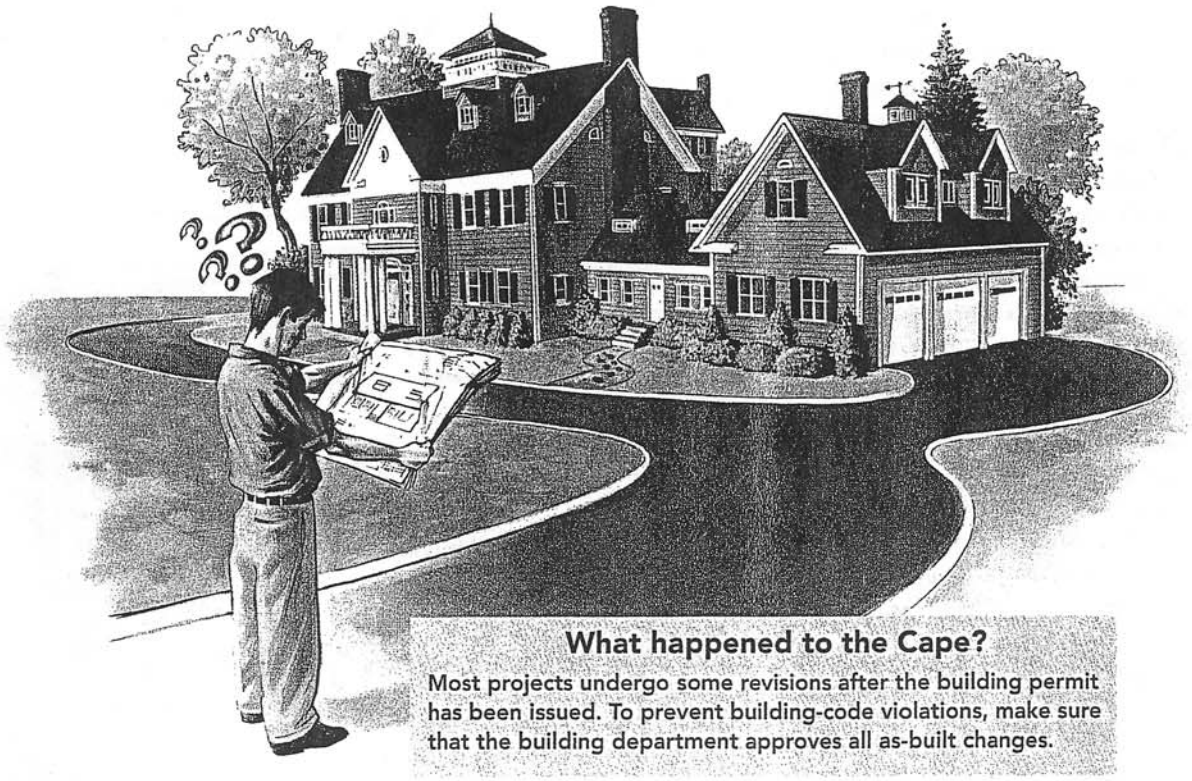
Top 10 Building-Code Violations

A veteran building inspector reviews the mistakes he sees over and over

BY LYNN UNDERWOOD



What happened to the Cape?
Most projects undergo some revisions after the building permit has been issued. To prevent building-code violations, make sure that the building department approves all as-built changes.

I've been on both sides of the fence. Soon after I finished college, I went into business building spec houses. During that time, the part of my job I dreaded most was accompanying the building inspector on his walk-through (that experience always made me feel as if I were taking my driver's test all over again). After several years as a builder, I went over to the dark side and became the person I dreaded: a building inspector.

Professional builders have a love-hate relationship (at best) with building inspectors. The truth is that we all have the same goal: building safe, durable houses. But nobody likes it when their job is stopped because of a technicality or a nuance they don't understand. I hope most builders know that building inspectors and their office counterparts, plans examiners, serve as a second set of eyes trained to search out and prevent serious construction problems.

Before addressing those problems, however, I need to make the point that building codes vary depending on jurisdiction. I've drawn my code references from the 2000 International Residential Code (IRC). (To obtain a copy, contact the International Code Council; 703-931-4533; www.intlcode.org.) Even if your locality has adopted a different code, my experience (having worked as an inspector in New Mexico, Washington, Arizona and Virginia) tells me that the most common code violations are the same nationwide. Here's my top-ten list.

Drawing this page: Matt Collins

1. Failure to follow the approved plans

I don't meet a lot of builders who willfully disregard house plans. However, I do see a lot of builders—or, more often, their subcontractors—who don't realize they're working from an outdated set of plans (drawing facing page). To avoid delays at the outset, architects often ask contractors to submit bids based on preliminary drawings.

Those drawings often undergo many revisions before being submitted to the building department. Only after the building department's plans examiner has verified that the drawings comply with all applicable codes are they issued as approved plans. Copies of approved plans must be made available to all subcontractors, and an additional copy must remain on the job site at all times. To make sure that everyone on the job is building the same house, it's good practice to require that all copies of preliminary drawings be returned before work begins.

Field changes are another problem. During the course of a typical project, builders often have to make field changes to apply the design to real-world conditions. Drawings must be made to reflect these changes, and these as-built drawings must be routed through the building department for analysis and approval.

"Failure to follow the approved plans" might sound like a technicality—the last refuge of an unreasonable building inspector—but today's houses are more than just an assemblage of parts. Even a minor alteration in a complicated system, such as an exterior-wall assembly, can compromise the integrity of the structure or the safety of its occupants.

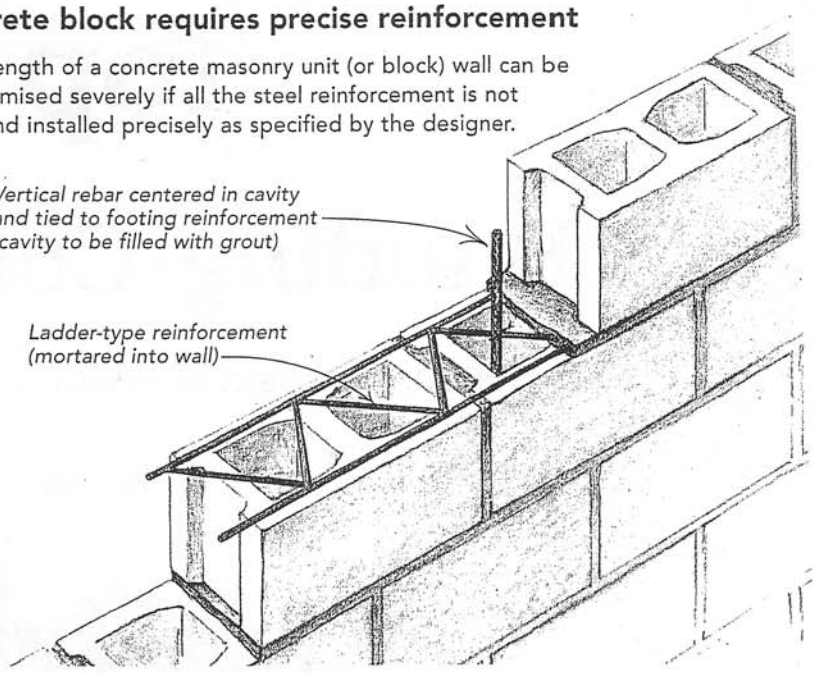
2. Inadequate soil preparation

The importance of the soil that supports a foundation cannot be overemphasized. If soil settles, shifts or expands, resulting foundation failure can affect the structural integrity of the entire building (see "Soil: The Other Half of the Foundation," *FHB* #136, pp. 68-73). Compaction is the most common method of achieving a stable soil base. But even compacted soil must be free of organic materials such as vegetation, roots or branches; these items decay, leaving voids in compacted fill. Settling is the result.

It's easy to pass the soil inspection. If it's obvious to an inspector that fill has been brought to the site, he or she may request a compaction report from an engineer before al-

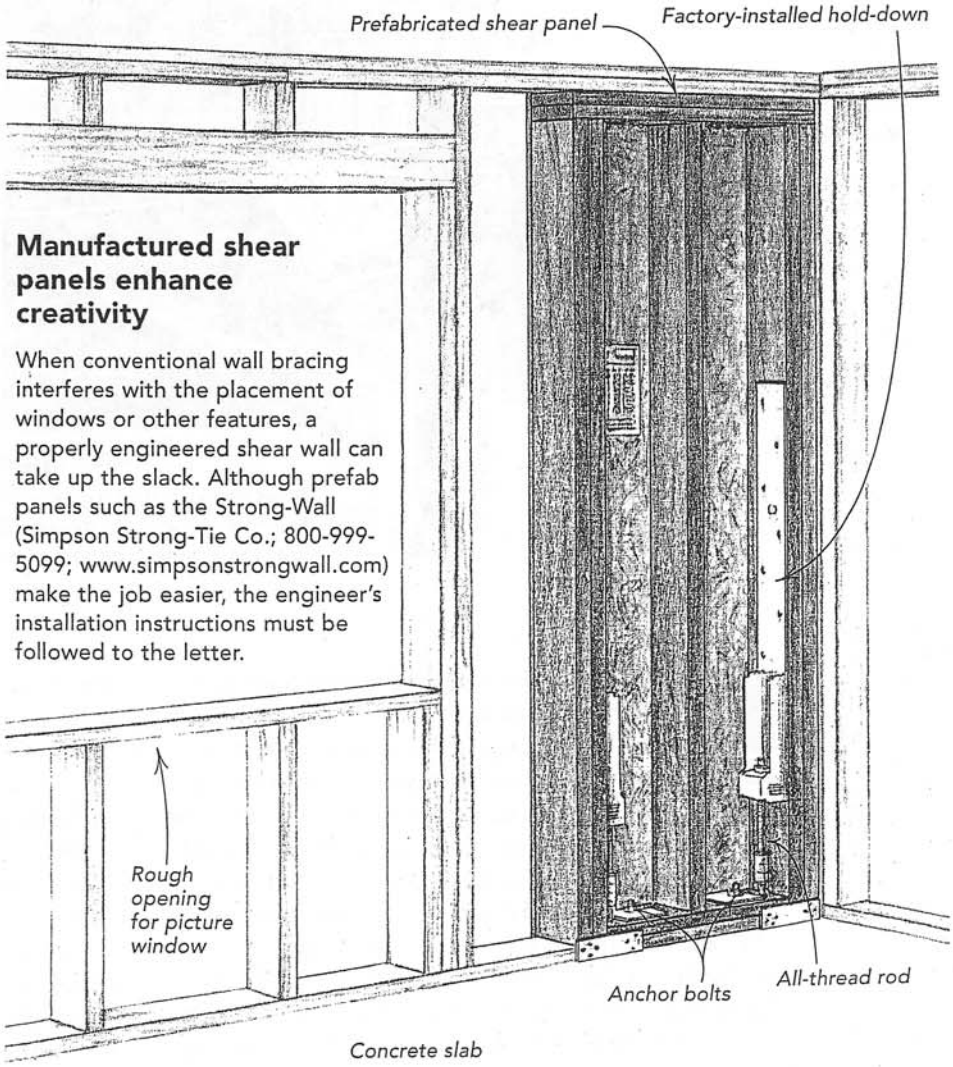
Concrete block requires precise reinforcement

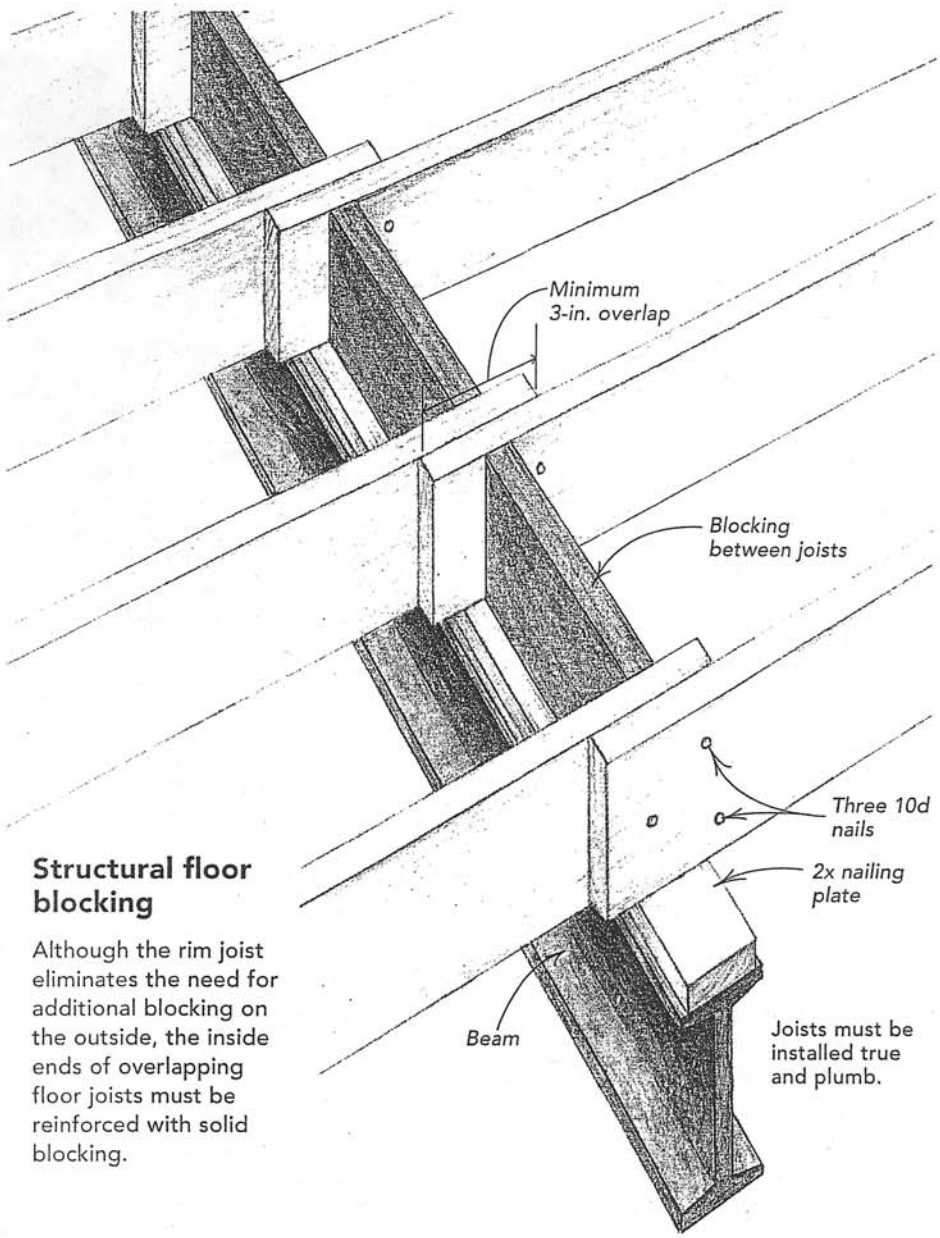
The strength of a concrete masonry unit (or block) wall can be compromised severely if all the steel reinforcement is not clean and installed precisely as specified by the designer.



Manufactured shear panels enhance creativity

When conventional wall bracing interferes with the placement of windows or other features, a properly engineered shear wall can take up the slack. Although prefab panels such as the Strong-Wall (Simpson Strong-Tie Co.; 800-999-5099; www.simpsonstrongwall.com) make the job easier, the engineer's installation instructions must be followed to the letter.

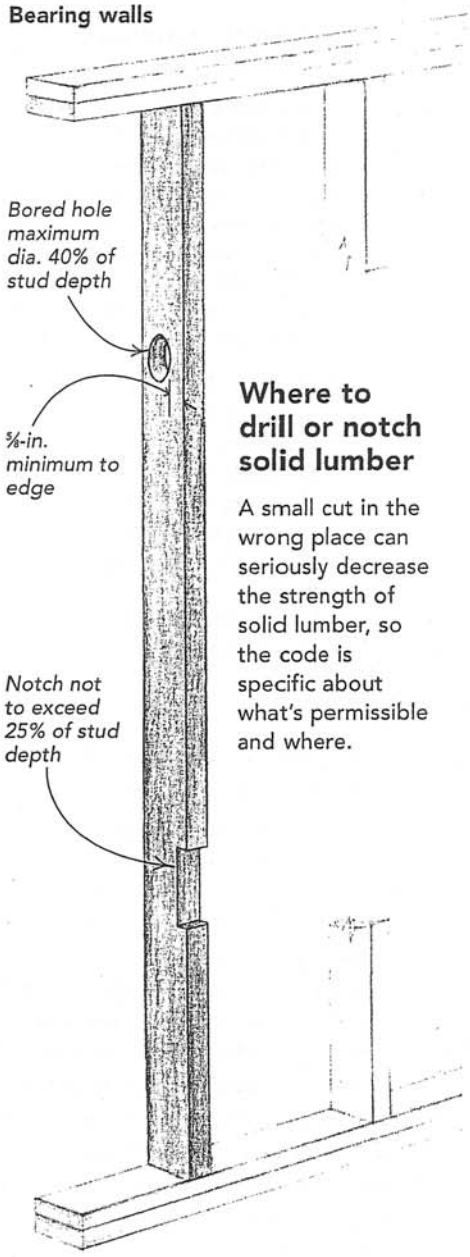




Structural floor blocking

Although the rim joist eliminates the need for additional blocking on the outside, the inside ends of overlapping floor joists must be reinforced with solid blocking.

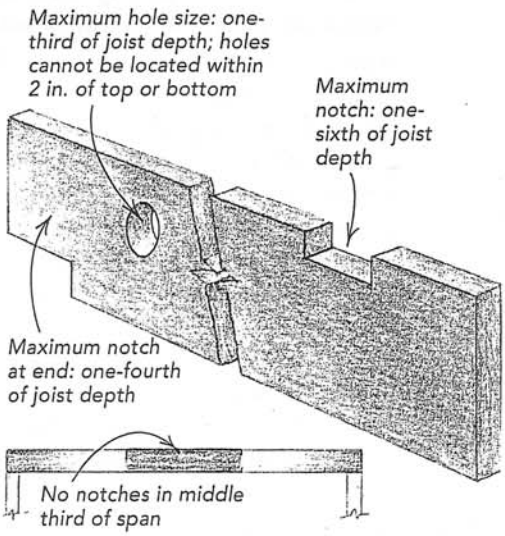
Bearing walls



Where to drill or notch solid lumber

A small cut in the wrong place can seriously decrease the strength of solid lumber, so the code is specific about what's permissible and where.

Solid-sawn joists



Fastener schedule for structural members

For nonengineered applications, Table R602.3(1) of the International Residential Code spells out the size as well as the spacing of required fasteners. (Partial table)

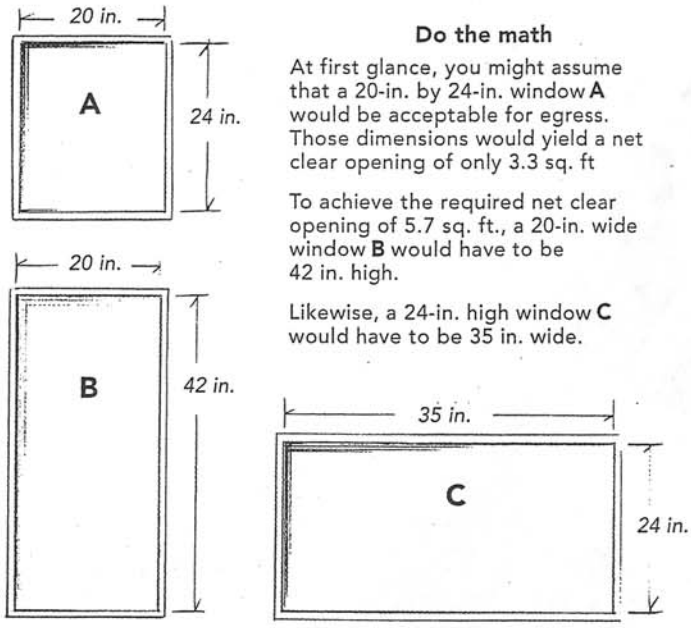
Description of building elements	Number and type of fastener	Spacing of fasteners
Sole plate to joist or blocking, face nail	16d	16 in. o.c.
Top or sole plate to stud, end nail	2-16d	—
Stud to sole plate, toenail	3-8d or 2-16d	—
Double studs, face nail	10d	24 in. o.c.
Double top plates, face nail	10d	24 in. o.c.
Sole plate to joist or blocking at braced wall panels	3-16d	16 in. o.c.
Double top plates, minimum 48-in. offset of end joints, face nail in lapped area	8-16d	—
Blocking between joists or rafters to top plate, toenail	3-8d	—
Rim joist to top plate, toenail	8d	6 in. o.c.
Top plates, laps at corners and intersections, face nail	2-10d	—

Table: Courtesy of the International Code Council

Egress windows serve two functions

At least one window in each bedroom must be of sufficient size to permit the occupants to escape a fire and also to allow a fully outfitted firefighter to enter. An egress window must satisfy all four IRC criteria:

1. Minimum width of opening: 20 in.
2. Minimum height of opening: 24 in.
3. Minimum net clear opening: 5.7 sq. ft. (5.0 sq. ft. for ground floor).
4. Maximum sill height above floor: 44 in.



Do the math

At first glance, you might assume that a 20-in. by 24-in. window **A** would be acceptable for egress. Those dimensions would yield a net clear opening of only 3.3 sq. ft

To achieve the required net clear opening of 5.7 sq. ft., a 20-in. wide window **B** would have to be 42 in. high.

Likewise, a 24-in. high window **C** would have to be 35 in. wide.

lowing concrete to be poured. Otherwise, inspectors just use their eyes and their boots to search for signs of compaction; digging their heels into the subbase tells them something about the surface-layer compaction.

If you fail the soil inspection, you should be grateful that a potentially serious problem was discovered in time to be corrected. If you pass, however, you should not make too big a deal out of it; the only way to verify that both the soil quality and the level of compaction are truly adequate is to have an evaluation performed by a geotechnical engineer. If you're building on suspect terrain, calling in a soil specialist is the best investment that you can make.

3. Inadequate or poorly installed reinforcing steel in masonry walls

Although the IRC permits unreinforced masonry walls in some cases, their use is limited to areas of low seismic activity. To create a wall assembly strong enough to resist natural forces such as gravity, wind and earthquakes, most masonry (concrete as well as block) walls must include steel reinforcement properly tied to the footing (drawing top right, p. 59).

Some inspection failures occur because the wrong size rebar is used: If plans call for #5 grade-60 rebar at 24 in. o. c., don't allow the mason to substitute #4 grade-40 rebar at 16 in. o. c. even though he swears that the tighter spacing of the bars makes up for their smaller size. The engineered design for the performance of a reinforced wall is based on the precise reinforcement at the exact location. Substitutions are not permitted (without the proper design and approval by the plans examiner).

Other reinforcement-type violations are triggered by sloppy workmanship or poor housekeeping. No sections of rebar are allowed to touch the inside face of a block cavity, or form wall; otherwise, that part of the wall will be weaker than other sections where the steel is encased in concrete. The rebar also must be clean when it's installed: Coatings such as rust or mud decrease the rebar's ability to bond properly with concrete or grout.

4. Improper stud-wall framing methods

This broad category of building-code violation is sometimes cited by an inspector who may see a plethora of code violations and has no room to list them all. The following are some of the most common framing errors:

- **Inferior lumber grade.** Utility-grade studs generally are not permitted for load-bearing applications, but even properly graded lumber may be rejected if damaged due to shipping, storage or weather.
- **Omission of properly treated sole plate.** Only pressure-treated lumber, heartwood redwood, black locust or cedars are permitted if the sole plate is resting on concrete.
- **Inadequate corner framing.** Three studs are generally required in each corner.
- **Inadequate header for span and bearing condition.** Maximum allowable header spans for specific sizes and species of lumber are clearly specified in the IRC, according to different loading conditions.
- **Second top plate not offset sufficiently.** The lap joints in top plates must be offset by at least 24 in.
- **Emergency-egress windows too small.** The one thing that inspectors never fail to check is the required emergency-egress window from a sleeping room. One window in each sleeping room must be large enough to ensure that occupants can escape a fire safely or that a firefighter can enter for a rescue (drawing above).

5. Inadequate shear walls

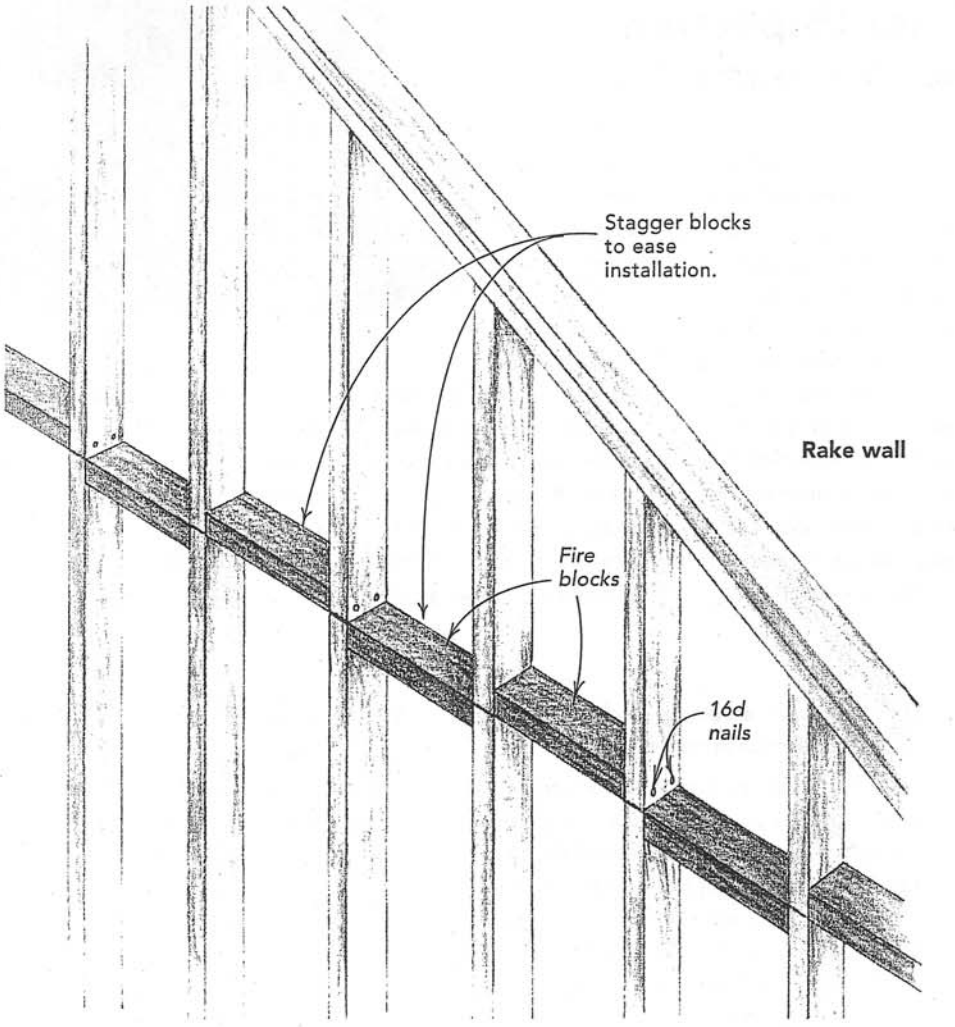
Lateral loads such as earthquakes and wind can exert tremendous force on walls as well as on foundations. Proper bracing enables walls to absorb these forces and transfer them to the foundation. The IRC contains specific requirements for braced walls in wood-frame houses. These requirements include a minimum 4-ft. wide braced wall section at each corner of a building. Long walls also must have a braced wall panel installed every 25 ft.

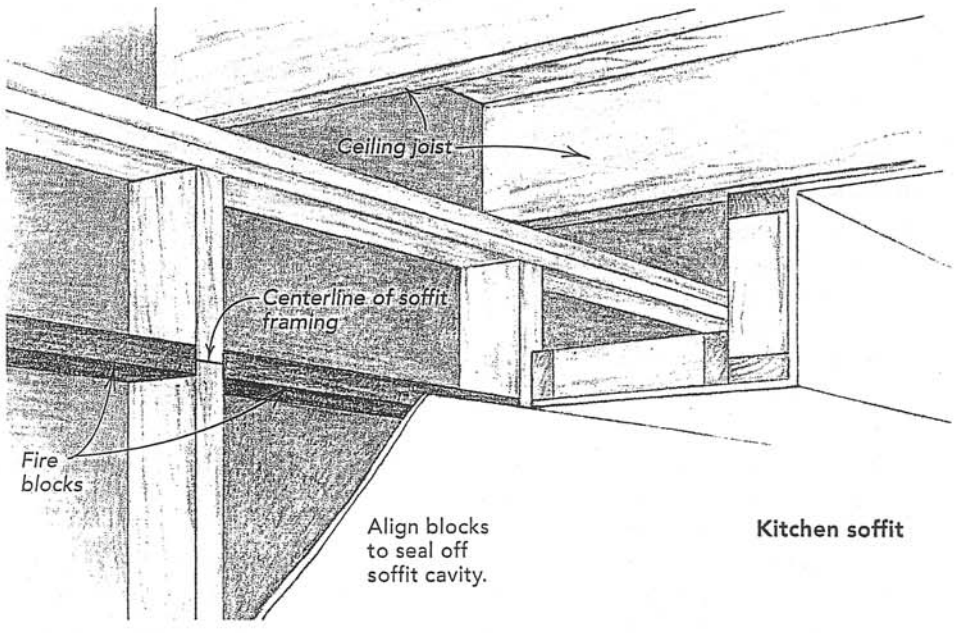
Such conventional bracing requirements can stifle the elaborate designs homebuyers often seek; what do you do when code requires a shear wall where you want to put a picture window? The answer is to obtain a

Drawing this page: Matt Collins

Don't forget the fire blocking

To prevent wall cavities from becoming flues should a fire start, most codes require fire blocks in walls that are more than 10 ft. high (such as rake walls). Fire blocks also must be used to close off framed areas such as dropped ceilings and kitchen soffits.





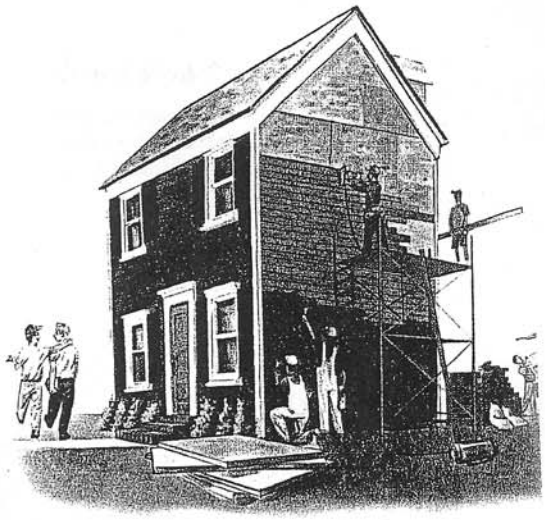
lateral design from a registered engineer (drawing bottom right, p. 59). However, an engineered design then must be built exactly as specified. Anchors, hold-downs and other structural connections must be installed precisely. Even the smallest field change must be approved by the engineer of record and reviewed by the building department's plans examiner to ensure compliance with the required design criteria.

6. Inadequate floor-framing or roof-framing methods

As with wall framing, this catch-all term is used by an inspector who encounters many code violations and hasn't room on the rejection form to list them all. Common errors in floor and roof framing include:

- **Floor joists not installed true and plumb.** If floor joists are allowed to lean, their strength axis will not be along the plane of gravity, and the joist will tend to twist and lose load-bearing capacity.
- **Missing structural blocking.** Although bridging is no longer required (unless the joist is larger than 2x12), joists must be supported at both ends by full-depth, solid blocking (drawing top left, p. 60).
- **Improper lap or connection in wood joists.** Floor joists that meet over a bearing partition or girder must be lapped at least 3 in. and then nailed with three 10d nails (drawing top left, p. 60).
- **Misplacement of trusses.** Trusses are manufactured based on engineering. They are designed to be installed in a specific way at a specific place. Your truss layout (and orientation) must be followed to the letter. If you don't read the instructions, I guarantee that your inspector will do it for you.
- **Repairing damaged trusses yourself.** Truss damage must be analyzed by the engineer who designed the truss. Fixes must be prescribed by the engineer and, in some cases, repaired by the factory. Do not attempt this repair yourself.
- **Truss bracing missing or installed improperly.** Truss-roof or floor systems are designed to act as a homogenous unit. Bracing is required at strategic locations to achieve that end. This bracing is specified in the truss layout and design criteria, and must not be ignored.
- **Hold-down clips for floor joists, rafters or trusses are missing.** Part of the anchoring requirements to control wind includes framing connectors at strategic locations.

Don't call for inspection until you're ready



In the construction business, time is money. If you're building a home, you need the job to progress smoothly, and you expect subcontractors to honor their schedules. But subcontractors have their own priorities and their own labor problems; so even the most carefully organized jobs often run behind schedule.

Regardless of who's to blame, if you call for an inspection before you're ready, the inspector will not be amused or moved by your dilemma. If this problem happens on a regular basis, you can expect to be hit with a reinspection fee. Remember, inspectors also have schedules to maintain, and theirs are probably even tighter than yours. Be sure to walk the project before the inspector arrives. Make sure subcontractors have finished their work. Also, make sure the project is clean. A clean project makes a good first impression, while a messy job site begs the question: "What else could be wrong here?" Be ready for the inspector, demonstrate that you respect his or her time, and you'll both benefit.

—*L. U.*

Read the plans, look for the details, and follow them.

7. Inadequate connections

You don't have to witness a roof blowing off in a hurricane to know that building materials must be attached properly to withstand nature's fury. Structural inspection failures are commonly the result of ignoring the connection details specified on the building plan. Although you may be familiar with common building practices, don't assume that all connections always can be made the same way.

Conventional standards for connections, such as the required nailing between wood plates and studs, are clearly spelled out in the IRC (chart bottom left, p. 60). These prescriptive standards mandate the size and spacing of the elements most commonly used to connect materials. Although they are easy to follow, these standards are not flexible. As an alternative, the International Building Code (IBC) includes a comprehensive set of standards for connections. These design standards specify the potential strength that is available from a particular connection device or method. Using these standards allows design professionals to work backward (taking into account the forces that are applied by nature) to determine the best type of connection to apply in a situation.

8. Excessive cutting and notching of wood structural members

Wood derives its strength from fibers that work together to resist bending. The flexural strength of a stud, joist or beam is degraded if the fibers are interrupted by holes, notches or cuts. Although code specifies the maximum allowable cutting, boring or notching for any solid-sawn wood member (drawings right, p. 60), it is important to remember that any of these acts decreases the wood's strength.

For manufactured I-joists, the cutting and notching permitted are based on the product listing. Inspectors rely on manufacturers' specifications for cutting and notching in these joists.

9. Improper stair or guardrail construction

Stairs can be dangerous even if they look perfectly safe. To ensure safety, code prescribes the following conventions:

- Maximum tread rise: 7¾ in.
- Minimum tread run: 10 in.
- Maximum variation between riser heights: ⅜ in.
- Handrails must be installed between 34 in. and 38 in. above the nosing of the tread.
- Handrails must have a gripping surface between 1¼ in. thick and 2⅝ in. thick.
- Stairway ceiling height must be at least 6 ft. 8 in. above the nosing of the tread.

10. Fire blocking missing

The humble fire block is every bit as much a lifesaver as a smoke alarm. Fire normally begins in a home's living portion and spreads upward. If fire reaches the attic, it can spread rapidly by engulfing the roof structure. Firefighters can extinguish a fire only if they know where it is and what it is burning. Unfortunately, a stud-wall frame contains numerous shafts that lead directly to the attic with almost total concealment. Properly installed fire blocking can prevent fire from spreading inside these cavities, allowing occupants to escape.

Fire blocking is required in a wall frame every 10 ft. both horizontally and vertically. In most cases, fire blocking can be made of wood scraps the same dimension as the wall studs. In addition to ensuring that fire blocks are positioned correctly, inspectors verify that fire blocks fit tightly against each stud.

In most types of wall framing, the top plates serve as the fire stops. A few places, however, always require dedicated fire blocking (drawing facing page). If they are not properly sealed off, rake walls, interior soffits, stair stringers, chases and chimneys all can allow fires to spread. □

Lynn Underwood is the building official for Arlington County, VA. Drawings by Christopher Clapp, except where noted.

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