Study Guide for Structural Issues for Home Inspectors Course

This study guide can help you:

- take notes;
- read and study offline;
- organize information; and
- prepare for assignments and assessments.

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Student Verification & Interactivity

Student Verification

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Introduction

Observe and Report

This course will help prepare the home inspector to observe and report on structural components and their condition in a residential property.

The structural portion of a home inspection is perhaps the single most important part. A house's structural integrity is often the issue of the greatest interest to home-buying clients. If the home is structurally unsound, not much else matters. This is why it's critical for the inspector to be competent in his ability to observe and report on what he sees during the structural portion of a home inspection.

But it isn't enough to simply look at the foundation and framing elements. Almost every part of a home reveals what's going on with its structure.

The course improves the inspector's awareness of structural defects, helps him avoid misdiagnosing problems, and defines his role in performing the structural portion of a home inspection.

The course is open to all and includes three short quizzes and a 65-question final exam. Upon passing the final exam, members can download and print their own Certificate of Completion. The course and final exam assume that you already have a basic understanding of the structural components of a home.

Reporting structural observations is part of a home inspector's job. Offering a definitive determination as to the cause of any defects or anomalies is not. So, remember: Home inspectors are barred from providing engineering services. The job of the home inspector is to OBSERVE and REPORT. This course is designed to help you do just that.

Be sure to refer to InterNACHI's Standards of Practice for Performing a General Home Inspection to read the requirements and exclusions for conducting the structural aspects of a residential property inspection.

What Inspectors Need to Know

Common Structural Terms

Bearing Wall

A bearing wall, or a load-bearing wall, is designed to carry the weight of structural components above, through itself, and to the supporting components below. Removal of or modification to bearing walls without specific design considerations can lead to loss of

structural integrity of the dwelling. Sometimes, the structural weakness is seen almost immediately. In other cases, the weakness is discovered only over time.

Beam

This is a horizontally placed wooden, steel or engineered member which supports floor framing members. It is a primary support member, and it's often supported by wooden or steel columns (or posts), exterior walls, or foundational elements.

Column

A masonry column is a vertical compression member whose height exceeds three times its thickness and whose width is less than one and one-half times its thickness. A column might be a slender vertical, structural compression member such as a post. A column supports loads that act primarily in the direction of its longitudinal axis.

Corner Post

This describes an assembly of perhaps three or even four vertical studs nailed together tightly to make up a corner framing element in a dwelling.

Cripple

This describes a grouping of short studs commonly found over (or sometimes below) openings, such as for windows and doors, where a full-length stud could not fit.

Footing

Typically seen at the bottom of the foundation or stem walls, the footing is generally made of poured reinforced concrete. Often wider than the foundation wall, the footing bears the full weight of the dwelling. In some instances when the soil is not completely compacted or is wet, a spread footing is designed and installed.

A spread footing is wider than normal. Footings can be affected by soil conditions, water intrusion, and soil erosion. Improperly supported footings can crack and cause a host of structural problems, starting at the foundation wall and extending throughout the dwelling. Remember that in some newer foundation configurations, footings are not required. Only time will tell how well these homes will fare. A no-footing installation is most typically seen with pre-cast concrete foundation assemblies, where tamped gravel supports the load transferred through the foundation walls.

Foundation

The foundation is the wall below the floor nearest grade serving as a support for a structural part of a home. The foundation is supported by a footing.

Header

Typically, a header is a horizontally placed wooden framing member that is made to support the load when an opening is made in a load-bearing wall. Headers are usually installed above windows and exterior doors, or wherever an opening is made in an interior load-bearing partition.

Jack Stud

A jack stud is a wooden member or stud placed at the sides of an opening in a load-bearing partition, and designed to support a header assembly above. Jack studs are sometimes called trimmers. The header is supported by a jack stud at each end. Jacks fit under each end of a header, and they transfer the load that the header carries down to the bottom plate and the framing beneath. Nailed to the jacks are full-height studs called king studs; they support the assembly between the plates. Sometimes jacks must be doubled on wide openings so there's enough supporting surface for the header to bear on. Jacks can be replaced with a steel header hanger attached to the king stud.

Joist

These members are typically made of dimensional lumber, although some products (sometimes called TJIs, the abbreviation for the manufacturer Truss Joist International) are also used. The purpose of the joist is to provide a nailing and support system for the floor sheathing and for the floor itself. The joist supports the live and dead loads placed on the floor assembly. TJIs (or the equivalent) are like mini wooden I-beams, with 2x2 square stock on the top and bottom (chords), and plywood or oriented strand board (OSB) between the two. Attic or ceiling joists are used to provide floor support in attic spaces, and also help prevent the roof rafters from collapsing downward and pushing outward.

King Stud

King studs are nailed to jack studs and are full-height studs. King studs support the assembly between the plates. See jack stud.

Pier

A pier is a sturdy point, typically at or below ground level, and generally constructed of concrete or a similar material, which supports a point load transferred from above. An example of this would be a pier installed below grade and covered by a concrete basement slab, on top of which rests a steel lolly column supporting a wooden girder assembly.

A pier is defined as an isolated vertical column of masonry whose horizontal dimension measured at right angles to its thickness is not less than three times its thickness nor greater than six times its thickness and whose height is less than five times its length.

Pilaster

A pilaster is a masonry structural element defined by its sectional configurations and heights. A masonry pilaster is a vertical member of uniform cross section built as an integral part of a wall which may serve as either a vertical beam or a column or both. A

pilaster projects from one or both faces of an unreinforced wall and usually projects in a reinforced wall. Pilasters are designed similar to columns except that pilasters are laterally supported in the direction of the wall, while columns are typically unsupported in both directions. Masonry foundations may have pockets built in the walls to support the ends of beams. A concrete block foundation might have a pilasters built to support the beam end.

Pitch

Pitch is the incline of the roof expressed as a fraction derived by dividing the rise by the span, where the roof span is the distance between the outside of one wall's top plate to another.

Post

A post is a vertical member which may be made of steel, concrete, wood or masonry materials. It is designed to carry a point load vertically downward onto a pier or block.

Rafter

Typically, this is a wooden framing member extending from the ridge to beyond the top plate of an exterior wall, or serving as a connecting point between two sloping sections of the roof structure. Though this is the most common description, there are other named rafters that are installed in a slightly different manner. For instance, a jack rafter (short) may not extend to the top plate but may connect a variety of structural roofing components.

Ridge

The ridge (or ridge beam) is installed at the intersection of roof rafters at their uppermost point. Ridge beams are typically made of wooden components. Be advised that not all roof structures require a ridge beam. On high-sloping roofs, the ridge beam may be comprised of thin materials used only as a nailing point or spacer. This may be seen where no horizontal support is needed. On lower sloping roofs, the ridge actually carries a load and should be comprised of properly sized materials suitable for the purpose.

Roof Truss

A roof truss is a pre-engineered assembly of smaller individual framing components attached together and in a design suited to provide greater support and economy, as well as a faster installation time. It takes the place of rafters, attic (or ceiling) joists, and ridge beams, and is hoisted and nailed in place, forming the entire roof and attic structure. A roof truss spans the distance between exterior walls and requires no additional support. It is designed to take the guesswork out of field-framing for the connecting points for intricate or multiple rooflines, tray and cathedral ceilings, roof penetrations, etc.

Sheathing

This describes the outer skin of the dwelling. Sheathing is attached to the outside of walls and roof assemblies. It can be comprised of fibrous materials, such as Celotex®, backer board, or other materials in older homes, plywood, particleboard, planking or OSB, among other materials. Sheathing on roofs may also be referred to as roof decking.

Sill Plate

The first course of horizontal lumber placed on top of and attached to the foundation wall is known as the sill plate.

Slope

Slope is the incline of the roof expressed as a ratio of the vertical rise to the horizontal run, where the run is some portion of the span. This ratio is always expressed as inches per foot.

Slope Ratio

A roof that rises 4 inches for every 1 foot or 12 inches of run is said to have a “4 in 12” slope. If the rise is 6 inches for every 12 inches of run, then the roof slope is “6 in 12.”

The slope can be expressed numerically as a ratio. The slope ratio represents a certain amount of vertical rise for every 12 inches of horizontal run. For example, a “4 in 12” slope can be expressed as the ratio of 4:12. A “6 in 12” slope is expressed as 6:12.

Sole Plate

In platform framing, this is the first course of horizontally placed lumber that goes on top of the sub-flooring material. It comprises the bottom of exterior walls and interior partitions where vertically positioned studs are attached.

Sub-Floor

A sub-floor is comprised of materials (usually plywood, OSB or planking) which are attached to joists and make up the top structural portion of the platform assembly on which occupants walk.

Trimmer

See jack stud.

For more terms, visit InterNACHI's Inspection Glossary.

Common Foundation Types

Slab-on-Grade Foundation

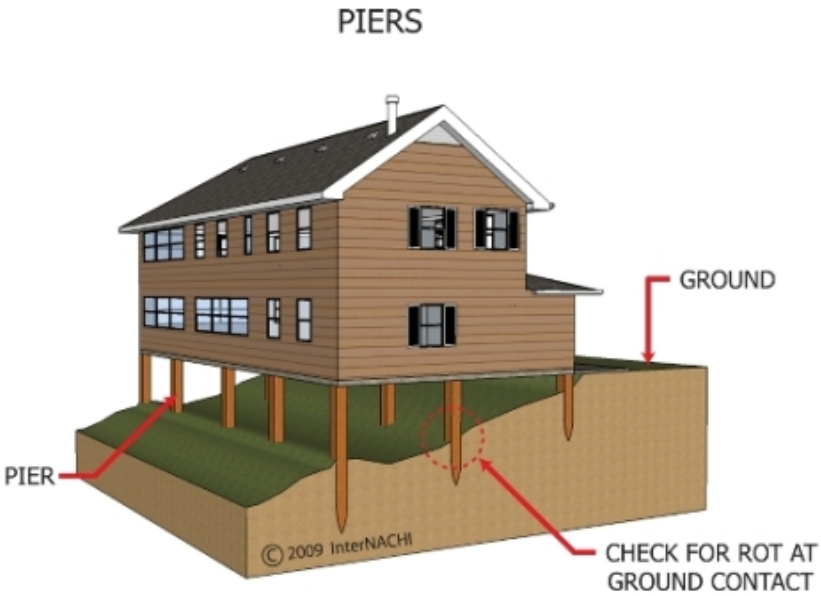
A slab-on-grade foundation is a type of foundation consisting of a structural concrete slab poured directly on the grade. No accessible space exists in slab-on-grade construction. Slab-on-grade foundations are popular in areas where there is a high water table.

Crawlspace

A crawlspace is an accessible space between the ground and the bottom of the first floor of a home.

Full Basement

A full basement creates an accessible space between the ground and the bottom of the first floor of a home. Full basements are popular predominantly in cold climates where the footer needs to be below the frost line.



Pier

Pier foundations, like slab-on-grade foundations, are typically installed in areas that do not have the proper type of soil to support a full basement foundation.

Pre-Cast

Pre-cast wall sections are cast in a factory and shipped to the construction site. Sections are then lifted into place on a simple gravel footing and bolted together. The wall sections are then sealed.

Common Framing Styles

There are two common styles of wood framing: balloon and platform. The main difference between balloon and platform framing is apparent at the floor lines. The balloon wall studs extend from the sill of the foundation all the way to the top plate of the second floor. The platform framed wall, on the other hand, is independent for each floor.

Balloon Framing

Balloon framing is an older method of wood framing that utilizes long, continuous framing members (studs) that run from sill to eaves, with intermediate floor platforms nailed to them. Once popular when long lumber was plentiful, balloon framing has been largely replaced by platform framing. However, balloon framing is growing in popularity again in light-gauge, steel stud construction. For light-gauge steel, long framing members are not as much of an issue. Some electricians prefer working in balloon frame buildings because the lack of fire blocking makes it much easier to add circuits.

Home inspectors should be able to explain that, in balloon framing, there exist chases for fire to quickly travel from floor to floor. This hazard can be mitigated by the use of firestops at each floor level, but firestops can't always be confirmed by home inspectors. Balloon framing has been outlawed by building codes in many areas because of the fire danger that it poses. Again, this can be mitigated by adding firestops.

The home inspector might notice a down-slope in the floor toward central walls caused by the differential shrinkage of the wood framing members at the perimeter.

Platform Framing

In platform framing, the joists comprise any number of individual floors or platforms that wall framing components are constructed on top of--hence, the term platform framing.

Platform framing is the most common method of frame construction. The floor, or platform, is made up of joists that sit on supporting walls, beams or girders and covered with a plywood or OSB sub-floor. In the past, 1x planks set at 45 degrees to the joists were used for the sub-floor.

Floor joists can be engineered lumber trusses or I-beams that have increased rigidity and longer spans, with the added benefit of conserving natural resources. They allow easier access for runs of plumbing, HVAC, etc.

Inspector Safety

The structural part of a home inspection is the most dangerous. Here are some tips that will help keep you safe on the job.

Ladder Safety

You are not required to walk the roof in order to perform a complete home inspection. If you are using a ladder on your inspection, choose a location that is well away from all power lines. Coming into contact with live wires can be fatal. If you transport your ladder on the roof of your vehicle, the ladder may become wet, so dry off the rungs before climbing it. Place the ladder on level ground and open it completely, making sure all locks are engaged. Read telescopic ladder instructions carefully. Use the "4-to-1 Rule" for extension ladders, which states that for each 4 feet of distance between the ground and the upper point of contact (such as the roof), move the base of the ladder out 1 foot. Always face the ladder when climbing, and wear slip-resistant, rubber-soled shoes. Keep your body centered on the ladder and gauge your safety by your belt buckle. If your buckle passes beyond the ladder rail, you are over-reaching and at risk of falling. Stand at or below the highest safe standing level on a ladder. For a step ladder, the safe standing level is the second rung from the top, and for an extension ladder, it's the fourth rung from the top.

Attic Safety

Risks of inspecting a roof attic include: falling through the floor (or the ceiling of the level below); bumping your head on rafters or collar ties; breathing insulation dust; and coming into accidental contact with exposed wiring. Be conscious of these risks while inspecting an attic.

Crawlspace Safety

Crawlspaces pose the riskiest part of a home inspection. Dangers include: bumping your head; breathing insulation dust; exposure to rodents and their droppings (which can lead to illness); exposure to mold; cutting yourself on sharp duct edges; touching exposed wiring; and contact with snakes, spiders, and even wild animals. It is unwise to inspect a crawlspace without letting someone know of your location. Never enter a crawlspace that has standing water in it.

Quiz #1

In the U.S., full basements are popular in the _____.

- North
- South

T/F: Balloon framing is the latest style of framing.

- False
- True

The "4-to-1 Rule" for ladder safety states that for every 4 feet of distance between the ground and the upper point of contact of the ladder, move the base out _____.

- 1 foot
- 4 feet
- 2 feet

Slope is the incline of the roof expressed as a ratio of the _____ to the _____, where the run is some portion of the span.

- vertical rise... horizontal run
- horizontal run... vertical rise
- vertical rise... pitch
- length.... height

Jack studs are sometimes called trimmers.

- True
- False

A _____ is a horizontally placed wooden framing member that is made to support the load when an opening is made in a load-bearing wall.

- header
- kick board
- double top plate
- footer

A masonry _____ is a vertical compression member whose height exceeds three times its thickness and whose width is less than one and one-half times its thickness.

- column
- footing
- beam
- stud

A _____ describes an assembly of perhaps three or even four vertical studs nailed together tightly to make up a corner framing element in a dwelling.

- corner post
- sill plate
- diagonal brace
- lag bolt attachment
- doubled header

_____ describes a grouping of short studs commonly found over (or sometimes below) openings, such as for windows and doors, where a full-length stud could not fit.

- Cripples
- Double heading
- Full studs
- King studs
- Collar ties

A pilaster is a masonry structural element defined by its sectional configurations and heights.

- True
- False

Typically, a _____ is a wooden framing member extending from the ridge to beyond the top plate of an exterior wall, or serving as a connecting point between two sloping sections of the roof structure.

- rafter
- beam
- stud
- joist

_____ is the incline of the roof expressed as a fraction derived by dividing the rise by the entire span, where the roof span is the distance between the outside of one wall's top plate to another.

- Pitch
- Slope

A _____ placed wooden, steel or engineered member which supports floor framing members is called a beam.

- horizontally
- diagonally
- vertically

The _____ is installed at the intersection of roof rafters at their uppermost point.

- ridge
- footing
- joist hanger
- sill plate

The purpose of the joist is to provide a nailing and support system for the floor sheathing and for the floor itself.

- True
- False

T/F. King studs are nailed to jack studs and are full-height studs. King studs support the assembly between the plates.

- True
- False

In platform framing, the _____ is the first course of horizontally placed lumber that goes on top of the sub-floor material.

- sole plate
- sill plate
- footing

What to Look for Outside

Property Lot

Home inspectors should look for and take note of:

- steep slope

  A home inspector should note if a home is on a steep slope and, therefore, subject to erosion or movement. The maximum slope of a lot is roughly 1-in-2.

- negative grading

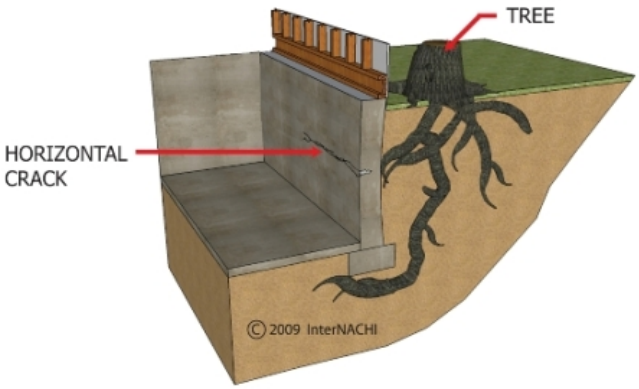
  A home inspector should note if a home is subject to negative grading or poor drainage. Water penetration could damage the foundation over time. Also, take note of driveways that slope toward the home.

- high grading

  Wood siding and sill plates should be at least 6 inches above grade. Rotten sills will be crushed by the weight of the home and lead to settlement. Furthermore, a rotten sill weakens the anchoring of the framing to the foundation.

- downspouts discharging near the foundation. A home inspector should note if the downspouts for the guttering system are discharging too near the foundation.

FOUNDATION FAILURE: TREE ROOT



- nearby vegetation

A home inspector should note the existence of any trees near the home. Plants growing next to a house could raise the soil level too high against the foundation.

Exterior

Home inspectors should look for and note:

- mortar joint condition;
- loose bricks;
- misdirected downspouts;
- overflowing gutters;
- horizontal cracks;
- vertical cracks;

- step cracks;
- untreated wood in contact with soil;
- previous repairs;
- sagging lintels;
- missing or obstructed weep holes;
- too few weep holes; and
- missing or improperly installed flashing.

Vertical Cracks

A vertical foundation crack could be due to serious settlement if it is significantly large or shows signs of ongoing movement. If the cause is shrinkage, it is of less concern than if the cracks are a result of settlement. Vertical cracks are not caused by frost.

Diagonal Cracks

Diagonal cracks that grow in width, especially ones that are wider at the bottom than at the top, indicate settlement. Diagonal cracks over windows indicate a weak header. Diagonal cracks in a poured concrete foundation that are fairly uniform in width or are hairline-type are caused by shrinkage and, though they may allow water entry, do not constitute a structural defect.

V's Heave and Pyramids Fall

Two cracks that form a V shape indicate heaving, especially if accompanied by crushed mortar joints. Two cracks that form an upside-down V or pyramid shape indicate settlement or drooping in the middle.

Horizontal Cracks Below Grade

Horizontal cracks are not caused by settlement, yet they can still be a cause for concern. Horizontal cracking is caused by pressure on the outside of the foundation wall below grade. Most often, the cause is improper back-filling, but expansive soil and frost are also possible causes.

Horizontal cracks are often accompanied by lateral displacement, meaning that one side of the crack is pushed in (or out) further than the other side. In time, and depending on conditions, the wall may begin to bow in and even collapse.

Active Crack Indications:

- The crack has been patched and has opened up again.
- The edges of the crack in brick are sharp, and not rounded with time.
- There is no dust or debris inside the crack.
- The wall is painted, but there is no paint inside the crack.

The longer a crack has been there, the less of a structural issue it is.

Cracks That Follow Mortar Joints

Some home inspectors think that if the crack follows the mortar joint, rather than going through the brick or block, the crack isn't a problem. This is false. Walls crack at their weakest point. If the mortar is stronger than the brick, the wall will crack through the brick.

Indications of Inward Bowing at the Top of the Foundation:

- The end of an I-beam pokes out through the wall.
- The overhang of the brick veneer is most pronounced near the middle of the wall, and then disappears at the ends. Up to a 1-inch overhang is considered acceptable.

Attached Garage

When an attached garage slab heaves or settles, it will often pull away from the home and leave cracks.

Parge Coating

Block foundation walls are often parge-coated on the exterior. This coating is a mixture of Portland cement and sand, and is applied to give a smooth and uniform appearance to the foundation's exterior. Often, moisture gets behind this parge coating. In the winter through freeze and thaw cycles, the moisture pushes outward at the coating, causing it to crack and crumble. This should be noted by the inspector.

Weep Holes

Weep holes should exist at least every 36 inches.

Cantilevered support beam on wooden deck is over-extended, and is sagging. Condition is unsatisfactory, and is indicative of an amateur design and inexperienced installation.

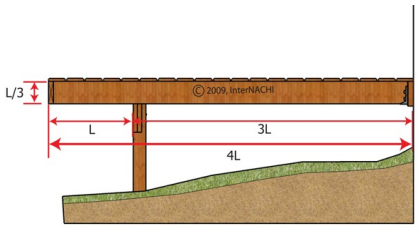
Decks and Porches

Home inspectors should take note of:

- who built it;

- missing or loose fasteners;
- the condition of fasteners;
- a lack of fastener nails;
- the use of untreated wood;
- whether the deck is pulling away from the house;
- wobbly rails or unsound steps; and
- rot, especially where cantilevered joists penetrate the wall.

Decks and porches are often add-ons to the original home. Many of them have been poorly built by "weekend warrior" homeowners or handyman-type contractors. So, the first question to ask is: "Who built the deck?"



Rule of Thumb for Cantilevered Joists

The image above depicts a cantilevered deck. Joists should be cantilevered no more than one-quarter of the joist length, or three times the joist width (nominal depth), whichever is smaller.

CLICK HERE for Maximum Post Height Chart

CLICK HERE for Maximum Joist Span Chart

CLICK HERE to read InterNACHI's "Inspecting a Deck, Illustrated" article.

Roof

Home inspectors should take note of:

- sagging rafters;
- sagging roof sheathing between rafters;
- sagging or crooked ridge board;
- leaking gutters; and
- roof spreading.

CLICK HERE for Roof Sheathing Span Chart

Roof Spreading

Roof spreading often pushes out the middle top of the exterior walls.

Quiz #2

The maximum slope of a lot is roughly _____.

- 1 in 2
- 1 in 12
- 1 in 10
- 1 in 3

Wood siding and sill plates should be at least ___ inches above grade.

- 6
- 2
- 18

T/F: V's heave and pyramids fall.

- True
- False

Deck joists that cantilever half their length are _____.

- dangerous
- safe

The _____ style of roof does not have a gable.

- hip
- shed
- gambrel

T/F: A deck built with untreated wood is not considered an issue if the deck is sturdy.

- False
- True

Horizontal cracks below grade are generally not caused by _____.

- settlement
- expansive soil
- frost
- improper back-filling

A home inspector _____ note if a home is subject to negative grading or poor drainage.

- should
- need not

T/F. It is difficult to tell if slab-on-grade cracks indicate a structural problem, so all such cracks should be noted and reported.

- True
- False

Deck joists that cantilever half their length are considered _____.

- dangerous
- safe

What to Look for Inside

Roof Structure and Attic

In an unfinished attic, the home inspector can see any number of structural framing elements, including rafters, trusses, joists, collar ties and roof sheathing.

Here's a view of a large, stick-framed roof structure, with ridge beam installed.

The home inspector should take note of:

- truss modification;
- cut rafters, especially around skylights;
- sagging rafters;
- sagging roof sheathing;

- poor ventilation;
- mold;
- roof leaks;
- sistered or repaired rafters;
- missing or broken collar ties;
- cracked or split rafters;
- evidence of past fires;
- trusses out of plumb more than 1/50th of the height; and
- truss modifications.

Collar Ties

Collar ties connect opposing rafters and are typically placed in the top third of the attic spaces. Collar ties hold the rafters down against the ridge board and, to an extent, help prevent rafter spread. Home inspectors should take note of attics without collar ties, especially where the rafters run perpendicular to the joists. Collar ties must be at least 1x4 (nominal) and spaced not more than 4 feet on center.

Finished Attics

One of the biggest problems with attics is when they have been finished into a living space. Often, the floor joists were only large enough to carry the ceiling below and were never meant to support a living space above.

Poor Ventilation

Ventilation is important to prevent condensation that could lead to structural water damage. Ventilation is also important to prevent excessive heat build-up which can warp and shrink wood. Insulation must be at least an inch away from sheathing, and must not block vents.

Rafter Spread

A lack of rafter ties can cause rafter spread, especially during heavy snows. This often occurs near the middle of the ridge board, as outside walls keep the ends of the ridge supported. Rafter spreading causes ridge sagging and can push the top parts of the walls out, especially during heavy snows.

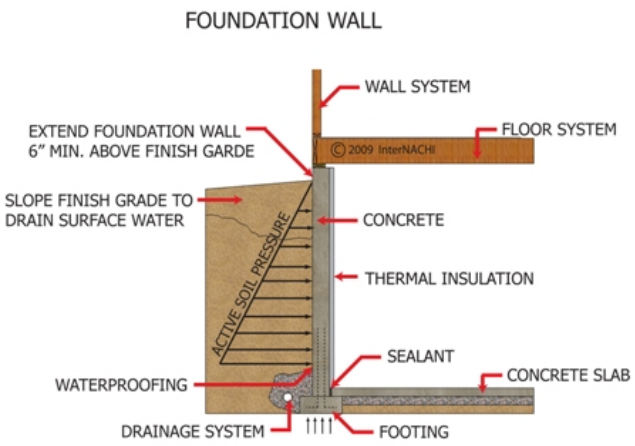
Roof Leaks

If you discover a roof leak, try to determine the path of the water, and what structural damage it may have caused.

Basement and Crawlspace

The home inspector should look at all visible surfaces in the basement and crawlspace and take note of:

- access opening restriction;
- water stains;
- standing water;
- efflorescence;
- cracks;
- walls that are out of plumb;
- piers and columns that are out of plumb;
- sagging floor joists;
- band joist rot;
- sill plate rot;
- untreated wood in direct contact with concrete (but note that some codes permit untreated wood to contact interior piers filled with concrete);
- evidence of animals;
- mold or fungus;
- crumbling mortar joints;
- repairs;
- sealers;
- paint;
- dehumidifiers;
- rust at the bottom of the heating system;
- crawlspace ventilation;
- evidence of wood-destroying organisms;
- wood-destroying organism treatment holes;
- daylight through the foundation;
- insulation vapor-barrier orientation;
- waterproofing systems;
- standing water in the sump pit;
- exposed dirt floor in the crawlspace;
- additional jack or pier supports;
- cold joints in poured concrete walls;
- rusted steel columns;
- missing column-to-beam connections; and
- poor ventilation.



Check both walls and slab floors for any signs of cracking. Any cracks that are 1/4-inch wide or wider may be an indication of serious problems that require evaluation by a licensed professional engineer. Remember, the job of the inspector is to observe and report -- not to analyze.

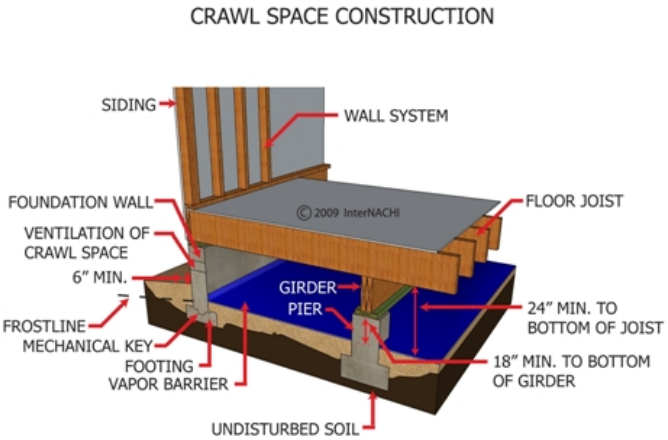
Diagonal cracks that grow in width, especially ones that are wider at the bottom than at the top, indicate settlement. Diagonal cracks over windows indicate a weak header. Diagonal cracks in a poured concrete foundation that are fairly uniform in width or are hairline-type are caused by shrinkage and, though they may allow water entry, are not considered a structural defect.

Horizontal wall cracks are typically caused by frost and exist at about the frost line.

Sill plate anchor bolts should have 2-inch washers, be no closer than 7 bolt-diameters from the end of the sill, no further away than 12 inches from the end of the sill, and no fewer than two per piece of sill material.

Check the bottom of the heating system if it sits on the floor. Is it rusted? If so, there may have been flooding or standing water in the past.

If the house has been winterized and the heat has been turned off, the frost depth goes down. Unheated homes can suffer heaving.



Crawlspaces

Access openings must be a minimum of 18 inches high by 24 inches wide.

Where physical entry is impossible, use a powerful flashlight. A digital camera with a zoom lens works well.

Frost heave may occur during the winter after the crawlspace walls are insulated because the lack of insulation was keeping the soil near the building warm enough to prevent freezing.

The grade (soil) should be at least 18 inches below the bottom of the floor joists, and 12 inches below beams. However, some codes require 24 inches below the bottom of the floor joists and 18 inches below the beams so that inspectors and contractors can enter. Most codes require 18-inch-high access openings. So, if a beam is lower than that, the inspector should note it in his report as a restriction. Columns and posts must be constrained to their footings, must be a minimum of 4x4, must be connected to girders with approved hardware, and be pressure-treated if closer than 8 inches to the soil.

This photo was taken in a crawlspace. Believe it or not, these small tree trunks were all that supported the main girder of an addition.

Piers made of hollow concrete block or cinder block should be installed with the hollow channels set vertically.

Within 3 feet of each corner of the crawlspace, one ventilation opening should be installed. The minimum net area of ventilation should be at least 1 square foot for each 150 square feet of underfloor space area, unless the ground surface of the crawlspace is covered by a vapor retarder.

Joist Span Chart

CLICK HERE for Joist Span Chart

Unvented Crawlspaces

In most climate zones, conditioned crawlspaces perform better than vented crawlspaces in terms of safety, health, comfort, durability and energy consumption. Research has demonstrated how these conditioned crawlspaces also do not cost more to construct than vented crawlspaces. Crawlspace venting is a widely accepted business practice across the country. However, in humid climates, the warm humid air entering the crawlspace is more likely to condense on crawlspace framing than to help dry out the crawlspace. This is because the outside air can often have a dew point that is higher than the interior crawlspace framing surface temperature. As evidence, existing vented crawlspaces have experienced serious moisture and mold problems costing builders and homeowners significant resources to repair.

The housing industry has been reluctant to use unvented crawlspaces despite their compelling benefits and the history of problems with existing vented crawlspaces. One of the reasons commonly cited by builders and designers is "the code does not allow me to build unvented crawlspaces." This is both generally correct and misleading. The model codes do not allow the construction of "unvented" crawlspaces—except in very limited circumstances, but they do allow the construction of "conditioned" crawlspaces. The distinction is important and necessary.

Unvented, conditioned crawlspaces with insulation on the perimeter perform better in terms of safety and health (pest control), comfort (warm floors, uniform temperatures), durability (moisture), and energy consumption than passively vented crawlspaces with sub-floor insulation. This is because they are cooler and dryer in the summer, which minimizes condensation on framing surfaces. In addition, there is less heat loss from the home during winter, which results in more comfortable floors and less risk of freezing pipes. Crawlspace temperatures, dew points, and relative humidities should mirror those of the house interior.

Crawlspaces should be designed and constructed as mini-basements, as part of the house within the conditioned space. To meet code requirements, the crawlspace floor should:

- be covered with a ground cover consisting of 6-millimeter plastic that is overlapped and sealed at the edges and secured to the side walls;
- perimeter walls should be insulated to code-specified levels (e.g., rigid foam on the exterior or rigid fiberglass, spray foam, or rigid foam on the interior); and
- perimeter drainage should be provided just like a basement when the crawlspace ground level is below the ground level of the surrounding grade.

The crawlspace can be conditioned in one of three ways:

1. supply air from the home to the crawlspace,
2. return air to home via transfer grille or to outside via exhaust fan, or
3. connect the crawlspace to a conditioned basement.

A soil gas venting system should be installed as part of a complete radon-resistant construction system.

Research encourages the use of slab-on-grade foundations rather than crawlspaces for locations that are not subject to frequent flooding.

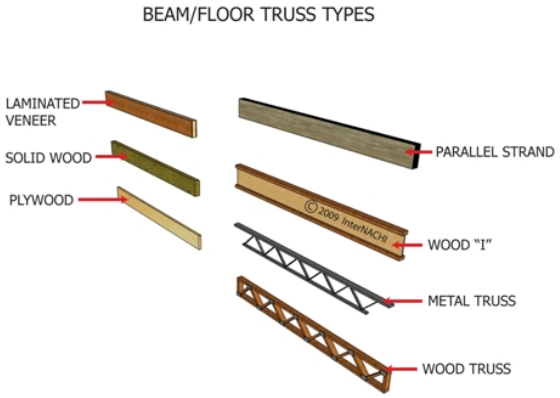
Crawlspace Safety

Be especially careful if access to the crawlspace area is from the exterior. Animals can be living inside, including raccoons, snakes and rats. It is not advisable to enter any crawlspace area that is wet or where standing water can be seen. Pay close attention to electrical wiring, and look for open junction boxes. Use extreme caution in any crawlspace where a dirt floor is all that exists, and never assume that there is solid dirt present under a polyethylene sheet. It could be covering a hole.

Floors

The home inspector should take note of:

- un-level flooring;
- cracked tiles;
- sagging floor joists;
- evidence of wood-destroying organisms;
- treatment holes for wood-destroying organisms;
- joist or sub-floor rot;
- sistered or repaired joists;
- evidence of missing joists that should have been installed or were removed and not replaced;
- evidence of missing joists under load-bearing walls;
- cracked joists;
- signs of deflection, and a noticeable bounce to floors;
- squeaking floors;
- wood in contact with concrete;
- poor joist-end bearing;
- inappropriate notching or holes in joists;
- joist splits;
- over-spanning or under-sized joists;
- joists too close to grade (soil);
- over-spanned or under-sized sub-flooring;
- swollen wafer board or OSB sub-flooring; and/or
- crowning.



Generally speaking, it will be rare to see joists spread more than 24 inches apart, but if this condition is discovered, look for any signs of a joist that may have been removed.

In rooms where exterior covered porches may have once existed, it is not unusual to find that sleepers and a new sub-floor were installed because exterior porch floors are often pitched away from the dwelling to allow rain water to run off and away from the home.

Home inspectors often notice a hump in the floor on either side of the beam underneath. This is generally caused by excessive joist overlap where the ends of an extra-long joist kick up. This "teeter-totter" effect also occurs with cantilevered joists when deck joists run through a wall, for example. These humps are not a serious structural problem.

Cracked tiles are usually the result of the sub-floor not being rigid enough.

You are not seeing things. This photo shows a wooden girder assembly comprised of four (4) 2"'14" Microllam beams, which are connected together via face nailing, instead of through-bolting, and with a 4" diameter drain pipe run smack through all of it. Notice the addition of the 2"x4" for additional support, to the immediate right of the lally column.

General rules about standard dimensional joists:

- Double joists should be installed under parallel bearing walls.
- Maximum holes should not exceed a third of the height of a joist.
- Holes should not be within 2 inches of the top or bottom of a joist.

- No notches should appear in the middle third of a span.

General rules about prefabricated I-joists:

- There should be no notching of either flange.
- There should be no big holes or notches in the ends of the joists.
- There should be no holes within 6 inches above a bearing wall or girder.

Cracks in Concrete Floors with Basements

The concrete floor is not an integral part of the foundation and is often poured after the home is nearly finished.

Cracks in Slab-on-Grade

It is difficult to tell if slab-on-grade cracks indicate a structural problem, so all such cracks should be noted and reported.

Wood in Contact with Concrete

Sill plates on top of concrete foundations should be made from treated wood, or have sill sealers or separators between them. Wood beams embedded into concrete foundations should be treated.

Crowns

A best practice when constructing a floor system with dimensional lumber joists is to install the boards with the crown upward. Floor joists tend to have a slight bend, referred to as a crown. Engineered floor joists and trusses do not have inherent crowns. Many bridges have crowns. Take a look at some bridges, and you may see that many are built with a crown, a hump in the center of the bridge that is higher than the ends of the bridge. To check for a crown on a floor joist, position your nose near one end of a board and look down the lengthwise edge of the board. You just might see a slight curve in the board. Contractors will install floor joists with all of the crowns upward. Crowning floor joists in this way will help provide a consistent floor surface. After the floor decking and additional loads are installed, the weight will push down on the joist crowns and will help provide a consistent and flat floor surface.

Walls and Ceilings

The home inspector should take note of:

- bowing walls;
- cracks;
- no visible support beneath load-bearing walls;
- bulging paneling;
- waves and bows;
- walls out of plumb; and
- rusty nail heads.

The thickness of some interior walls may give the inspector clues as to how the house is constructed. For instance, if all interior walls are framed with 2x4 studs and you come across a wall framed with 2x6s, or even 2x8s, you could be looking at a plumbing wall, a load-bearing wall, or even a marriage wall between two sections of a modular home configuration.

Tiny cracks that follow the plaster surface that look like spider veins may be indicative of a moisture problem behind the plaster itself. Diagonal cracks can be associated with settlement or shifting of foundational elements. Cracks over doors and windows can be attributed to the expansion and contraction of wooden framing components, and are generally not considered structural defects.

Waves and bows can be the result of the lath pulling away from wooden framing components.

Water intrusion is always a factor, so look for staining and dark areas. Mold and water stains can be an indication of long-term problems associated with faulty plumbing, or moisture intrusion from exterior walls or leaking roofs. If walls below windows look stained or are wet, check the sills of the windows above them. Look for rusty nail heads that can be seen through wallpaper.

Truss Uplift

Truss uplift occurs in the winter when the bottom chord of roofing trusses arch up. Home inspectors often mistake it for settlement of central walls. Don't be fooled. Not everything settles downward. Use of a long level can reveal what is going on. There is no cure for truss uplift but it is not a structural problem.

Windows, Doors and Moldings

The home inspector should take note of:

- daylight showing through around exterior doors and windows;
- windows and doors that stick;
- large gaps at trim and molding joints;
- frame rot;
- signs of moisture;
- cracked glass;
- lock sets that no longer line up;
- door frames out of plumb;
- planed doors; and
- doors cut as the home settles.

Quiz #3

Which roof framing members reduce rafter spread?

- collar ties
- ridge boards
- cripple walls

In crawlspaces, the grade (soil) should be at least ___ inches below the bottom of the floor joists, and ___ inches below the beams.

- 18.....12
- 12.....18

The maximum size of a hole should not exceed _____ the height of the joist.

- one-third
- one-half

T/F: Truss uplift is a major structural problem.

- False
- True

In a crawlspace, if the distance between the soil and the bottom of a girder is 15 inches, the inspector should _____.

- note it as restricted access in the report.

- dig to gain access to the area on the other side of the girder.

_____ help prevent rafter spread.

- Collar ties
- Rafters
- Trusses

_____ pose the riskiest part of a home inspection.

- Crawlspaces
- Ladders
- Attics

In crawlspaces, piers made of hollow concrete block or cinderblock should be installed with the hollow channels set _____.

- vertically
- horizontally

T/F: Home inspectors should note floors that squeak or groan.

- True
- False

T/F: Cracked tiles are usually a result of the sub-floor not being rigid enough, but this is not a structural issue.

- True
- False

T/F. Truss uplift occurs in the summer when the bottom chord of roofing trusses arch up.

- False
- True

Tiny cracks that follow the plaster surface that look like spider veins may be indicative of a _____ problem behind the plaster itself.

- moisture
- foundation
- animal
- insect

Collar ties span between _____.

- rafters
- plates

- headers
- footers
- joists

The Report

Report Writing

The home inspector should use InterNACHI's Pre-Inspection Agreement.

InterNACHI's Pre-Inspection Agreement helps protect you and clearly explains to your client what home inspectors do and don't do, such as:

"5. INSPECTOR does not perform engineering, architectural, plumbing, or any other job function requiring an occupational license in the jurisdiction where the inspection is taking place, unless the inspector holds a valid occupational license, in which case he/she may inform the CLIENT that he/she is so licensed, and is therefore qualified to go beyond this basic home inspection, and for an additional fee, perform additional inspections beyond those within the scope of the basic home inspection. Any agreement for such additional inspections shall be in a separate writing or noted here..."

The home inspector should note limitations in his/her report.

Most of a home's structure is buried underground or hidden behind walls, but the home inspector should still note limiting factors in the report. Examples include references to:

- finished basements;
- inaccessible or dangerous crawlspaces;
- beams, girders, posts and joists that may be covered, boxed in, or above ceilings;
- insulation in the joist bays;
- inaccessible rooms;
- owner's personal items that may obstruct access and visibility;
- fresh paint; and
- dogs.

The home inspector should include (or at least reference) InterNACHI's SOP in his/her report.

Here are the Limitations, Exceptions and Exclusions from InterNACHI's Residential Standards of Practice (April 2007), a copy of which should be included (or at least referenced) in every home inspection report. The highlighted sections pertain directly to the structural portion of a home inspection.

2.1. Limitations:

I. An inspection is not technically exhaustive.

II. An inspection will not identify concealed or latent defects.

III. An inspection will not deal with aesthetic concerns or what could be deemed matters of taste, cosmetic defects, etc.

IV. An inspection will not determine the suitability of the property for any use.

V. An inspection does not determine the market value of the property or its marketability.

VI. An inspection does not determine the insurability of the property.

VII. An inspection does not determine the advisability or inadvisability of the purchase of the inspected property.

VIII. An inspection does not determine the life expectancy of the property or any components or systems therein.

IX. An inspection does not include items not permanently installed.

X. These Standards of Practice apply only to properties with four or fewer residential units.

2.2. Exclusions:

I. The inspector is not required to determine:

a. property boundary lines or encroachments.

b. the condition of any component or system that is not readily accessible.

c. the service life expectancy of any component or system.

d. the size, capacity, BTU, performance or efficiency of any component or system.

e. the cause or reason of any condition.

f. the cause for the need of correction, repair or replacement of any system or component.

g. future conditions.

h. compliance with codes or regulations.

i. the presence of evidence of rodents, birds, animals, insects, or other pests.

j. the presence of mold, mildew or fungus.

k. the presence of airborne hazards, including radon.

l. the air quality.

m. the existence of environmental hazards, including lead paint, asbestos, or toxic drywall.

n. the existence of electromagnetic fields.

o. any hazardous waste conditions.

p. any manufacturers' recalls or conformance with manufacturer installation, or any information included for consumer protection purposes.

q. acoustical properties.

r. correction, replacement or repair cost estimates.

s. estimates of the cost to operate any given system.

II. The inspector is not required to operate:

A. any system that is shut down.

B. any system that does not function properly.

C. or evaluate low-voltage electrical systems such as, but not limited to:

1. phone lines;
2. cable lines;
3. satellite dishes;
4. antennae;
5. lights; or
6. remote controls.

D. any system that does not turn on with the use of normal operating controls.

E. any shut-off valves or manual stop valves.

F. any electrical disconnect or over-current protection devices.

G. any alarm systems.

H. moisture meters, gas detectors, or similar equipment.

III. The inspector is not required to:

a. move any personal items or other obstructions, such as, but not limited to: throw rugs, carpeting, wall coverings, furniture, ceiling tiles, window coverings, equipment, plants, ice, debris, snow, water, dirt, pets, or anything else that might restrict the visual inspection.

b. dismantle, open or uncover any system or component.

c. enter or access any area that may, in the opinion of the inspector, be unsafe.

d. enter crawlspaces or other areas that may be unsafe or not readily accessible.

e. inspect underground items, such as, but not limited to: lawn-irrigation systems; or underground storage tanks (or indications of their presence), whether abandoned or actively used.

f. do anything which may, in the inspector's opinion, be unsafe or dangerous to the inspector or others, or damage property, such as, but not limited to: walking on roof surfaces, climbing ladders, entering attic spaces, or negotiating with pets.

g. inspect decorative items.

h. inspect common elements or areas in multi-unit housing.

i. inspect intercoms, speaker systems, or security systems.

j. offer guarantees or warranties.

k. offer or perform any engineering services.

l. offer or perform any trade or professional service other than general home inspection.

m. research the history of the property, or report on its potential for alteration, modification, extendibility or suitability for a specific or proposed use for occupancy.

n. determine the age of construction or installation of any system, structure or component of a building, or differentiate between original construction and subsequent additions, improvements, renovations or replacements.

o. determine the insurability of a property.

p. perform or offer Phase 1 or environmental audits.

q. inspect any system or component that is not included in these Standards.