



The fastest way to create success with rehabs and rentals.





SESSION 3

Basic Structural Systems - Floors

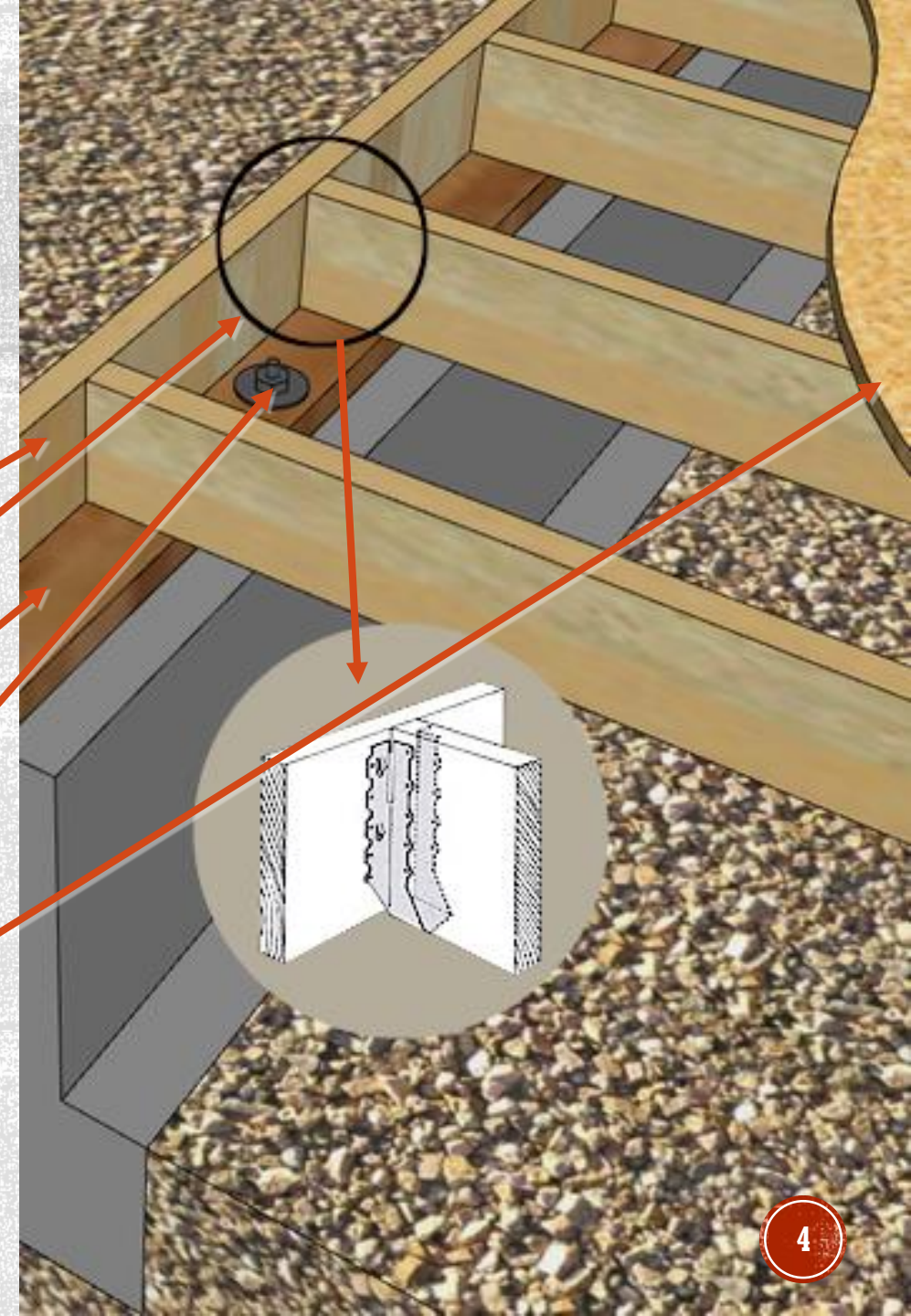
BASIC STRUCTURAL SYSTEMS



- These components provide the framework that make it a “structure” or building.
- Typically constructed by 4 different trades...
 - Excavation contractor - basic site preparation for footings, piers, and flatwork.
 - Concrete contractor –prep for, then pour footings, foundation walls, and slabs.
 - Framing contractor – constructs the primary wood framework of the structure.
 - Roofing contractor – applies roof decking (sometimes by the framing contractor).
- Each trade must take into account their impact on follow-on trades.
 - E.g., concrete contractor makes allowances for plumbing inlets and sewers, and places “J-bolts” on the top of foundation walls for framer to attach sill plates.
- In this section, we will be covering **Floors**.
 - Framing systems (joists), sub-floors, underlayment, and loading issues.

FLOOR STRUCTURAL SYSTEMS

- We all understand “floors”, but what’s underneath?
 - In a word, “joists”. The structural framing members.
 - A “rim joist” around the perimeter where joists attach.
 - Can nail through the rim joist into the floor joists, or
 - Can use a joist hanger to attach joists to rim joist.
 - Joists sit on the “sill plate” on top of the foundation wall.
 - The sill plate is bolted to the foundation with anchor bolts.
 - Floor joists extend edge-to-edge on the foundation wall, and frequently on a center beam in the middle.
 - The sub-floor is glued and nailed or screwed to floor joists.



FLOOR SYSTEMS



- Types of Floor Joists
 - Standard – 2x10 or 2x12 boards on 16” centers.
 - Engineered – wooden I-beams offer more strength.
 - Truss – built-up, easy to run mechanicals.
- Standard joists typically have cross-bridging to transfer loads from joist to joist.



FLOORING SUPPORT ISSUES



- Flooring support issues are the result of one of these causes:
 1. Improper design and/or construction.
 2. Failure of another system (e.g., siding or plumbing) that causes problems.
 3. Homeowner modifications that destroy the integrity of the support system.

We will explore each of these three causes in more detail to uncover the common things that you will find during a rehab and how to deal with them.

FLOORING SUPPORT ISSUE 1



- Improper design or construction.
 - A rare occurrence because building inspectors should catch this stuff during the construction process. Still, people often remodel without getting a permit.
 - Wrong size floor joist for either (a) the joist span or (b) the joist spacing. Here is a rule-of-thumb for determining proper joist sizing:

Joists should be set 16" O.C. (on-center) or closer. For standard solid boards, measure the span – the distance between the two support points at the ends - round up to the nearest foot, then divide by 2. Take that number and add 2 to it. This is the nominal size of your joist, usually 8, 10, or 12. EXAMPLE:

The span between the foundation wall and center support beam is 15'-3". Round that up to 16 and divide by 2 = 8. Now, add 2 + 8 = 10. Your floor joists need to be at least 2x10's.


FIXING SUPPORT ISSUE 1

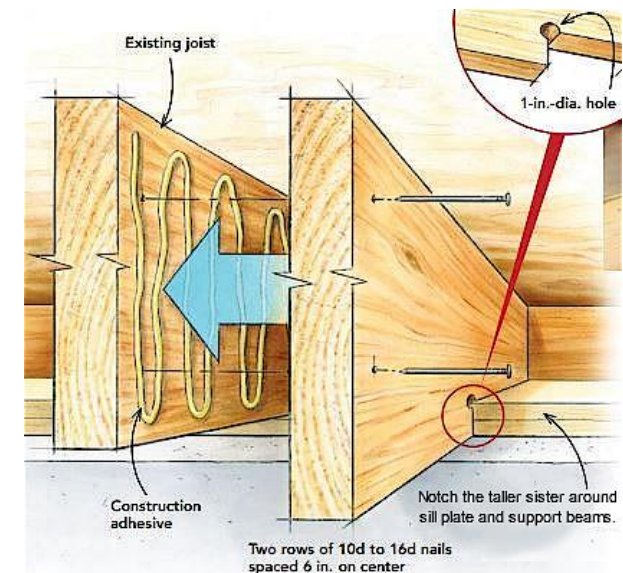


- If the wrong size joists were used or spaced too far apart, you may see:
 - Sagging in the floor – hard-surface coverings may split, crack, or be uneven.
 - A “mushiness” to the floor - it tends to bounce or move when walked on.
 - Note: Squeaks, especially with hardwood floors are usually NOT a structural problem.

■ Fix 1: Sistering the Joists

- Using larger joist boards, attach to the side of existing joists.
- Notch out the ends of the new boards to fit onto support ends.
- Use construction adhesive like PL-3X to glue the boards.
- Nail through new boards every 6 inches to firmly attach.

 Slightly raise the old joists in the center of the span using a floor jack before adding the new joist. When the adhesive cures, remove the jack.



FIXING SUPPORT ISSUE 1



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 - Sagging in the floor – hard-surface coverings may split, crack, or be uneven.
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- Fix 2: Adding a Beam (space permitting)
 - Run a new double or triple beam down the center of the span.
 - Support the beam with one-piece floor jacks every 8-10 feet.
 - You may need a footing for the length of the run.

Note: These fixes apply to the most common types of floor joists only – the standard 2-by boards. Wooden I-beam and truss floor systems need a professional consult for repair.

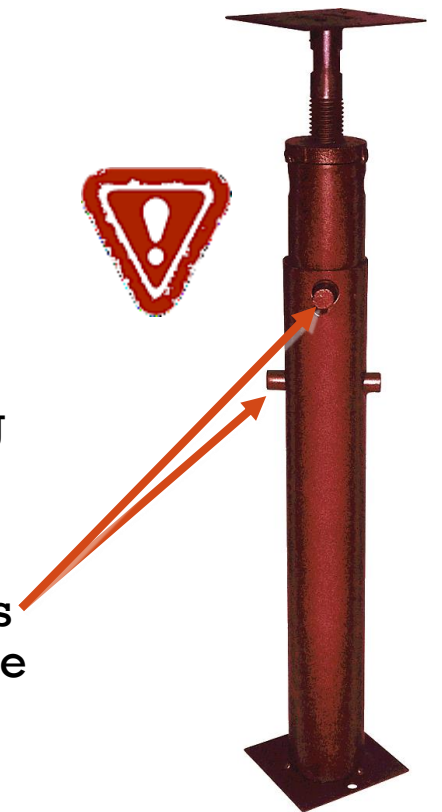


FLOORING SUPPORT ISSUE 2



- Failure of another system. Here are some example failures:
 - Siding or related exterior system leaking water that rots joist ends.
 - Leaking plumbing that rots joists over time and weakens the floor support.
 - Broken or nearly broken adjustable lally column pins.
 - Note: Split jack posts or adjustable lally columns are illegal for permanent use and must be replaced with concrete-filled jack posts or shored-up with double 2x4's on each side of the post.
 - The jack post has broken through the floor either because of missing footing under the floor slab, a failed or too-small footing, or soil subsidence.

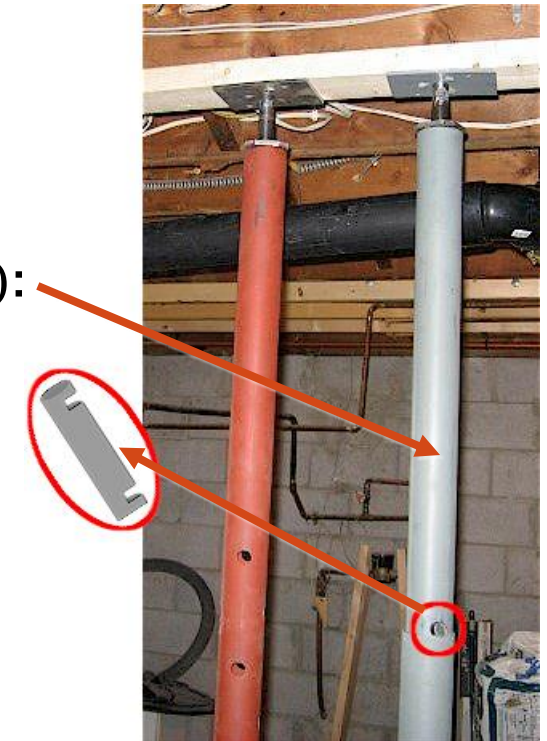
Adjustable lally column or split jack post. The problem is that the support pins can rust and break (especially the notched pins), allowing the upper part of the column to drop and the floor could collapse.



FIXING SUPPORT ISSUE 2



- Rotting joist ends or softening of joists because of water infiltration or leakage:
 - Fix the source of the problem first. Yes, this is a 'duh' moment.
 - Clean the rotted area as best as possible.
 - Sister the rotted joist as described above in Support Issue 1.
 - Coat the rotted area with wood hardener to prevent further rotting.
- Failure (or existence of) split jack posts (adjustable lally columns):
 - Old notched pins rust, break, and drop the top section of column.
 - Even newer solid bolts can be a problem and are not allowed.
 - Replace with a new one-piece, concrete-filled column, or
 - Shore-up with double 2x4's on each side of the column.



FIXING SUPPORT ISSUE 2



- Footing (or lack thereof) under jack post has broken or dropped down:
 - Temporarily support floor load with beam and jacks.
 - Remove failed jack post and bust open floor under jack post.
 - Dig out the soil below and compact it firmly.
 - Pour a new 24" x 24" x 12" thick footing under the post.
 - Restore the floor around new under-slab footing.
 - Replace support with a one-piece floor jack.

The footing pad is the typical size for a concrete-filled one-piece jack post. After it has set up, repair the floor by pouring more concrete in the busted-out hole, covering the new footing and leveling out the floor.



FLOORING SUPPORT ISSUE 3

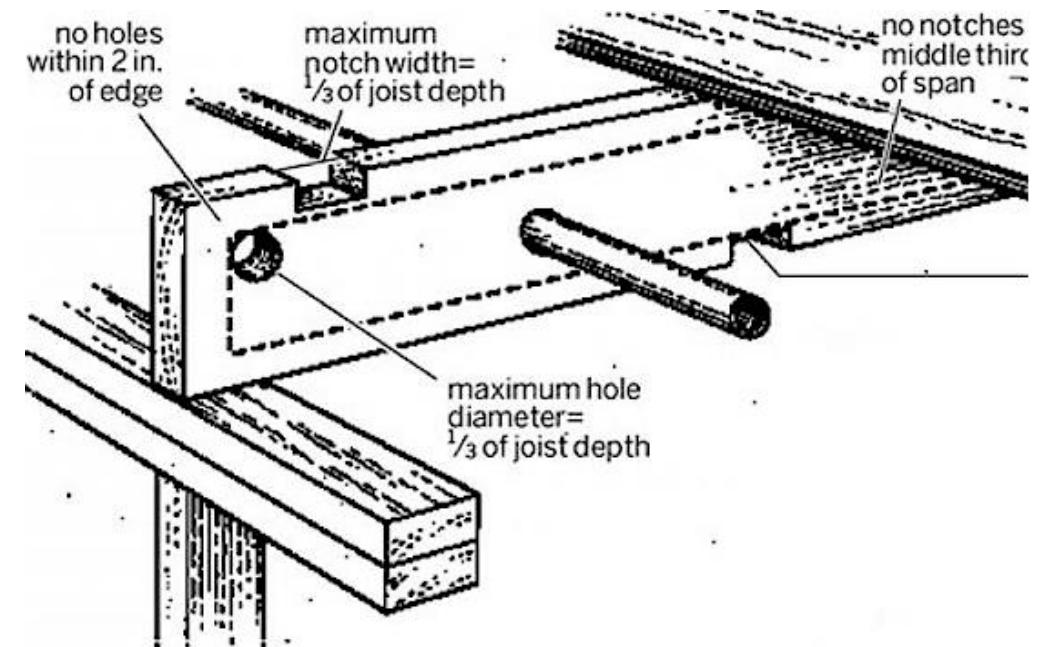


- Homeowner modifications that destroy the integrity of the support system.
 - Most commonly, homeowners (or bad remodelers) have notched or drilled joists improperly.
 - Rules for notching and drilling joists to allow for mechanicals, pipes, wires, etc. are as follows:

Maximum notch at the end of a joist (where it rests on a plate or beam) cannot exceed $\frac{1}{4}$ of the joist depth.

Maximum depth in the outer third of a joist is $\frac{1}{6}$ of the joist depth. Notch length cannot exceed $\frac{1}{3}$ of the joist depth. No notching in the middle third of a joist.

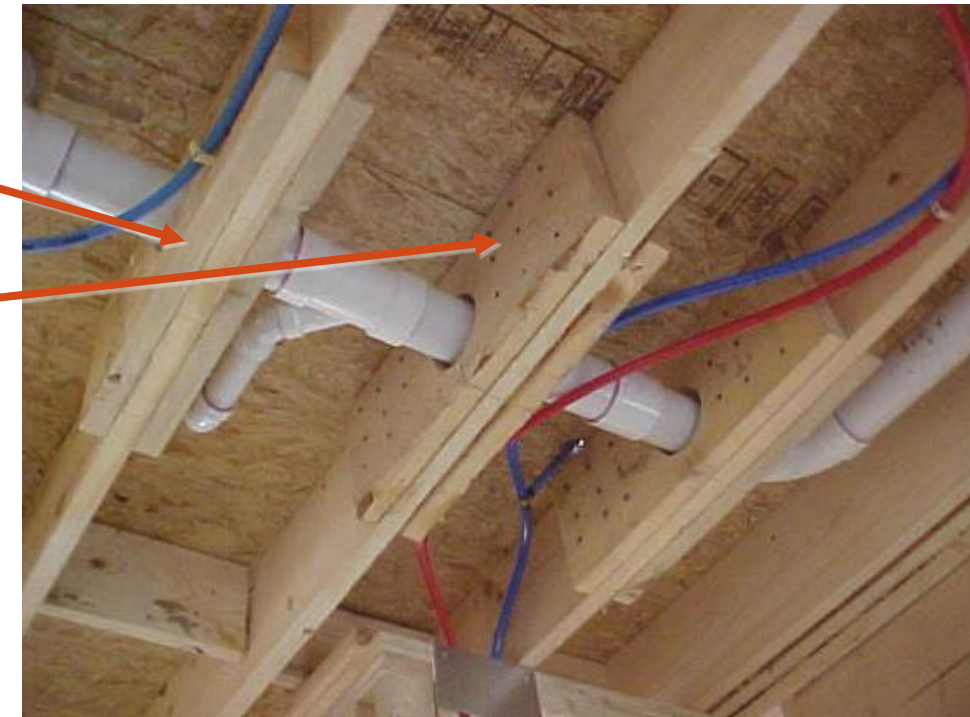
The maximum hole diameter for a drilled opening is $\frac{1}{3}$ of the joist depth. Holes may not be drilled within 2" of any joist edge.



FIXING SUPPORT ISSUE 3



- While you may not notice symptoms of a notching/drilling problem, when the house gets inspected for resale, having code violations like this could stop the sale.
- The straightforward repair is sistering the joist.
- If it's not terrible, you can use a "short sister".
- You can beef-up the bottom of the joist as well.
- Use lots of construction adhesive and nails.



SUBFLOORS



- Subfloors are the structural layer on the top of the joists that support the finished floor.
- Early subfloors were individual plank boards.
 - Sometimes the boards were attached at a 45-degree angle to the direction of the joists.
- Subfloors can be layered; e.g., $\frac{1}{2}$ " of plywood, a layer of felt paper, then $\frac{1}{2}$ " of OSB.
- Oriented-Strand Board (OSB) is a glued and pressed board material used for decking.
- $\frac{3}{4}$ " tongue-and-groove (T&G) is a popular single-layer subfloor



SUBFLOORS



- Subfloor and roof decking materials have a span rating stamped on one side.
- The first number (e.g. 24) is the maximum rafter span when used on a roof.
- The second number (e.g. 16) is the maximum joist span when used on a floor.
- Exposure 1 type board (also called CDX) can be temporarily exposed to weather during construction. It is not intended for long-term exposure.
- The total thickness of most subfloors should be $\frac{3}{4}$ ".
- Thinner subfloors may be used with solid $\frac{3}{4}$ " hardwood finished floors.
- Subfloors should be both glued and nailed or screwed to the joists.



SUBFLOOR PROBLEMS



- Most subfloor problems are related to water infiltration.
 - Leaking toilet wax ring seal, tank-bowl seals or the feed tube / valve.
 - Leaks in shower or tub valves or the feed tubes supplying those valves.
 - Slow leaks in sink feed tubes, valves, or the fixture connections.
 - Dishwasher failure or the feed tube / valve (if a valve is present).
 - Washing machine failure or the feed tubes, valves, or feed hoses.
 - Bad roof flashing or roofing allowing water to travel down pipes or chimney chase.
 - Leaks around windows or other siding penetrations that allow water to seep in and down.
- Subfloor may have been compromised by improper remodeling.
 - Improper patching of removed floor penetrations (pipes, chimney, etc.)

FIXING SUBFLOOR PROBLEMS

- What needs to be repaired and why it needs attention.
 - Faulty subfloors can cause squeaks or a “softness” in the feel of the floor.
 - Ceramic or porcelain tile over a faulty subfloor will crack and break.†
 - Toilets can rock, wobble, and crack from a rotted subfloor.
 - If soft, the subfloor is a likely source of mold that will become airborne in the property.
- Subfloor problems always look bad.
 - If clearly visible, represents a deterrent to most people.
 - Easily fixed by the savvy rehabber.

† Tile should NEVER be set directly onto a sub-floor; instead, a tile backer board like HardieBacker, Durock, or Wonderboard is set on the sub-floor, then tiled.





FIXING PROBLEMS



- Absolutely and positively identify *and correct* the source of the problem before repairing the floor!
- Check water fixtures first; both feed lines and drain lines.
 - Toilet problems are most obvious.
 - Look for indications that an appliance failed but was replaced.
- Check the attic for leaks around brick chimneys or other roof penetrations like a plumbing vent stack.
 - Tuckpoint and/or fix chimney flashing if leaking.
 - Replace rubber vent pipe boots if old or cracked.
 - Repair or replace faulty roof shingles or flashing.



FIXING PROBLEMS



- Most common toilet failure issues.
 - If older, just replace the whole toilet. Internal porcelain could be cracked and leaking.
 - Never use “real wax” seals for the floor flange; instead, use “no wax” seals.
 - Check the rubber grommets around the tank / bowl attachment bolts.
 - Check the rubber gasket that connects the tank to the bowl.
 - Replace the fill valve inside the toilet.
 - Replace the feed tube valve if it is leaking.
 - Replace the flexible feed hose connecting the toilet to the feed valve.
- Most common fixture failure issues.
 - Replace feed tube valves and/or the flexible feed hose from valve to fixture.
 - Replace drain pipes from bottom flange to wall.



FIXING PROBLEMS



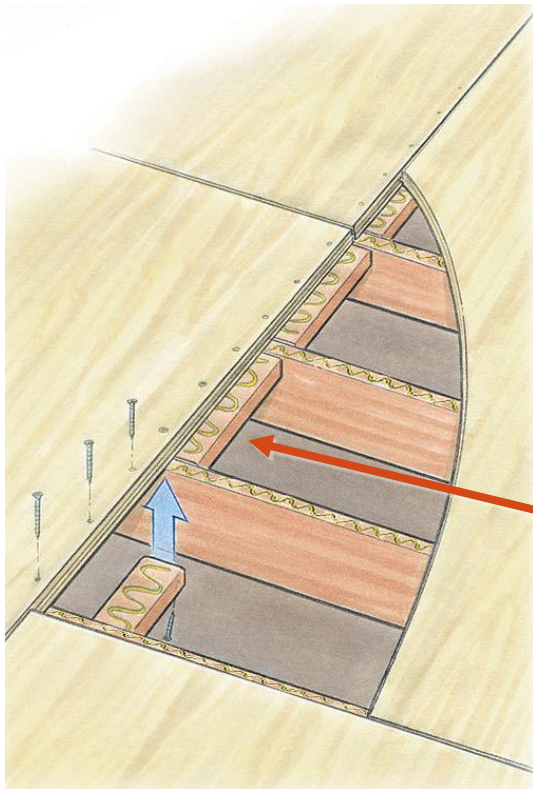
- These are the general steps to repairing a damaged subfloor:
- 1. Identify and CORRECT the source of the problem. Do not skip this step.
- 2. Remove floor covering and completely expose the damaged subfloor.
- 3. Set the blade depth on your circular saw to floor thickness (usually $\frac{3}{4}$ ").
- 4. Find and mark the locations of the two floor joists on either side of the damage.
- 5. Mark two locations perpendicular to joists, creating a full square around the damage.
- 6. With the circular saw, cut the old, damaged subfloor on the lines you've drawn.
- 7. Remove the damaged section with a pry bar or hammer, as appropriate.
- 8. Clean up all the surrounding framing. Does anything else need replacing?
- 9. Ensure the integrity of the joists and sister them where necessary.
- 10. Cut out a piece of new subfloor, then glue and nail or screw to the joists.



FIXING PROBLEMS — ALL AREAS



- When you put in the new subfloor, you must support the “floating” seams.



- If you can get below it, like in the basement, install solid blocking onto which you can nail or screw both new subfloor board edges.
- If you can't, install blocking from above in two steps. First, glue and screw blocking boards to existing subfloor. Install the new subfloor, gluing and screwing seam edges.



FIXING PROBLEMS — TOILET AREA



- The toilet flange must sit on the subfloor or the finished floor.
- Cut out a damaged toilet flange and prep the drain pipe.
- If it's easy to replace an OK flange (e.g. PVC), then do it.
- Cut a hole and align with the drain pipe, keep the hole tight.
- If keeping the old flange, cut the new subfloor in half. —————→
- Ensure there is blocking under the new seams. —————→
- Install the new subfloor with glue and nails or screws.



FINAL WORD ON FLOOR SYSTEMS



- Whether building new or rehabbing old, understand how floor structural systems work, what materials are required, and how those materials are put together.
- Never gloss-over structural requirements and potential breaches of integrity; an inspector may halt your ability to re-sell your rehabbed property.
 - Waiting to see “what will happen” is never a good thing. Delays in project completion can add up the costs quickly, especially from your funding source.
 - You could be legally liable for out-of-code problems, especially if you or your contractors have done work on the structure.
- A solid flooring structure is essential to the integrity of other building systems such as walls and ceilings, so problems can snowball and cost you a lot of money.

TAKING CHARGE



- Before acquisition, have a contractor, engineer, or architect do a walk-through to look for obvious flooring structural issues, and assess the cost of repair.
- While inspectors can *find* problems based on best practices and code, they cannot offer possible solutions or costs for fixing those problems.
- Learn how to make simple repairs yourself and then *do the work*.
 - Sistering joists that are failing or under-engineered for the load.
 - Bridging improper joist penetrations for utilities, mechanicals, or whatever.
 - Rebuilding support and sub-floor problems in water-damaged areas.
 - Add posts in basements or crawl spaces for extreme joist spans.
- Be careful to not *create* structural problems with floor modifications.





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