UPDATED TO THE CURRENT INTERNATIONAL AND UNIFORM CODES

CODE CHECK® BUILDING

A Field Guide to the Building Codes

PUT HUNDREDS OF CODE FACTS AT YOUR FINGERTIPS WITH CODE CHECK BUILDING

- ☑ Accurate and up to date
- ☑ Helps avoid costly mistakes
- ☑ Easy and fast to use

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CODE CHECK® Building

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Code Check Building is a condensed guide to commonly cited code violations in the construction of one- and two-family dwellings. Building codes and code-authoring organizations throughout the country are undergoing major transformations. The purpose of the book is to emphasize the life safety principles at the heart of these building codes. To be sure of compliance in your area, we recommend consulting your building department early and often during the course of a construction project. Code Check is limited to conventional construction, and in many projects it is necessary to use engineering provisions of other codes that are beyond the scope of this book or of the IRC.

Table 1 • Codes & Standards Referenced in Code Check Building

Organization	Code	
ACI	ACI 318	Code Requirements for Structural Concrete
IAPMO	UMC 2000	Uniform Mechanical Code
IAPMO	UPC 2000	Uniform Plumbing Code
ICBO	UBC 1997	Uniform Building Code
ICC	IECC 2000	International Energy Conservation Code
ICC	IRC 2003	International Residential Code
ICC	IBC 2000	International Building Code
NFPA	NEC 2002	National Electrical Code
SBCCI	SSTD 10-99	Hurricane Resistant Residential Construction
TPI	HIB-91	Handling, Installing & Bracing Trusses

Model Codes & Organizations

ACI = American Concrete Institute
BOCA = Building Officials & Code Administrators International
IAPMO = International Association of Plumbing and Mechanical Officials
ICBO = International Conference of Building Officials
ICC = International Code Council
NFPA = National Fire Protection Association
SBCCI = Southern Building Code Congress International
TPI = Truss Plate Institute

Beginning in January 2003, the three formerly regional code-authoring organizations (BOCA, ICBO, and SBCCI) merged into the ICC. They publish a suite of codes covering building, plumbing, mechanical, energy, fire, fuel gas, and the International Residential Code (IRC), which is the basic reference document for Code Check Building. The NFPA publishes hundreds of codes and guides to recommended practices, including the electrical code, life safety code, and fire prevention code. They recently produced their first building code, NFPA 5000. Some states have adopted one or more of these codes, while others are still using the codes that were in effect before the transformation of these organizations. As of this writing, Florida is using an amended version of SBCCI's Standard Building Code. We have included references for the 1997 Uniform Building Code (UBC) because that code is the basis of California's code until at least 2006, and the UBC is therefore the second most widely adopted code at this time. Other codes are mentioned in various sections of Code Check Building.

Key

[Straight-bracketed information refers to the 2003 IRC]
{Squiggle-bracketed information refers to the 1997 UBC}
[403.1] {...} The left straight-bracket number refers to the IRC code number
[...] {1806.1} The right squiggle-bracket number refers to the UBC code number
Example:
☐ 6in block OK for one story to 9ft . . . . . .[606.2.1] {2109.6.1}
The rule above is found in section 606.2.1 of the 2003 IRC and section 2109.6.1 of the 1997 UBC.
Codes ending in numbers separated by commas refer to multiple code sections-example: {1507.5,6} refers to {1507.5} & {1507.6}
Other abbreviations in code references:
T-xx refers to Code Check Building tables
F-xx refers to Code Check Building figures
[local] = not code though commonly a local amendment
A superscript E ($XXX.X^{E}$) after a code citation refers to the 2002 NEC
A superscript M ($XXX.X^{M}$) after a code citation refers to the 2000 UMC
A superscript P ($XXX.X^{P}$) after a code citation refers to the 2000 UPC
A superscript EC ($XXX.X^{EC}$) after a code citation refers to the 2000 IECC
A superscript B ($XXX.X^{B}$) after a code citation refers to the 2000 IBC
EXC means the following line contains an exception to the cited rule

Abbreviations

AG = Appendix G of the IRC
ASTM = American Society for Testing and Materials
alum = aluminum
appl = appliance
bldg = building
BO = building official
CMU = concrete masonry units
dia = diameter
dist = distance
emrgy = emergency
eng = engineered
eqpmt = equipment
exc = except
EXC = exception to rule will follow in next line
ext = exterior
exten = extension
fndn = foundation
ft = feet
galv = galvanized
GL = glue-laminated timber
gyp = gypsum
horiz = horizontal
hr = hour, hours
in = inches
LVL = laminated veneer lumber
manu = manufacturer's requirement
max = maximum
mech = mechanical
min = minimum
No. = number
o.c. = on center
perp = perpendicular
PL = property line
PT = pressure treated
psf = pounds per square foot
psi = pounds per square inch
req = require
req'd = required
reqs = requires
SDC = Seismic Design Category
specs = specifications
SZ = Seismic Zone
TJI® = manufactured I-joists (TJI® is a trademark of Trus Joist™, a Weyerhaeuser business)
vert = vertical
w/ = with
w/o = without

The Building System

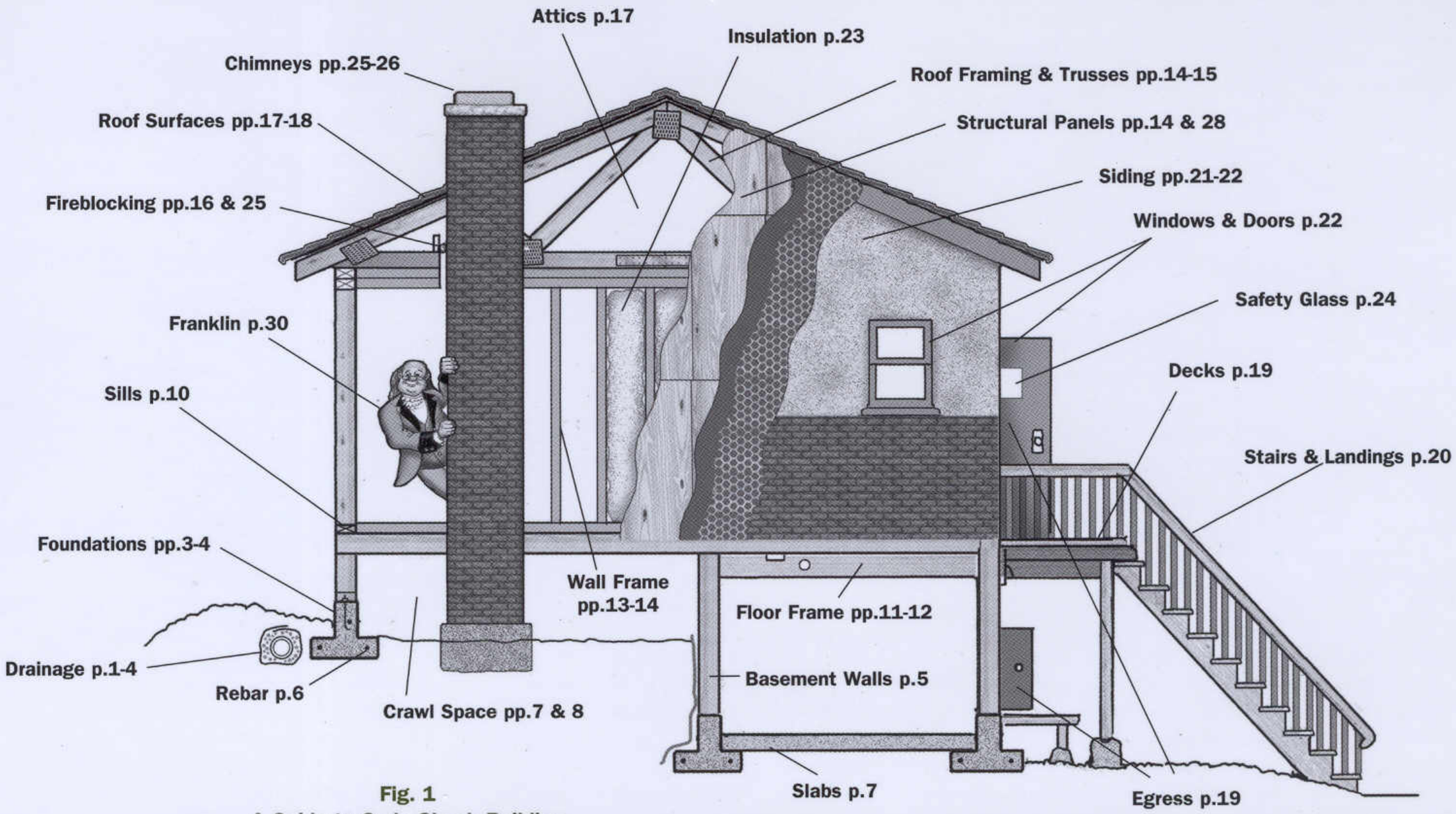


Fig. 1
A Guide to Code Check Building

Planning, Site & Grading

A safe building requires proper planning and construction details that respond to local environmental conditions. Depending on what part of the country the building is located, it may be necessary to consider snow loads, wind, earthquakes, flooding, or other factors. The IRC includes a map showing the Seismic Design Category of each part of the country, with areas broken down into Category A (least prone to seismic activity), B, C, D1, D2, and E. The maps presume an IBC Class D soil type, and if the soils are different the category could change. A design in accordance with the IBC is needed for Category E, or the building official can allow a reclassification to Category D2 for regular-shaped buildings with continuous shear walls and with no cantilevers. Information on these issues is usually available from the local building department. The building must comply with local zoning, setback, and daylight plane requirements. The next step is site preparation to assure a competent foundation. The soil is part of the foundation and must be firm to support the building. Final grading must slope away from the building or other drainage control must be used to prevent water intrusion and damage.

Planning	IRC	UBC
☐ IBC specs an acceptable alternative	[301.1.3]	{local}
☐ Determine climatic and geographic design criteria	[301.2]	{1804.1}
☐ Determine seismic design category {seismic zone}	[301.2.2.1]	{1610}
☐ Consider wind limitations in building design	[301.2.1]	{1605.2.2}
☐ Consider snow loads in building design	[301.2]	{1608}
☐ Are special inspection reports req'd? (p. 29)	T22 [109.1.5]	{106.3.5}
☐ Are tests needed to determine expansive soils?	[401.4]	{1804.4}

General Requirements		
☐ Permits req'd EXC: fences <6ft, retaining walls<4ft, sheds <200sq ft, painting	[105.2]	{106.2}
☐ Approved plans and permit card on site	[106.3.1]	{106.4.2}
☐ Non-conventional aspects of building per accepted engineering practice	[301.1.3]	{2320.2}
☐ Verify setbacks—unrated walls min 3ft to PL	[302.1]	{T-5-A}
☐ Walls <3ft of PL req 1hr rating & no openings EXC	[302.2]	{T-5-A}
fndn vents OK & openings in walls perp to PL OK	[302.2X]	{Ø}
☐ Inspection and approval prior to covering any work	[109.1]	{108.1}
☐ Utility trench may not undermine footing	F6 [2604.4]	{313.3[P]}

Fig. 2
Graded Site Drainage

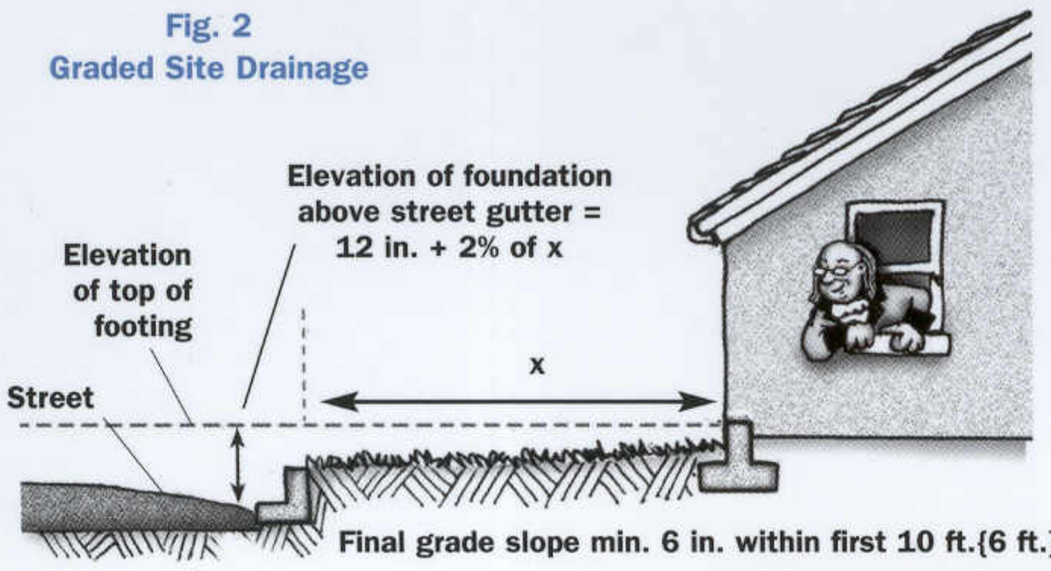
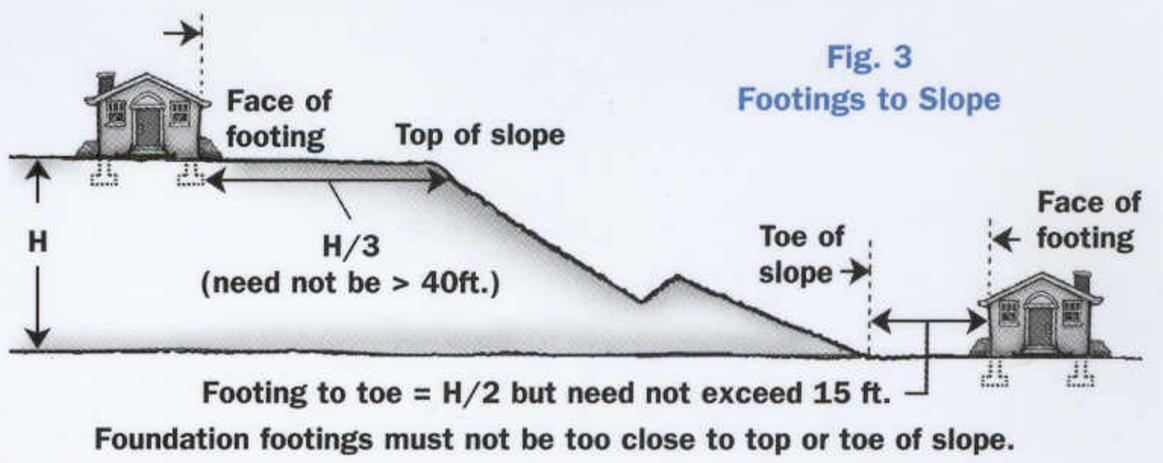
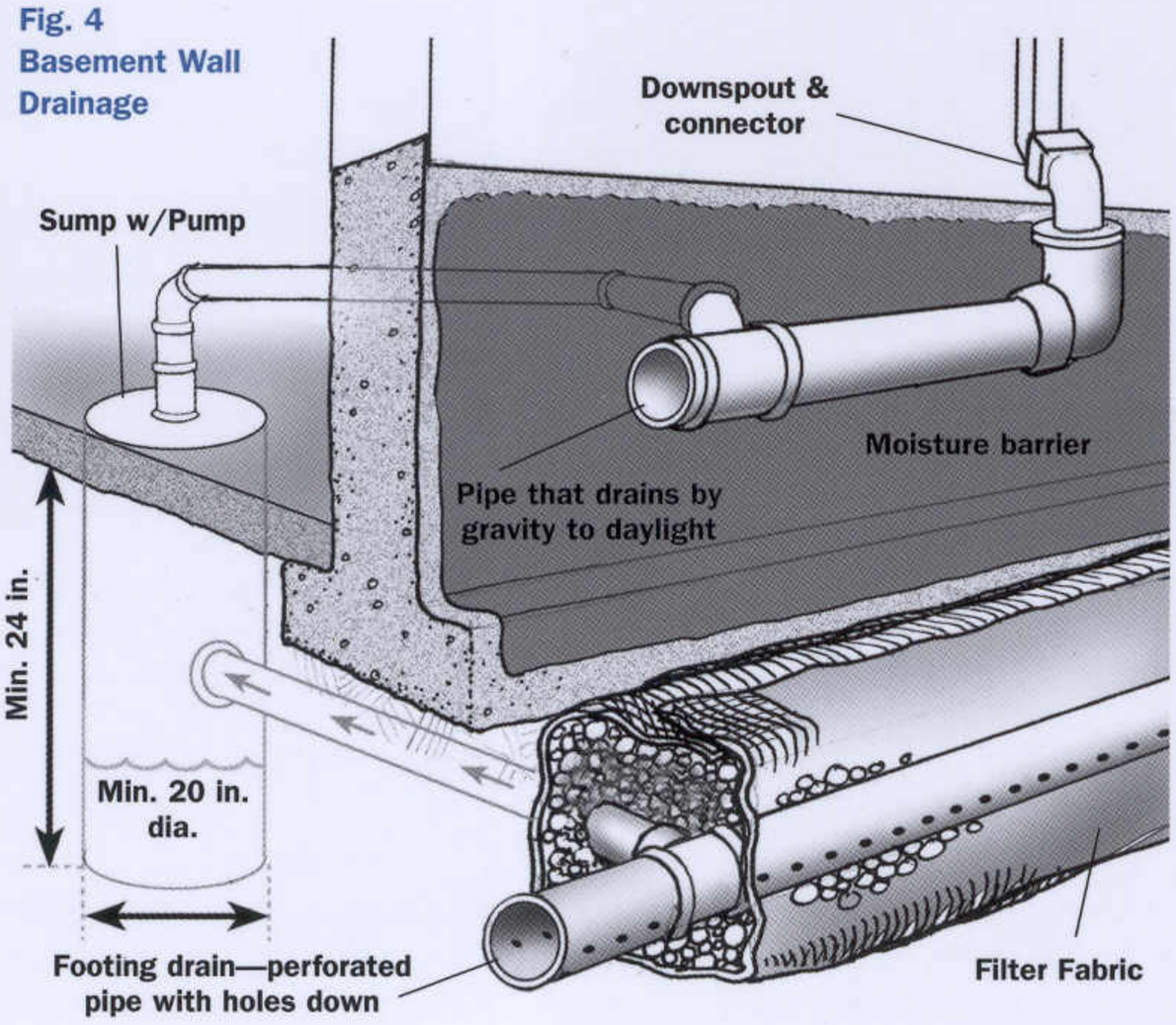


Fig. 3
Footings to Slope



Slope/Grade	IRC	UBC
☐ Surface graded away from fndn min 6in/10ft {6ft}	F2[401.3]	{1838.2}
☐ Setbacks & clearances to slopes >1 vert: 3 horiz	F3 [403.1.7]	{1806.5.2}
☐ Lot slope >1:10—footing stepped or level	[403.1.5]	{1806.4}
☐ Graded site—top of fndn min 12in+2% above street drain	F2 [403.1.7.3]	{1806.5.5}

Fig. 4
Basement Wall Drainage



Footing drain discharges by gravity to daylight OR to sump pump.

Fig. 5
Retaining Wall

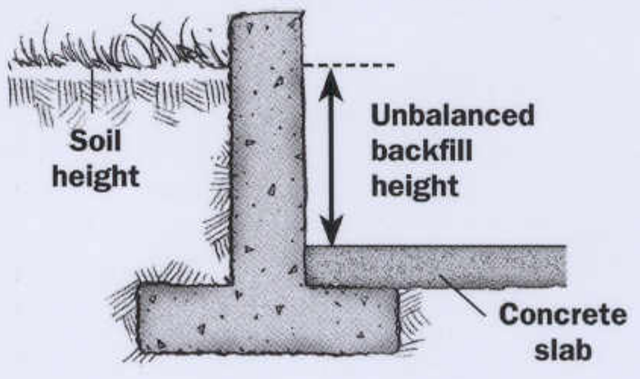
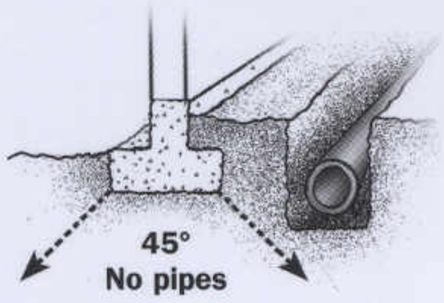


Fig. 6
Pipes near Footings



Drainage & Retaining Walls

Retaining walls may support soil only, or soil and a building, such as a basement wall. These are often called restrained walls. The IRC only addresses those retaining walls that are part of a basement. Other retaining walls on the site should be designed in accord with the IBC or other applicable local building code.

☐ Unrestrained walls supporting >4ft of backfill OR walls subject to hydrostatic pressure req design	F5 [404.1.3]	{106.2}
☐ Surcharge within >45° must be engineered	[105.2, 404.1.3]	{1804.6}
☐ Enclosing habitable or usable space—reqs moisture barrier	[406.1]	{1831}
☐ Foundations retaining earth and enclosing usable space req footing drains discharging to approved drain system	F4 [405.1]	{1834.1}
☐ Backfill free of organic material or large rocks	[local]	{1838.1}
☐ Install backfill in lifts and compact fill w/o damaging dampproofing	[local]	{1838.1}
☐ Do not install backfill ≥ 4ft until walls anchored to floor	[404.1.7]	{1838.1}
☐ Basement sump req'd if other than group 1 soils*	[405.2.3]	{1834.4}

* Group 1 soils include gravels, sands, and gravel-sand mixtures with good drainage characteristics and low-to-medium frost heave potential. Clay soils are not included in group 1. Foundations enclosing useable space and basements require drain systems such as F4 and F8.

Footings & Foundations

The stability of a house depends upon a foundation footing keyed into stable soil. In general, footings should be poured at least one foot deep into previously undisturbed soil, or soil that has been consolidated per specifications of a soils engineer. The footing must also extend at least one foot below the frost line. The footing must be large enough to bear the weight of the building (dead load) as well as the environmental and live loads. Most foundations are made of concrete (plain or reinforced) or concrete masonry units (CMU's). Each major building code has minimum footing width and depth requirements. As with many foundation issues, these codes also refer to the standards of the American Concrete Institute. Many portions of ACI 318 are adopted by specific references in the IRC.

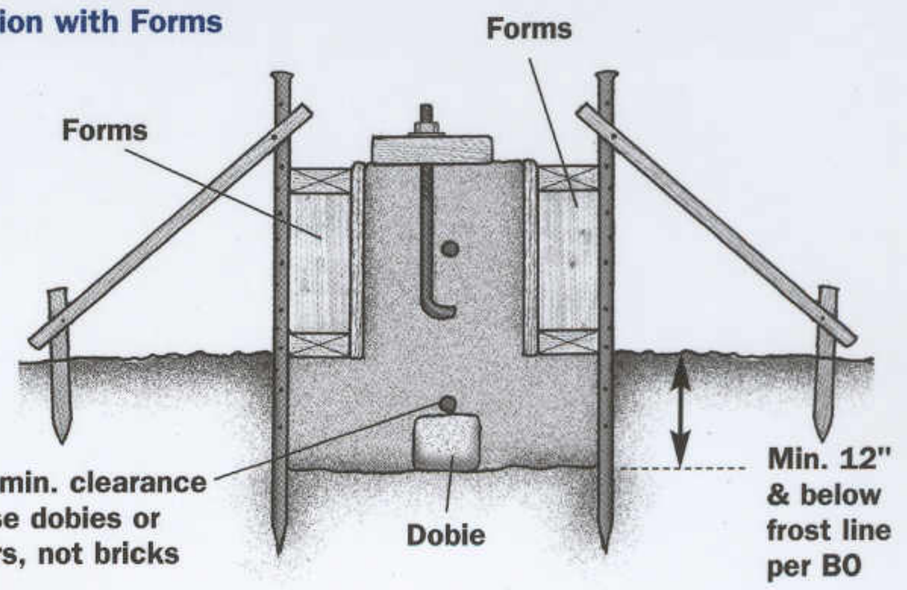
Footings	IRC	UBC
☐ Soil test req'd if soil likely to be expansive, shifting, or compressible	[401.4]	{1804.1}
☐ Geotech report req'd if BO suspects bearing value <1,500 psf	[T401.4.1]	{1804.2}
☐ Footing depth min 12in into previously undisturbed natural soils or engineered fill	F7 [403.1.4]	{1806.1}
☐ Footings must extend below frost line per local BO	[403.1.4.1]	{1806.1}
☐ SDC D1&D2 monolithic slab footing min 18in deep from top of slab	F10 [403.1.4.2]	{n/a}
☐ Footing depth above bottom reinforcement min 6in when on soil, 12in when on piles	[n/a]	{1915.7}
☐ Footing width per table	T2 [403.1.1]	{1806.1}
☐ Foundations & slabs on expansive soil isolated from the expansive soil or designed to prevent uplift	[403.1.8]	{1804.4}
☐ Lot slope >1:10—fndn must be stepped or level	[403.1.5]	{1806.4}
☐ All exterior walls req'd to be supported on continuous footings	[403.1]	{n/a}
☐ Sill plate to be anchored to foundation w/bolts or straps at max 6ft o.c. spacing	[403.1.6]	{1806.6}
☐ SDC D1&D2 continuous footings req'd under interior braced wall panels with plan dimension >50 ft	[403.1.2]	{2320.5.6}

Table 2 • Minimum Foundation Size—also see Table 19

Dimension	Number of Floors Supported by Foundation		
	1	2	3
Depth into previously undisturbed soil	12in.	[12in.] {18in.}	[12in.] {24in.}
Wall thickness	6in.	8in.	[8in.] {10in.}
Footing thickness	6in.	7in.	8in.
Footing width	12in.	12in.	[17in.] {18in.}

Based on [T403.1] & {T18-1-C} for conventional light frame construction

Fig.7
T Foundation with Forms

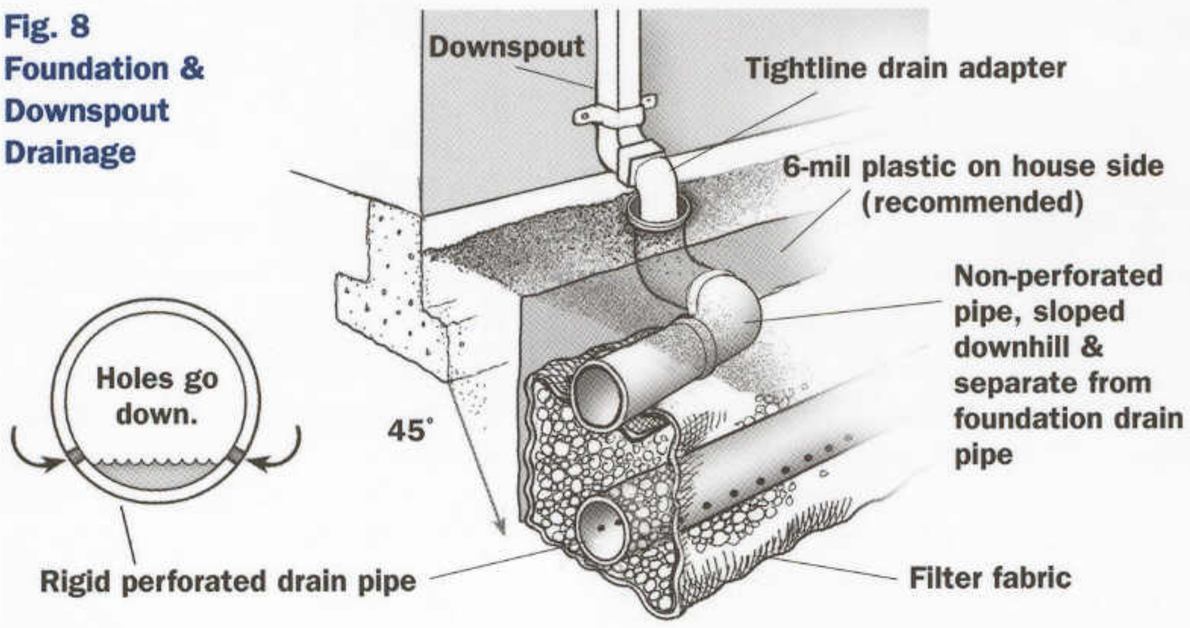


Foundation Drainage

Expansive soils are the cause of millions of dollars of property damage each year. The type of soil must be considered in the design of the building. A major cause of basement damage is hydrostatic pressure that could be controlled with a properly designed drainage system. Surface grading, control of roof runoff, and drainage systems must coordinated to prevent water entry.

	IRC	UBC
☐ Concrete & CMU {dampproofed} fndns enclosing habitable or useable space req drainage EXC . . . . . .F8 [405.1]		{1834.1}
Where underfloor area is on same grade as exterior OR[405.1X]		{1834.1X}
On well-drained ground or sand/gravel mixture . . . . . .[405.1X]		{n/a}
☐ Filter fabric req'd over top of drain field . . . . . .F8 [405.1]		{1834.3}
☐ Min 2in of crushed rock under drain pipe . . . . . .F8 [405.1]		{1834.3}
☐ If soils are expansive or collapsible, roof drain must discharge min 5ft from footing or to approved drain system . . . .[801.3]		{n/a}

Fig. 8 Foundation & Downspout Drainage



Foundation Size

The foundation must be a sufficient size to support all the loads imposed on it, including the weight of the building and contents, and the lateral loads from the soils. The foundation must have sufficient strength and mass to transmit environmental loads on the structure (such as wind, snow, and earthquakes) to the ground. Many building departments have standard foundation design drawings, such as those found in IRC chapter 4, to assist homeowners and builders in planning the foundation.

☐ Plain concrete and masonry per tables . . . . . .T2&T3 [404.1.1]		{n/a}
☐ Plain CMU fndn min 8in thick in SDC D1&D2 . . . . . .[404.1.4(5)]		{1922.7.4}
☐ Eng design req'd if fndn walls subject to hydrostatic pressure . . . . . .[404.1.3]		{1830}
☐ Eng design req'd if foundation walls support >48in backfill without lateral support at top and bottom . . . . . .[404.1.3]		{106.2}
☐ Thickness of fndn not less than wall supported EXC . . .[404.1.5]		{n/a}
8in fndn can support 10in veneered or cavity wall to 20ft . .[404.1.5]		{n/a}
☐ Flat Insulating Concrete Form (ICF) fndns min 5½in thick [404.4.2]		{n/a}
☐ Waffle & screen grid ICF min 6in thick . . . . . .[404.4.3,4]		{n/a}

ACI Prescriptive Requirements

ACI 318—Building Code Requirements for Structural Concrete—is allowed as an alternative to the prescriptive requirements of the various building codes. In instances where a conflict arises between the two codes, you must stay with just one code for the entire project, and not pick and choose between the two. For example, you could not use T3 for determining the thickness of a plain concrete basement wall and also use ACI 318.

Basement Walls	ACI 318
☐ Min reinforcement spacing vert & horiz not > 3 times wall thickness or >18in 14.3.5	
☐ Min 2 No. 5 bars around door and window openings 14.3.7, 22.6.6.5	
☐ Bars around doors & windows min 24in past openings 14.3.7, 22.6.6.5	
☐ Plain concrete continuously supported on soil 22.6.1	
☐ Thickness of plain concrete ext basement & fndn walls min 7½in . . .22.6.6.3	

Basement Walls

Plain concrete or masonry basement walls are allowed in areas that are not subject to seismic activity or hydrostatic pressure. They may not support unbalanced backfill without a floor to restrain the top and bottom of the wall. These walls rely on gravity to stay in place. In many parts of the country, it is common practice to build basements with unreinforced CMUs. Though the codes permit "plain" concrete or masonry in Seismic Design Categories D1 and D2, local building officials may insist on reinforced foundations in those areas, and the UBC does not allow structural plain concrete walls in Seismic Zones 3 & 4.

Plain Concrete or Masonry	IRC	UBC
☐ Plain concrete must be continuously supported by soil	[404.1]	{1922.2.2}
☐ Plain concrete or masonry thickness per table T3	[404.1.1&2]	{T18-I-C}

Seismic Design Category D1 & D2 {SZ 3&4} Requirements		
☐ Min thickness 7½in EXC	[404.1.4]	{Ø1922.2.5}
6in thickness OK if height not > 4ft 6in	[404.1.4]	{Ø1922.2.5}
☐ Plain masonry in SDC D1&D2 min thickness 8in	[404.1.4]	{Ø1922.2.5}
☐ Max height 8ft max unbalanced backfill 4ft	[404.1.4]	{Ø1922.2.5}
☐ Plain concrete or masonry in SDC D1&D2 min 1 #4bar in upper 12in	[404.1.4]	{Ø1922.2.5}

Table 3 • Plain Foundation Walls

Max. Wall Height	Max. Unbalanced Backfill Height	Plain Concrete Thickness [a]	Plain Masonry Thickness [a]
5ft.	4ft.	6in.	6in. solid[b] or 8in.
	5ft.	6in.	8in.
6ft.	4ft.	6in.	6in. solid[b] or 8in.
	5ft.	6in.	8in.
	6ft.	8in.	10in.
7ft.	4ft.	6in.	8in.
	5ft.	6in.	10in.
	6ft.	8in.	12in.
8ft.	5ft.	6in.	10in.
	6ft.	8in.	12in.
	7ft.	10in.	12in. solid[b]
9ft.	5ft.	8in.	10in.
	6ft.	8in.	12in.
	7ft.	10in.	12in. solid[b]
	8ft.	10in.	design req'd

Based on IRC T404.1.1(1)

a. assumes moderate bearing soil min. 1500 psf
b. solid grouted hollow units or solid masonry units

Reinforced Concrete or Masonry		
☐ Vert reinforcement min dist from soil side	T4 [404.1.1,2]	{n/a}
☐ Eng design req'd if fndn walls subject to hydrostatic pressure	[404.1.3]	{1830}
☐ Min height above finished grade 6in [4in if veneer]	[404.1.6]	{1806.1}

Table 4 • Min. Distance of Vertical Steel from Soil Side of Wall

Thickness of Wall	8"	10"	12"
Distance face of soil to center of steel	5"	6.75"	8.75"

Table 5 • Reinforced Concrete & Masonry Foundation Walls

Max. Wall Height	Max. Unbalanced Backfill Height	Min. Size & Spacing of Vert Reinforcement
6ft.	5ft.	#4 at 48in. o.c.
	6ft.	#4 at 48in. o.c.
7ft.	4ft.	#4 at 48in. o.c.
	5ft.	#4 at 48in. o.c.
	6ft.	#4 at 48in. o.c.
	7ft.	#4 at 40in. o.c.
8ft.	5ft.	#4 at 48in. o.c.
	6ft.	#4 at 48in. o.c.
	7ft.	#5 at 48in. o.c.
	8ft.	#5 at 40in. o.c.
9ft.	5ft.	#4 at 48in. o.c.
	6ft.	#4 at 48in. o.c.
	7ft.	#5 at 48in. o.c.
	8ft.	#5 at 40in. o.c.

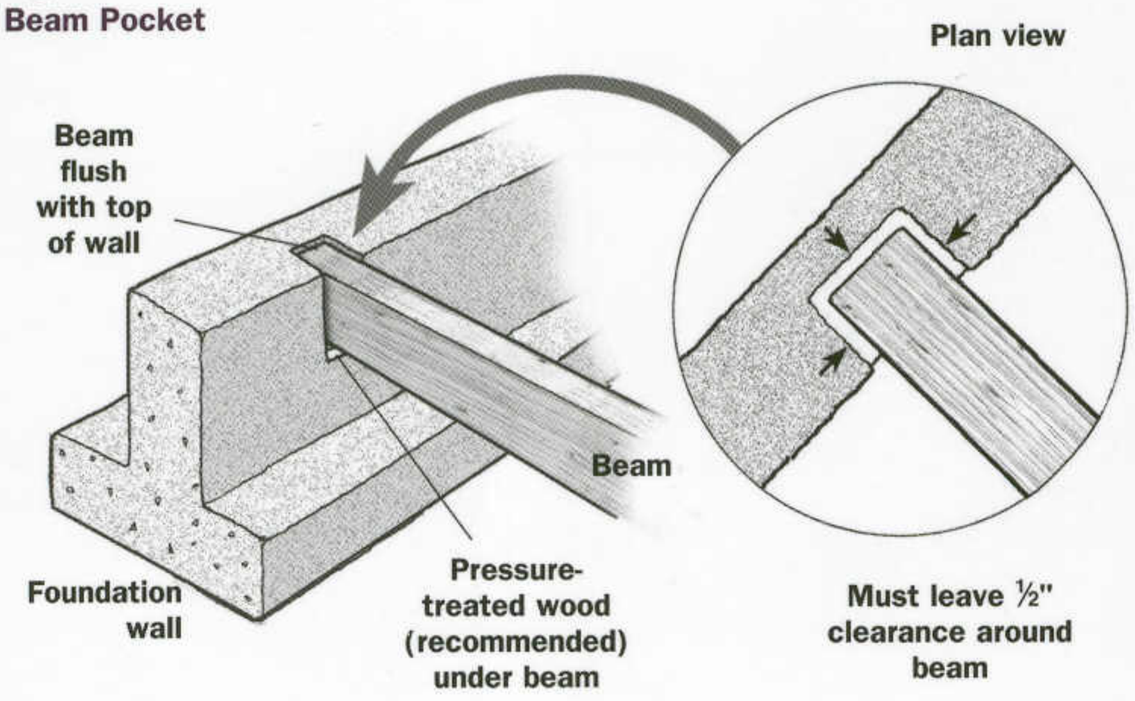
Based on IRC Table 404.1.1(2) and assuming good drainage characteristics, low frost heave potential, and low potential for soil volume change

Forms

Foundation forms contain concrete while it is still in its fluid state and provide protection for reinforcing steel and other elements that are to be permanently embedded. Forms must not be removed until the concrete is sufficiently cured, and all traces of wood forms must be removed to prevent any potential wood-destroying organism from entering the building.

Forms	IRC	UBC
☐ Size per tables	T2,T3,T5 [403.1.1]	{T18-1-C}
☐ Pipe penetrations must be sleeved	[2603.5]	{313.10.1[F]}
☐ Excavation free of debris and roots	[408.4, 506.2]	{3302}
☐ Wood beam connections ½in air space on 3 sides	F9 [319.1]	{2306.6}
☐ Fndn wall to extend min 6in above finish grade EXC 4in OK if masonry veneer to be used	[404.1.6] [404.1.6]	{1806.1} {Ø}

Fig. 9
Beam Pocket



ACI - Forms	ACI 318
☐ Confirm forms will result in concrete proper place & size per plans	6.1.1
☐ Forms substantial & sufficiently tight to prevent leakage	6.1.2
☐ Forms properly braced & tied to maintain position & shape	6.1.3
☐ Design forms to consider placement rate, loads & specialty accessories	6.1.5
☐ Do not remove until concrete will not be damaged by removal	6.2.1

Reinforcement

Reinforced concrete derives its tensile strength from its reinforcing steel. The amount of steel depends on soil conditions, foundation size and shape, and the forces that it must be designed to handle. Check with your local BO for reinforcement requirements in your area because the amounts shown below are code minimums.

ACI Reinforcement:	ACI 318
☐ Partially embedded reinforcement may NOT be field bent	7.3.2
☐ Reinforcement clean of mud, oil, or nonmetallic coatings	7.4.1
☐ Reinforcement secured against displacement before pouring	7.5.1
☐ Concrete cover per table	T6 7.7.1
☐ Increase amount of cover in severe or corrosive environments	7.7.5
☐ Max bend in bars per table	T7 T7.2
☐ Splices 12in min lap or per design	12.14.1
☐ Splices staggered min 24in	7.6.6.1, 12.15.4

Table 6 • Reinforcing Steel Cover

Foundation Surface	min. Cover ≤ No. 5 bars	min. Cover ≥ No. 6 bars
Concrete cast against and permanently exposed to earth	3in.	3in.
Concrete exposed to earth or weather	1½in.	2in.
Not exposed to weather, e.g. top of indoor slab	¾in.	¾in. up to No. 11 bars

Based on ACI 7.7.1

Table 7 • Minimum Diameters of Bend (based on ACI 318 Table 7.2)

Bar Size	Minimum Diameter (in terms of nominal diameter of bar)
No. 3 through No. 8	6
No. 9, No. 10, and No. 11	8
No. 14 and No. 18	10

IRC and UBC – Reinforcement	IRC	UBC
☐ Professional design required if subject to pressure from ground water	[404.1.3]	{1611.8}
☐ SDC D1&D2 {SZ 3&4} #4 horiz bar req'd in bottom of footing and top of stem wall	F7 [403.1.3. 1]	{1806.7.1}
☐ SDC D1&D2: min #4 vert bar 4ft on center	[403.1.3]	{n/a}
☐ Clearance to forms and soil per table	F7, T6 [404.1]	{1907.7.1}

Concrete

Cement particles, through the chemical reaction process of hydration, develop crystals when wet that bond the concrete mix together. Too much water can severely weaken concrete.

The three basic ingredients in concrete are:

1. **Portland Cement.** Cement and water form a paste that coats the aggregate and/or sand in the mix. The paste hardens and binds the aggregates and sand together.

2. **Water.** Water (hydration) is needed to chemically react with the cement and to allow workability with the concrete. The amount of water in the mix compared with the amount of cement is called the water to the cement ratio. The lower the water to cement ratio, the stronger the concrete (higher strength, less permeability).

3. **Aggregates**. Sand is the fine aggregate. Gravel or crushed stone is the coarse aggregate in most mixes.

Preparation: **ACI 318**

- ☐ Remove all debris and ice from space to be filled by concrete 5.7
- ☐ Forms properly coated & clean 5.7
- ☐ Reinforcement clean of ice or mud 5.7

Curing:

- ☐ Maintain above 50˚ F for first 7 days 5.11.1
- ☐ Keep moist first 7 days (plastic sheeting) 5.11.1

Inspections:

- ☐ Inspect before cover up 1.3.1
- ☐ If ambient temperature below 40˚F or above 95˚F, inspection records to include record of concrete temperature & protection during placement and curing 1.3.3

Mixing & Strength

The proportion of water to cementitious material determines the compressive strength of the concrete. The codes provide minimum requirements for compressive strength based on the exposure conditions, soil types, and seismic design category.

Mixing and Strength	**IRC**	**UBC**
☐ Min 2,500psi concrete for any residential use	[402.2]	{1905.1.1}
☐ Min 3,000psi compressive strength in seismic design . . .	[n/a]	{1921.2.4.1}
☐ Min 3,000psi if exposed and moderate or severe weathering potential	[402.2]	{n/a}
☐ Air entrained if exposed to freeze-thaw conditions . . .	[402.2]	{1904.2.1}

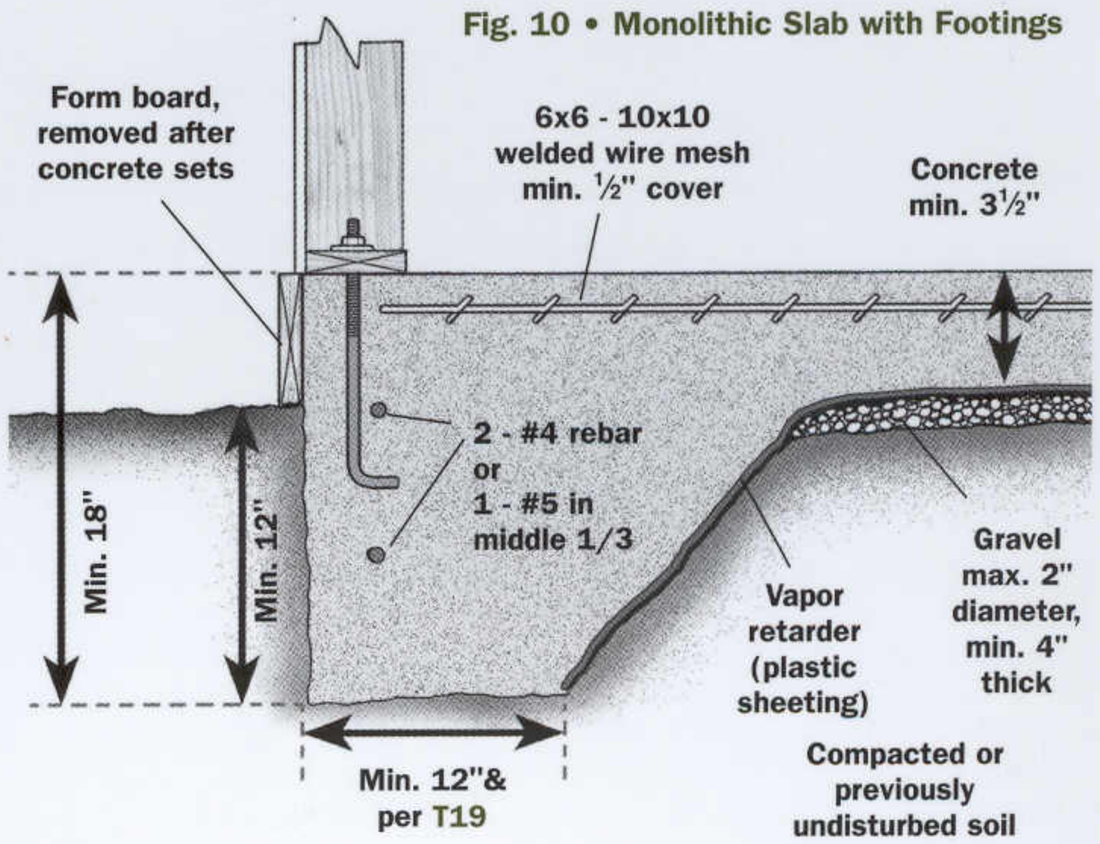
Concrete Slabs

Concrete slabs that serve as floors require vapor retarders to prevent moisture from rising into the building and damaging the floors or creating indoor air quality problems, such as mold. Slabs require reinforcement to resist cracking and upheaval.

Concrete Slabs

☐ Slab floor on grade min 3½in thick & 2500psi concrete	[506.1]	{1900.4.4}
☐ Elevated or wood-supported slab must be engineered . .	[local]	{2307}
☐ Soil compacted & free of debris	[506.2.1]	{3313.3}
☐ Soil treatment to prevent termite infestation	[320.1]	{n/a}
☐ Base 4in sand, gravel, or crushed stone <2in dia . . .	[506.2.2]	{1834.2}
☐ Vapor retarder joints min 6in lap under habitable space	[506.2.3]	{1832.2}
☐ Slab w/turned down footing reqs 1 #5 or 2 #4 bars in middle ⅓ of footing depth	F10 [403.1.3.2]	{1806.7.2}
☐ Wire mesh located min ½in down from top of slab	F10 [local]	{1907.7.1}
☐ Soil-supported sidewalks & slabs not governed by code unless transmitting building loads to soil	[105.2]	{1922.1.1.2}

Fig. 10 • Monolithic Slab with Footings

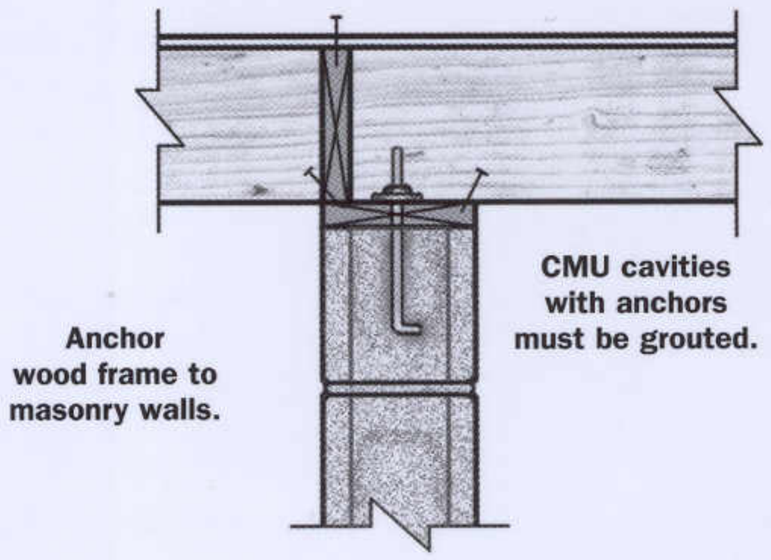


Concrete Masonry Units (CMUs)

Concrete masonry units (a.k.a. concrete blocks) have compressive strength only in the vertical direction—the same direction as the open cells. They require reinforcing steel and grout (concrete fill) in the reinforced cells to resist lateral movement. The American Concrete Institute publishes ACI 530—Building Code Requirements for Masonry Structures. Specific parts of this code are adopted by reference into all the major model codes.

General CMU Wall Requirements	IRC	UBC
☐ 6in block OK for one story to 9ft	[606.2.1]	{2109.6.1}
☐ 8in block if more than one story or >9ft	[606.2.1]	{2109.6.1}
☐ Beam connections—½in airspace on three sides	[319.1]	{2306.6}
☐ Anchor roof & floor structures to masonry walls	F11 [606.10]	{2309}

Fig. 11
Anchoring to Masonry Walls



Grout

☐ All cells with reinforcement must be filled	F11[609.4.1]	{2104.6.1}
☐ Cleanouts req'd at bottom of each grouted cell for pours >4ft {5ft}	[609.1.5.2]	(2104.6.1}
☐ Grout continuous pour max lift 5ft	[609.1.4]	{2104.6.1}
☐ Clean grout space—max ½in projections	[609.1.3]	{2104.6.1}

Reinforcing for masonry units

☐ SDC D1&D2: min #3 vertical bars 4ft o.c.	[404.1.4]	{2106.1.12.4}
☐ Vertical Rebar ≤6% of grout space	[T609.1.2]	{2107.2.2.1}
☐ Lap Rebar splices 40x bar diameter	[F606.10(2)]	{2107.2.2.6}
☐ Support/positioners min 200 bar dia (8ft #4 bar)	[609.4.1]	{2104.5}
☐ Min cover 2in to weather or soil {1½in to weather}	[606.12]	{2107.2.2.2}

Underfloor

Houses with underfloor crawl spaces may require a plumbing and mechanical inspection before the floor can be installed. Also verify that proper clearances, ventilation, and access openings have been provided. Vent openings should not be blocked with insulation or mechanical equipment.

General

☐ All formboards & organic debris must be removed	[408.4]	{1906.2.1}
☐ Repair {prevent} rock pockets or voids	[local]	{1906.2.1}
☐ Corrosion-resistant fasteners in pressure-treated sills [unless ≥½in dia]	[319.3]	{2304.3}

Ventilation

☐ 1sq ft/150sq ft of underfloor area	[408.1]	{2306.7}
☐ Vent openings within 3ft {as practical} of each corner	[408.1]	{2306.7}
☐ Vents ≤3ft of property line OK	[302.2X2]	{n/a}

Access Openings

☐ Min 18in high x 24in wide in floor {or perimeter wall}	[408.3]	{2306.3}
☐ 16in high OK in perimeter wall	[408.3]	{Ø}
☐ Perimeter wall opening NOT allowed under door	[408.3]	{n/a}
☐ Opening must allow removal of eqpmt in crawlspace	[1305.1]	{305.0ᴹ}

Fig. 12
Access Opening Size

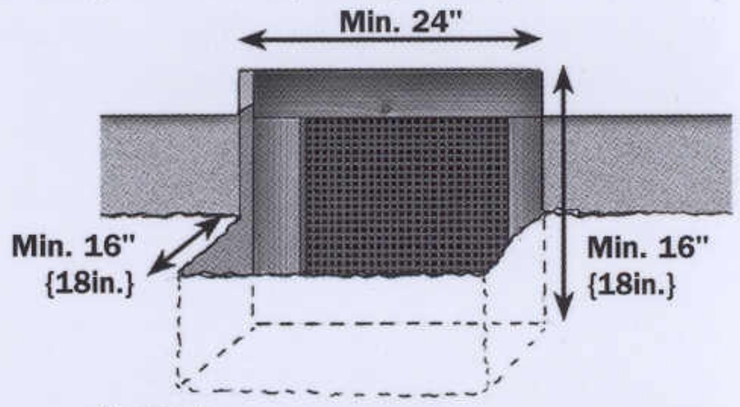
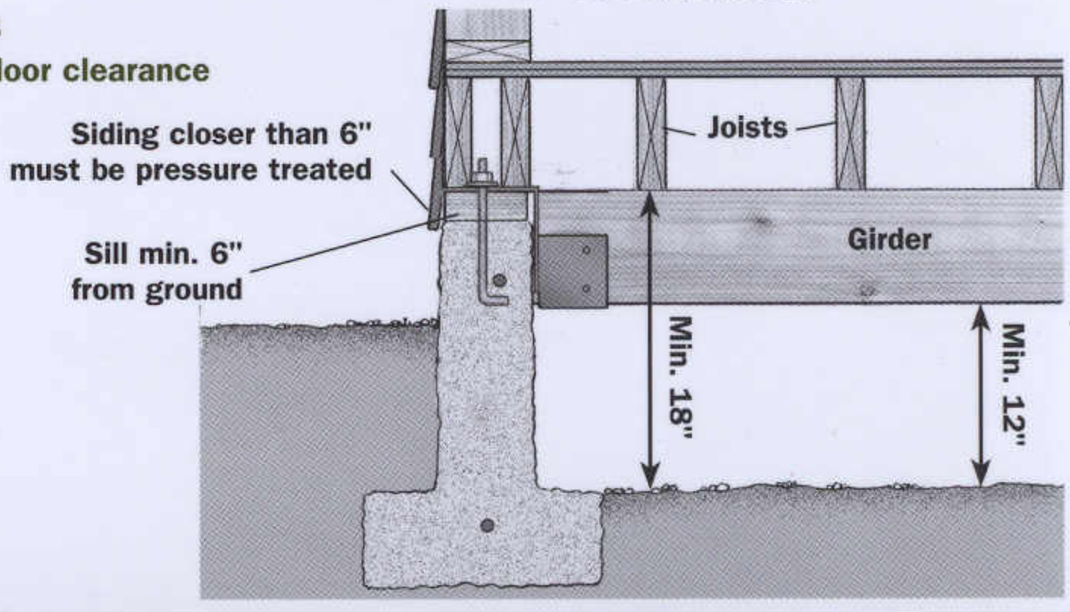


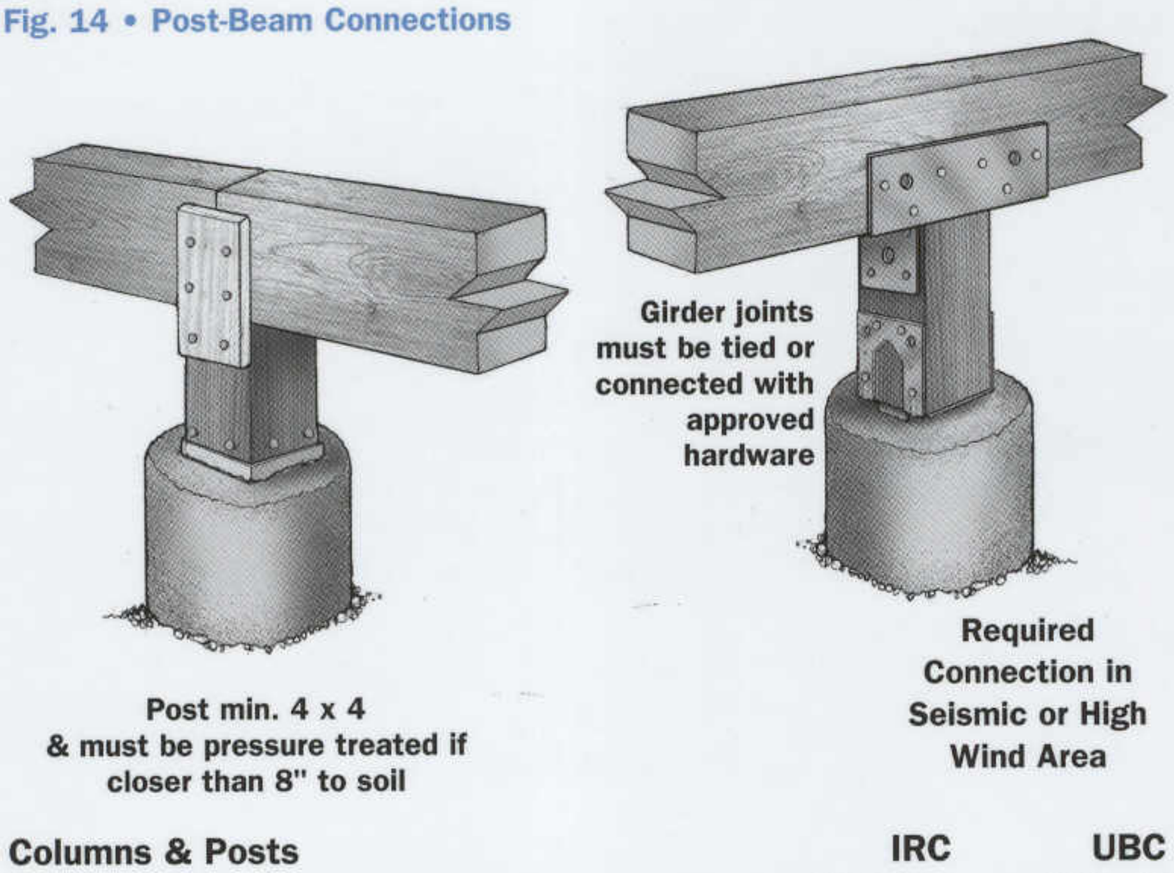
Fig. 13
Underfloor clearance



Posts, Columns & Girders

Most houses with crawl spaces are built over concrete piers and posts that support wood girders. Clearance must be maintained between the soil and wood if the wood is not pressure treated. In the UBC, the entire floor assembly, including the subfloor, must be pressure treated when any of the required clearances are not attained. The placement of interior bearing walls must be considered in laying out the locations of piers, posts, and girders. Houses in Seismic Design Categories D1 and D2 sometimes require continuous footings under interior walls as a means of transferring shear forces to the earth.

Fig. 14 • Post-Beam Connections



Columns & Posts	IRC	UBC
☐ Pile foundations req fndn investigation	[301.1.2]	{1807.1}
☐ Piles in SDC D1&D2 interconnect rebar to fndn	[407.3]	{1807.2}
☐ Concrete or masonry piers min 8in above ground unless post PT	F14 [407.1]	{2306.5}
☐ Wood columns min 4x4 [steel min 3in dia]	F14 [407.3]	{n/a}
☐ SDC D1&D2 restrain lower end of post to prevent lateral displacement	[407.3]	{1605.2.3}
☐ Steel columns must be corrosion protected	[407.2]	{n/a}
☐ Bottoms of all columns must be constrained	F14 [407.3]	{1605.2.3}
☐ CMU piers must be filled solid if height >4X their width	[606.5]	{local}
☐ Hollow CMU piers req min 4in concrete cap	[606.5.1]	{local}
☐ Cast in place piers or piles min 2,500psi	[T402.2]	{1808.2.1}

Girders		
☐ Girder spans per table	T8 [502.5]	{2320.7}
☐ Spacing per bearing wall loc & joist span table	T9 [502.3]	{2320.8.1}
☐ Girder end joints must be over supports	[502.6]	{2320.7}
☐ Girder bearing on concrete min 3in	[502.6]	{2320.7}
☐ Girder joints over supports must be tied	F14 [502.9]	{2320.7}
☐ Max 1 joist depth horiz under perp bearing walls	F15 [502.4]	{2320.8.5}
☐ Holes max ⅓ girder depth	F19 [502.8.1]	{local}
☐ Holes min 2in from top or bottom	F-19 [502.8.1]	{local}
☐ No notches in middle third of span or on tension side of ≥4in thick members except at ends	[502.8.1]	{local}

Fig. 15 Bearing-Wall Support

Bearing walls should not offset more than the joist depth from the supporting girder below the floor.

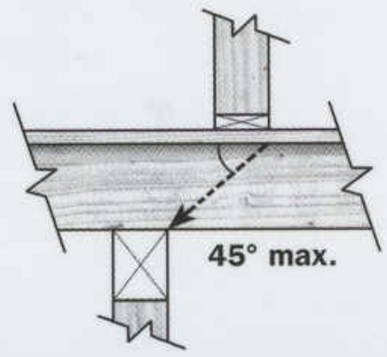


Table 8 • Girder Spans for Interior Bearing Walls[a] (feet-inches)

No. of floors supported	Min. Girder Size	Building Width[b]		
		20	28	36
1	2-2x6	4-6	3-11	3-6
	2-2x8	5-9	5-0	4-5
	2-2x10	7-0	6-1	5-5
	2-2x12	8-1	7-0	6-3
	3-2x8	7-2	6-3	5-7
	3-2x10	8-9	7-7	6-9
	3-2x12	10-2	8-10	7-10
2	2-2x6	3-2	2-9	2-5
	2-2x8	4-1	3-6	3-2
	2-2x10	4-11	4-3	3-10
	2-2x12	5-9	5-0	4-5
	3-2x8	5-1	4-5	3-11
	3-2x10	6-2	5-4	4-10
	3-2x12	7-2	6-3	5-7

(a) Based on IRC TR502.5(2) and assuming #2 grade lumber
(b) For widths between those shown, spans may be interpolated

Plates & Sills

The wood plates on the top of foundations must be sufficiently clear of soil to protect the wood from termites and moisture. In areas prone to seismic activity, they must be anchored to the foundation to prevent the house from sliding off the foundation.

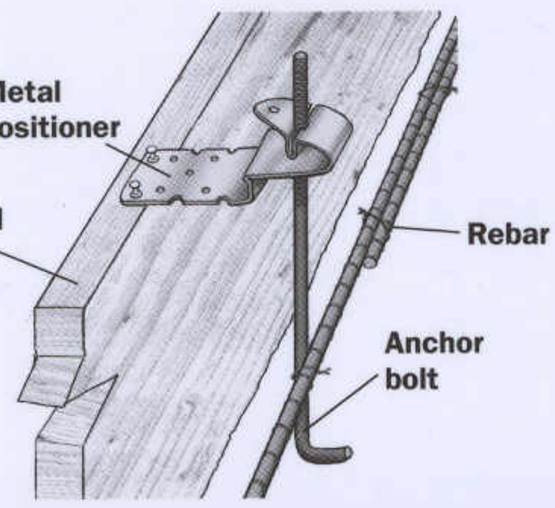
Sills	IRC	UBC
☐ Bottom of sill 6in min to earth	F13 [404.1.6]	{1806.1}
☐ Concrete or masonry fndn wall to extend 6in above finished grade [4in OK if masonry veneer]	F13 [404.1.6]	{1806.1}
☐ Sill material treated or naturally decay-resistant	F13 [319.1]	{2306.4}
☐ Soil clearance to untreated wood joists min 18in	F13 [319.1]	{2306.3}
☐ Soil clearance to untreated wood beams min 12in	F13 [319.1]	{2306.3}
☐ Fasteners for treated wood to be hot-dipped galv steel, stainless steel, silicone bronze or copper	[319.3]	{2304.3}

Anchor Bolts

Anchor bolts resist lateral forces that could cause a building to lift or slide off the foundation. Anchor bolts must have sufficient embedment to resist pullout, and must be spaced properly to secure the sill in place. Washers must be capable of distributing a load across the sill without it cracking or splitting.

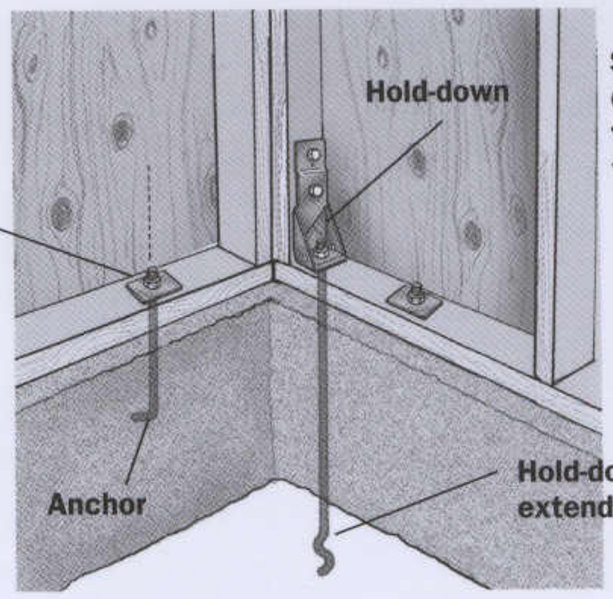
☐ ½in bolts min {⅝ SZ4} 7in embedment max 6ft spacing EXC	[403.1.6]	{1806.6}
Straps placed at intervals providing equivalent anchorage as ½in bolts	[403.1.6]	{n/a}
☐ Max distance 12in from end of sill	F17 [403.1.6]	{1806.6}
☐ Min distance 7 bolt diameters from end of sill	[403.1.6]	{1806.6}
☐ Min 2 bolts per piece of sill material	[403.1.6]	{1806.6}
☐ SDC C, D1&D2 {SZ3&4}: 2in plate washers	[403.1.6.1]	{1806.6.1}
☐ Sufficient distance from edge for washer to fully seat on sill	F16 [403.1.6.1]	{1806.6.1
☐ SDC C, D1&D2 4ft o.c. for 2 story	[403.1.6.1]	{local}

Fig. 16
Anchor Bolt Positioner



Anchor bolt positioners help to keep the bolt correctly aligned and also reduce the likelihood of the foundation cracking around the bolt.

Fig. 17
Anchor Bolts and Hold-Downs

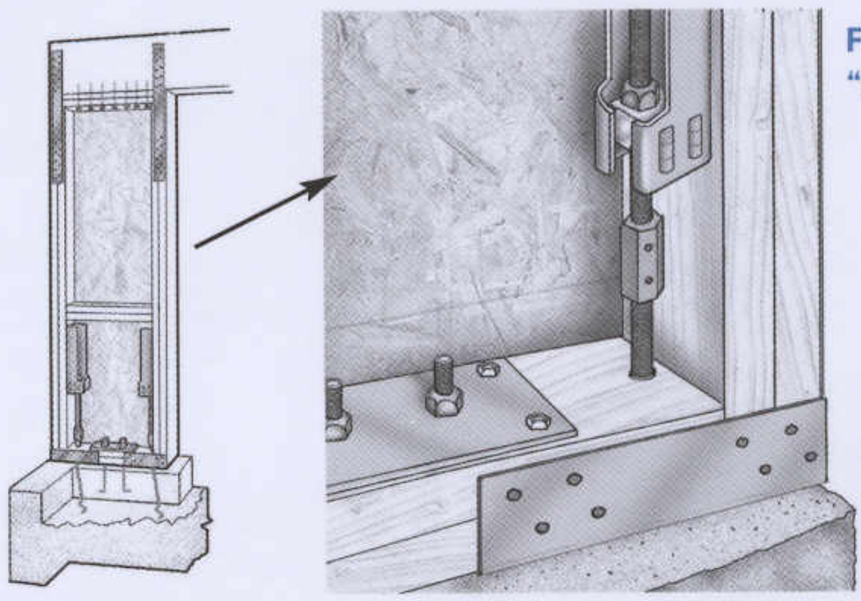


Hold-downs

In addition to the bolts that secure the sill, houses in areas with high winds or with seismic activity must be designed to resist overturning forces. Hold-downs work with shear paneling to resist the overturning forces created by seismic and wind loads. Shear paneling limits distortion of the building frame while hold-downs constrain the shear assembly. Hold downs must be installed per the exact specifications of the manufacturer.

☐ Hold-down embedment per design specs	[manu]	{1605.2.2}
☐ Bolts installed to manufacturer's specs	[manu]	{1605.2.2}
☐ All load transfers floor to floor to design specs	[601.2]	{1629}

Fig. 18
"Strong Walls"



(Drawing courtesy Simpson Strong Tie®)

"Strong Walls" are an example of a manufactured shear assembly designed for specific applications—such as the walls at the sides of a garage door. They can be a time-saver in situations where the aspect ratio (height to width) is limited and would otherwise require steel moment frames or heavy site-constructed shear assemblies. They should bear an evaluation agency approval and be installed according to the exact specifications of the manufacturer.

Cripple Walls

Cripple walls raise the floor to a higher elevation and are used with stepped foundations. They must be braced to resist lateral loads.

- ☐ Cripple studs no less than size of studs above them . .[602.9] {2320.11.5}
- ☐ Cripple walls >4ft height must be sized as add'l story [602.9] {2320.11.5}
- ☐ Cripple wall <14in fully sheathed or solidly blocked . . .[602.9] {2320.11.5}
- ☐ Cripple wall bracing per table (see p.14) . . . . . .T12 [602.10.2] { T23-IV-C-2}

Floor Framing

Floor framing supports the live loads inside the building, and in some instances supports walls and other parts of the structure. Horizontal framing members must have sufficient size to support these loads, and must not be damaged by excessive or improper notching or boring.

General—Standard Dimensional Sawn Lumber	IRC	UBC
☐ Joist spans not to exceed max numbers in table. . . T9	[502.3]	{2320.8.1}
☐ Min end bearing 3in on concrete; 1½in on wood	[502.6]	{2320.8.2}
☐ Max 1 joist depth horiz under perp bearing walls. . F15	[502.4]	{2320.8.5}
☐ Double joists under parallel bearing walls F20	[502.4]	{2320.8.5}
☐ Holes max size ⅓ of joist depth F19	[502.8.1]	{2320.8.3}
☐ Holes min 2in from top or bottom F19	[502.8.1]	{2320.8.3}
☐ No notches middle third of span F19	[502.8.1]	{2320.8.3}

Fig. 19
Notching & Boring Joists

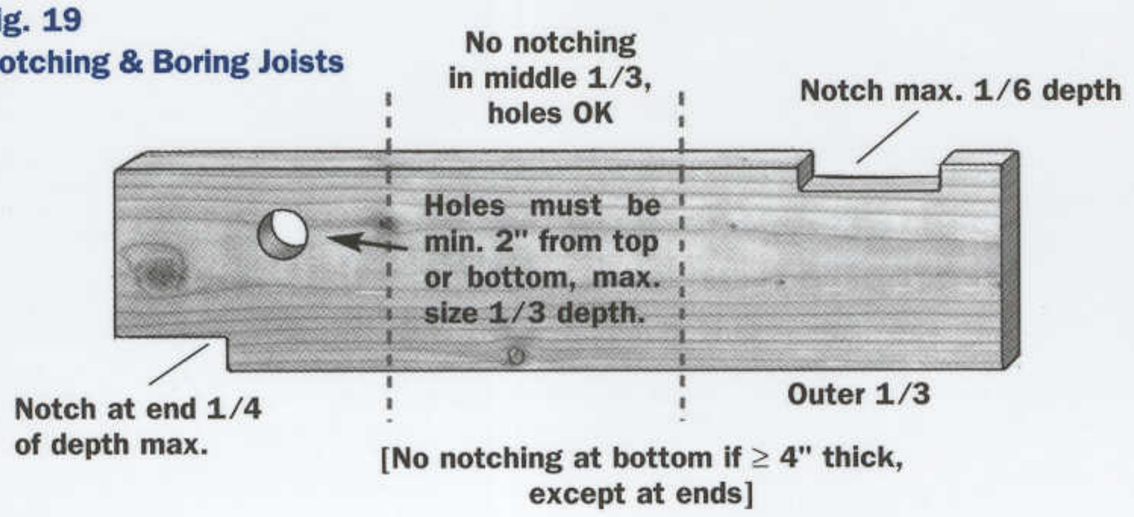
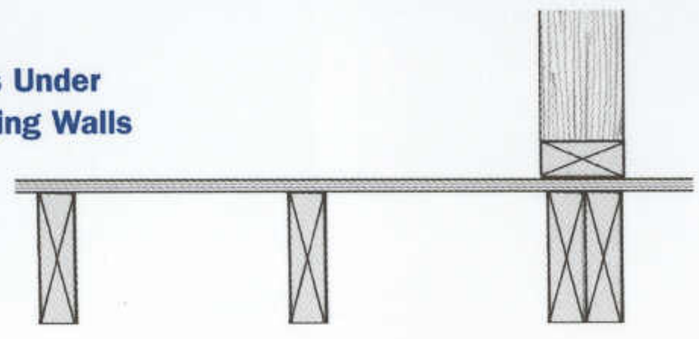


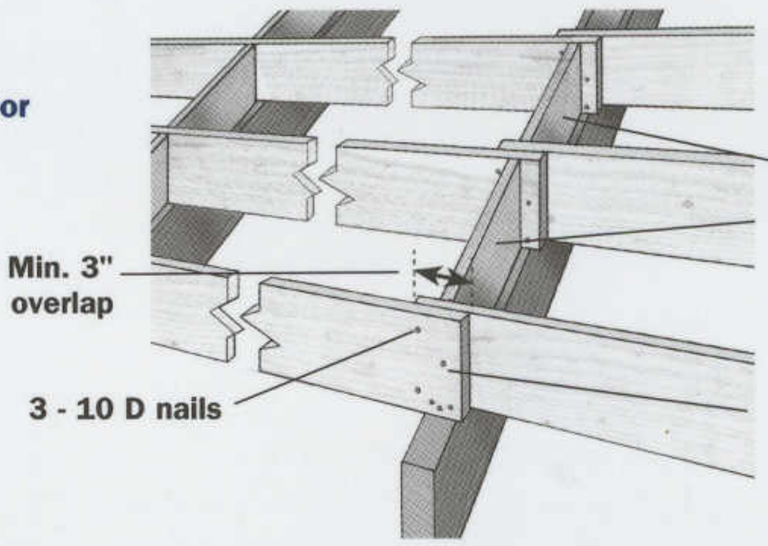
Fig. 20
Double Joists Under Parallel Bearing Walls



Joist or Beam Bearing

- ☐ On concrete or masonry—min 3in . . . . . .[502.6] {2320.8.2}
- ☐ On wood plates—min 1½in . . . . . .[502.6] {2320.8.2}
- ☐ Joists into side of girder req hanger or min 2x2 ledger . .[502.6.2] {2320.8.3}
- ☐ Joist lap min 3in and 3 10d nails . . . . . .F21 [502.6.1] {2320.8.3}

Fig. 21
Overlap Floor Blocking



Joist Blocking

- ☐ Joists blocked at all ends {and intermediate supports} [502.7] {2320.8.3}
- ☐ Joists blocked at intermediate supports [in SDC D1 or D2] . . . . . .[502.7X] {2320.8.3}
- ☐ Joists >2x12 blocked or bridged @ 8ft on center . . . .[502.7.1] {2316.2}

Framing at Openings

- ☐ Single header & trimmer joists OK to 4ft header span .[502.10] {2320.8.4}
- ☐ Double header and trimmer when header spans >4ft .[502.10] {2320.8.4}
- ☐ Header joists >6ft reqs joist hanger {or beam bearing} .[502.10] {2320.8.4}
- ☐ Tail joists >12ft req joist hangers or min 2x2 ledger [502.10] {2320.8.4}

Table 9 • Joist Spans, Notching & Boring

Floor Joist Spans—40lb. live load				Notching		Boring
DF#2	12"o.c.	16"o.c.	24"o.c.	End	Outer⅓	2" to edge
[2x6]	10'9"	9'9"	8'1"	1⅜"	⅞"	1½"
{2x6}	10'9"	9'9"	8'6"			
[2x8]	14'2"	12'7"	10'3"	1⅞"	1½"	2⅜"
{2x8}	14'2"	12'10"	11'3"			
[2x10]	17'9"	15'5"	12'7"	2⅜"	1½"	3⅛"
{2x10}	18'0"	16'5"	14'4"			
[2x12]	20'7"	17'10"	14'7"	2⅞"	1⅞"	3½"
{2x12}	21'11"	19'11"	17'5"			

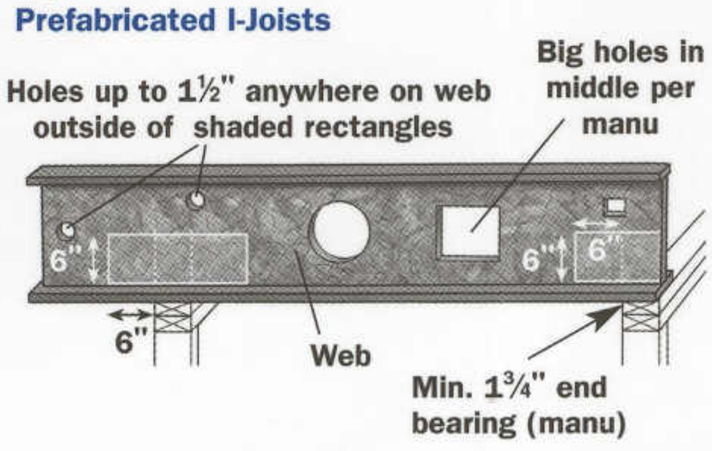
Based on IRC T502.3.1(2) & 502.8.1 and on UBC T23-IV-J-1

Floor Trusses & Wood I-joists

Sawn dimensional lumber is less popular today, and many homes are framed with wood I-joists, laminated veneer lumber, metal-plate connected trusses, and other manufactured products. These have the advantage of dimensional uniformity and do not shrink after construction. It is essential that these manufactured products be applied appropriately and per the manufacturers specifications. They must not be altered except according to the instructions that are provided. Installation guides from one manufacturer are not applicable to another manufacturer's products.

	IRC	UBC
☐ Install manufactured I-joists per manu specs	[502.1.4]	{2320.1}
☐ No alteration of trusses, incl add'l weight such as WH or HVAC	[502.11.3]	{2320.1}
☐ Floor trusses req design drawings to BO before truss installation	[502.11.4]	{2304.4}
☐ No modification of TJI's, LVL and GL members EXC.	[502.8.2]	{2304.4.1}
When specific to the design of the member	[502.8.2]	{2304.4.1}

Fig. 22
Prefabricated I-Joists



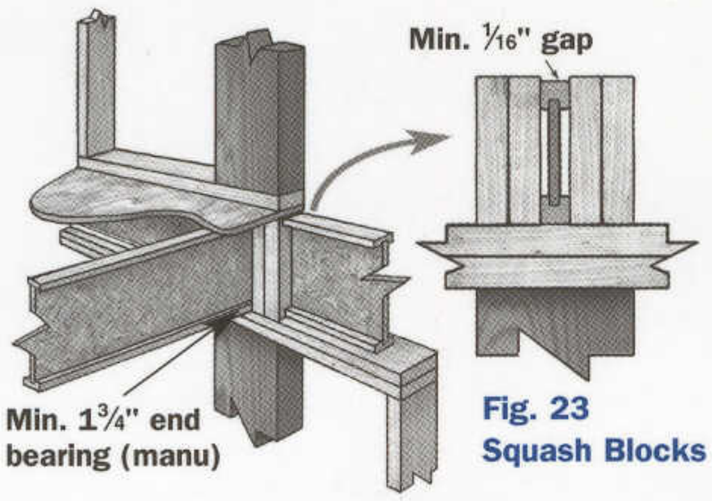
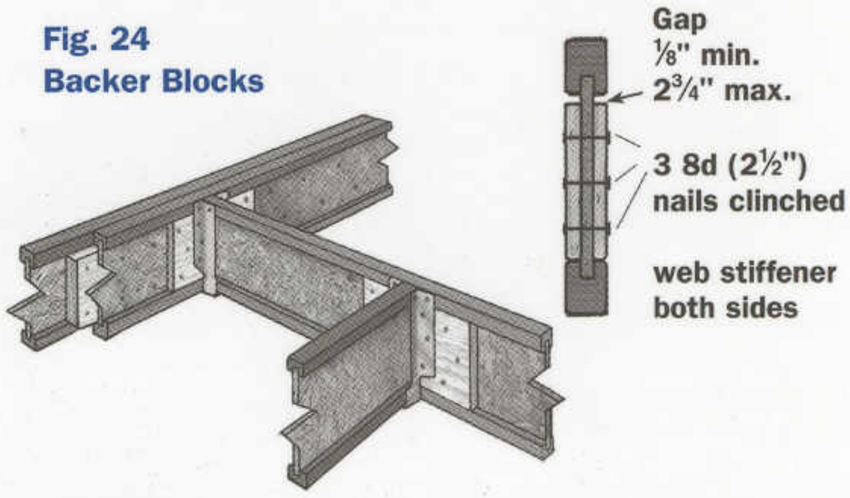


Fig. 23
Squash Blocks

Fig. 24
Backer Blocks



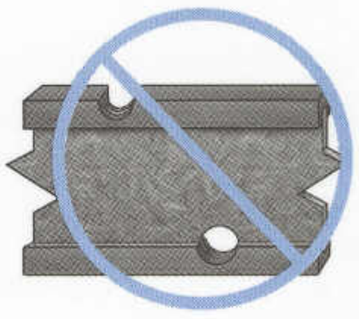


Fig. 25
No Notching of Flange

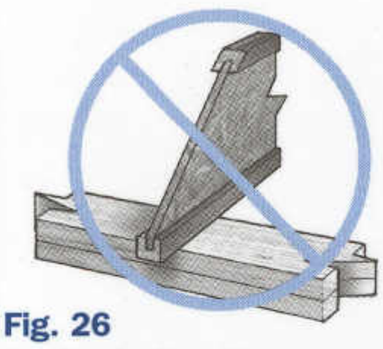


Fig. 26
No Angle End Cut

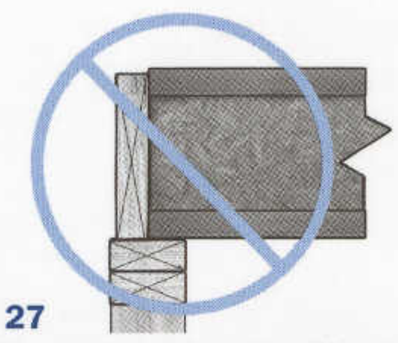


Fig. 27
No Dimensional Lumber Rim Joists

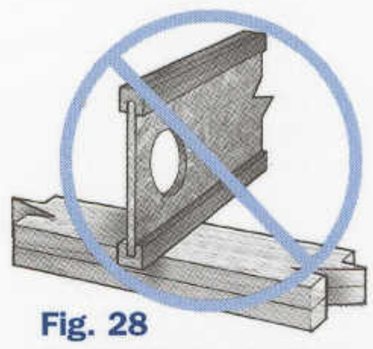


Fig. 28
No Big Holes in Ends

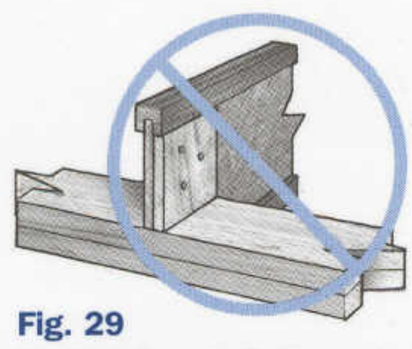


Fig. 29
No Notches in Ends

Steel Framing

Steel framing is becoming more popular as the costs of lumber increase and the search for straight lumber becomes more difficult. Many new homes are framed with dimensional and engineered lumber for exterior walls and steel for all interior nonbearing walls. Steel can also be the sole framing material of the house. While not specified in the code, insulating pads on joists, studs, and trusses can greatly reduce noise in steel framed houses. The IRC has extensive prescriptive requirements for steel framing. The UBC and NFPA 5000 each reference other standards and do not have prescriptive residential requirements.

Steel Framing	IRC
☐ Steel floor framing straight and free of defects	[505.1]
☐ Load bearing steel must be marked with manu identification, thickness coating designation & strength	[505.2.2, 603.2.2]
☐ Steel framing limited to bldgs 60ft length perp to joist span	[505.1.1]
☐ Steel framing limited to bldgs 36ft length parallel to joist span	[505.1.1]
☐ No steel framing in areas with designed wind speed >130mph	[505.1.1]
☐ SDC D1&D2 and high wind areas (≥110mph) req add'l bracing OR engineering	[301.2]
☐ Studs in line with joists, rafters, and trusses max ¾in offset	[603.1.2]
☐ Bearing stiffeners req'd all bearing locations of floor joists	[505.3.4]
☐ No splicing of studs or structural members	[505.3.8, 603.3.6]
☐ Harsh environments (coastal) req min G-90 protective coating	[505.2.3]
☐ Steel-to-steel connections min ½in center to center & edge distance	[505.2.4]
☐ Floor sheathing screws countersunk & min ⅜ edge distance	[505.2.4]
☐ All screws min 3 exposed threads through steel	[505.2.4]
☐ Sheathing fastened #8 min screws every 6in at edges 12in field	[T603.3.2(1)]

Wall Framing

The building frame must be capable of supporting the dead loads—the weight of the building and its fixed equipment—and the live loads—the weight of its occupants and furnishings. Additionally, the frame must be capable of withstanding environmental (earthquakes, wind, rain, and snow) loads.

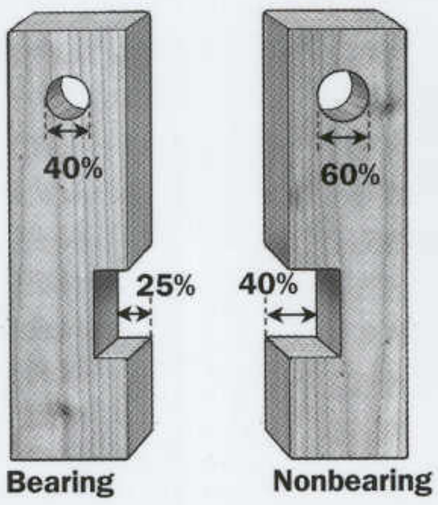
Stud Framing

	IRC	UBC
☐ Stud size and spacing per table	T11 [602.3.1]	{2320.11.1}
☐ End-jointed lumber OK if identified by grade mark	[602.1.1]	{2304.2}
☐ Studs must fully bear on min 2in nominal sole plate	[602.3.4]	{2320.11.2}
☐ Bridging req'd if height/thickness ratio >50:1	[n/a]	{2320.11.8}

Stud Notching and Boring

☐ Bearing or ext wall max notch 25% boring 40%	F30 [602.6]	{2320.11.9}
☐ 60% boring if doubled & ≤2 successive studs	F30 [602.6X]	{2320.11.10}
☐ Non-bearing max notch 40%, boring 60%	F30 [602.6]	{2320.11.10}
☐ Holes no closer than ⅝ to face of stud	[602.6]	{2320.11.10}

Fig. 30 Notching & Boring Studs



60% hole OK on bearing walls if the studs are doubled and the holes do not pass through more than 2 parallel studs.

Corner Framing

☐ Exterior corners—3 studs min EXC	F32 [F602.3(2)]	{2320.11.2}
2 studs OK if wood spacers or backup cleats or other approved material for attaching interior surfaces is used	[F602.3(2)]	{2320.11.2}
☐ Lap plates at corners	[602.3.2]	{2320.11.2}

Top Plates

☐ Bearing wall intersections & corners must overlap	[602.3.2]	{2320.11.2}
☐ End joints must offset 24in {48in} min	F31 [602.3.2]	{2320.11.2}
☐ Nailing min 10d@24in o.c. {16d@16in o.c.}	T21 [602.3]	{ T23-II-B-1}
☐ 16 gage straps over notches/holes [≥50% of plate width] {all holes} EXC	F31 [602.6.1]	{2320.11.7}
if notch or cut is covered by structural panel	[602.6.1X]	{n/a}
☐ Single top plate OK if tied with 3in x 6in steel plate with 6-8d nails AND joists/trusses/rafters land within 1in over stud	[602.3.2X)	{2320.11.2X}
☐ Top plates face nailed max 24in {16in}	T21 [T602.3(1)]	{T-23-II-B-1}
☐ Top plates nailed 10d {16d}	T21 [T602.3(1)]	{T-23-II-B-1}
☐ Openings <4ft in bearing walls req min 2-2x4 header	[602.7]	{2320.11.6}
☐ Min header bearing 1½in	[T502.1(1)]	{2320.11.6}
☐ Header spans	T10 [602.7, 502.5]	{2320.11.6}

Fig. 31 Plate Lap & Notches

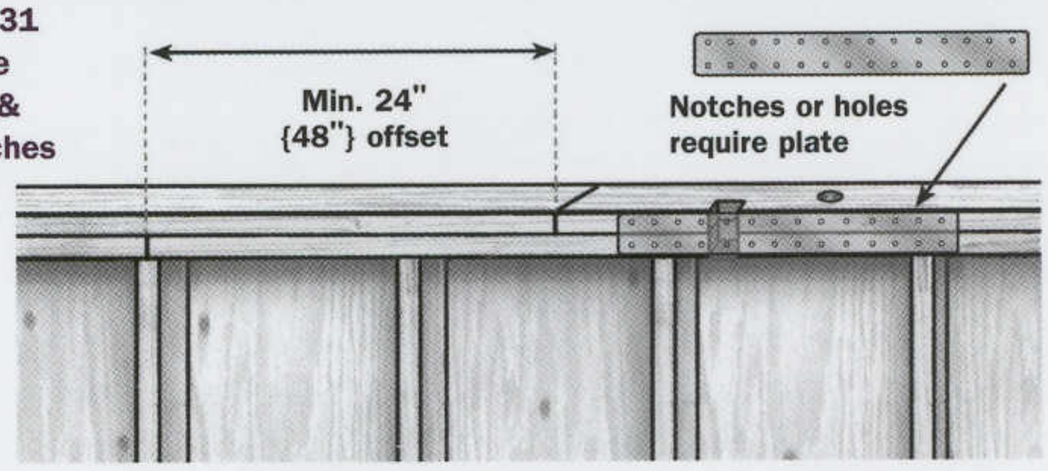


Fig. 32 • Corner Framing Examples

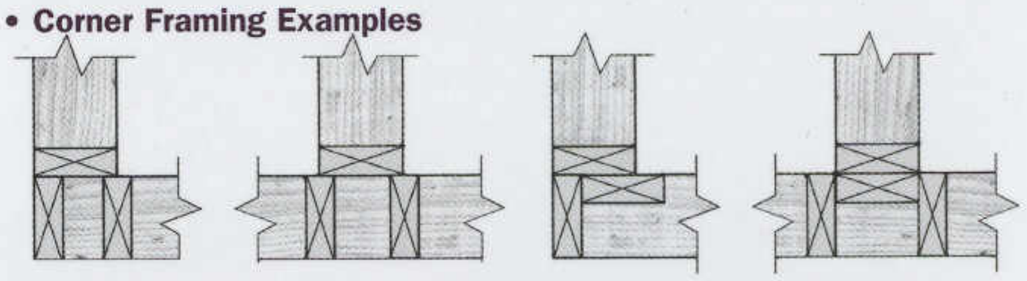


Table 10 • Header Spans for Exterior Bearing Walls[a] in feet-inches

Support	Min. Header Size	Building Width[b] 20ft. Span	20ft. NJ[c]	28ft. Span	28ft. NJ[c]	36ft. Span	36ft. NJ[c]
Roof & Ceiling	2-2x4	3-6	1	3-2	1	2-10	1
	2-2x6	5-5	1	4-8	1	4-2	1
	2-2x8	6-10	1	5-11	2	5-4	2
	2-2x10	8-5	2	7-3	2	6-6	2
	2-2x12	9-9	2	8-5	2	7-6	2
Roof, Ceiling & One Center-Bearing Floor	2-2x4	3-1	1	2-9	1	2 5	1
	2-2x6	4-6	1	4-0	1	3-7	2
	2-2x8	5-9	2	5-0	2	4-6	2
	2-2x10	7-0	2	6-2	2	5-6	2
	2-2x12	8-1	2	7-1	2	6-5	2
Roof, Ceiling & One Clear-Span Floor	2-2x4	2-8	1	2-4	1	2-1	1
	2-2x6	3-11	1	3-5	2	3-0	2
	2-2x8	5-0	2	4-4	2	3-10	2
	2-2x10	6-1	2	5-3	2	4-8	2
	2-2x12	7-1	2	6-1	3	5-5	3
Roof, Ceiling & Two Center-Bearing Floors	2-2x4	2-7	1	2-3	1	2-0	1
	2-2x6	3-9	2	3-3	2	2-11	2
	2-2x8	4-9	2	4-2	2	3-9	2
	2-2x10	5-9	2	5-1	2	4-7	3
	2-2x12	6-8	2	5-10	3	5-3	3

(a) Based on IRC TR502.5(1)&(2) and assuming #2 grade lumber and 30psf ground snow load
(b) For widths between those shown, spans may be interpolated
(c) NJ = number of jack studs to support each end. If only one needed, hangers may be used
For header spans of interior bearing walls, use Table 8.

Table 11 • Stud Sizing, Spacing, Notching & Boring			
Stud Size	**2x4**	**3x4**	**2x6**
Bearing Walls (to 10ft. high)			
Supporting roof & ceiling	24" o.c.	24" o.c.	24" o.c.
Roof & ceiling + 1 floor	16" o.c.	24" o.c.	24" o.c.
Roof & ceiling + 2 floors	n/a	16" o.c.	16" o.c.
Notching **Fig. 30**	7/8"	7/8"	1 3/8"
Boring **Fig. 30**	1 3/8"	1 3/8"	2 3/16"
Boring 2 doubled consec.	2"	2"	3 1/4"
Nonbearing Walls			
Notching **Fig. 30**	1 3/8"	1 3/8"	2 3/16"
Boring **Fig. 30**	2"	2"	3 1/4"
Based on IRC T602.3(5) and 602.6 and UBC T23-IV-B			

Structural Sheathing/Bracing

Sheathing and bracing are used to strengthen and stiffen stud walls from horizontal movement. Bracing is also used to help create a vertical load path from the roof to the foundation for loads such as winds and earthquakes. This energy must be directed to the ground to help prevent catastrophic damage to the building.

	IRC	UBC
☐ Plywood—5/16in min @16 o.c.; 3/8@24 o.c T12	[602.10.3]	{2320.11.3-3}
☐ Fiberboard—1/2 min for studs 16 o.c	[602.10.3]	{2320.11.3-4}
☐ Gypsum board—nailed (not screwed) at 7 o.c	[602.10.3]	{2320.11.3-5}
☐ Wood panels must have span rating on grade stamp	[602.10.3]	{2304.1}
☐ Framing or blocking at all edges	[602.10.7]	{2315.5.3}
☐ Nail to schedule (6in edge–12in field min)	[T602.3(1&2)]	{T-23-II-B-1}
☐ Alternate methods OK if engineered & approved F17	[104.11]	{104.2.8}

Table 12 • Wall Bracing (based on IRC T602.10.1)[a]			
SDC	**Condition**	**Type of Brace**	**Amt. of Bracing[b]**
A & B[c]	1 story, top of 2nd or 3rd story, 1st story of 2, 2nd story of 3	let-in 1x4 or structural sheathing	16%
A & B	1st story of 3 story	structural sheathing	25%
C	1st story of 2 or 2nd of 3	structural sheathing	30%
	1st story of 3 story	structural sheathing	45%
D1	1 story, top of 2nd or 3rd	structural sheathing	20%
	1st story of 2 or 2nd of 3	structural sheathing	45%
	1st story of 3 story	structural sheathing	60%
D2	1 story or top of 2 story	structural sheathing	25%
	1st story of 2 story	structural sheathing	55%
	Cripple Walls	wood structural panels	75%

a. UBC T23-IV-C-1&2 requirements can be met by application of the IRC table
b. bracing must be at each end and a maximum of 25 feet on center
c. also acceptable for category C top one story or top of 2nd or 3rd story

Rafters & Ceiling Joists

Rafters and ceiling joists tie the walls together and are not typically designed for live loads other than light attic storage. Special attention must be paid to hip and valley rafters, as they may carry a much larger area of dead load and environmental loads.

Rafters & Joists	**IRC**	**UBC**
☐ Spans per tables. T13,14	[802.4,5]	{2320.12.2}
☐ Prefabricated wood I-joists per manu. spec . . F22-29	[802.7.2]	{2320.1}
☐ No notching tension side of ≥4in thick members exc . at ends	[802.7.1]	{n/a}
☐ Notching & boring–see floor joists & girdrs p.11 . . F19	[802.7]	{2320.12.4}
☐ Supports such as ridge for <3:12 slope roof designed as beams not rafters	[802.3]	{2320.12.1}
☐ Rafter ties—1x4, 4ft o.c. {if joist not parallel to rafters}	[802.3.1]	{2320.12.6}
☐ Ridge board min 1x & full depth of cut rafter	[802.3]	{2320.12.3}
☐ Hip & valley rafters min 2x & full depth of cut rafter . . .	[802.3]	{2320.12.3}
☐ Purlin dimension no smaller than rafter	[802.5.1]	{2320.12.7}
☐ Headers & trimmers >4ft must be doubled	[802.9]	{2320.12.5}
☐ Header >6ft must be hung with hardware	[802.9]	{2320.12.5}
☐ Max allowable deflection ceiling joists L/240*	[301.6]	{2320.12.2}
☐ Max allowable deflection roof rafters L/180*	[301.6]	{2320.12.2}
☐ Max horiz support between ceiling joists T13	[802.4]	{2320.12.2}
☐ Max horiz support between roof rafters T14	[802.5]	{2320.12.2}
☐ Rafter span can be measured from purlin support. . .	[802.5.1]	{2320.12.7}
☐ Ends of rafters must have min 1½in bearing	[802.6]	{local}

* L/ = length in inches

Table 13 • Ceiling Joist Span						
DF#2	**IRC, 10lb. live load**			**UBC, 20lb. live load**		
	12"o.c.	16"o.c.	24"o.c.	12"o.c.	16"o.c.	24"o.c.
2x4	9'10"	8'9"	7'2"	9'10"	8'11"	7'10"
2x6	14'10"	12'10"	10'6"	15'6"	14'1"	12'3"
2x8	18'9"	16'3"	13'3"	20'5"	18'6"	16'2"
2x10	22'11"	19'10"	16'3"	26'	23'8"	20'8"
Based on IRC T802.4(2) and UBC T23-IV-J-4						

Table 14 • Roof Rafter Horizontal Span Distance (no snow load)						
Size DF#2	**IRC**			**UBC**		
	12"o.c.	16"o.c.	24"o.c.	12"o.c.	16"o.c.	24"o.c.
2x4	9'10"	8'11"	7'10"	–	–	–
2x6	15'6"	14'1"	11'9"	16'5"	14'2"	11'7"
2x8	20'5"	18'2"	14'10"	21'7"	18'9"	15'3"
2x10	25'8"	22'3"	18'2"	–	23'11"	19'6"
2x12	–	25'9"	21'	–	–	23'9"
Based on IRC T802.5.1(2) and UBC T23-IV-R-1 20lb. live load + 10lb. dead load						

Roof & Ceiling Trusses

The most common roof trusses have 2-point bearing, i.e., they do not bear on the interior walls. The outside members of a truss are called chords, and the inside members are called the web. Trusses must not be cut or altered from their original design, and must be installed in exact accord with the instructions included in the truss shipment. Because of possible seasonal truss movement, the attachment of interior partition walls to the trusses can be made with hardware that allows vertical movement, as in F34. Trusses must also be anchored at their bearing points to resist wind uplift, especially in high wind areas such as Florida. During construction, trusses require temporary bracing. The Truss Plate Institute standards are incorporated into the IRC, and they also publish HIB-91, a guide to handling, installing and bracing metal-plate-connected wood trusses.

Trusses – General	**IRC**	**UBC**
☐ No field modification exc w/ engineer approval. . . .	[802.10.4]	{2320.1}
☐ Provide design drawings, calculations & approvals w/shipment {marked on truss}	[802.10.1]	{2321.4}
☐ Web bracing req'd per drawings (or per HIB if no spec on drawing).	[802.10.3]	{2321.4}

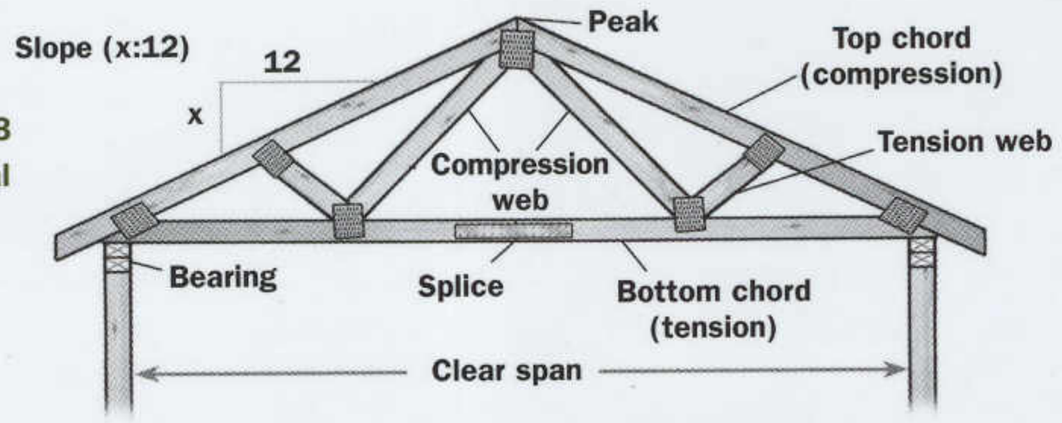


Fig. 33
Typical Truss

The requirements below are from HIB-91 (see above), published by the Truss Plate Institute. The IRC references TPI in its truss design and bracing sections.

Installation	**HIB 91**
☐ Follow truss drawings	.6.2
☐ Max out of plumb installation is 1/50 height	.10.3
☐ Cutting, boring, or relocation of truss member or plate req's engineering	.11.3
☐ Anchoring at bearing points per designer [3-16d min typ.]	.7 & A-3
☐ Use of slotted "L" clips is recommended	.F34 D-5

Fig. 34
Slotted "L" clip

Fig. 35
Truss Connector

Wind Uplift

High wind areas, such as much of the Gulf and Eastern coasts, as well as Alaska, require reinforced framing connections to prevent building distortion and damage. In many ways, the requirements are similar to those in areas of high seismic activity. Fastening of roofing materials and siding also becomes a major consideration in high wind areas. For regular-shaped buildings, SBCCI publishes a prescriptive code for hurricane-resistant construction, SSTD 10-99, which includes illustrations for ways to secure roof trusses and the building frame. Builders can use SSTD 10-99 and its prescriptive requirements for regular-shaped buildings subject to approval by the local building official. In actual practice, most builders prefer to have engineering specifications provided for each project in a high wind area. The uplift strength of different types of hardware is considered in the engineering drawings. The illustrations below show common examples of the hardware that will be specified.

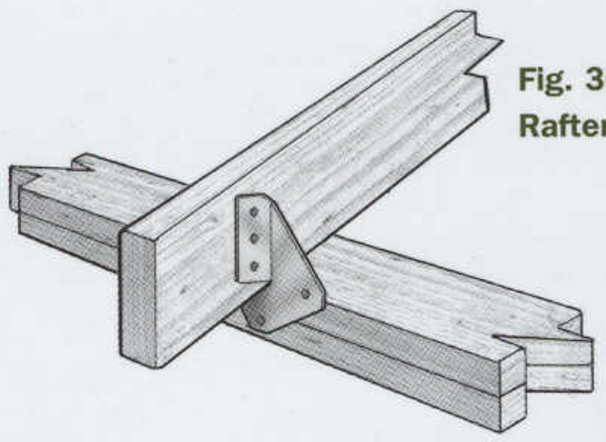


Fig. 36
Rafter to Plate Connector

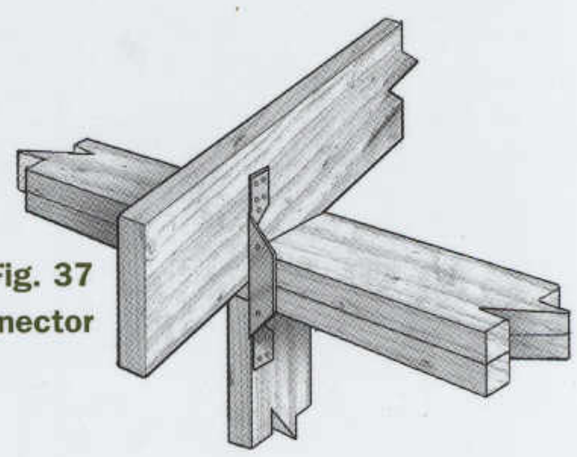


Fig. 37
Rafter to Stud Connector

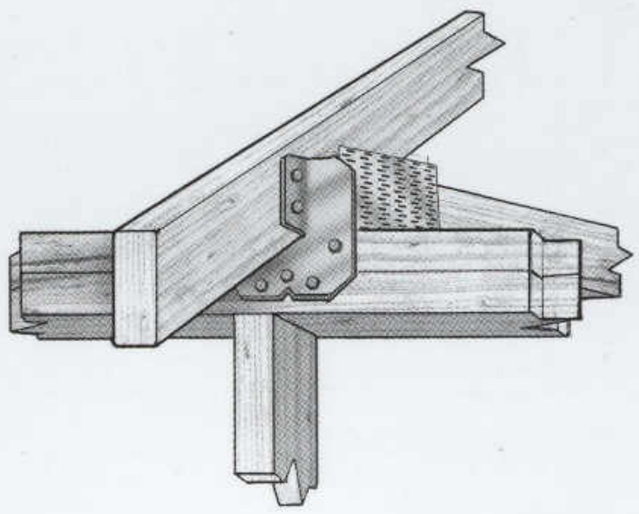


Fig. 38
Truss to Plate Connector

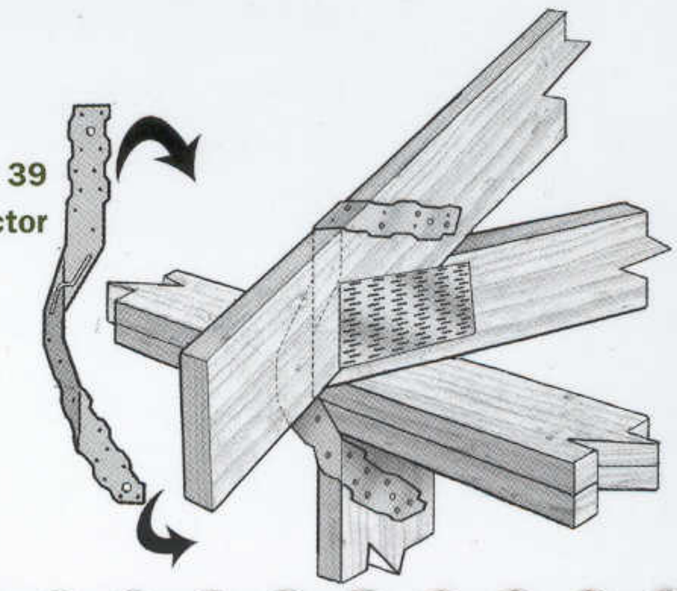


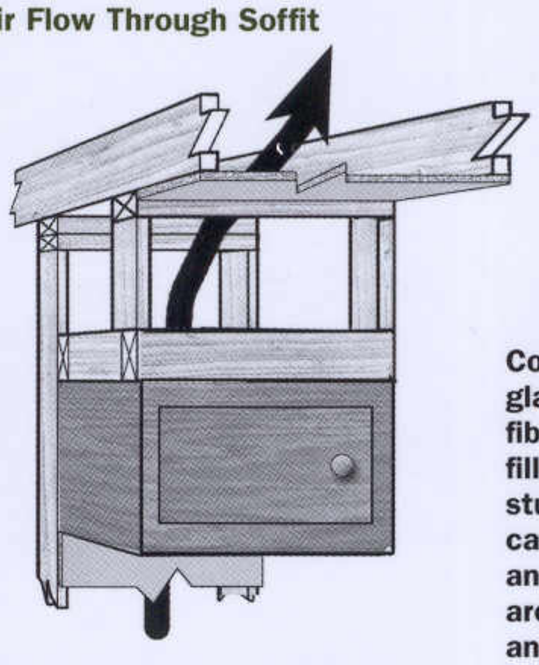
Fig. 39
Truss to Stud Connector

Fire Protection

Fireblocking does not actually stop fire; it cuts off air flow (draft) in concealed building cavities. Air flow through concealed cavities could allow a fire to spread more quickly, and fireblocking therefore prevents buildings from being quickly engulfed in fire. Fireblocking gives the occupants more time for escape and gives firefighters more protection by helping to prevent catastrophic building collapse. In multi-family dwellings, larger open spaces are divided by draftstops to prevent the spread of flame. Building areas with different uses, such as a garage and house, require fire-resistive separation, as do buildings with different occupancies, such as a two-family or multi-family dwelling or a dwelling above a commercial building.

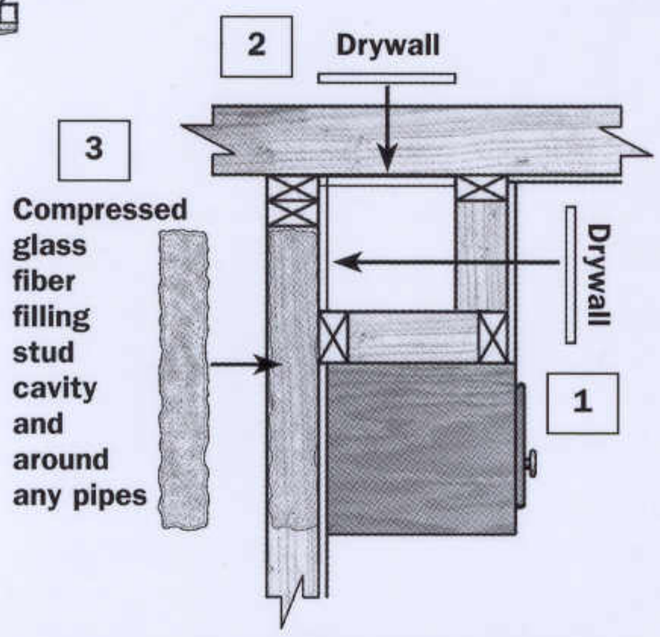
Fireblocking & Draftstopping	**IRC**	**UBC**
☐ Block concealed wall spaces every 10ft horiz & vert	[602.8]	{708.2.1}
☐ Block at ceiling/floor levels	[602.8]	{708.2.1}
☐ Horiz/vert intersections such as soffits, drop & cove ceilings	F40-42 [602.8]	{708.2.1}
☐ Concealed space under stairs @ top & bottom of stringers	[602.8]	{708.2.1}
☐ Seal gaps around ducts & pipes @ floor & ceiling level penetration	F43 [602.8]	{708.2.1}
☐ Material may be 2x lumber, ½in gypboard, compressed glass fiber	F41 [602.8.1]	{708.2.2}
☐ Compressed glass fiber should be tightly packed	F41 [602.8.1]	{708.2.2}
☐ Unfaced fiberglass min 16in vert when used as fireblock in wall cavity	F41 [602.8.1.1]	{local}
☐ Noncombustible fireblock between chimneys & framing	F76 [1001.16]	{3102.7.13}
☐ Floor/ceiling draftstopped if >1,000sq ft (open web trusses)	[502.12]	{708.3.1.1.1}
☐ Floor/ceiling draftstopped if >1,000sq ft & ceiling hung from bottom of joists	F67 [502.12]	{708.3.1.1.1}

Fig. 40
Air Flow Through Soffit



Air communicates through soffit to attic or ceiling space above

Fig. 41
Soffit Fireblocking Options



Fireblocking is achieved by implementing either 1, 2, or 3

Separation and Protection from Garage

☐ Min ½in {⅝in} gypboard on garage side of walls common to house	[309.2]	{302.4X}
☐ Min ½in gypboard on walls that support ceilings common to house	[309.2]	{302.2}
☐ Min ⅝in on garage ceiling common to house	[309.2]	{302.4X}
☐ Exterior walls <3ft from PL 1hr construction	[302.1]	{T-5-A}
☐ Ducts through wall or ceiling common to house min 26 gauge steel	[309.1.1]	{302.4X}
☐ No duct openings in garage	[309.1.1]	{302.4X}
☐ Door to house rated 20-minute or 1⅜in solid-core {self-closing}	[309.1]	{302.4X}
☐ Non-combustible floor [with slope to vehicle door or to a drain]	[309.3]	{312.5}
☐ 16sq.in max size for electrical boxes penetrating firewall	[n/a]	{709.7X}
☐ No back-to-back electrical boxes (24in horiz separation)	[n/a]	{709.7X}
☐ Listed plastic boxes or putty pads OK	[321.3.2X]	{709.7X}
☐ Electrical panel installation in firewall restricted per BO	[n/a]	{709.7}
☐ Carport means open on at least two sides	[309.4]	{302.1X3}

Separation in 2-Family Dwellings & Townhouses
(see also p.23)

☐ 2-family reqs 1hr construction at common walls & floor/ceiling EXC	[317.1]	{310.2.2}
½ hr OK if automatic sprinkler system present	[317.1X]	{n/a}
☐ Townhouses req 2hr {1hr} construction at common walls	[317.2]	{310.2.2}
☐ 16sq.in max size for electrical boxes in firewall	[317.3.2X1]	{709.7X}
☐ Listed plastic electrical boxes OK	[317.3.2X2]	{709.7X}
☐ No back-to-back boxes (24in horiz separation) OR	[317.3.2X1.1]	{709.7X}
Putty pad system in accordance with listing	[317.3.2X1.4]	{709.7X}

Separation Walls in Multi-Family Dwellings

☐ 1hr construction req'd at common walls & floor/ceiling	[n/a]	{310.2.2}
☐ All construction (exc. nonbearing interior partitions) min 1hr if >2 stories or >3,000sq ft above first floor	[n/a]	{310.2.2}
☐ 1hr construction between storage/laundry and dwellings	[n/a]	{310.2.2}
☐ Separation walls to extend in parapet above roof OR Common attic spaces sprinklered OR Divided by draftstops & returns above separation walls	[n/a]	{708.3.1.2.1}

Fig. 42
Coved or Dropped Ceiling

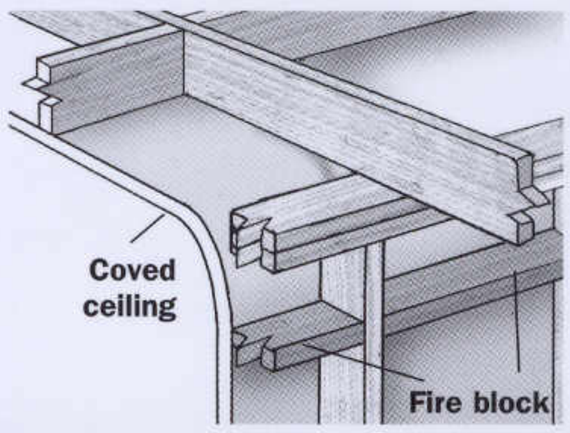
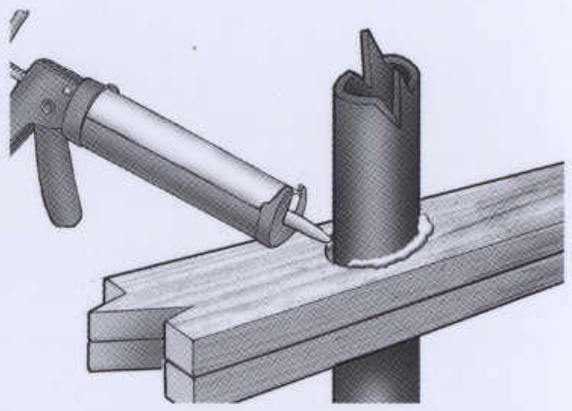


Fig. 43
Fireblock Openings around Pipes

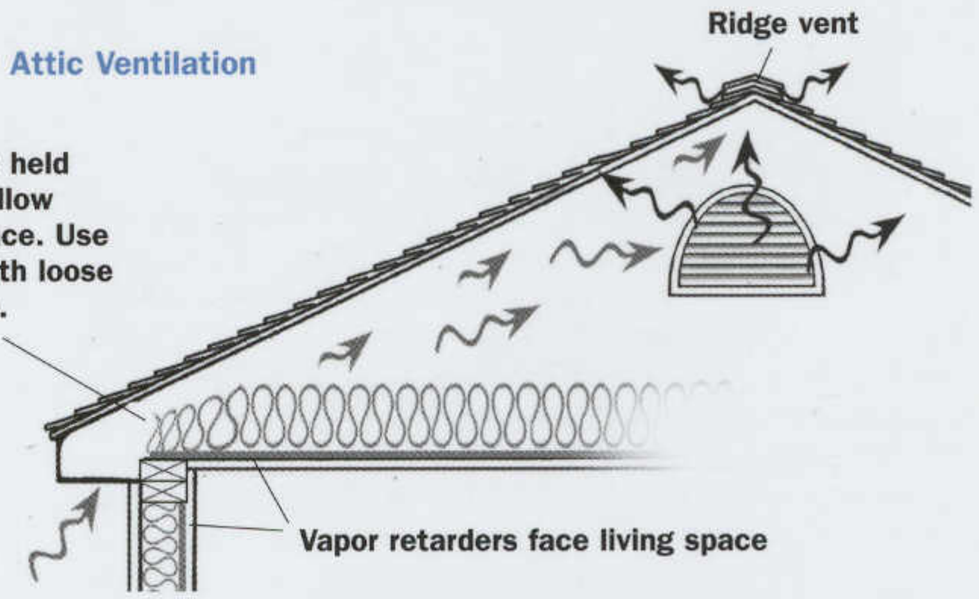


Attics

Attic spaces serve as a thermal buffer between the conditioned interior space and the outdoor environment. Insulation and vapor retarders must be properly installed so they conserve energy in the interior conditioned space. Ventilation is important to prevent condensation that could lead to water damage. Ventilation can also help to prevent excessive heat buildup in the attic.

Access	**IRC**	**UBC**
☐ Attics >30in high [& >30sq ft] require min 22in x 30in access opening {per BO}	[807.1]	{1505.1}
☐ Access opening large enough to allow removal of mech eqpmt	[1305.1.3]	{305.0M}
Ventilation		
☐ Vent each enclosed attic and rafter bay	[806.1]	{1505.3}
☐ [⅛in to] ¼in mesh screen over openings	[806.1]	{1505.3}
☐ Net opening area min 1/150th of vented area or F44	[806.2]	{1505.3}
1/300th if 50%–80% of venting near top or vapor retarder	[806.2]	{1505.3}
☐ Min 1in clearance to sheathing near vents F44	[806.3]	{1505.3}

Fig. 44 • Attic Ventilation



Roofs

Specialty trades such as mechanical and electrical need to wait until the roof deck and roof membrane (such as felt paper on a slope roof) are in place before they can begin their work. Roof systems can be generally categorized into two types: low slope, where the roof material includes a watertight membrane, and steep slope, where the roofing materials shed water to the next lower level. The most common sloped roofing material is asphalt shingle, though tile and metal are common in parts of the country. Care must be taken in stacking tile to avoid overloading any one point on the roof structure. Door and window frames should not be installed until a tile roof is loaded. Roof systems are also categorized according their fire rating: class A, B, C, and non-rated. Additional membranes are needed to protect against ice dams in snow country. The National Roofing Contractors Association (NRCA) provides installation guidelines.

Roof Sheathing		
☐ Solidly sheathed decking req'd for asphalt shingles	[905.2.1]	{T15-B-1}
☐ Solidly sheathed decking or spaced structural sheathing req'd for tile	[905.3]	{T15-D-2}
☐ Nail sheathing per tables T21	[T602.3(1)]	{T23-II-B-2}
☐ Install sheathing per stamped span rating	[803.2.2]	{T23-II-E-2}
☐ ⅛ gap on sheathing marked "sized for spacing"	[manu]	{2312.2}
Roof Surfaces—General		
☐ Tile and metal considered Class A fire-resistant	[902.1]	{1504.2}
☐ Fire-retardant treated wood roofs req test agency label each bundle	[902.2]	{1507.12}
☐ Follow manu installation instructions	[903.1]	{1507.5,6,7}
☐ Flashing req'd at all penetrations & intersections	[903.2.1]	{1509}
☐ Sloped roofs req chimney cricket if >30in wide F45	[1001.17]	{manu}
☐ Drains at each low point of roof unless designed to run over edges	[903.4]	{1506.2}
☐ Roofing materials must bear manu i.d. marks & test agency labels	[904.4]	{1507.2}
Low Slope Built-Up Roofing (BUR)		
☐ Built-up roofs (asphalt & gravel) min slope ¼in vert in 12in horiz	[905.9.1]	{1506.1}
☐ Install per manu installation instructions	[905.9.3]	{1507.6}
☐ Built-up roofing per ASTM standards	[905.9.2]	{1507.1}
☐ Secondary drains req'd 2in above low points of roof	[903.4.1]	{1506.3}

NRCA and ASTM Requirements	
☐ Store rolls on end not sides to prevent deformation	[NRCA]
☐ Water-based materials must be protected from freezing prior to installation	[NRCA]
☐ Protect insulation from moisture	[NRCA]
☐ Do not install roofing while rain, snow, or ice are present	[NRCA]
☐ Use cant strips to limit bends to 45 degrees at horiz to vert intersections	[NRCA]
☐ Sample temperature (typical 350°F to 425°F Type I asphalt)	[ASTM D 312]
☐ Aggregate dry and clean to adhere to hot bitumen	[ASTM D 1863]

Fig. 45 • Chimney Cricket

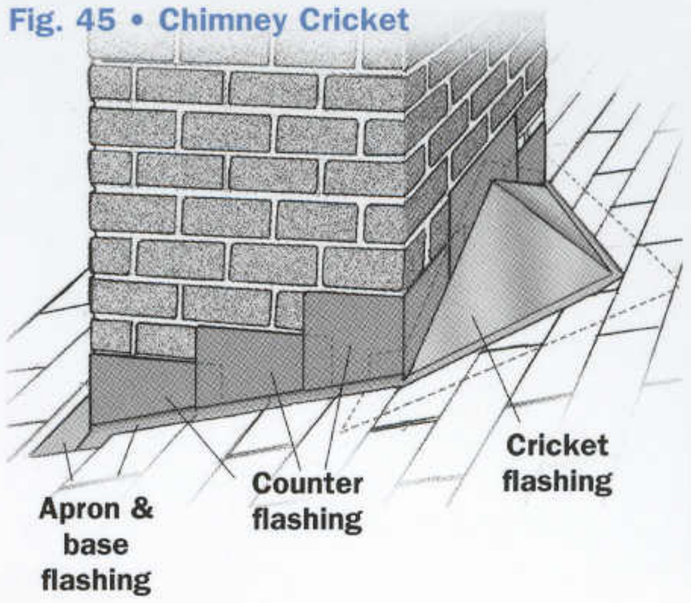
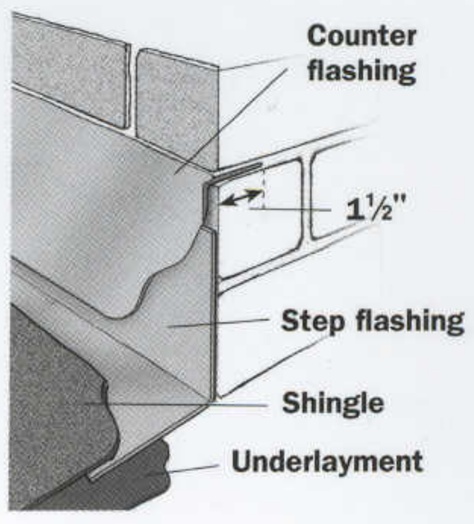
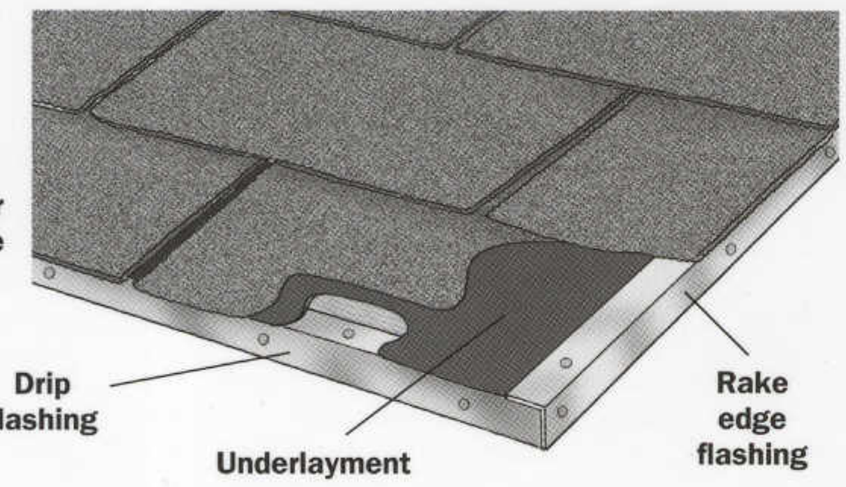


Fig. 46
Flashing Detail



Other Low Slope Roofing	IRC	UBC
☐ Mineral-surfaced roll roofing only on solidly sheathed roofs	[905.5.1]	{1507.10}
☐ Mineral-surfaced roll roofing min slope 1ft vert per 12ft horiz	[905.5.2]	{1507.10}
☐ EPDM roofing marked with ASTM 4637 designation max 13ft intervals	[905.12.2]	{1507.14}
☐ EPDM seams straight, flat, and no ripples	[905.12.3]	{1507.14}
☐ Provide secondary drain 2in above low point of roof	[903.4.1]	{1506.3}
Wood Shingles and Shakes		
☐ 16in Wood shingles min slope—3:12 {3¾in max exposure if <4:12}	[905.7.2]	{T15-B-2}
☐ Wood shakes min slope—3:12 {4:12}	[905.8.2]	{T15-B-2}
☐ Noncombustible or fire-retardant req'd	[n/a]	{1503, T15-A}
Asphalt Shingles		
☐ Asphalt shingles min slope—2:12 (double underlayment if <4:12)	[905.2.2]	{T15-B-1}
☐ Fasteners min ¾in into sheathing (or through if sheathing <¾in)	F49 [905.2.5]	{T15-B-1}
☐ Min 4 fasteners per strip shingle (3ft wide)	F48 [905.2.6]	{T15-B-1}
☐ Special fastening per manu on steep slopes (>20:12) or high wind areas	[905.2.6]	{T15-B-1}
☐ Ice-dam (BUR or modified bitumen) from roof edge to min 24in {12in} inside exterior wall line of building in areas where average daily January temp <25˚F	[905.2.7.1]	{T15-B-1}
☐ Closed {all} valleys req min 36in wide valley lining underlayment	[905.2.8.2]	{1508.2}
☐ Drip flashing below underlayment, rake flashing above underlayment	F47 [905.2.8.1]	{manu}

Fig. 47
Roof Edge Flashing



Clay & Concrete Tile		
☐ Clay/concrete tile min slope—2½:12 [double underlayment if ≤4:12] {BUR if <3:12}	[905.3.2]	{T15-D-1}
☐ Flashing at roof/wall intersections, penetrations, chimneys, etc	[903.2]	{1509}
☐ Number of fasteners per manu, min 1 per tile if tile <9lb/sq.ft, min 2 per tile in snow areas	[905.3.7]	{T15-D-1,2}
☐ If drains req'd then overflow drains also req'd	[903.4.1]	{1506.3}
☐ Fasteners must be corrosion resistant and penetrate sheathing min ¾in	[905.3.6]	{T15-D-2}
☐ Metal valley flashing with diverter rib min 11 in each side of center line with a min 4in overlap	F50 [905.3.8]	{1508.4}

Fig. 48
Asphalt Shingle Nail Zone

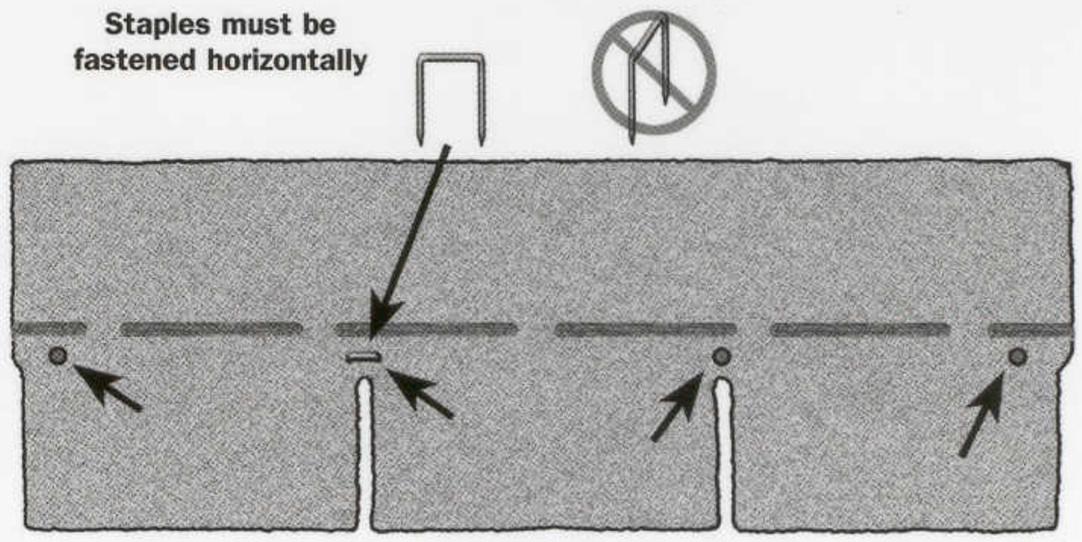


Fig. 49
Asphalt Shingle Nailing Method

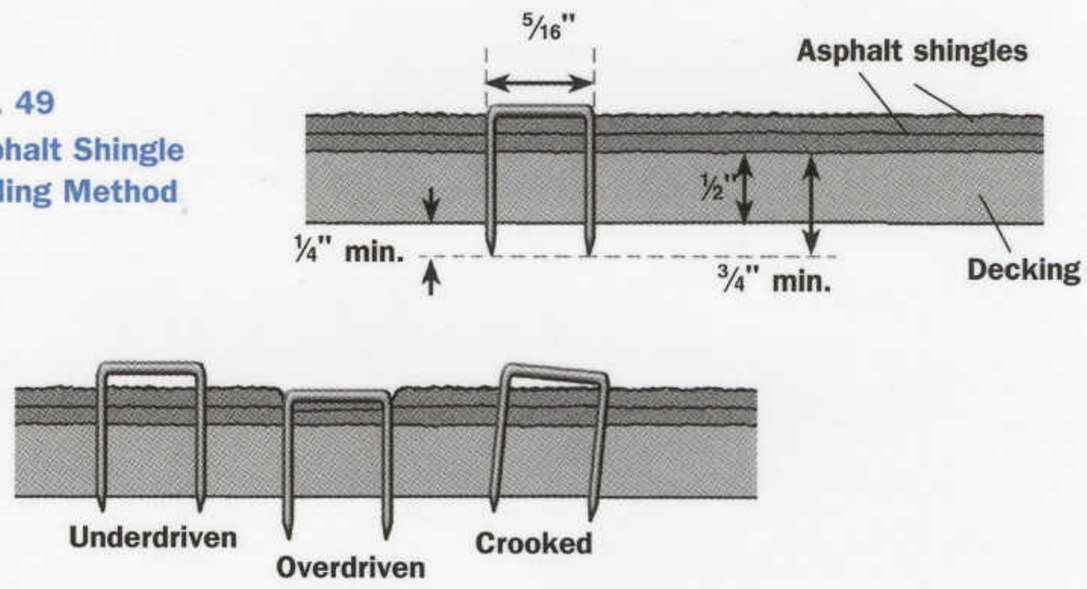
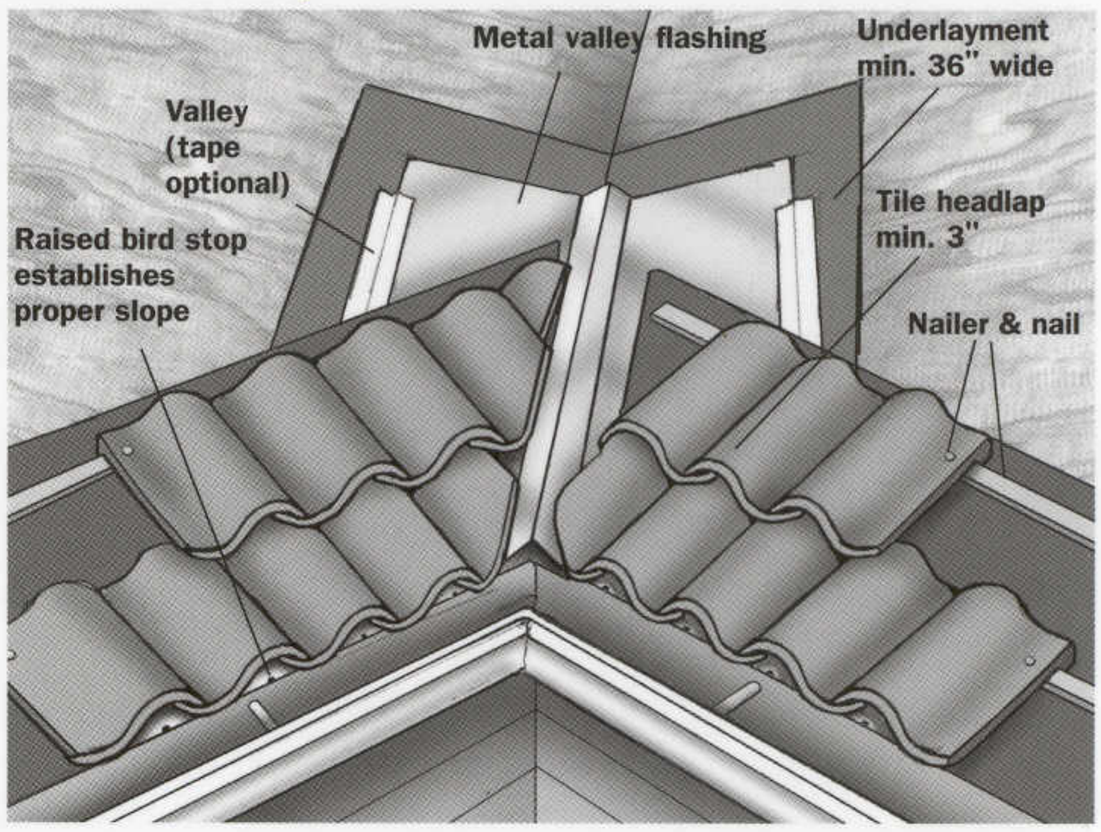


Fig. 50 • Tile Roof Valley



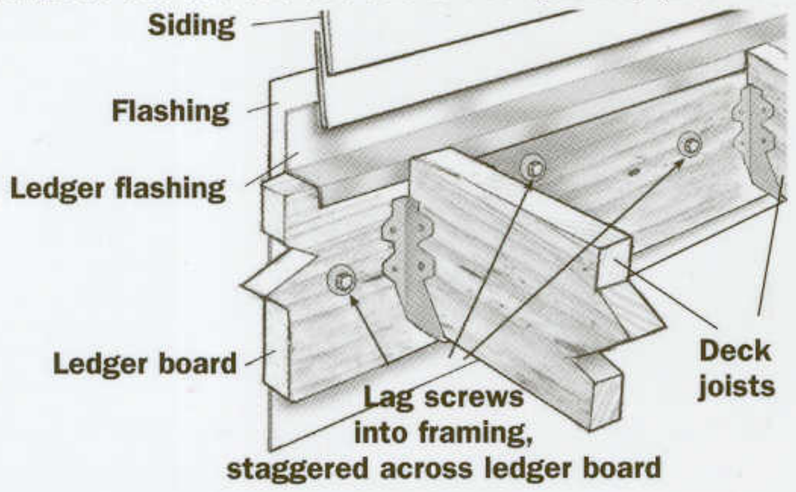
Egress

A means of egress (emergency escape) is an essential safety issue at the heart of the building codes. Properly sized doors must open from the inside without use of a key or tool to ensure an escape route to the exterior. A second means of egress to the exterior is needed for each bedroom and for basements with habitable space. The egress path must be stable. If it includes a balcony or deck, the deck must be securely attached to the building. Stairs with enclosed construction beneath them require fire protection, usually in the form of drywall under the stair.

Doors

	IRC	UBC
☐ Door w/direct access to exterior req'd [not through garage]	[311.4.1]	{1005.3.2.3}
☐ Req'd exit is min 3ft wide x 6ft 8in high [side hinged] door	[311.4.2]	{1005.3.2.1}
☐ Min clear width of door when open is 32in	[n/a]	{1003.3.1.3}
☐ All doors req keyless operation from interior	[311.4.4]	{1003.3.1.8}
☐ Hallway min 36in wide	[311.3]	{1004.3.3.2}

Fig. 51
Deck Ledger Flashing



Decks, Balconies & Landings (also see page 20)

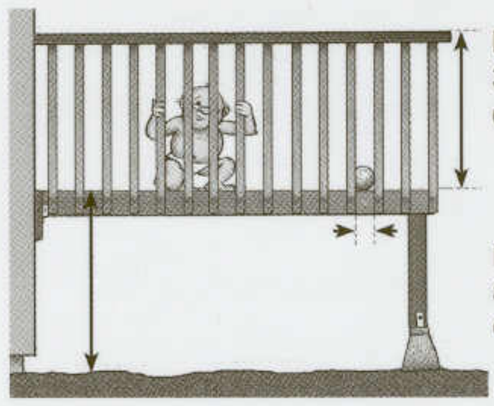
☐ Positively anchored (not toenailed) to resist lateral & vertical forces	F51	[311.2.1]	{2320.13}
☐ Floor or landing each side of ext doors EXC		[311.4.3]	{1003.3.1.6}
2 risers OK at exterior door that is not req'd exit		[311.4.3X]	{Ø}
☐ Landing min 36in deep x width of door		[311.4.3]	{1003.3.1.7}
☐ Floor or landing [at req'd exit] max 1½in {1in} below threshold EXC		[311.4.3]	{1003.3.1.6}
Landing [7¾ below threshold] {8in below floor} OK if door does not swing over landing (screen door may swing over)		[311.4.3X]	{1003.3.1.6X}
☐ Door may not swing over lower landing EXC		[311.4.3X]	{1003.3.1.6X}
Screen or storm door can swing over lower landing		[311.4.3X]	{1003.3.1.6X}

Guardrails

☐ Req'd for any walkoff >30in above floor or grade	F52	[312.1]	{509.1}
☐ Screened porches req guards if walkoff >30in		[312.1]	{509.1}
☐ {Min height 42in in multi-family} OR min height 36in if only accessible from one unit (34in if stair handrail)		[312.1]	{509.2X1}
☐ Max opening size <4in EXC	F52	[312.2]	{509.3}
☐ 6in opening OK at tread/riser/rail triangle		[312.2X]	{509.3X}
☐ Open risers on stairs must not allow 4in sphere to pass through		[311.5.3.3]	{509.3}
☐ Guardrail must be strong enough to resist 200 {50}pounds point load any direction		[301.5]	[1607.3.4]

Fig. 52
Guardrails

Guardrail req'd when deck surface to ground >30"

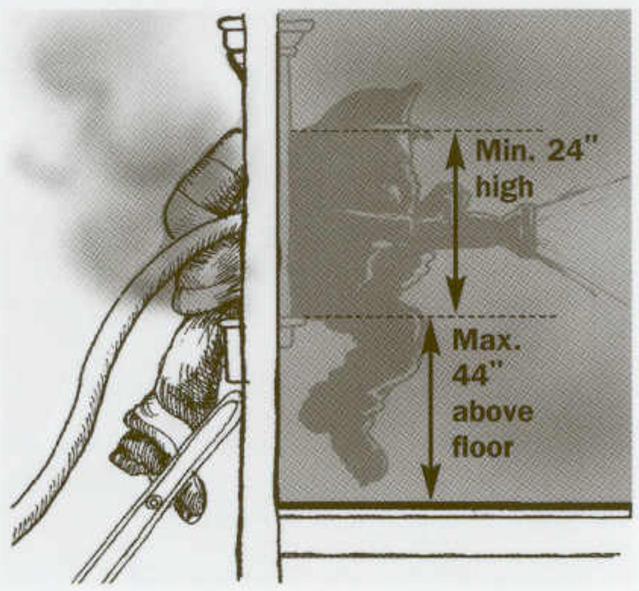


Bedroom Egress

☐ Every sleeping room req's emergency escape & rescue opening		[310.1]	{310.4}
☐ Sill height 44in max above finished floor	F53	[310.1]	{310.4}
☐ 5.7sq ft min clear opening EXC	T15	[310.1.1]	{310.4}
[5.0sq ft OK if direct grade level access]		[310.1.1X]	{Ø}
☐ Min 20in width & min 24in height per	T15	[310.1.2,3]	{310.4}
☐ No windows closer than 3ft to PL		[302.2]	{T-5-A}
☐ Req'd glazed openings must open to street, yard or court on same lot		[303.7]	[310.4]
☐ Security bars must have approved release hardware		[310.4]	{310.4}

Fig. 53
Bedroom Window Egress

The second exit required in a bedroom is usually a window. The dimensions of the openings are to ensure the residents an escape route, but equally important, they are designed to allow a firefighter with a backpack to enter. The opening must be at least 24" high and at least 20" wide, with a net area at least 5.7sq.ft., per T15. The window sill must not be higher than 44" from the floor.



Basement Egress

☐ Basements [with habitable space] req escape & rescue opening		[310.1]	{310.4}
☐ Window wells min 9sq ft & 36in min horiz dimension	F54	[310.2]	{310.4}
☐ Wells >44in below grade req permanent ladder	F54	[310.2.1]	{310.4}
☐ Ladder may project 6in into req'd well space	F54	[310.2X]	{310.4}
☐ Bulkhead enclosure doors must provide min req'd opening when open		[310.3]	{n/a}
☐ Bulkhead stairs no landing OK if hinged bulkhead door fully covers stair		[311.5.8.2]	{n/a}

Fig. 54
Basement Window Egress (plan view)

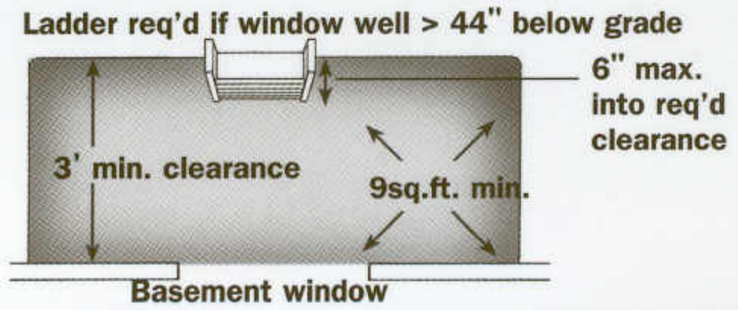


Table 15 • Bedroom Window Egress: Min. height and width requirements to meet req'd 5.7sq.ft. opening size (in inches)

Width	20	20½	21	21½	22	22½	23	23½	24	24½	25	25½	26	26½	27	27½	28	28½	29	29½	30	30½	31	31½	32	32½	33	33½	34
Height	41	40	39½	38½	37½	36½	35½	35	34½	33½	33	32½	31½	31	30½	30	29½	29	28½	28	27½	27	26½	26½	25½	25½	25	24½	24

Stairs

Stairs are the most frequent location of injury accidents in the home. A consistent rise and run is important for safety. The tallest riser can be no more than ⅜in higher than the shortest and the deepest tread can no more than ⅜in greater than the shallowest. Proper handrails and landings are also critical.

Stairways—General	IRC	UBC
☐ Headroom min 6ft 8in (spiral 6ft 6in)	F57 [311.5.2, 311.5.8.1]	{1003.3.3.4}
☐ Min stairway width above handrail 36in	[311.5.1]	{1003.3.3.2}
☐ Illumination req'd for stairs and landings	[303.6, 311.5.7]	{210.70A2[E]}
☐ Exterior stair lighting at top landing, control inside dwelling	[303.6, 303.6.1]	{210.70A2[E]}
☐ Interior stair light control top and bottom of stairs {with 6 or more risers}	[303.6]	{210.70A2[E]}
☐ Min stair & landing width 36in [31½in clear if 1 handrail, 27in clear if 2 handrails]	[311.5.1]	{1003.3.3.2}
☐ Max riser height 7¾in {8in},	F56 [311.5.3.1]	{1003.3.3.3X}
☐ Min tread depth 10in {9in}	F56 [311.5.3.2]	{1003.3.3.3X}
☐ Min riser height 4in	[n/a]	{1003.3.3.3}
☐ Riser or tread maximum differential ⅜in	[311.5.3.1,2]	{1003.3.3.3}
☐ Winder-tread min 6in at inner edge	F55 [311.5.3.2]	{1003.3.3.8.2}
☐ Winders min 10in {9in} tread depth within 12in from inside	F55 [311.5.3.2]	{1003.3.3.8.2}
☐ Nosing min ¾in max 1¼in req'd on stairs with solid risers	F56 [311.5.3.3]	{n/a}
☐ Nosing not req'd on stairs with treads ≥ 11in	[311.5.3.3X1]	{n/a}
☐ Beveling of nosing max ½in.	[311.5.3.3]	{n/a}
☐ Curvature radius of tread leading edge max 9/16in	F56 [311.5.3.3]	{n/a}
☐ Slope of [tread]{exterior landing} max 1:48 (2%)	[311.5.5]	{1003.3.3.5}
☐ Accessible space below stairs req's ½in gypsum board {1-hour const}	[311.2.2]	{1003.3.3.9}

Fig. 55 • Winding Stairs

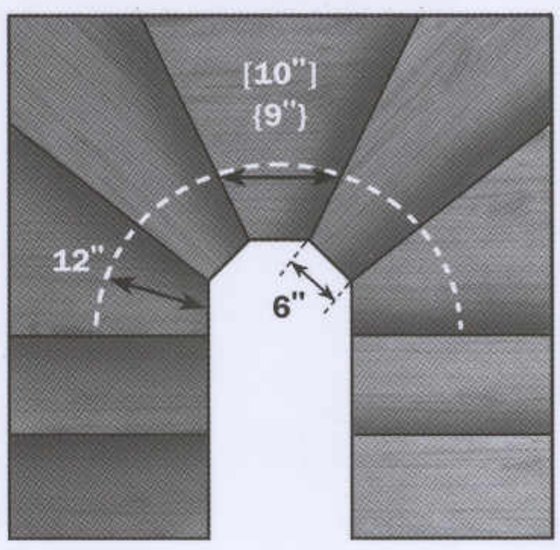
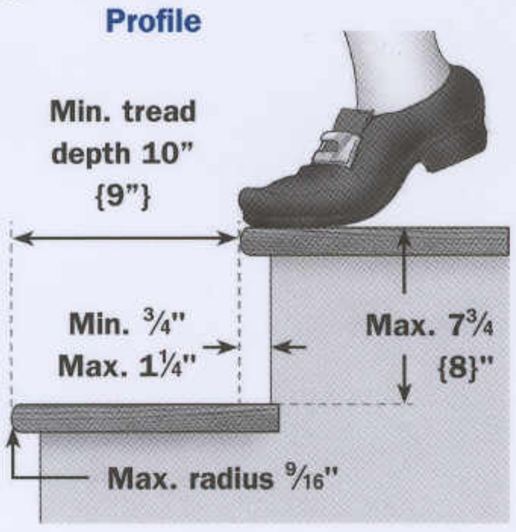


Fig. 56 • Stair Profile



Landings

☐ Landing req'd at top & bottom of stairs EXC	F57 [311.5.4]	{1003.3.3.5}
Door at interior stair may open away from top step	[311.5.4.X]	{1003.3.1.6X}
☐ Landing not req at ext stair w/2 or fewer risers if door is not required exit	[311.4.3]	{Ø}
☐ Max 12ft vert stairway rise between landings	[311.5.4]	{1003.3.3.5}
☐ Landing min 36in deep x width of door or stair	[311.5.4]	{1003.3.3.5}
☐ Landing at ext door max 7¾ {8in} below top of threshold {floor above}	[311.4.3]	{1003.3.1.6X}
☐ Screen or storm door OK to swing over lower landing	[311.4.3X]	{1003.3.1.6X}

Handrails

☐ Grippable rail req'd if 4 or more risers	[311.5.6]	{1003.3.3.6}
☐ Handrail height min 34in and max 38in	F57 [311.5.6.1]	{1003.3.3.6}
☐ Grips must be 1¼in–2in circular cross section .	F58 [311.5.6.3]	{1003.3.3.6}
☐ Max projection into stairway 4½in {3½in}	F58 [311.5.1]	{1003.3.3.2}
☐ Ends shall return to wall or newel post or volute	F57 [311.5.6.2]	{1003.3.3.6}
☐ Handrails must be strong enough to resist 200 pounds point load in any direction	[301.5]	[1607.3.4]
☐ Handrail on open side of stairs must not allow 4in sphere to pass through	[312.2]	{509.3}
☐ Open risers no opening > 4in EXC	[311.5.3.3]	{n/a}
6in OK on open side of stair at tread-riser-rail triangle	[312.2X1]	{509.3X2}

Fig. 57 Handrail Height

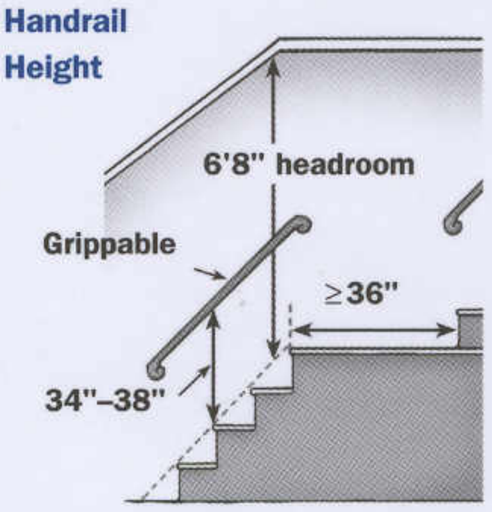
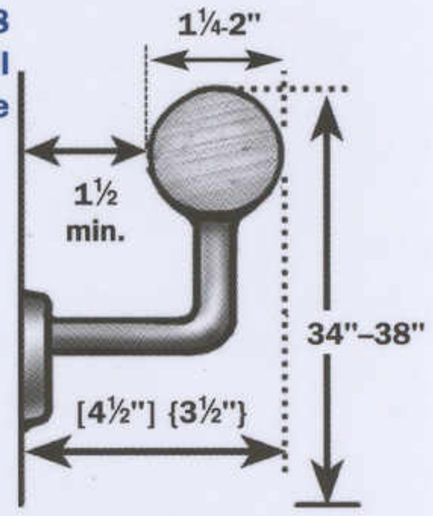


Fig. 58 Handrail Size



Spiral Stairways—General

☐ Min width 26 in, all treads identical, min headroom 6ft 6in	[311.5.8.1]	{1003.3.3.8.3}
☐ Min tread with 7½in at 12in from narrow edge	[311.5.8.1]	{1003.3.3.8.3}
☐ May be used as required egress for up to 400sq ft	[n/a]	{1003.3.3.8.3}

Light & Ventilation

Openable windows, doors, louvers, and skylights provide natural ventilation of habitable spaces. Mechanical ventilation can be substituted for these openings. Skylights, windows, and doors must also provide sufficient natural light for habitable rooms. The proper type of glazing must be used in areas where glass could break and create a safety hazard (see p. 24).

Light

☐ In habitable rooms, natural light min 8% floor area {10% & min 10sq ft}	[303.1]	{1203.2}
☐ Artificial light OK for {kitchens} [rooms where emrgy egress not req'd]	[303.1X2]	{1203.2X}
☐ Bathrooms min 3sq ft glazing or may have artificial light only	[303.3X]	{210.70A1[E]}

Ventilation

☐ Natural ventilation ≥4% of floor area {5% min & 5sq ft} OR	[303.1]	{1203.3}
Mech 0.35 air changes/hr or 15cfm per occupant	[303.1X1]	{1203.3}
☐ Bathroom window min 1½sq ft {5% floor area} OR	[303.3]	{1203.3}
Artificial light & 50cfm {5 air changes/hr.} fan ducted directly to outside	[303.3X]	{1203.3}
☐ Two rooms are considered one for light & ventilation if opening between them min 50% of common wall AND ≥10% floor area of interior room AND at least 25sq ft	[303.2]	{1203.1}

Exterior Wall Covers

Every component in the weather envelope must be properly integrated with other components. One of the fundamental concepts of this process is called "shingling" of materials. Whatever material is above must lap over the top of what is below so water is directed away from the building. Failure to pay attention to proper weather protection will result in water intrusion, deterioration, and the formation of bio-organic growth such as mold. Many exterior wall systems, such as adhered or supported veneer and stucco (plaster), lap and shingle sidings, are "water managed" rather than "barrier" systems—they rely on building paper behind the surface to direct water away from the framing. That water must be provided with a means of escape. Wall coverings such as plywood that can also function as structural sheathing must be installed per the structural rules on p. 14.

General	IRC	UBC
☐ Ext wall shall prevent water penetration	[703.1]	{1402.1}
☐ Lap sheathing paper 2in horiz and 6in vert	[703.2]	{1402.1}
☐ Ext sheathing must be dry before installing ext cover	[701.2]	{n/a}
☐ All penetrations/intersections/projections flashed	F63 [703.8]	{1402.2}
☐ Effective flashing around windows & door openings	F63 & F64 [703.8]	{1402.2}
☐ Ext wall envelope designed to prevent accumulation of water inside	[703.1]	{n/a}
☐ Foam plastic sheathing board ≤½in thick OK as siding backer board	[314.2.5]	{n/a}
☐ All fasteners shall be corrosion-resistive	[703.4]	{2310.7}

Stucco—General	IRC	UBC
☐ 3-coat system req'd EXC	F59 [703.6.2]	{2508.1}
2-coat OK over masonry or concrete or if covered by ext facing material	[703.6.2]	{2508.1}
☐ Weep screed req'd min 4in above earth 2in above paving	F60[703.6.2.1]	{2506.5}
☐ No stucco below screed	F60[703.6.2]	{2508.1}
☐ Tops of parapets & balcony walls req min ¼in/ft slope	[703.1]	{1402.3}
☐ Stucco over wood steps: roll membrane up sides (between tread & side wall) w/counterflashing	[703.8]	{2306.9}
☐ Interval between coats	T16[T702.1(3)]	{T25-F}
☐ Total thickness from sheathing on ext walls ⅞in	[T702.1(1)]	{T25-D}

Table 16 • Portland Cement Plaster (Stucco) Exterior Wall Covering

Coat	Portland cement	Portland Cement Lime Plaster			Min. period moist coats	Min. interval before next coat
	Max. sand to cement volume ratio	Max lime to cement volume ratio	Max. sand to cement + lime volume ratio	Approx. thickness during curing		
Scratch coat	4	3:4	4	⅜"	48 hours	48 hours
Brown coat	5	3:4	5	⅜" (¾" min. total)	48 hours	7 days
Finish coat	3	-	3	⅛"	n/a	n/a

Based on [Table R702.1(3)] and {Table 25-F}

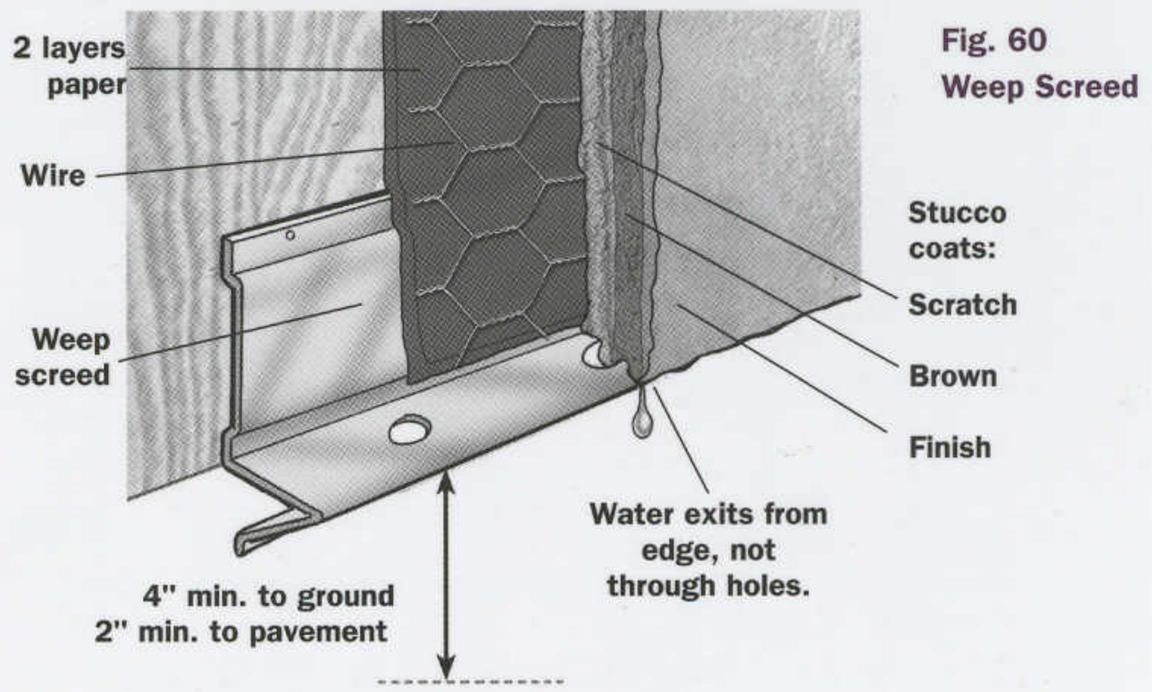


Fig. 60
Weep Screed

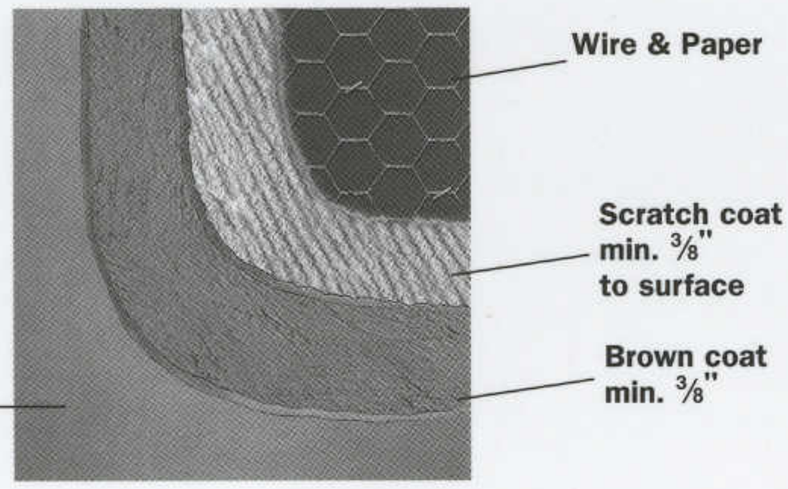


Fig. 59
3 Stucco Coats

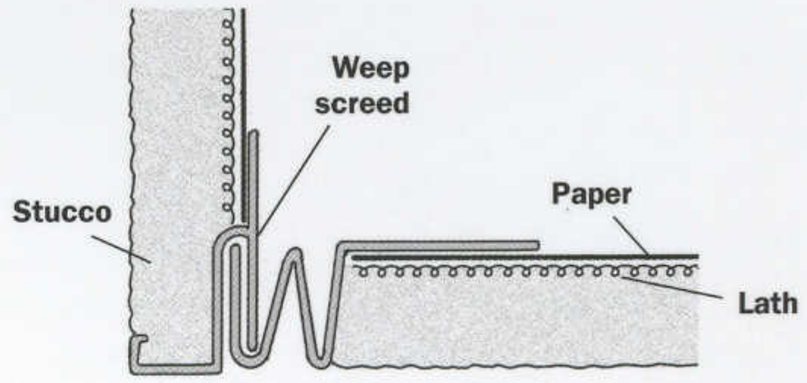


Fig. 61
Weep Screed at Soffit

Stucco—Paper & Wire	IRC	UBC
☐ Min 2 layers grade D paper barrier if over sheathing	[n/a]	{2506.4}
☐ Paper lap—horiz 2in; vert 6in	[703.2]	{1402.1}
☐ Min #14 felt paper attached to wood studs or solid sheathing	[703.2]	{2506.4}
☐ All fasteners to be corrosion resistant	[703.4]	{2506.2}
☐ Wire lap min one mesh or 1in	[trade]	{manu}
☐ Reinforce corners or lap wire one support distance	[trade]	{2506.5}
☐ Nail or staple wire with 6in max spacing	[703.6.1]	{manu}
☐ Attach to wood studs or solid sheathing (not random)	[manu]	{2506.3}
☐ Lap paper/paper & wire/wire (not wire/paper/wire/paper)	[703.1]	{2506.3}
☐ No holes on the top of horiz surfaces (copings, etc.)	[703.1]	{2506.4}

Exterior Insulation Finish Systems (EIFS)		
☐ Must follow manu. instructions	[703.9]	{manu}
☐ EIFS req's barrier & drainage plane behind surface	[703.9.1]	{1402.1}
☐ No decorative trim face nailed through EIFS	[703.9]	{manu}
☐ Terminate EIFS ≥6in above grade	[703.9]	{manu}
☐ Special inspections req'd unless over masonry or weather barrier (drained system)	[1704.12[B]]	{1701.1}

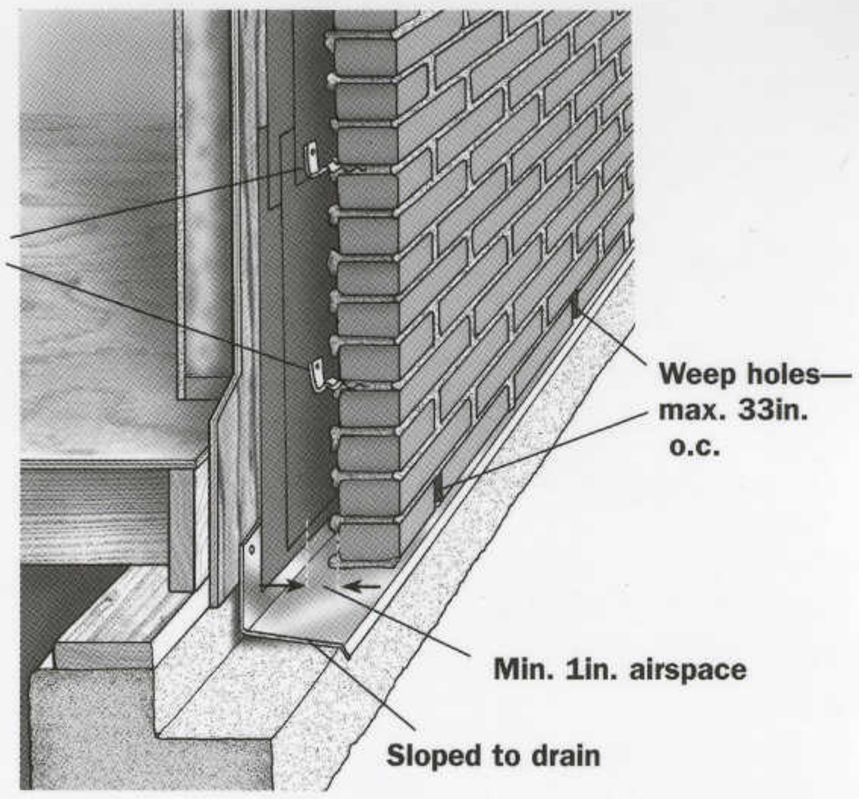
Masonry Veneer

	IRC	UBC
☐ Max thickness 5in & 30ft height	[703.7]	{1403.6.2}
☐ SDC D1&D2 max 4in thick & must have wall bracing	[703.7X3]	{n/a}
☐ Not OK to support additional loads on masonry veneer	[703.7.3]	{1403.4.1}
☐ Min ¾ gap between top of veneer & structural frame including roof rafters	[F703.7]	{1403.4.1}
☐ Metal ties max 24in horiz & vert spacing	F62 [703.7.4.1]	{1403.6.4.2}
☐ Ties in SDC D1&D2 must support no more than 2sq ft of wall area {hook into veneer reinforcement wire}	[703.7.4.1X]	{1403.6.4.2}
☐ Flashing to ext req'd at all openings & horiz transitions	[703.8]	{1402.2}
☐ Min 3/16in weepholes req'd above flashing max 33in on center	F62 [703.7.6]	{1403.6.1}
☐ Air space min 1in - max 4½in between sheathing & veneer OR	[703.7.4.2]	{1403.6.4.2}
Mortar or grout fill over weather-resistant membrane	[703.7.4.3]	{1403.6.4.2}
☐ Water resistant membrane not req if sheathing is water repellent	[703.7.4.2]	{1402.1}

Wood or Hardboard Panel or Lap Siding

☐ Hardboard lap siding req's sheathing paper	[T703.4]	{2310.6}
☐ Horiz siding min lap 1in (½in if grooved), ends caulked or covered	[703.3.2]	{2310.6}
☐ Panel siding vert joints over framing members EXC	[703.3.1]	{2310.6}
OK between studs if over structural sheathing or paper	[703.3.1]	{2310.3}
☐ Panel siding vert joints lapped or covered with batten	[703.3.1]	{2310.3}
☐ Panel siding horiz joints lapped min 1in or flashed (Z-bar)	[703.3.1]	{2310.3}

Fig. 62
Masonry Veneer



Wood Shakes & Shingles

☐ Weather-resistant membrane req'd behind shingles	[703.5.1]	{2310.4}
☐ Max spacing between shingles ¼in (shakes ½in)	[703.5.1]	{n/a}
☐ Min offset between shingle joints in adjacent courses 1½in	[703.5.1]	{n/a}
☐ Max weather exposure for 16in shingle is 7½in	[T703.5.2]	{T23-II-K}
☐ Fasteners to be hot-dipped galv steel, stainless or alum {corrosion resistant}	[703.5.3]	{2310.4}

Windows & Doors

Windows and doors are a common point of leakage into a building. Proper flashing and careful installation is needed to prevent leakage. The principle of "shingling" the materials, including the window flange, is critical, as is following any instructions included with the windows.The IRC requires that windows and glass doors be factory-built (not site built) and the manufacturer provide a label on the unit referencing the test method used to assure that the unit meets minimum air and moisture leakage limits. Thermal performance criteria and light emissivity must also be considered. Energy codes will limit the area of glazing unless other means are used to compensate for the energy loss created by large amounts of glazing.

General

	IRC	UBC
☐ Ext windows & glass doors req 3rd party test & label	[613.3]	{n/a}
☐ No windows <3ft to property line	[302.2]	{T5-A}
☐ Safety glazing where req'd (see page 24)	[308]	{2401}
☐ Design for internal pressure & wind-blown debris in high wind areas	[613.4]	{1615}
☐ Effective flashing around windows & door openings	F63&64 [703.8]	{1402.2}

Fig. 63
Window Flashing

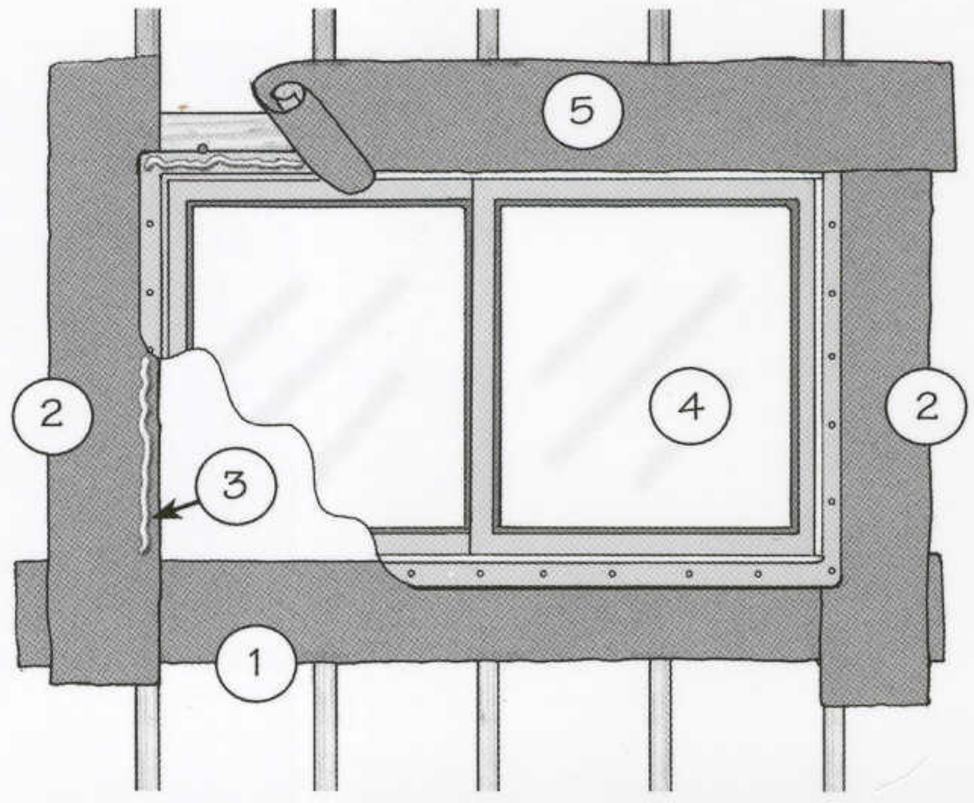
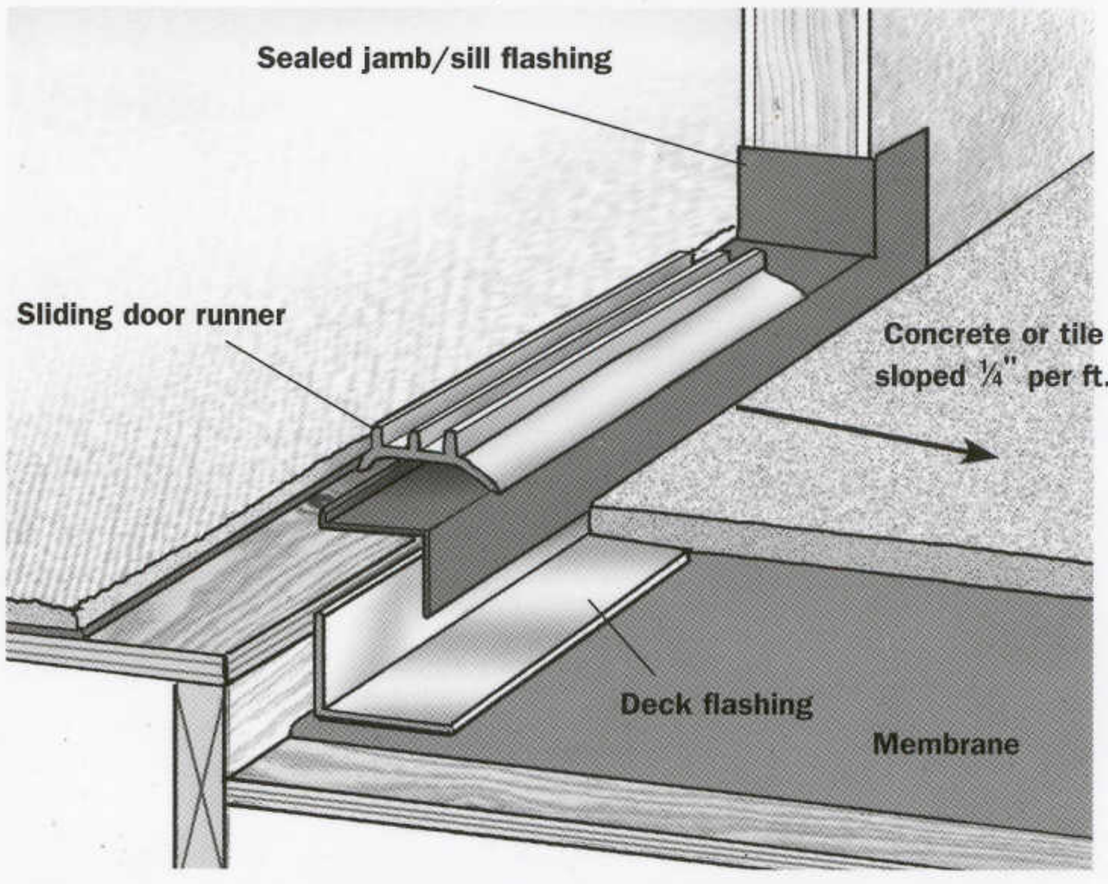


Fig. 64
Door to Deck Flashing



Deck flashing must be sealed to membrane.

Dry Walls

Interior wall surfaces cannot be installed until rough inspections are complete, including framing, mechanical, plumbing, and electrical. Many jurisdictions then have a separate inspection for insulation, and then for drywall fastening before the joints are taped.

Gypsum Board	IRC	UBC
☐ Interior gypboard not to be installed where subject to weather or water	[702.3.5]	{manu}
☐ Installed only after all rough inspections complete	[109.4]	{108.5.4}
☐ Installed after building is weathertight	[701.2]	{2511.1}
☐ Nailing per schedule	T17 [T702.3.5]	{2511.2}
☐ Edges & ends to occur over framing except where perp to framing	[702.3.5]	{2511.3}
☐ Wood frame support min 2x material EXC 1x2 furring strips OK over solid backing or framing ≤ 24in o.c.	[702.3.2]	{n/a}

Shower/Wet Walls

The Gypsum Association does not recommend use of water-resistant gypboard (greenboard) as a backer for mastic tile where it will be exposed to splashing water. It is appropriate for areas subjected to occasional moisture. Cement board is an appropriate backing material in showers. Be sure to read the manufacturer's instructions for cement backer board to determine if and what type of vapor barrier/retarder is required between it and the framing.

Greenboard (Water-Resistant Gypboard)		
☐ Not over vapor retarder [in shower or tub]	[702.4.2]	{2512}
☐ OK for adhesive ceramic tile (not in shower)	[702.4.2]	{2512}
☐ All cut or exposed edges must be sealed with water-resistant sealant	[702.4.2]	{manu}
☐ Not on ceilings with >12in o.c. framing	[702.4.2]	{2512}
☐ Finish to extend min 72in {70} above drain	[307.2]	{807.1.3}
Tile Backer Board (Cement Board)		
☐ Suitable for adhesive ceramic tile	[702.4.1]	{local}
☐ Reqs building paper backing	[manu]	{807.1.3}
☐ Corrosion-resistant fasteners	[manu]	{807.1.3}
☐ All joints covered with water resistant sealant	[702.4.2]	{807.1.3}
☐ Water resistant material to extend min 72in {70} above drain	[307.2]	{807.1.3}

Insulation

Insulation and vapor barriers are necessary to conserve energy and increase the comfort of a home. In most climates, the vapor barriers face the conditioned space. Sound insulation is also advised in common walls between dwellings. Ceiling assemblies with living areas above them also benefit from sound-isolating assemblies.

Insulation		
☐ Vapor retarder facing conditioned space EXC.	[318.1]	{707.3X2}
in primarily cooling condition (hot humid climate)	[318.1X3]	{707.3}
☐ Light fixtures in building envelope either Type IC airtight, Type IC max 2cfm leakage, or non-IC in airtight box	[1102.1.11]	{APDX13}
☐ Non IC rated lights req ½in clear to combustibles	[3904.8]	{410.66A1[E]}
☐ Non IC rated lights req 3in clear to insulation	[3904.9]	{410.66B[E]}
☐ Installer to provide certificate for blown-in	[1101.3.1]	{102.5.1[EC]}

Table 17 • ½in. Gypsum Board Nailing Schedule

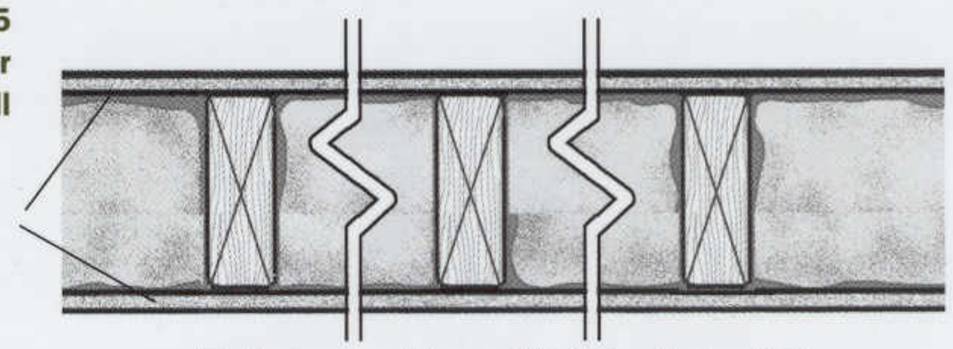
Location	Orientation to framing	Max. frame spacing	Nails	Screws
Ceilings	Perpendicular	24"	7	12
Ceilings	Either	16"	7	12
Walls	Either	24"	8	12
Walls	Either	16"	8	16

Based on IRC T702.3.5 and UBC T-25G for application without adhesive

Sound & Fire Assemblies

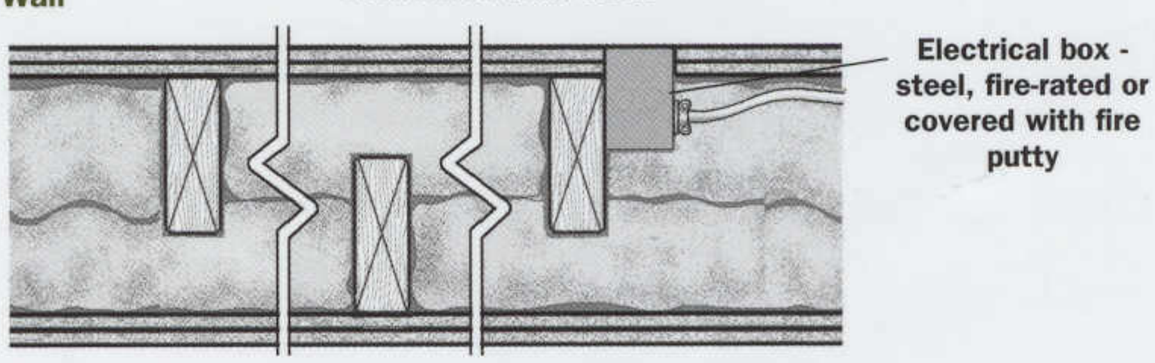
Assemblies are tested and recommended by the Gypsum Association. Adjoining dwelling units should have a minimum sound rating of STC 50 (Sound Transmission Class) and a 1-hour fire-resistance rating. These are only samples of the numerous assemblies possible. The Gypsum Association manuals contain additional information, and should be consulted in the design stages.

Fig. 65 Rated 1 Hour Wall



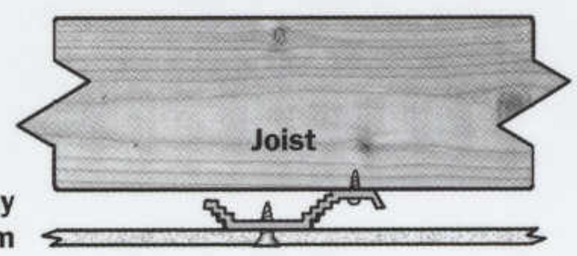
Typical separation wall in 2-family dwelling (Based on Gypsum Association Manual WP3514)

Fig. 66 Rated 2-Hour Wall



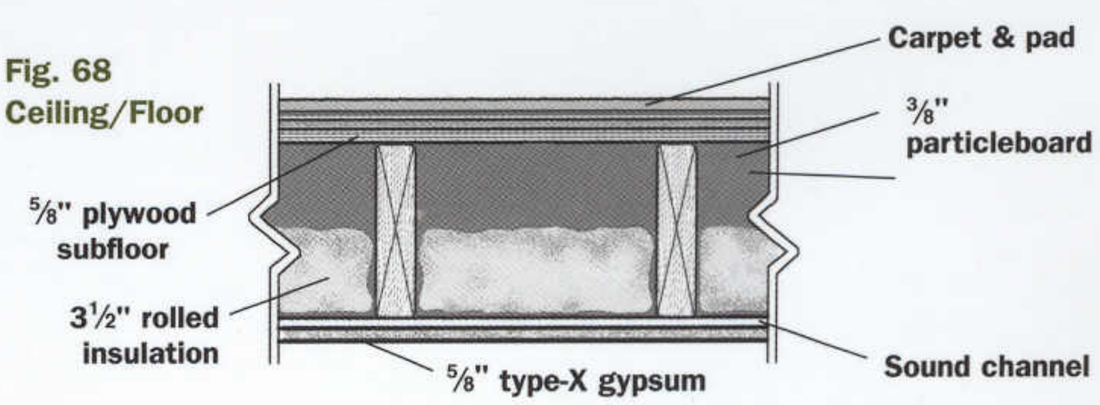
Typical separation wall in townhouse (Based on Gypsum Association Manual WP3910)

Fig. 67 Sound Channel a.k.a. Resilient Channel



Sound channel also may be used to isolate gypsum board from structure.

Fig. 68 Ceiling/Floor



(Based on Gypsum Association Manual FC 5120)

Safety Glass

Safety glass can be laminated, tempered, or an approved plastic. Proper use of safety glass is critical in areas that are subject to human impact. Shower and tub areas are especially dangerous, as persons could accidentally slip and fall into the glazing. Glazing in wardrobe doors is not required to be safety glass, but must meet the impact resistance tests required by the Codes. The size and types of acceptable glazing are also limited when the building is located in a high wind area.

Identification	**IRC**	**UBC**
☐ Tempered glass reqs permanent etched label EXC . .F69	[308.1]	{2406.2}
Spandrel glass may have removable paper label	[308.1X2]	{2406.2}
☐ [Glazing ≤1ft in multipane may bear "16-CFR 1201" label]	[308.1.1]	{Ø}

Fig. 69
Tempered Glass Label

Safety glazing req'd in following locations:

☐ Glazing <60in above tub or shower floor	[308.4]	{2406.4}
☐ All tub & shower doors & enclosures EXC	[308.4]	{2406.4}
Glass block is considered masonry not glazing	[610.1]	[2110.1]
☐ Door glazing if ≥3in sphere could pass through EXC F71	[308.4]	{2406.4}
Decorative glass (leaded, etched, or beveled)	[308.4X2]	{2406.4X5}
☐ Sidelights with vert. edge of glazing <24in of door swing & lower edge <60in from floor F71	[308.4]	{2406.4}
☐ Fixed and sliding panels of sliding doors F70	[308.4]	{2406.4}
☐ All unframed swinging doors	[308.4]	{2406.4}
☐ Glazing ≤3ft horiz of stair or landing & lower edge <60in from floor	[308.4]	{2406.4}
☐ Glazing <60in high in stair {enclosures} [if <60in from bottom nosing]	[308.4]	{2406.4}

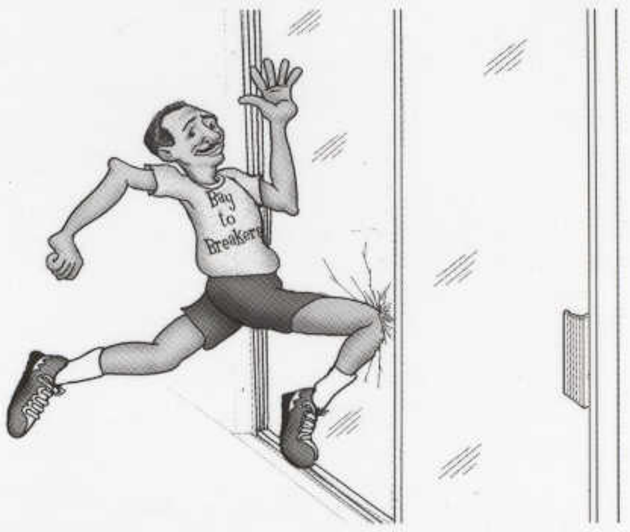


Fig. 70
Safety Glass in Doors

Safety glazing is required when a walk-through hazard exists, defined as meeting ALL of the following: **[308.4]** **{2406.4}**

- Exposed area of glazing >9sq ft. +
- Bottom edge <18in above floor or ground +
- Top edge >36in above floor or ground +
- Within 36in horizontal of walking surface
- **Exception:** Min 1½in high protective guard installed 34–38in above floor . . . . . .[308.4X5] {2406.4X2}

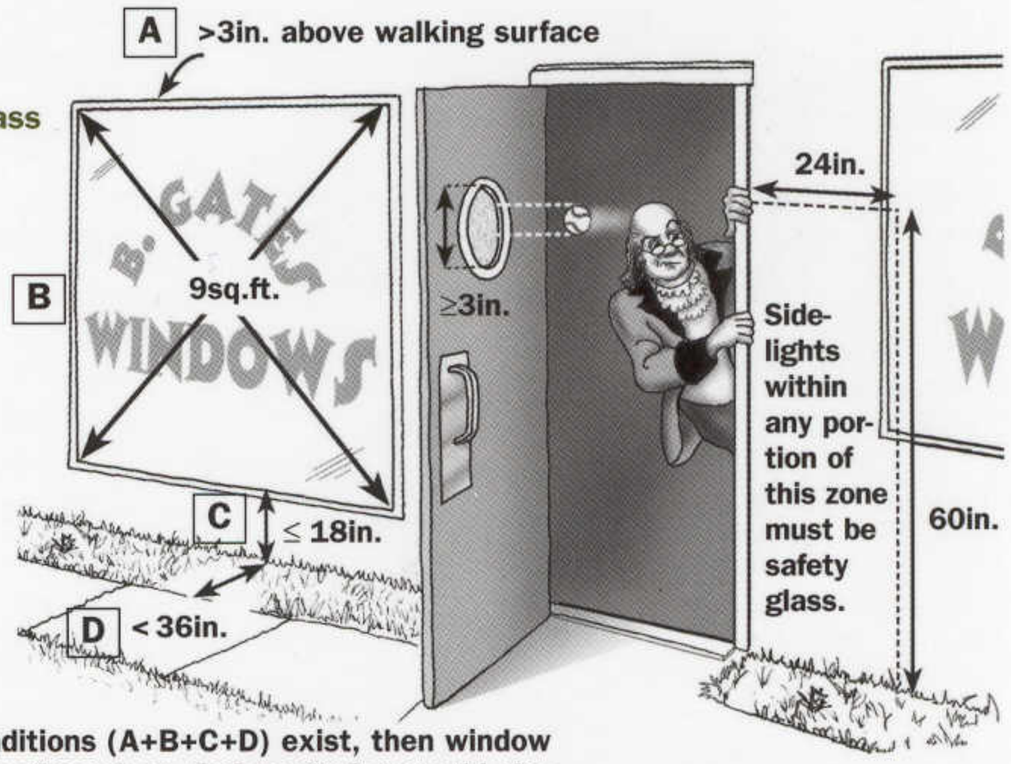


Fig. 71
Safety Glass

If all conditions (A+B+C+D) exist, then window must be safety glass. Safety glazing would also be req'd if within 2ft. of the door frame.

Skylights

Most residential skylights installed today are factory manufactured, called unit skylights. These are designed to meet requirements of the Codes and to provide ease of installation. Many are self-curbing and flashing and the manufacturer's instructions must be followed to provide a weather-tight installation. Skylights can also provide the required light and ventilation discussed on p. 20.

General

☐ Skylights may be tempered, heat-strengthened, laminated, wired, or approved rigid plastics	[308.6.2]	{2409.2}
☐ Tempered or heat-strengthened glass reqs screen below glass EXC	[308.6.3]	{2409.3}
Panes <16sq ft and ≤12ft above walking surface AND	[308.6.5]	{2409.3X4}
Greenhouses <20 ft above grade	[308.6.6}	{2409.3X3}
☐ Min 4in curb if roof slope < 3/12 {<12/12}	[308.6.8]	{2409.4}

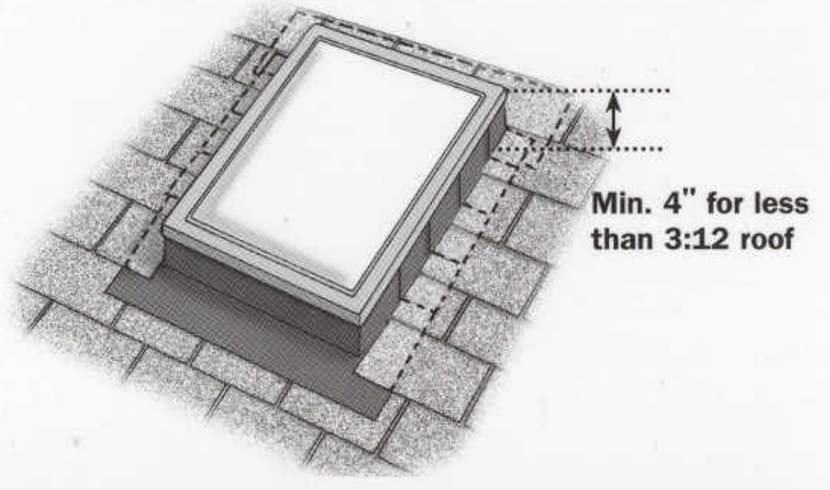


Fig. 72
Skylight

Masonry Fireplaces & Chimneys

Fireplace and chimney construction must safely separate the combustible building structure from heat sources. Chimneys must safely convey dangerous combustion products to the exterior. Fireplaces typically consume more heated indoor air than they provide. Also, environmental pollution must be considered and many communities restrict the use of wood-burning fireplaces and stoves. The EPA (Environmental Protection Agency) regulates the design of manufactured fireplaces. Consult your local BO before building or installing a wood-burning fireplace or appliance.

Chimney Construction	IRC	UBC
☐ Footing min 12in thick and 6in beyond sides	F1 [1001.1.1]	{3102.7.2}
☐ Footing thicker if more than 1 story	[1001.1.1]	{3102.7.2}
☐ Chimney walls min 4in thick	[1001.7]	{3102.4.2}
☐ Reinforcement req'd in SDC D1 or D2 {SZ 2, 3, & 4}:		
• Min 4-#4 vert reinforcing bars solidly grouted	F73 [1003.3.1]	{3102.4.3}
• 2 add'l bars for each 40in width after first 40in	[1003.3.1]	{3102.4.3}
• Min ¼in horiz ties each 18in	[1003.3.2]	{3102.4.3}
• [Prevent bonding to liner] {Min ½in grout cover}	[1003.3.1]	{3102.4.3}
• Anchored at each floor or ceiling >6ft above grade EXC chimney completely in building interior	F73&F74 [1003.4]	{3102.4.3}
☐ Min 2in clearance to combustibles EXC Wood sheathing, siding or trim OK if 12in from inside of flue liner	F73&76 [1001.15] [1001.15X3]	{3102.7.8} {3102.7.8}
☐ Fireblocking req'd between chimneys & ceiling	F76[1001.16]	{708.2.1}

Fig. 73 Chimney Reinforcement

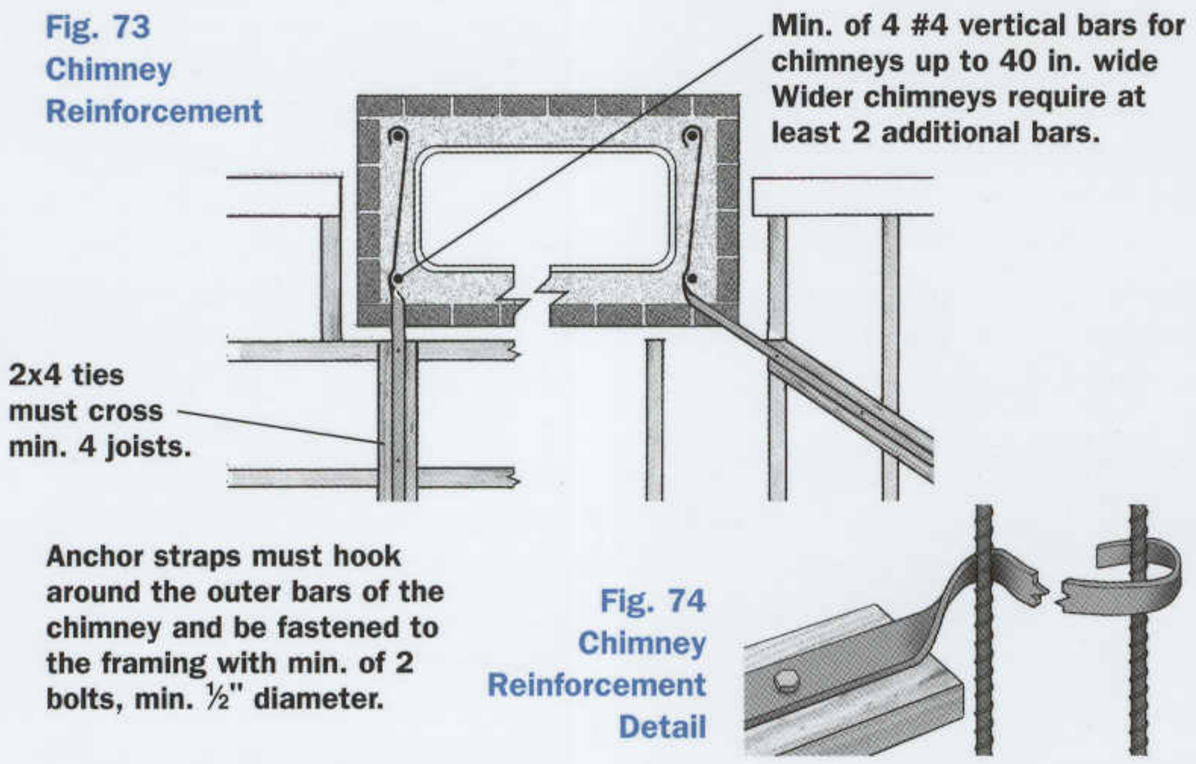
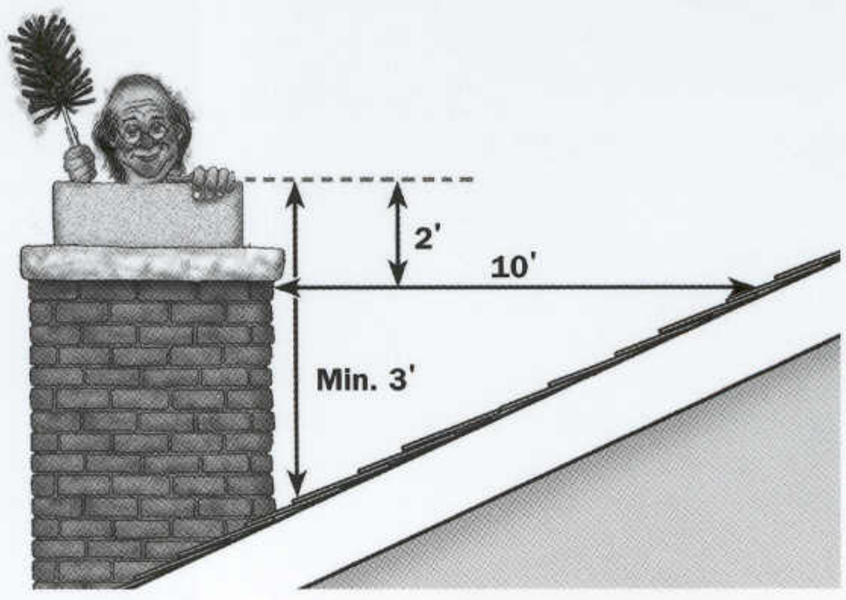


Fig. 74 Chimney Reinforcement Detail

Flue & Termination

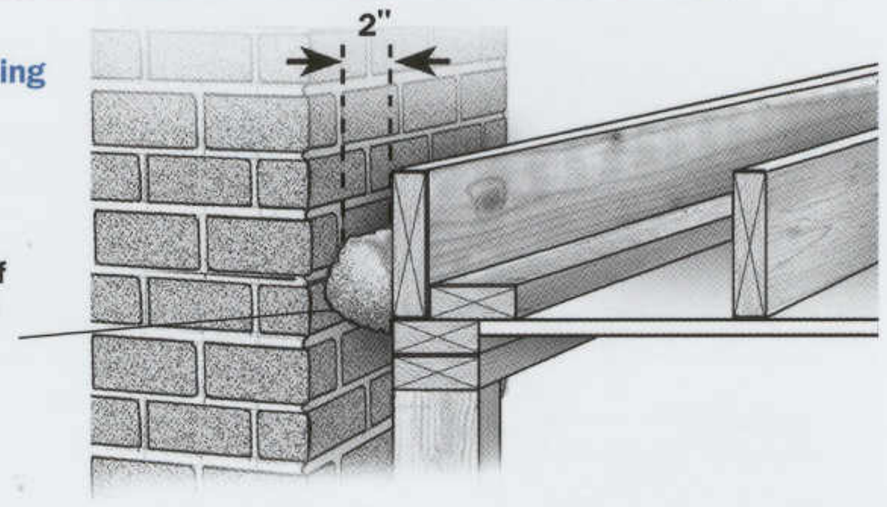
☐ Size flue for proper draft per fireplace opening size & chimney height	[1001.12]	{3102.3.5}
☐ Termination min 3ft above roof AND	F75 [1001.6]	{3102.3.6}
2ft above any part of building within 10ft	F75 [1001.6]	{3102.3.6}
☐ Spark arrester req'd	[local]	{3102.3.8}
☐ Spark arrester min area 4x flue opening	[1001.6.1]	{3102.3.8}
☐ Spark arrester mesh ⅜in min ½in max	[1001.6.1]	{3102.3.8}
☐ Crickets req'd if chimney >30in wide	F45 [1001.17]	{roof manu}

Fig. 75 Min. Chimney Height



Dirty chimneys are a fire hazard due to the accumulation of combustible creosote. Consult a certified chimney sweep annually for cleaning and inspections.

Fig. 76 Chimney Fireblocking

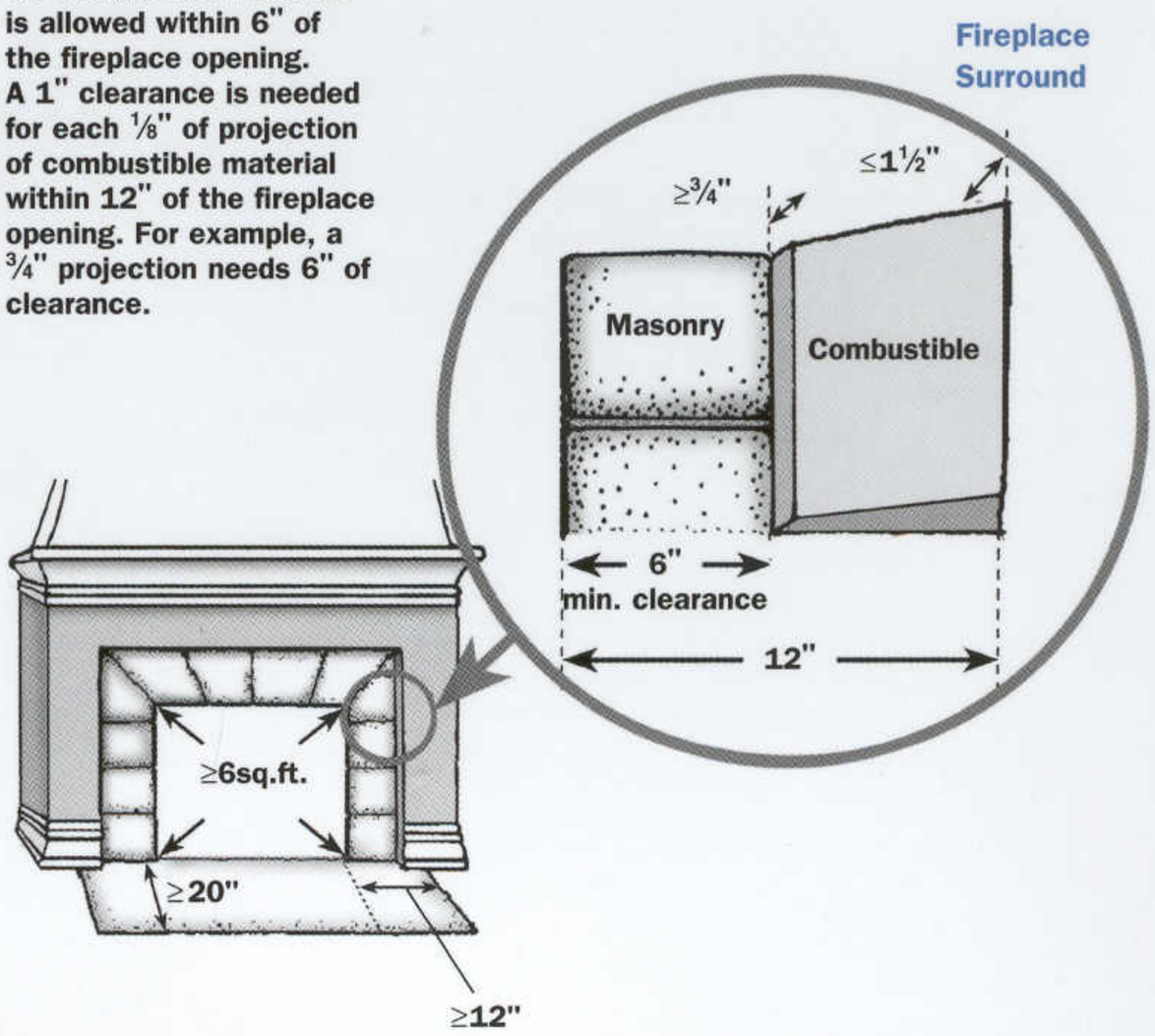


Fireplaces

☐ Hearth slab min thickness 4in	[1003.9.1]	{3102.7.11}
☐ Hearth exten min thickness 2in {4in}	[1003.9.2]	{3102.7.11}
☐ Remove combustible material from below hearth & hearth extension	[1003.9]	{3102.7.11}
☐ Hearth exten distinguishable from surrounding floor [manufactured fireplaces]	[1004.2]	{3102.7.12}
☐ Hearth extension depth min 16in front, 8in side if opening <6sq ft	F77 [1003.10]	{3102.7.12}
☐ Hearth extension depth min 20in front, 12in side if opening ≥6sq ft	F77 [1003.10]	{3102.7.12}
☐ Firebox min depth 20in EXC Rumford fireplaces	[1003.6]	{3102.7.3}
☐ Manufactured fireplace must be installed per listing	[1004.1]	{3102.5.1}
☐ Glass doors req'd	[1102.1.10]	{energy}
☐ All combustion air from outside	[1005.1]	{energy}
☐ No combustible material within 6in of opening	F77 [1003.12]	{3102.7.8}
☐ Combustible material <12in of opening limited to max ⅛in projection for each inch of clearance	F77 [1003.12]	{3102.7.8}

Fig. 77 Masonry-Fireplace Clearances

No combustible material is allowed within 6" of the fireplace opening. A 1" clearance is needed for each ⅛" of projection of combustible material within 12" of the fireplace opening. For example, a ¾" projection needs 6" of clearance.



Manufactured Fireplaces & Chimneys

Manufactured fireplaces and chimneys are very common in modern construction. They are tested and listed by independent laboratories, and must be installed in exact accordance with the terms of their listing.

Chimneys	**IRC**	**UBC**
☐ Must be listed and labeled and installed per listing	[1002.1]	{3102.5.1}
☐ Metal chimneys to be anchored [per listing] {6-8d} at each floor and roof	[1002.1]	{3102.6}
☐ Fireblocking req'd at openings between chimney chase (shaft) & attic	[1002.1]	{708.2.1}
☐ Termination min 3ft above point passing through roof	[manu]	{3102.3.6}
☐ Termination min 2ft above any part of building within 10ft	[manu]	{3102.3.6}
☐ Decorative shroud must be listed for use w/chimney system	[1002.2, 1004.3]	{3102.5.1}
☐ Spark arrestor req'd per BO	[n/a]	{3102.3.8}
☐ Chimney size not less than appl collar or connector or >3x area of connector or collar	[1805.3.1]	{808.0M}
☐ Joints to {be liquid-tight} prevent the escape of gas, moisture or creosote	[1801.3.2]	{814.1.3M}
☐ No unlisted single-wall chimneys in houses (connector can be single-wall)	[1801.1]	{814.1.1M}
☐ Proper transition thimble where passing through ceiling or roof if req'd for proper clearance from combustibles	[1805.1]	{814.1.6M}
Factory Built Fireplaces		
☐ Must be listed & installed per instructions	[1002.1, 1004.1]	{3102.5.1}
☐ Noncombustible hearth extension per instructions	[1004.2]	{3102.5.1}
☐ Secure fireplace to floor to prevent shifting	[1307.2]	{304.4M}
☐ Clearance to combustibles per listing	[1004.1]	{304.1M}
☐ Outside combustion air req'd not from above firebox F78	[1005.1,2]	{manu}
☐ Unvented gas log heaters prohibited [unless UL(Underwriter's Laboratory)127 compliant]	[1004.4]	{911.0M}

Fireplace with Gas Appliance

	IRC	**UMC**
☐ Glass doors req'd	[local, energy]	{local, energy}
☐ Factory-built chimney reqs spark arrester	[manu.]	{812.1}
☐ Damper req'd to be blocked open if gas in FP	[2433.1]	{912.1.2}
☐ Req'd valve ≤6ft {4ft} of FP & in same room	[2420.5]	{1211.17P}
☐ Decorative logs with pilots must have pilot safety	[2432.2]	{912.1.4}
☐ Log lighter alone req's hard gas pipe	[2433.1]	{1212.0P}
☐ Cosmetic logset OK with flex connector	[2432.1]	{912.1.1}

Wood Stoves (solid fuel)

Fireplace Stove (fire chamber open to room)

☐ Must be listed & installed per manu instructions	[1414.1]	{n/a}
☐ Hearth extension req'd at same level as stove support & readily distinguishable F78	[1414.2]	{3102.5.1}
☐ Install with clearance to combustibles per listing	[1306.1]	{304.1M}
☐ {Unlisted appl. OK if 48in min clear EXC}	[Ø]	{304.3M}
{36in min OK with approved clearance reduction system }	[Ø]	{304.3M}
☐ [Clearance reduction OK for listed appliances with approved clearance reduction system and min 12in from wall] F79, T17	[1306.2]	{n/a}
☐ Fasten or anchor in approved manner	[1307.2]	{304.4M}

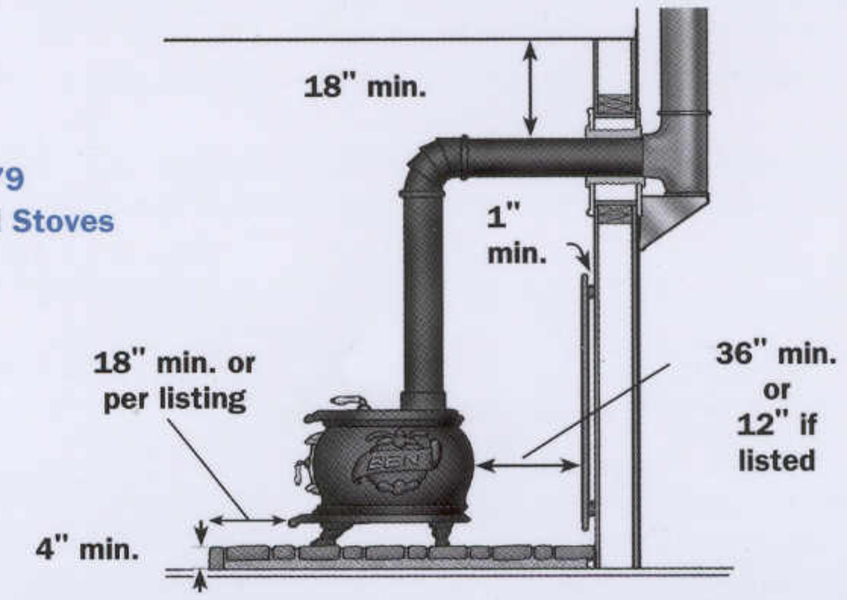


Fig. 79
Wood Stoves

Table 18 • Clearance Reduction

Protection Method	Above Appliance or Connector	Sides and Rear of Appliance
3½in.-thick masonry without ventilated air space	n/a	24"
½in. insulation board over 1in. glass fiber or mineral wool batts	24"	18"
0.024 sheet metal over 1in. glass fiber or mineral wool over wire and ventilated air space	18"	12"
3½in.-thick masonry with ventilated air space	n/a	12"
0.024 sheet metal with ventilated air space	18"	12"
½in.-thick insulation board with ventilated air space	18"	12"
1in. glass fiber or mineral wool batts sandwiched between two sheets 0.024 sheet metal with ventilated air space	18"	12"

Based on IRC Table 1306.2. This table will meet or exceed requirements of UMC T3-2.

Fig. 78
Manufactured Fireplaces & Stoves

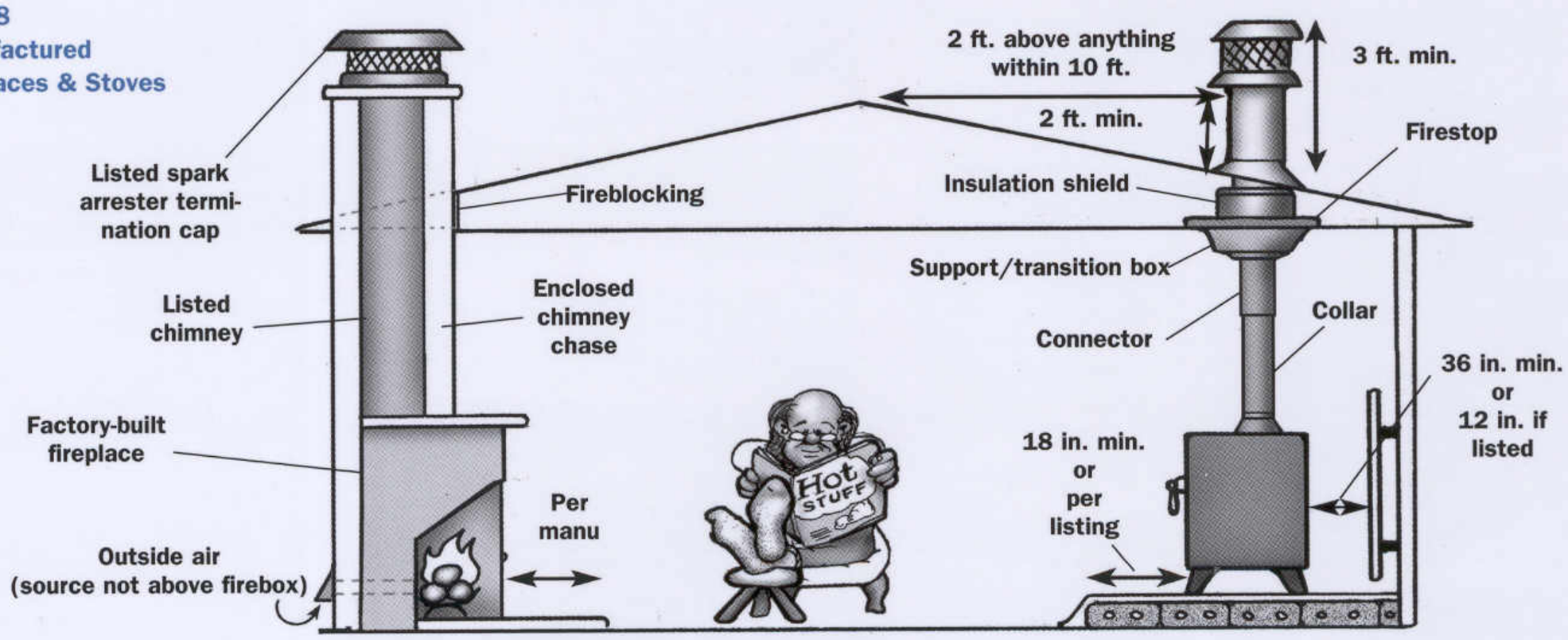


Table 19 •Minimum Footing Width (in inches)

Construction Type	# of Stories	Load-Bearing Value of Soil		
		1500	2000	3000
Conventional light frame construction	1	12	12	12
	2	15	12	12
	3	23	17	12
4" brick veneer over light frame or 8" hollow CMU	1	12	12	12
	2	21	16	12
	3	32	24	16
8" solid or fully grouted masonry	1	16	12	12
	2	29	21	14
	3	42	22	21

Based on IRC T-R403.1

Table 20 • Presumptive* Load-Bearing Values of Foundation Materials Based on T401.4.1 and {T-18-I-A}**

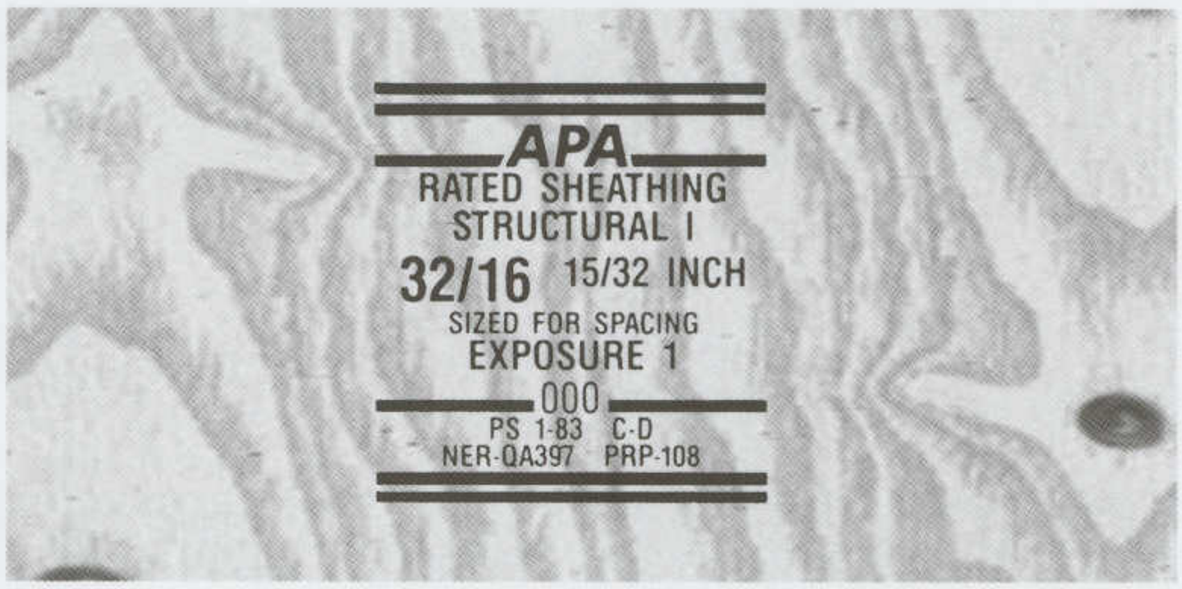
Class of Material	Load-Bearing Pressure (pounds per square foot)
Crystalline bedrock	12,000 {4,000}
Sedimentary and foliated rock	4,000 {2,000}
Sandy gravel and/or gravel (GW & GP)	3,000 {2,000}
Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	2,000 {1,500}
Clay, sandy clay, silty clay, clayey silt, silt and sandy silt (CI, ML, MH and CH)	1,500 {1,000}

* If a soils test or geotechnical evaluation exists, the design values from the report should be used.
** The UBC permits an increase in the allowable bearing value for each additional foot of depth or width of footing up to three times the values shown in the table.

Table 21 • Nailing Schedule—Based on IRC T602.3(1) and {UBC T23-II-B-1}

Connection	Nailing
Joist to sill or girder, toe nail	3-8d
1x6 subfloor or less to each joist, face nail	2-8d [2-1¾ staples]
2" subfloor to joist or girder, blind- and face nail	2-16d
Sole plate to joist or blocking, face nail	16d 16"o.c.
Top or sole plate to stud, end nail	2-16d
Stud to sole plate, toe nail	3-8d or 2-16d {4-8d}
Double studs, face nail	10d {16d} 24"o.c.
Double top plates, face nail	10d 24"o.c. {16d 16"o.c.}
Sole plate to joist or blocking at braced wall panels	3-16d 16"o.c.
Doubled top plates, face nail of lap splice	8-16d
Blocking between joists or rafters to top plate, toe nail	3-8d
Rim joist to top plate, toe nail	8d 6"o.c.
Top plates, laps and intersections, face nail	2-10d {2-16d}
Built-up or continuous header	16d 16"o.c. each edge
Ceiling joists to plate, toe nail	3-8d
Continuous header to stud, toe nail	4-8d
Ceiling joists, laps over partitions, face nail	3-10d {3-16d}
Ceiling joists to parallel rafters, face nail	3-10d {3-16d}
Rafter to plate, toe nail	2-16d {3-8d}
1" brace to each stud and plate, face nail	2-8d [2-1¾ staples]
1x6 sheathing to each bearing, face nail	2-8d [2-1¾ staples]
1x8 sheathing to each bearing, face nail	2-8d [3-1¾ staples]
Wider than 1x8 sheathing to each bearing, face nail	3-8d [4-1¾ staples]
Built-up corner studs	10d {16d} at 24"o.c.
Built-up girders and beams, 2" lumber layers	10d each layer 32"o.c. top & bottom staggered & 2 nails at ends & each splice
Built-up girders and beams	20d at 32"o.c. top & bottom staggered & two 20d nails at ends & each splice
2" planks	2-16d@each bearing
Roof rafters to ridge, valley, or hip rafters, toe nail	[4-16d]
Roof rafters to ridge, valley, or hip rafters, face nail	[3-16d]
Rafter ties to rafters, face nail	[3-8d]

Structural Wood Panels



Structural panels can be plywood, oriented strand board or other approved material. Approved panels will have a grade stamp, the most common being the American Plywood Association (APA) grade stamp. This stamp contains useful information. It is important to know these stamps are based upon the assumption that the strength axis is the long dimension (long side of panel goes perpendicular to studs/joists/rafters) unless noted otherwise on the grade stamp. "Structural 1" rated panels are designed for maximum performance as wall bracing, diaphragms, and shear-wall material.

The first item is the span rating, usually depicted as a number such as 32/16. The first number is the maximum span between supports when used for roof sheathing, the second when used for flooring. When panels are designed for wall or roof sheathing only, then just one useable number appears, such as 24/0.

The next numbers will be the thickness, such as $^{19}/_{32}$ inch or $^{15}/_{32}$.

Next are exposure durability ratings based on the following classifications:

Exterior: Panels are fully waterproof bonded and designed for permanent exposure to weather or moisture, when painted or sealed.

Exposure 1: Panels have full waterproof bond and are designed for use where long construction delays may occur before panels are protected or where high moisture conditions are expected in service. These panels are not a substitute for exterior-rated panels.

Exposure 2: Designed for use in protected construction applications where only moderate exposure to moisture is expected.

Interior: For protected, interior applications only.

Next items on panels are the veneer grades. The first letter is for the face veneer, the second for the back veneer. Classifications follow:

A Smooth and paintable, not more than 18 factory repairs.

B Solid surface, with some minor splits. Tight knots up to 1-in. Repairs of either wood or synthetic permissible.

C Splits to ⅛in. and knots or other defects to ½in. C-plugged will have wood or synthetic repairs, but similar open defects.

D Knots and knotholes to 2½in.—splits and stitching permitted. Exposure 1 or interior panels only.

X The old designator for exterior-rated plywood.

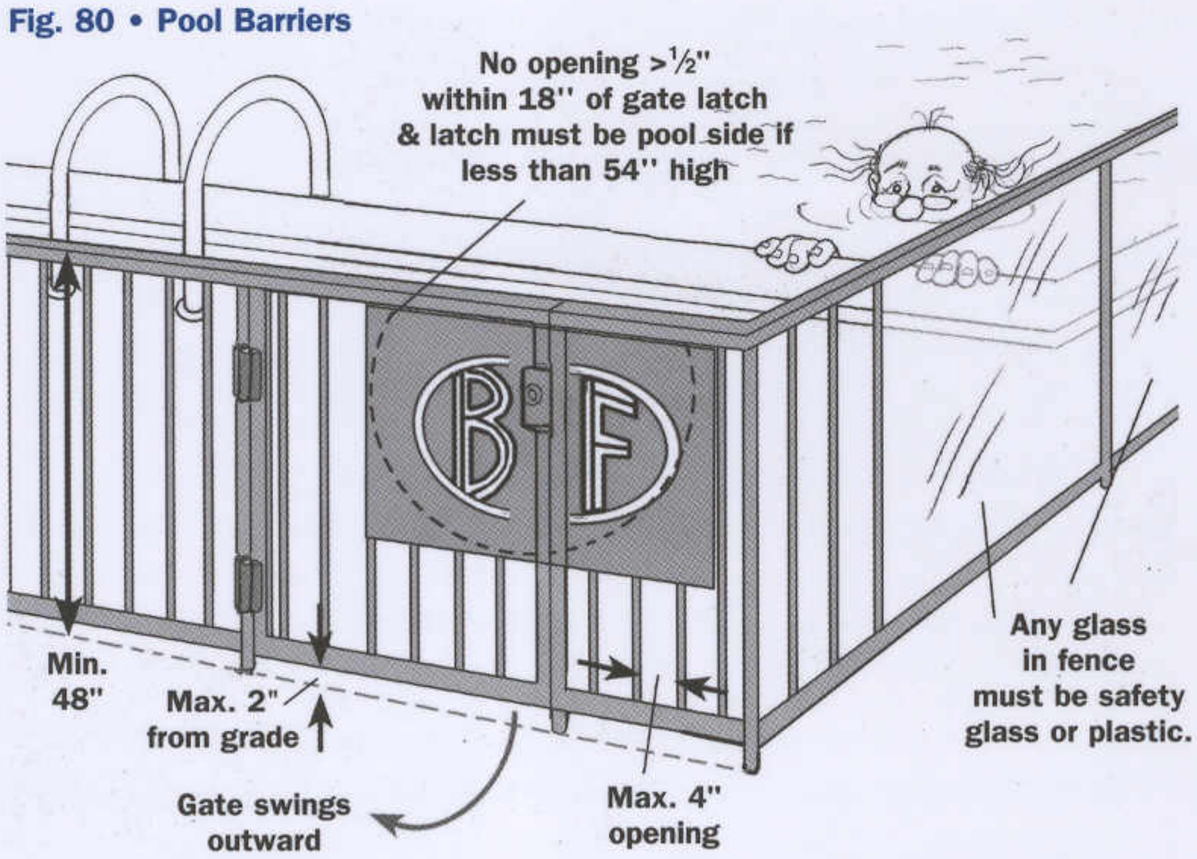
Source: American Plywood Association, various published documents

Swimming Pool Barriers

The Consumer Product Safety Commission has reported that drowning is the leading cause of accidental death in and around the home for children under the age of 5 years in California, Arizona, and Florida. Seventy five percent of the children involved in swimming pool submersion or drowning accidents are between 1 and 3 years old. Victims had been missing for five minutes or less when they were found in the pool drowned or submerged. Other bodies of water, such as fish ponds and fountains, have the same potential drowning hazards as pools.

General	IRC	UBC
☐ Applies to all pools or spas >24in deep	[AG102.1]	{420}
☐ Fence min 48in high	F80 [AG105.2]	{421.1#1}
☐ Gap under fence max 2in above grade {4in if concrete}	F80 [AG105.2]	{421.1#1}
☐ Bottom max 4in above pool structure when mounted on top of pool	[AG105.2]	{421.1#1}
☐ Max opening size must prevent passage of 4in sphere	F80 [AG105.2]	{421.1#1}
☐ Difficult to climb over (no ladder type rails)	F80 [AG105.2]	{421.1#1}
☐ Chain link max 1¼sq.in mesh unless filled with slats	[AG105.2]	{n/a}
☐ Gate lockable, self-closing, open away from pool	F80 [AG105.2]	{421.1#4}
☐ If latch <54in high: Must be poolside & min 3in below top	F80 [AG105.2]	{421.1#4}
☐ No openings >½in within 18in of latch	[AG105.2]	{421.1#4}
☐ Doors & screens with direct pool access req. alarm audible for 30 seconds throughout house	[AG105.2]	{421.1#5X}
☐ Alarm control min 54in high, must reset automatically EXC	[AG105.2]	{421.1#5X}
Doors from interior w/self close and release ≥54in above floor	[AG105.2]	{421.1#5X}
☐ If above ground pool ladder or steps must be lockable or barrier	[AG105.2]	{421.1#6}
☐ Safety glazing req'd for glass enclosing pool	F80 [308.4]	{2406.4}

Fig. 80 • Pool Barriers



General Habitability Requirements

☐ Heat req'd in habitable rooms 68° {70°} 3ft above floor	[303.8]	{310.11}
☐ Min one room ≥120sq ft	[304.1]	{310.6.2}
☐ Habitable rooms exc kitchens min 70sq ft & min dimension 7ft	[304.2,3]	{310.6.2,3}
☐ Ceiling height habitable spaces min 7ft {7ft 6in}	[305.1]	{310.6.1}
☐ Kitchens, baths, & hallways min ceiling height 7ft EXC	[305.1]	{310.6.1}
6ft 8in OK in baths over fixture & front clearance area	[305.1]	{Ø}
☐ Ceiling height unfinished basements min 6ft 8in	[305.1]	{n/a}

Smoke Detectors

The building codes provide occupants with minimum requirements for escape from fire. Included in these requirements is installation of smoke detectors. Smoke detectors should be tested often to check proper operation.

☐ Hard wired power req'd plus battery backup	[313.2]	{310.9.1.3}
☐ Req'd in each sleeping room & adjoining area	F81 [313.1]	{310.9.1.4}
☐ Min one detector each story & basement	F81 [313.1]	{310.9.1.4}
☐ Must be interconnected & audible from sleeping rooms	[313.1]	{310.9.1.4}
☐ Battery powered OK for remodel	[313.2]	{310.9.1.3}
☐ Compliance req'd for work {>$1,000}requiring permit or when alterations create an additional bedroom	[313.1.1]	{310.9.1.2}

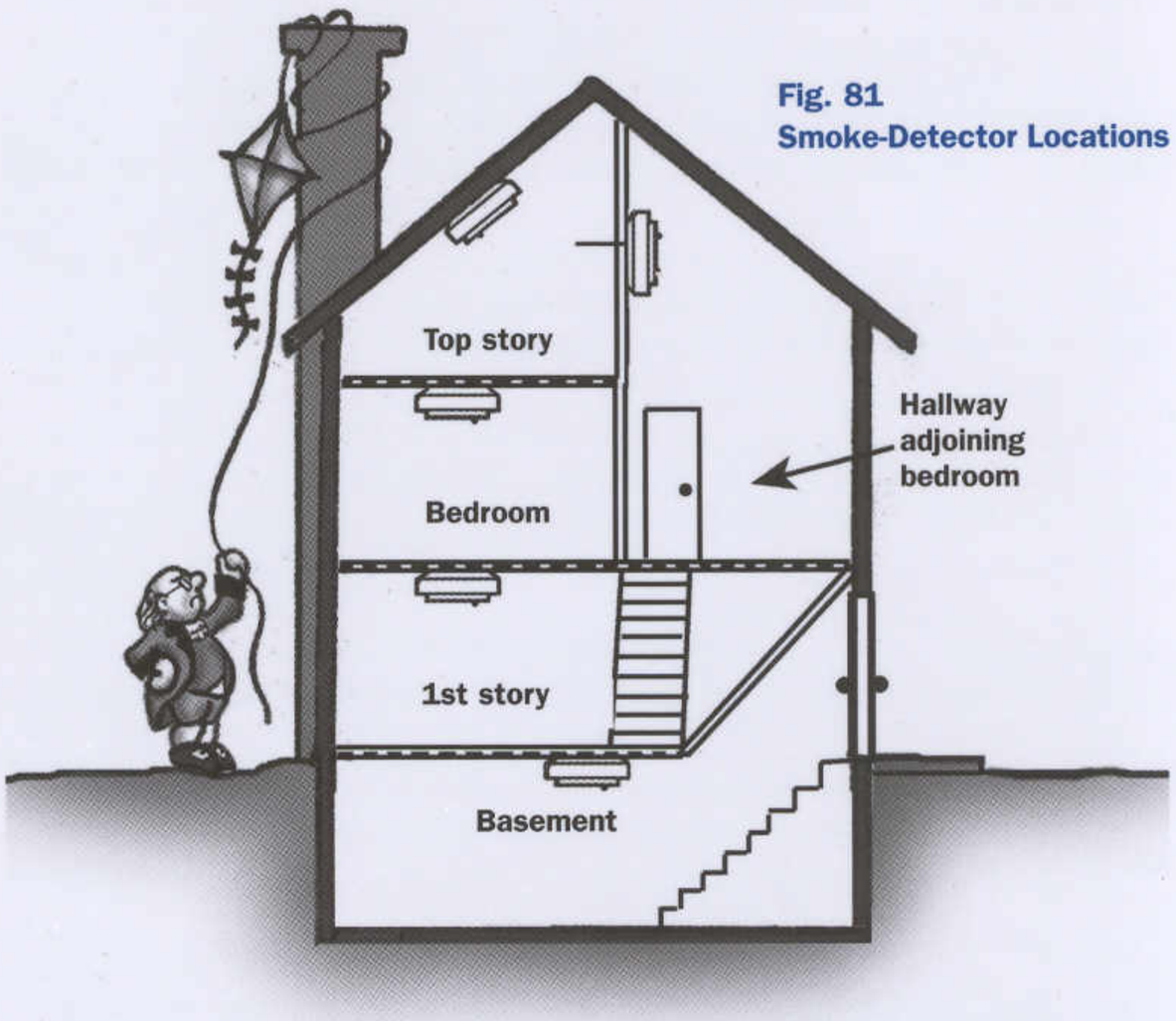


Fig. 81
Smoke-Detector Locations

Final Inspection

☐ Paperwork—special inspection reports on file	T19 [109.2]	{1701.3}
☐ Floor finishes that affect stairs or landings must be complete	[109.1.6]	{108.5.6}
☐ Appliances and fixtures must be in place	[109.1.6]	{108.5.6}
☐ Exterior pipe penetrations must be caulked	[2606.1]	{1402.2}
☐ Wood siding and trim min 6in from earth	[323.1]	{2306.8}
☐ Smoke detectors installed and operational	F81 [313.1]	{310.9.1.1}
☐ Exterior doors and windows must be weather tight	[1102.1.10]	{1402.2}
☐ Building address numbers legible from street	[321.1]	{502}

Table 22 • Special Inspection Reports

S.I. reports due before final inspection	Required	Received
Concrete >2,500 psi		
Pilings, drilled piers & caissons		
Structural masonry		
Bolts in concrete		
Structural Welding/Steel Moment Frames		
Glu-Lam certificate		
Shear nailing <4"o.c.		
High-strength bolting		
Prestressed concrete: rebar & tendons		
EIFS		
Special case:		

A

Addition: An extension or increase in floor area or height of a building.

Admixture: Material other than water, aggregate, or hydraulic cement used as an ingredient of concrete and added to concrete before or during its mixing to modify its properties. (ACI)

Aggregate: Granular material, such as sand, gravel, crushed stone, and iron blast-furnace slag, used with a cementing medium to form a hydraulic cement concrete or mortar. (ACI)

B

Balloon framing: A timber-framing system where wall studs and joists rest on a sill with the studs in one continuous piece from sill to the roof. At the second floor level, a ribbon is notched into the studs. The floor joists rest on the ribbon and are fastened into the studs, supporting and tying the structure together.

Bond beam: A horizontal grouted element within masonry in which reinforcement is embedded.

Building thermal envelope: Basement walls, exterior walls, floor, roof and any other part of the building that enclose conditioned spaces.

C

Concrete: Mixture of Portland cement or any other hydraulic cement, fine aggregate, coarse aggregate, and water, with or without admixtures. (ACI)

Type 1 is normal Portland cement and is used in most residential construction.

Type 2 is used for structures in water or soil containing moderate amounts of sulfate, or when heat build-up is a concern.

Type 3 is used when high early strength is desired. It is not common in single family residential construction.

Type 4 is low heat Portland cement and is used where the amount and rate of heat generation must be kept to a minimum. It is not common in single family residential construction.

Type 5 is sulfate resistant Portland cement, and is used where the water or soil is high in alkali.

Cripple wall: Wood framed wall extending from the foundation to joists below the first floor. Found in the underfloor area.

D

Dead load: The weight of all materials of the building and fixed equipment.

Diaphragm: A horizontal or nearly horizontal system acting to transmit lateral forces to the vertical resisting elements (e.g., roof sheathing).

G

Grade: The finished ground level adjoining the building at all exterior walls.

H

Habitable space: Space in a building for living, sleeping, eating, or cooking. Bathrooms, bathroom closets, halls storage, or utility areas are not considered habitable space.

Header: A structural member placed perpendicular to studs or joists that reinforces an opening, such as a window, and transfers loads to the adjacent framing member.

I

Insulating sheathing: Insulating board having a minimum rating of R-2.

J

Jack stud: Studs installed from top of header to bottom of top plate at a headered opening.

K

King stud: Wood framing members that extend unbroken from bottom plate to top plate next to a headered opening.

L

Live loads: Loads produced by use and occupancy of the building and not including wind, snow, rain, earthquake, flood, or dead loads.

P

Plain concrete: Structural concrete with no reinforcement or with less reinforcement than the minimum amount specified for reinforced concrete. (ACI)

Platform framing (a.k.a. Western framing): A wood frame house in which the wall, floor, and roof frames are independently built. The floor platforms are carried over the full thickness of the wall frames which are built in separate stories.

P.S.I: Pounds Per Square Inch: Common method of measuring concrete strength. Most common concretes come in 2000, 2500, 3000, 3500 and 4,000 psi strengths.

Pony walls: Walls of less than normal height (8-feet). Usually found in attic conversions at the low ends of the rafters enclosing space.

S

Seismic design category: Classification assigned to buildings based upon location and severity of earthquake ground motion expected at the site.

Shear wall: A braced wall designed to resist dynamic horizontal loads induced by seismic, wind, etc. and to act as a load transfer system to transfer such loads to the ground.

Story above grade: That part of the building which is more than six feet above grade for more than 50% of the total building perimeter or more than 12-feet above ground at any point.

Slump test: A method of field measuring of the stiffness of fresh concrete, usually performed with a cone shaped device. More water in the mix means higher slump and weaker concrete. Both the type of concrete ordered and psi will affect slump.

T

Townhouse: Single-family dwelling unit constructed in groups of three or more attached units in which each unit extends from foundation to roof and with open space on at least two sides. (IRC)

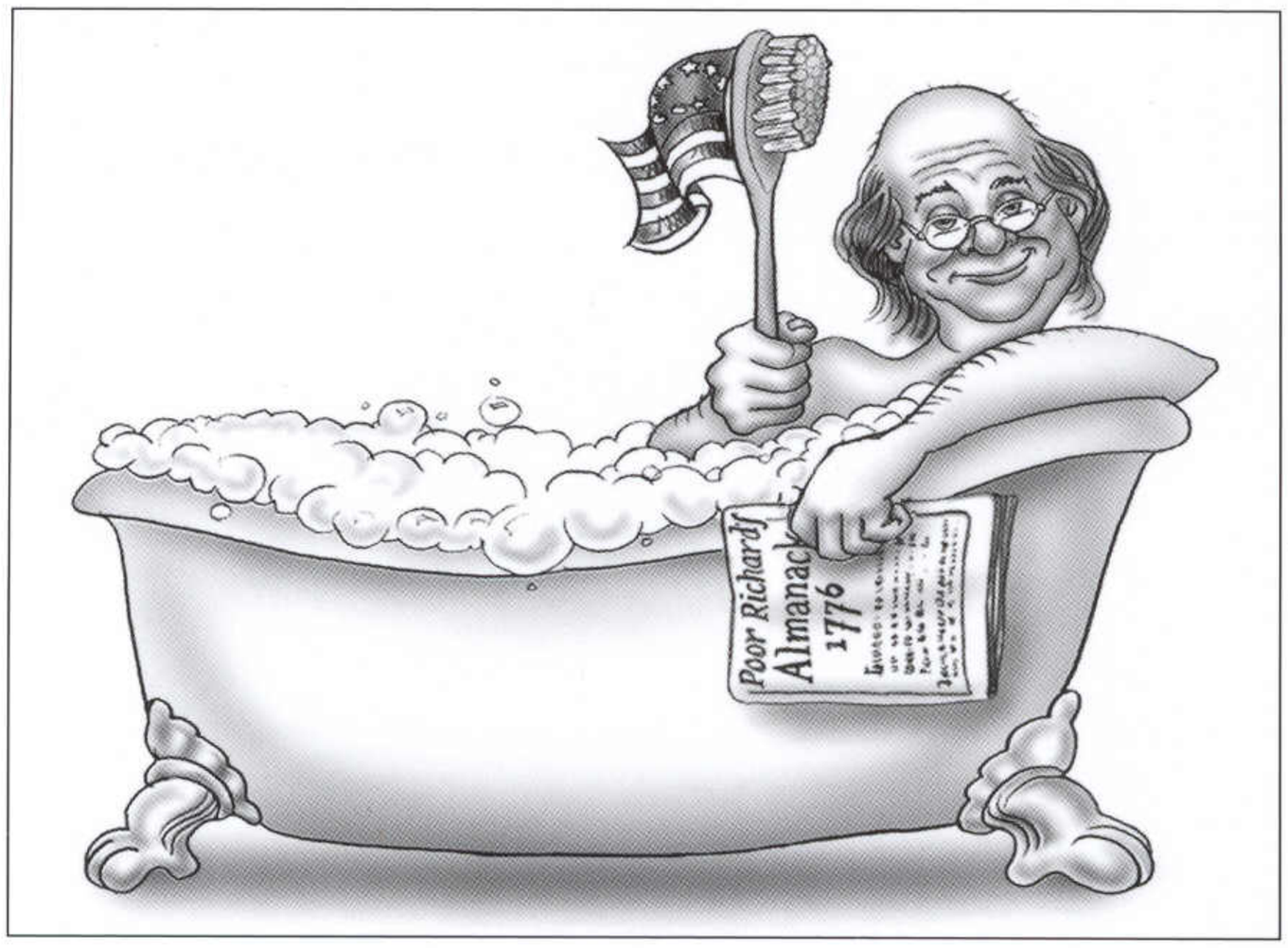
Trimmer stud: The stud that supports the header. Also called jamb stud. In horizontal applications the trimmer joist is the piece that the header is fastened to.

Y

Yard: Open space, other than a court, unobstructed from the ground to the sky, on the lot where the building is located.

WHY BEN FRANKLIN?

BENJAMIN FRANKLIN was chosen as the main character in our Code Check illustrations for a number of reasons. The "First American's" insatiable curiosity, scientific genius, and civic-mindedness drove him to study fire safety, safe exiting, public sanitation, improved heating methods, and, of course, electricity. Franklin made major contributions to each of the four main disciplines of building inspection: Building, Plumbing, Mechanical, and Electrical.



Franklin's first attempt to safeguard the public through building codes came in 1735 with his call for minimum standards in the design of fireplace hearths, hearth extensions, and combustible material clearance. The principles Franklin proposed are codified in all the modern building codes, which prescribe these clearances in detail.

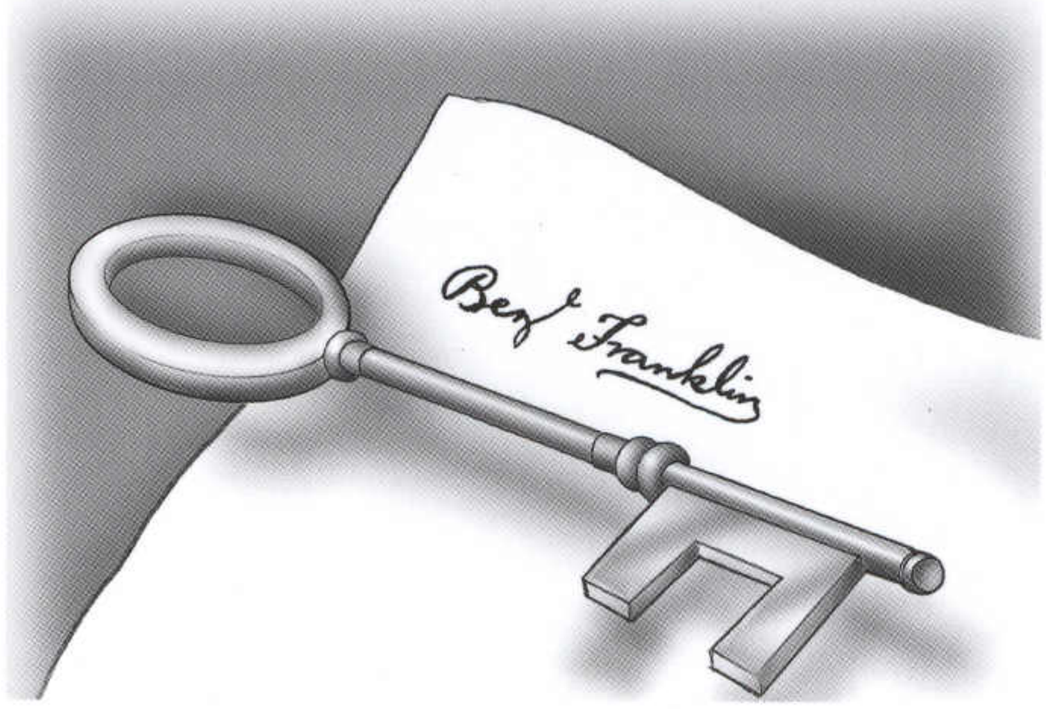
A main theme of the building codes is protection against fire and safe egress from a building. In 1735, Franklin organized the first volunteer Fire Department in Philadelphia, which still remains the model for our modern fire departments. He also understood the importance of building design in slowing the spread of a fire and was proud that his final home—built after his return from France in 1785—did not have concealed spaces where fire could spread and that "none of the wooden work from one room communicates with the wooden work of any other room." By judicious use of plaster, Franklin anticipated the fireblocking rules that are in today's codes (on page 16). He also took an interest in designing stairways that were the proper pitch.

One of Franklin's early inventions was the Franklin Stove, still called by his name today. By the mid-1740s, firewood was already scarce in the Philadelphia area, and air pollution was beginning to be a problem. Franklin's design in 1744 retained more heat than the fireplaces or stoves then in use, thus reducing the demand for wood. Ever the altruist, he refused to patent his invention and insisted on "giving it to the world." Franklin never lost interest in the subject. In 1785, concerned over the polluting effects of coal, he designed another stove that burned soft coal and consumed its own smoke.

An unusual aspect of Franklin's personality, at least by the standards of the 18th century, was his concern for personal hygiene. From his youth he was an avid swimmer, and in his adult life he bathed as often as once a week—a practice considered scandalous at the time. Franklin not only brought the first bathtub to America but also improved its design and spent much of his time reading and writing while soaking. His concern for sanitation went beyond his own personal needs, and he was instrumental in creating America's first public sewer system in Philadelphia.

Of all Franklin's scientific accomplishments, the best known is his lightning rod. After correctly hypothesizing the nature of lightning in 1750, his famous kite experiment in 1752 confirmed that lightning is a form of electricity and can be directed to the earth through rods and conductors. The principles of grounding all date back to him. To this day, passive lightning protection systems are referred to as "Franklin" systems. Leydon jars—the first storage media for electricity—were in use by experimenters in Europe and America when Franklin coined the word "battery." He was the first to describe a positive and a negative charge in electrical systems. As luck would have it, his own house was hit by lightning and saved by his invention. Franklin can also be said to be the "First Electrician," another word he introduced.

The purpose of the Building Codes is the practical safeguarding of persons and property. At Code Check, we feel that purpose to be a continuation of the work of Benjamin Franklin. His ideas are still alive in today's building codes and are carried on by code-making organizations and the people who practice those codes. As a tribute to Franklin, the main text of Code Check Building is typeset in Franklin Gothic. ■



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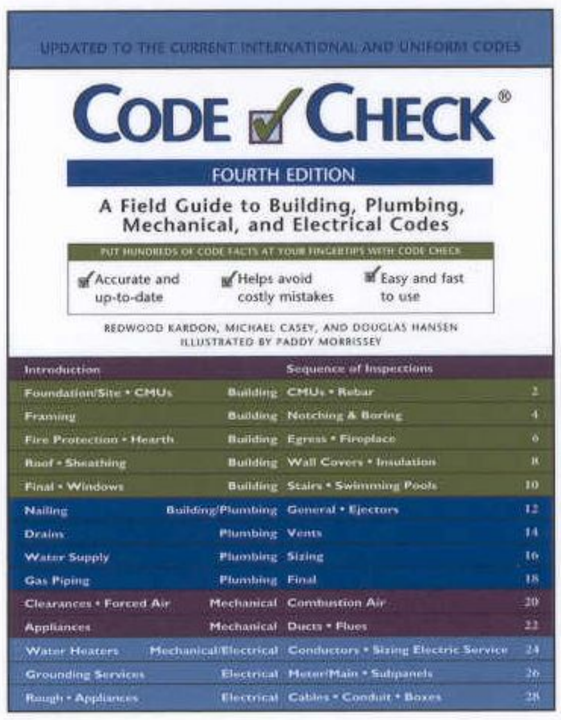

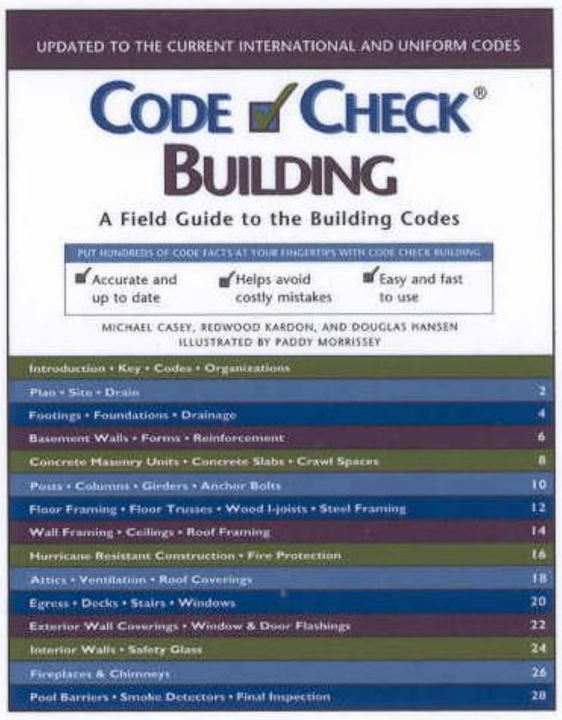

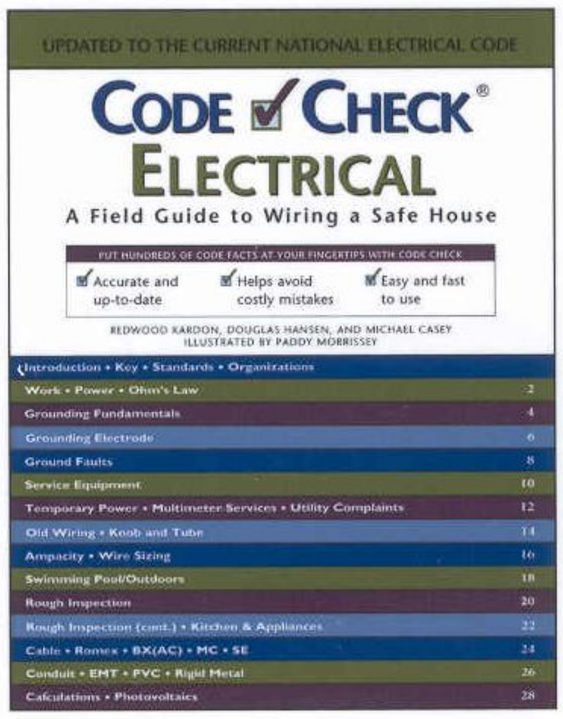

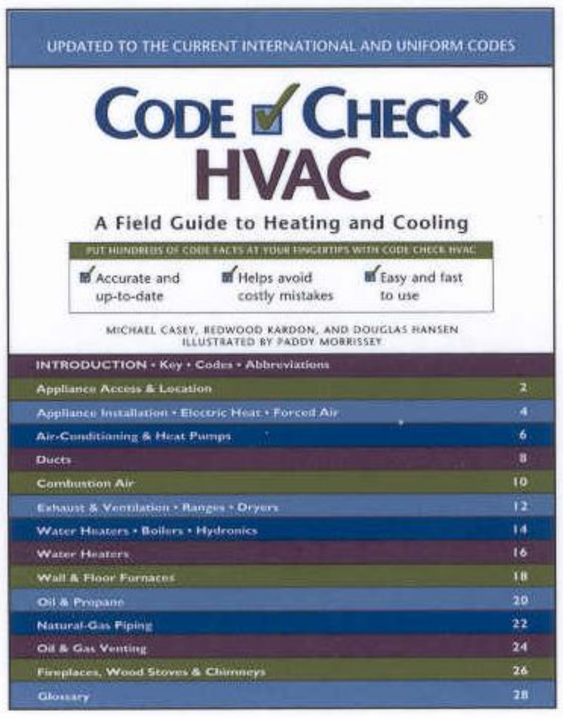

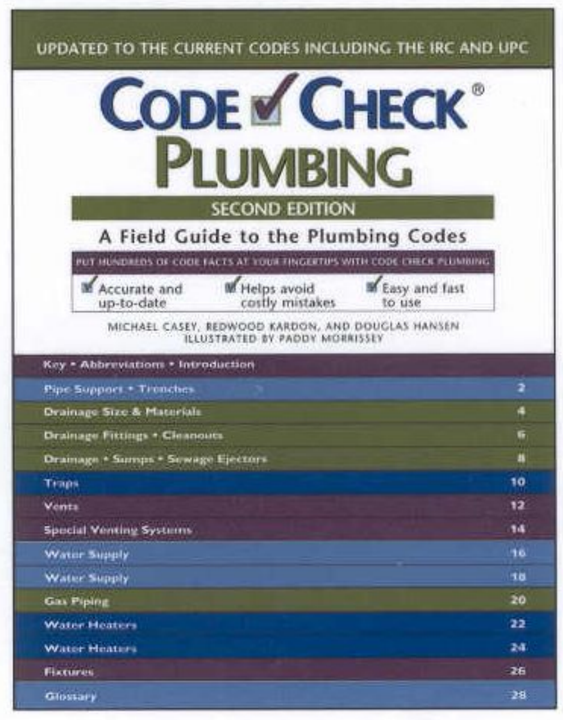

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