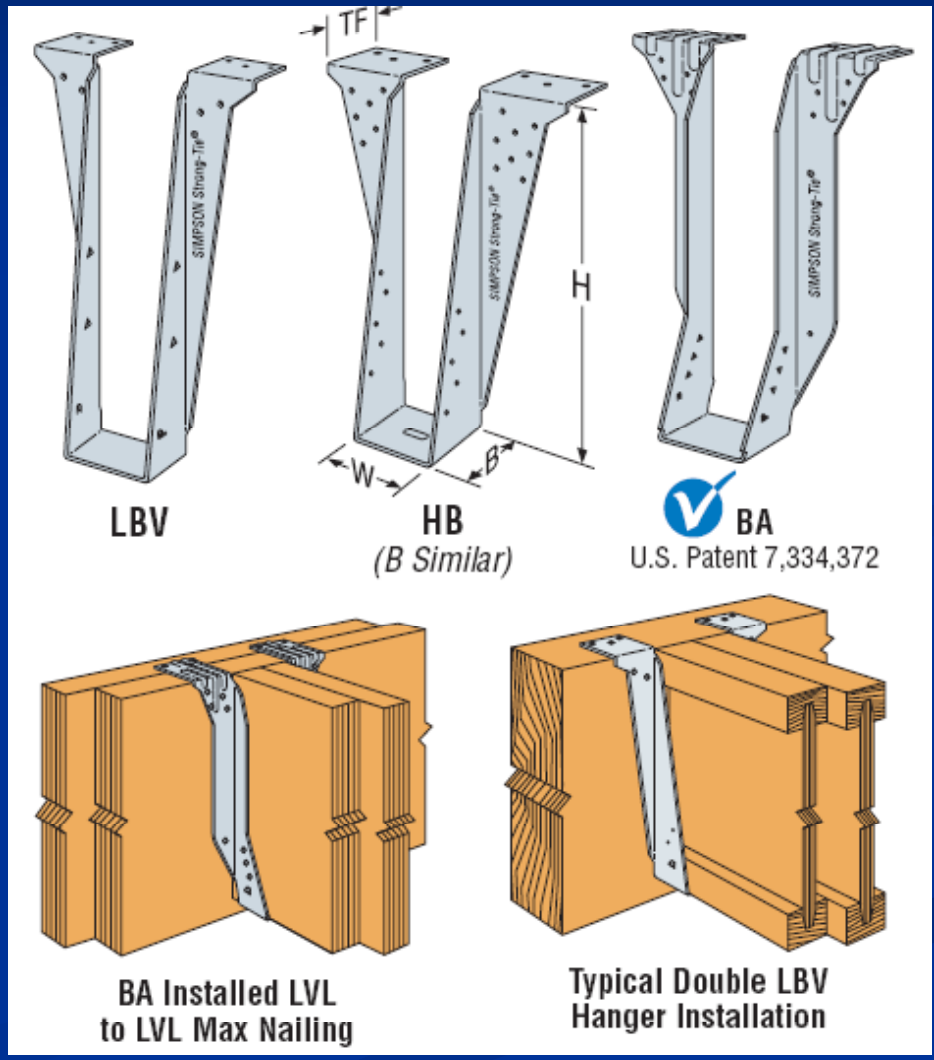
Hangers


"A" Flange
W
"A" Flange
H
3"
Slope up or down to 45°
LSU26
A
W
H
"A" Flanges
3½"
Slope to 45° up or down
LSSU410
(LSSU210-2 similar)
A
"A" Flanges
3½"
Slope to 45° up or down
LSSU28

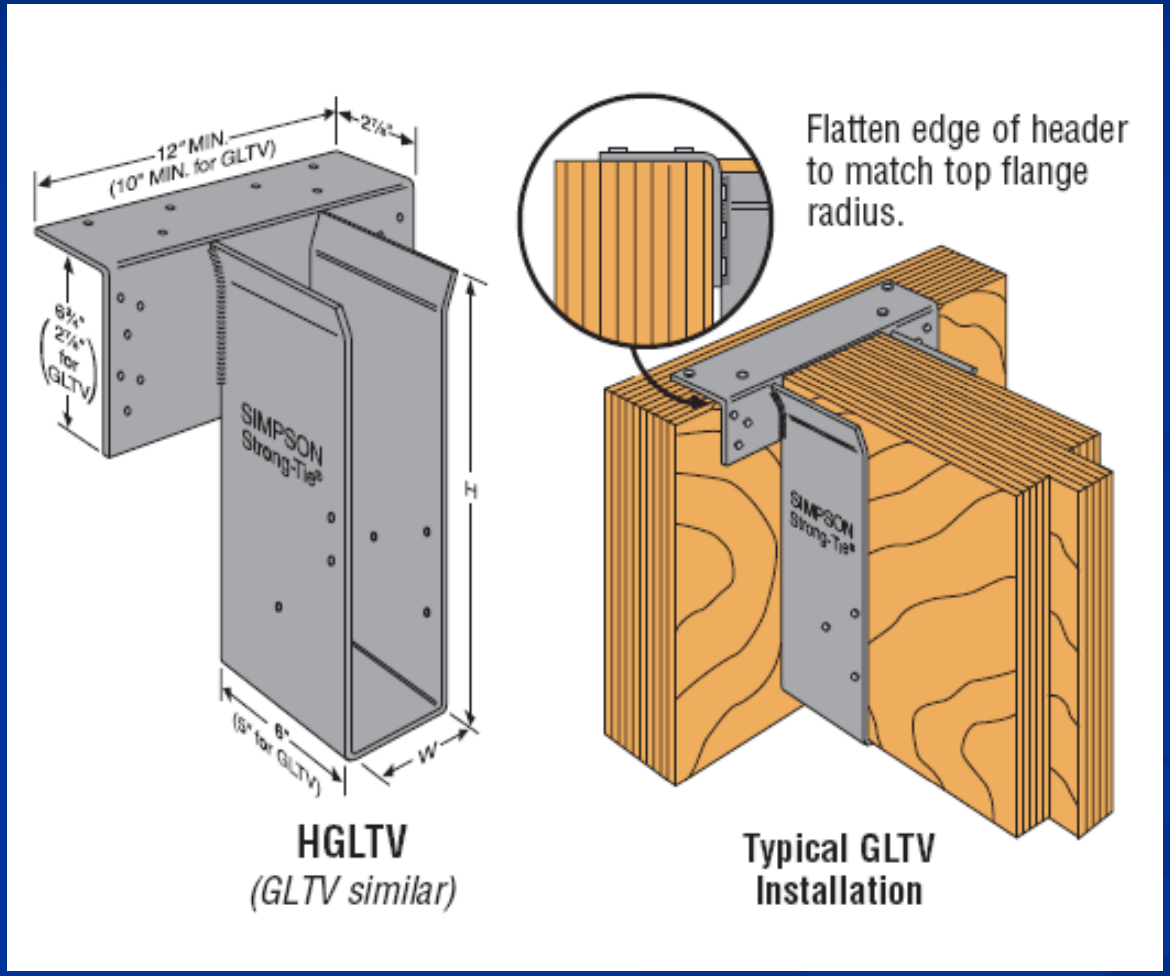

1¼"
H
W
B
HU410
Typical HU7 Installation
HUC412
Concealed Flanges
Typical HU7 Installation
H
W
B
HUCQ
Typical HUCQ Installed on End of a Beam

Hangers

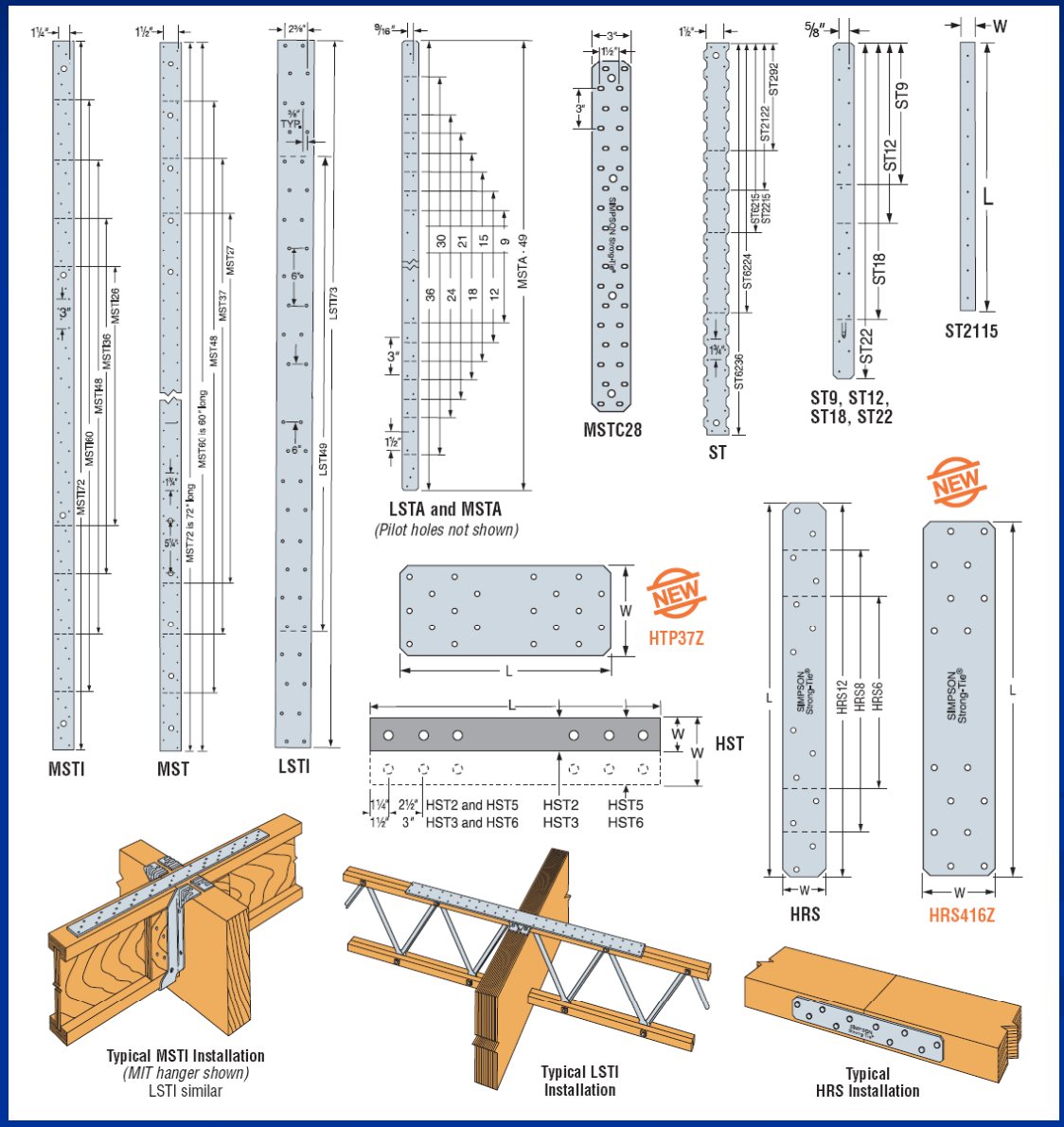

2"
H
W
B
HHUS410
HUS410
2" for 2x's
1⅛" for 4x's
HUSC
Concealed
Flanges
(not available
for HHUS,
HGUS and
HUS1.81/10)
2⅝"
HGUS46


TF
H
W
B
LBV
HB
(B Similar)
BA
U.S. Patent 7,334,372
BA Installed LVL
to LVL Max Nailing
Typical Double LBV
Hanger Installation

Hangers


12" MIN.
(10" MIN. for GLTV)
2½"
9¾"
2½" for GLTV
SIMPSON
Strong-Tie
H
6"
(5" for GLTV)
W
HGLTV
(GLTV similar)
Flatten edge of header to match top flange radius.
SIMPSON
Strong-Tie
Typical GLTV Installation

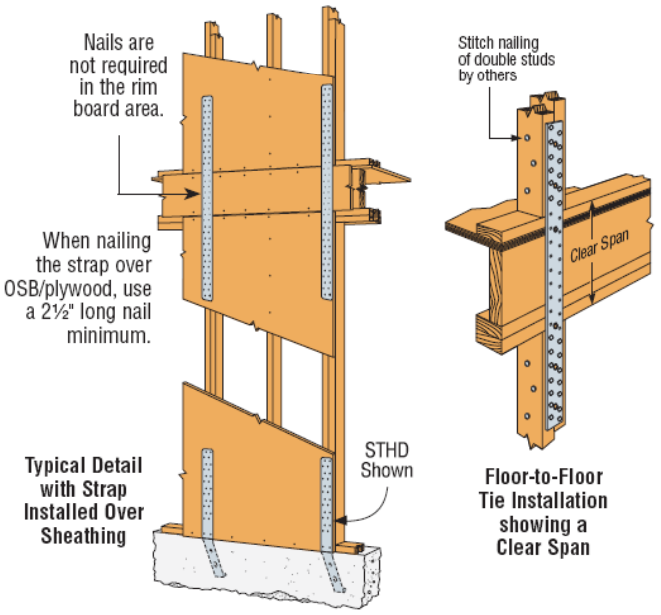
Metal Straps



Tie-Down Straps

Floor-to-Floor Clear Span Table

Model No.	Clear Span	Fasteners (Total)	Allowable Tension Loads (DF/SP)	Allowable Tension Loads (SPF/HF)
			(160)	(160)
MSTA49	18	26-10d	2020	2020
	16	26-10d	2020	2020
MSTC28	18	12-16d sinkers	1155	995
	16	16-16d sinkers	1540	1325
MSTC40	18	28-16d sinkers	2695	2320
	16	36-16d sinkers	3465	2980
MSTC52	18	44-16d sinkers	4235	3645
	16	48-16d sinkers	4620	3975
MSTC66	18	64-16d sinkers	5860	5495
	16	68-16d sinkers	5860	5840
MSTC78	18	76-16d sinkers	5860	5860
	16	76-16d sinkers	5860	5860
MST37	18	20-16d	2465	2135
	16	22-16d	2710	2345
MST48	18	32-16d	3695	3425
	16	34-16d	3695	3640
MST60	18	46-16d	4830	4830
	16	48-16d	4830	4830
MST72	18	46-16d	4830	4830
	16	48-16d	4830	4830



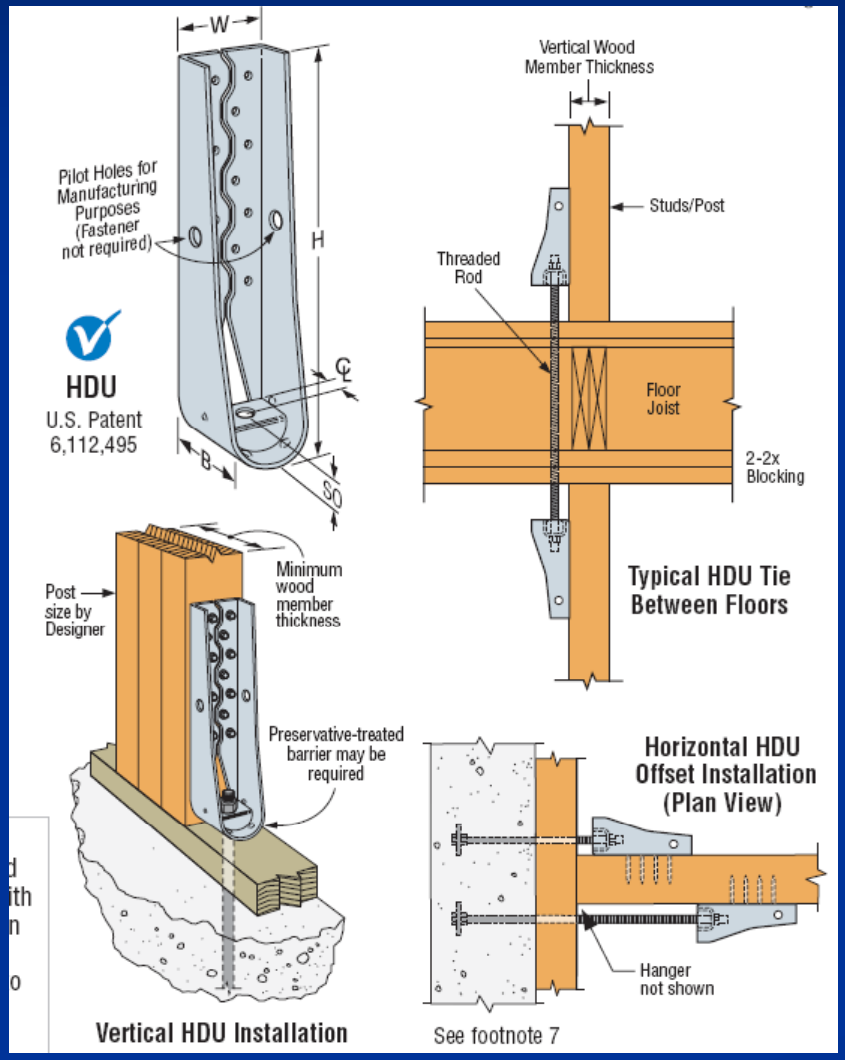
CODES: See page 12 for Code Reference Key Chart.

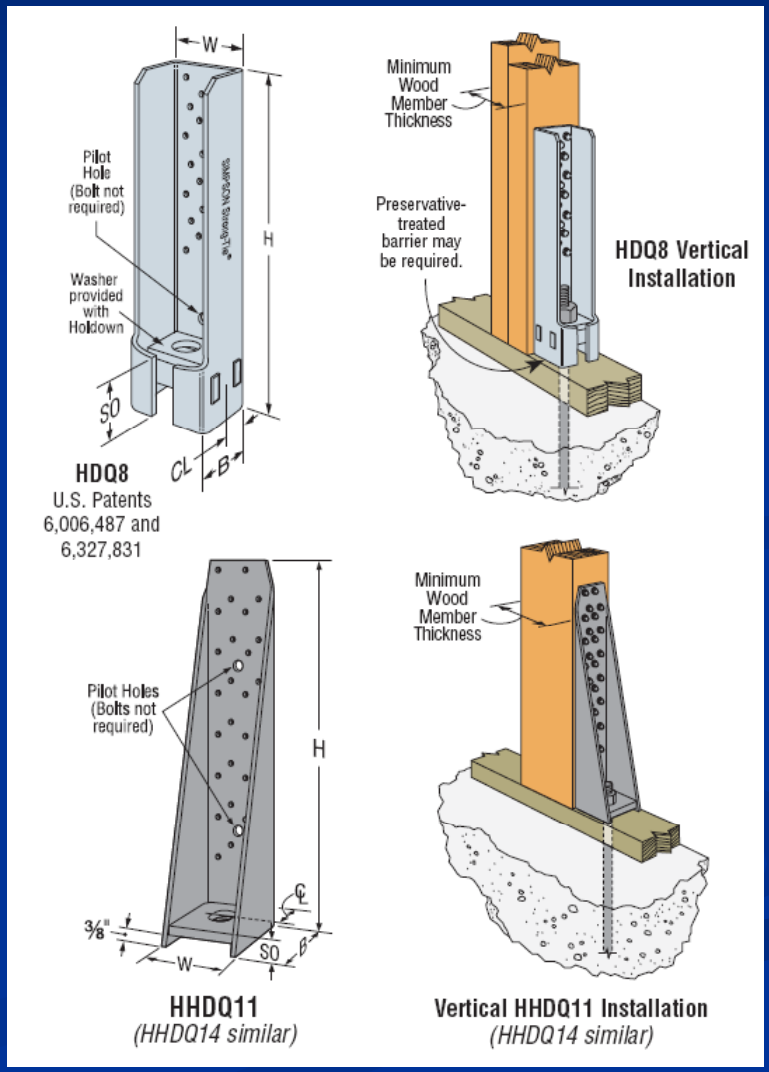
These products are available with additional corrosion protection. Additional products on this page may also be available with this option, check with Simpson Strong-Tie for details.

Model No.	Ga	Dimensions		Fasteners (Total)			Allowable Tension Loads (DF/SP)		Allowable Tension Loads (SPF/HF)		Code Ref.
		W	L	Nails	Bolts		Nails	Bolts	Nails	Bolts	
					Qty	Dia	(160)	(160)	(160)	(160)	
MST27	12	2⅛	27	30-16d	4	½	3700	2165	3200	2000	I4, L19, F2
MST37		2⅛	37½	42-16d	6	½	5080	3025	4480	2805	
MST48		2⅛	48	50-16d	8	½	5310	3675	5190	3410	
MST60	10	2⅛	60	68-16d	10	½	6730	4485	6475	4175	
MST72		2⅛	72	68-16d	10	½	6730	4485	6475	4175	
HST2	7	2½	21¼	—	6	⅝	—	5220	—	4835	
HST5		5	21¼	—	12	⅝	—	10650	—	9870	
HST3	3	3	25½	—	6	¾	—	7680	—	6660	
HST6		6	25½	—	12	¾	—	15470	—	13320	

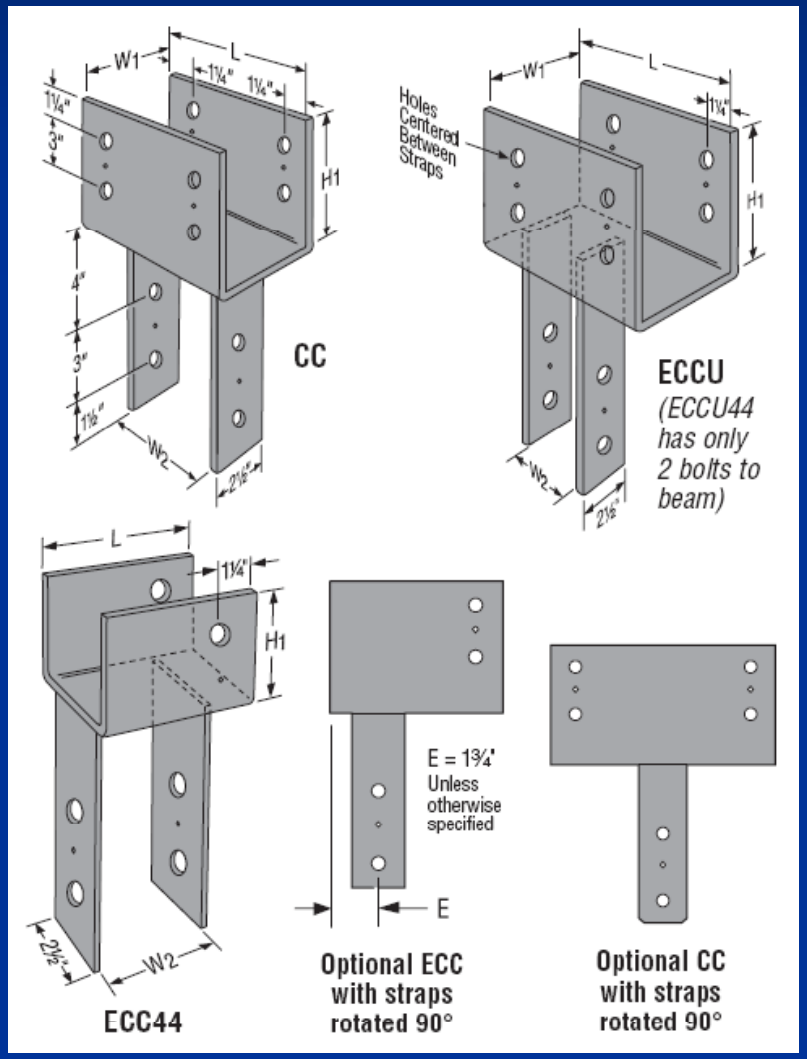
1. Loads include a 60% load duration increase on the fasteners for wind or earthquake loading.
2. 10d commons may be substituted where 16d sinkers are specified at 100% of the table loads.
3. 16d sinkers (0.148" dia. x 3¼" long) or 10d commons may be substituted where 16d commons are specified at 0.84 of the table loads.
4. Allowable bolt loads are based on parallel-to-grain loading and these minimum member thicknesses: MST–2½"; HST2 and HST5–4"; HST3 and HST6–4½".
5. Use half of the required nails in each member being connected to achieve the listed loads.
6. Straps not installed over sheathing with 10d (0.148 dia. x 3) nails specified may be substituted with 10dx1½ (0.148 dia. x 1½) with no reduction in load.
7. Tension loads apply for uplift as well when installed vertically.
8. **NAILS:** 16d = 0.162" dia. x 3½" long, 16d Sinker = 0.148" dia. x 3¼" long, 10dx1½ = 0.148" dia. x 1½" long. See page 16-17 for other nail sizes and information.

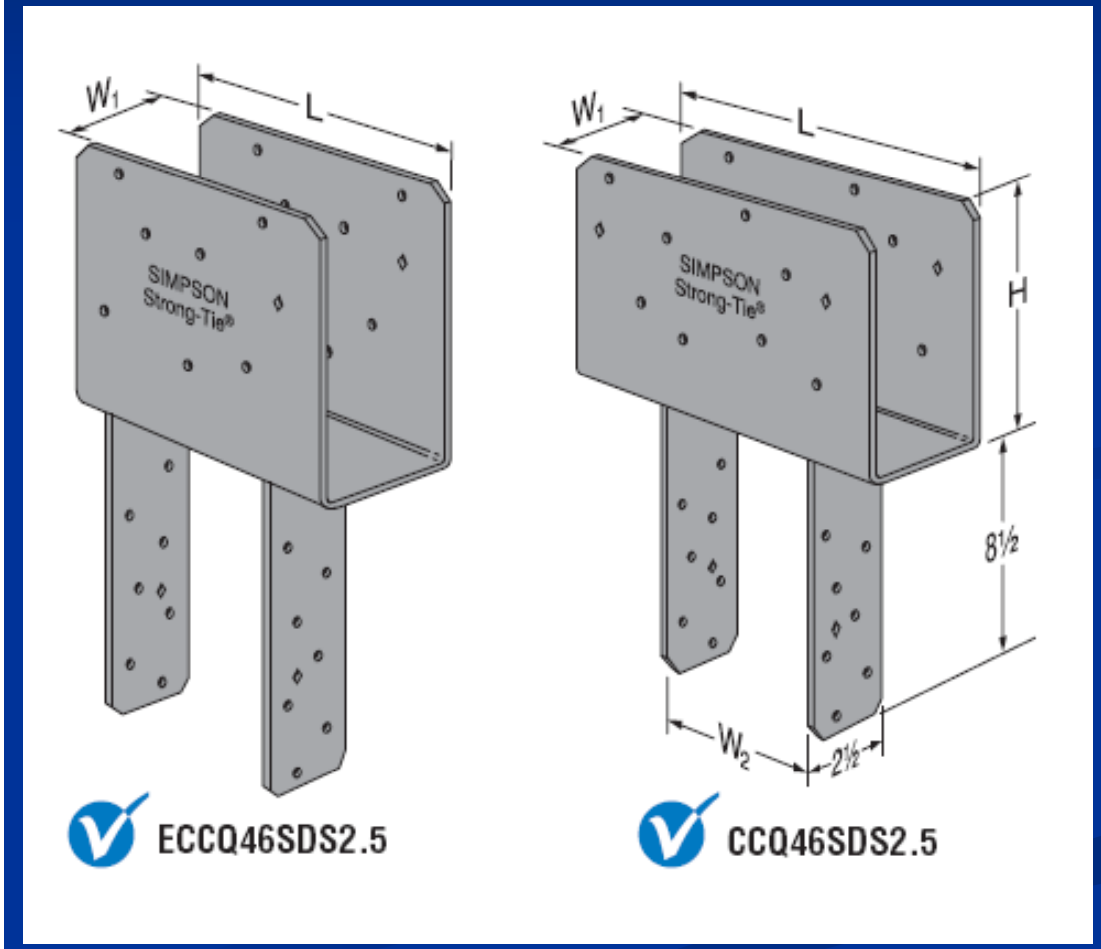
Hold-Downs


W
H
Pilot Holes for Manufacturing Purposes (Fastener not required)
HDU
U.S. Patent 6,112,495
B
SO
Vertical Wood Member Thickness
Studs/Post
Threaded Rod
Floor Joist
2-2x Blocking
Typical HDU Tie Between Floors
Post size by Designer
Minimum wood member thickness
Preservative-treated barrier may be required
Vertical HDU Installation
Horizontal HDU Offset Installation (Plan View)
Hanger not shown
See footnote 7

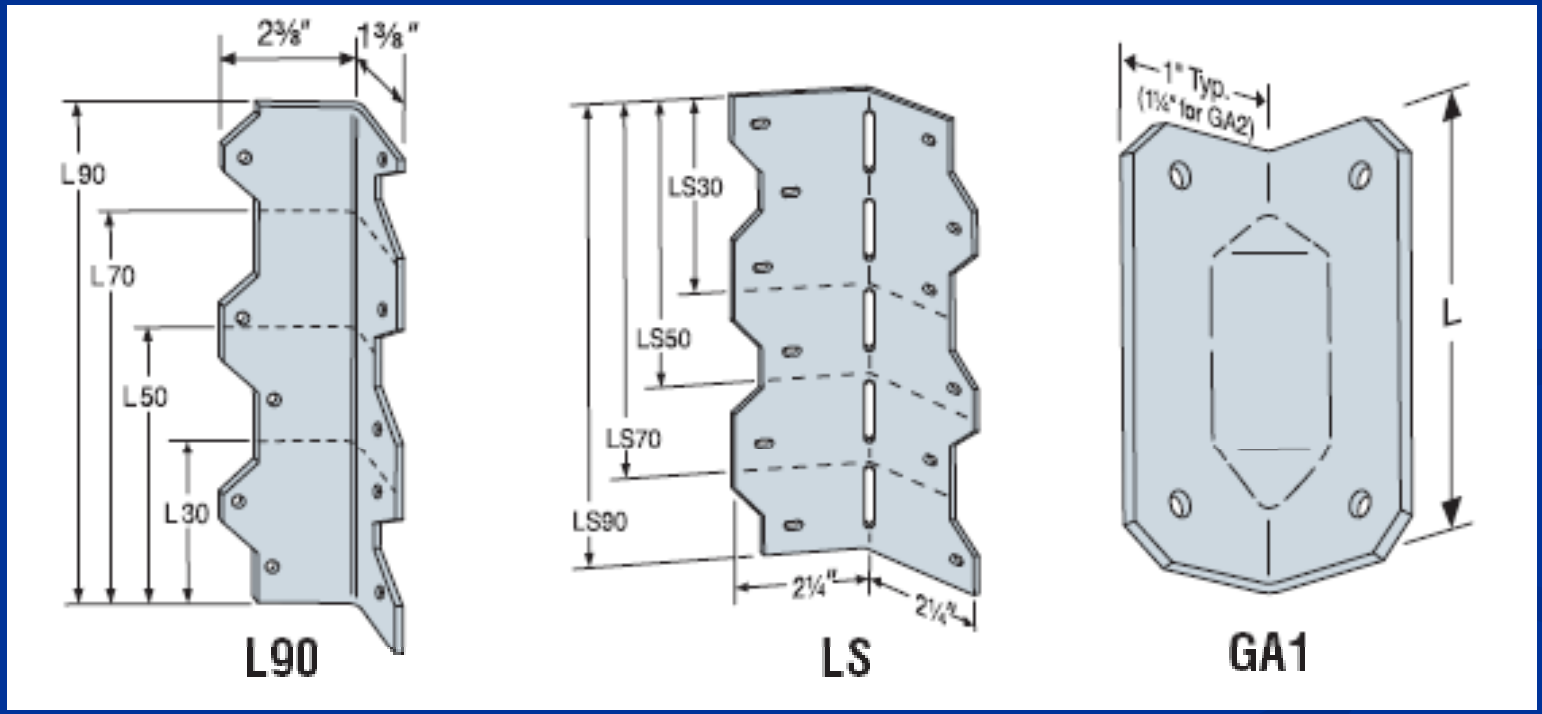

W
H
Pilot Hole (Bolt not required)
Washer provided with Holdown
SO
CL
B
HDQ8
U.S. Patents 6,006,487 and 6,327,831
Minimum Wood Member Thickness
Preservative-treated barrier may be required.
HDQ8 Vertical Installation
Pilot Holes (Bolts not required)
3/8"
W
HHDQ11
(HHDQ14 similar)
Minimum Wood Member Thickness
Vertical HHDQ11 Installation
(HHDQ14 similar)

Beam To Post Seats

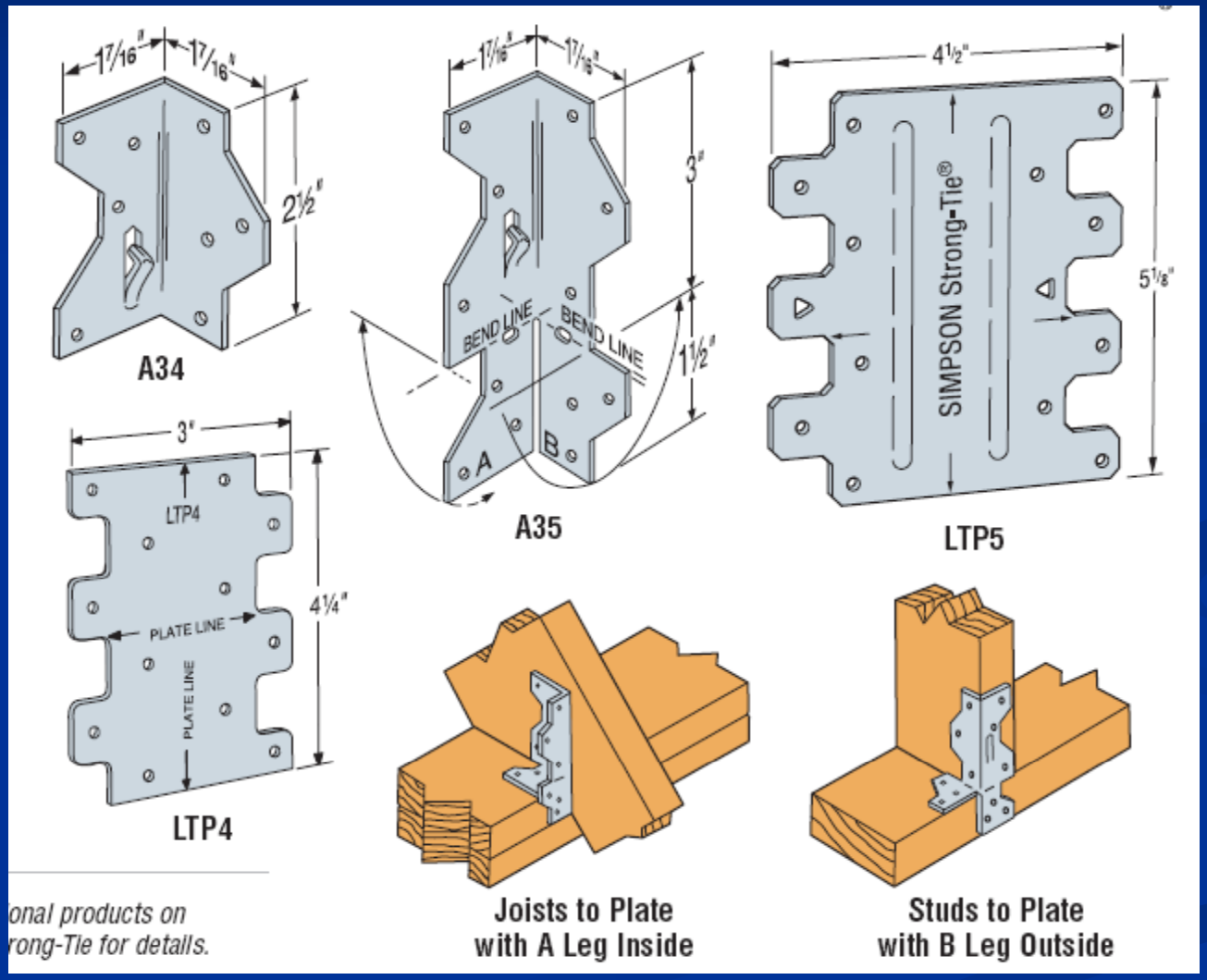




Shear Transfer Clips



Shear Transfer Clips



PRINCIPLES OF STRUCTURAL DESIGN IN WOOD

- Keep Simple, Symmetry, Uniform, Proportion, Module
- Watch out elevation difference vertically and horizontally for load path continuity
- Avoid big beam as possible unless necessary
- Avoid use Steel Beam
- Use nails and/or lag screws in stead of bolts as possible
- Consider construction & architectural aspects

WOOD DESIGN IN REAL LIFE

- Review the architectural drawings, civil drawings, and soil report
- Establish vertical and lateral loadings
- Layout the structural framing for vertical load
- Layout the lateral load resisting system
- Layout the foundation system
- Perform calculations and design
- Modify and revise and repeat as necessary

Real Design Case

- New Two Story Single Family Residence with Basement
- Location: Cupertino, California, USA
- Lot Condition: Empty lot with moderate hill slop

RESEARCH TOPICS

- New lateral force resisting elements
- New modular construction and material
- New analysis and design approach
- Innovative connection
- The application of Bamboo in Wood

  Structural Panel by Bamboo

  Stud & Beam by Bamboo

Any more???

Bored??
Interested??
Need help??

- Chia-Ching Lin (林家慶)

  (510)6230681

  cclin_510@yahoo.com

  cclin510@gmail.com