Reducing Electricity Use

Part 2

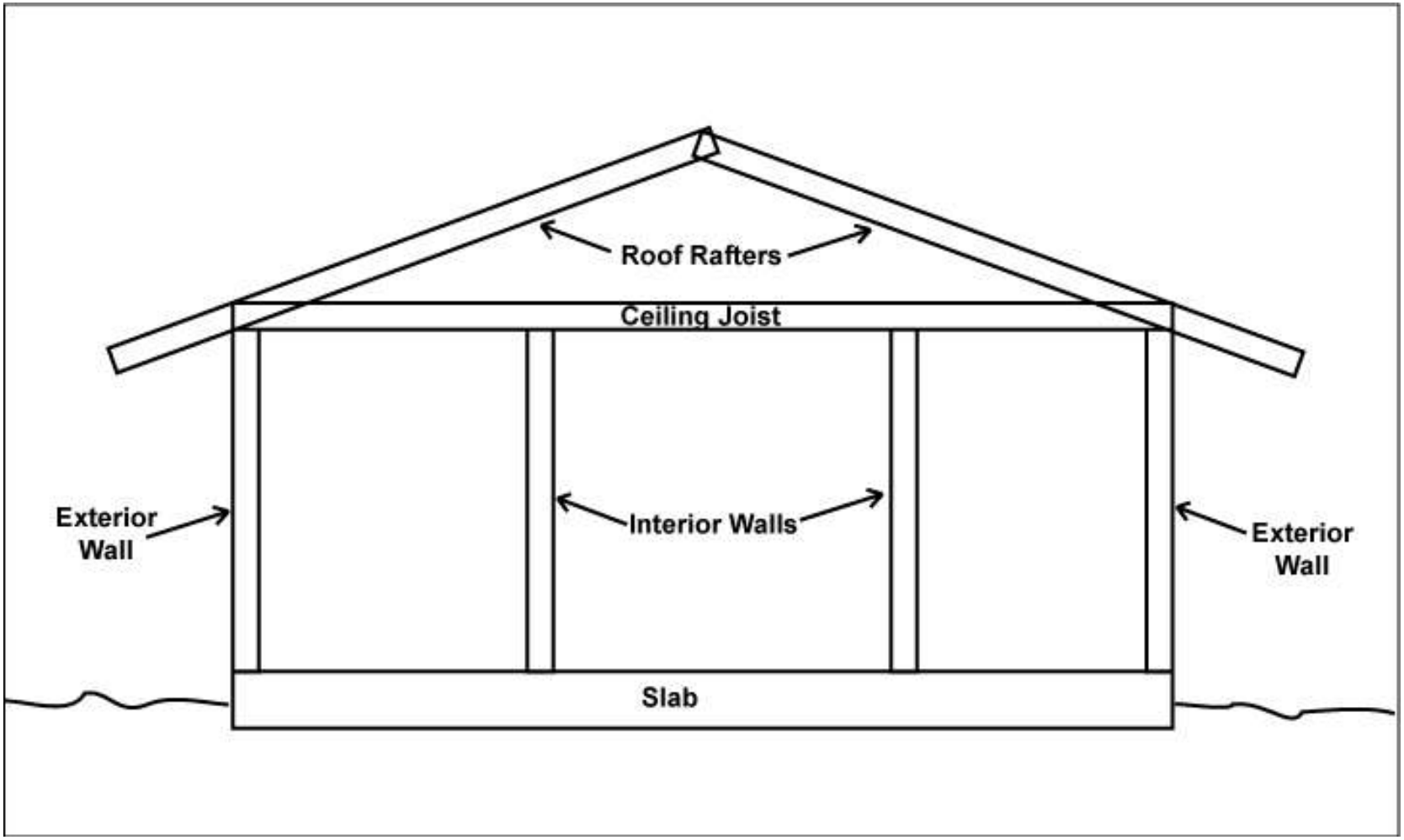
Focus Of Part 2

- **Part 1 discussed more lifestyle oriented stuff. It focused on reducing the energy used by individual devices and reducing the heat generated in the house.**
- **Part 2 is focused more on reducing heat flow from outside the house to inside the house, and vice versa.**
- **Part 2 discusses more construction oriented type stuff, such as:**
  - **Insulation, different materials and techniques.**
  - **Roofs, comparisons of different types, impact of color, venting.**
  - **More on sealing techniques.**

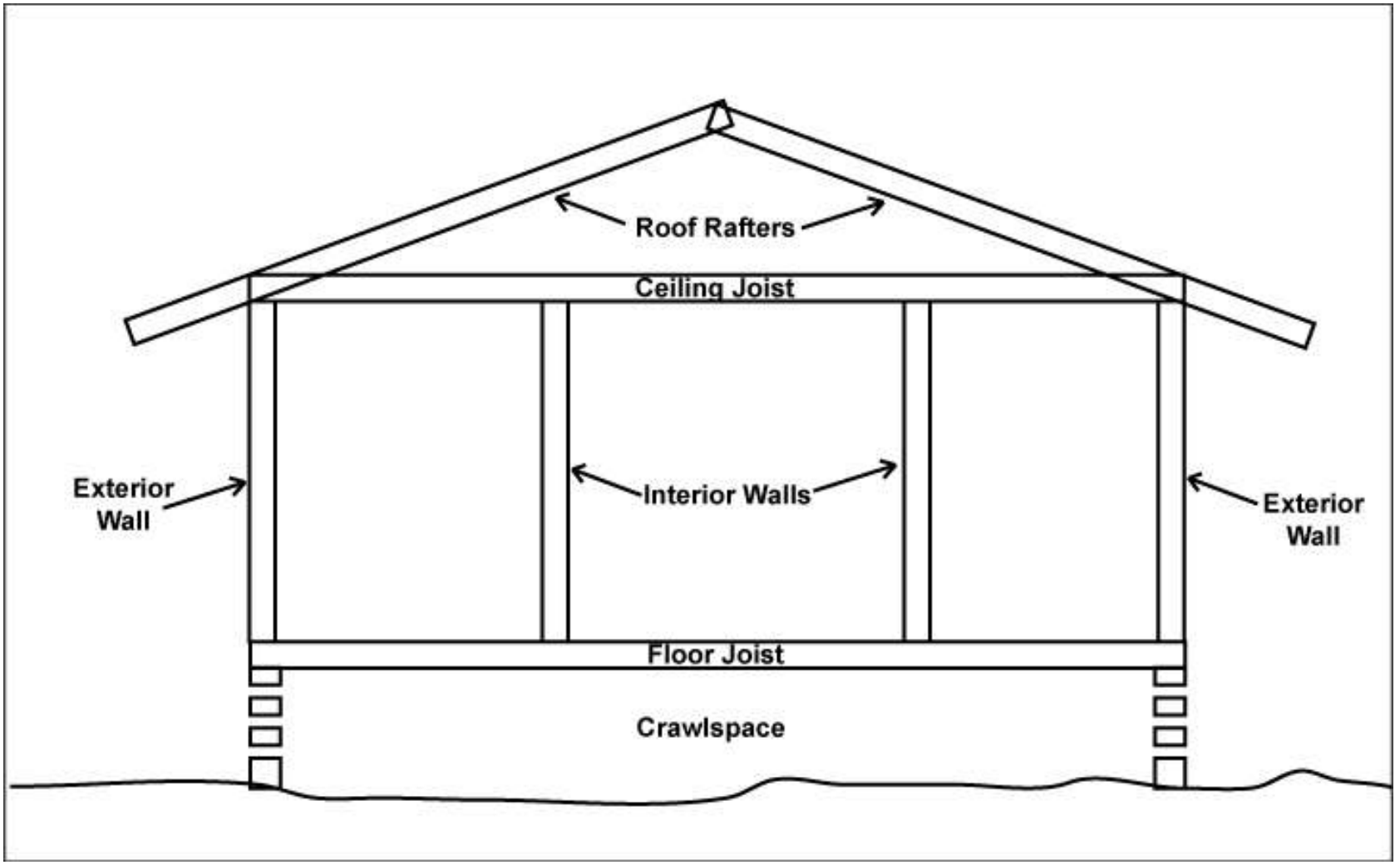
Reducing Heat Flow Into And Out Of House

- **Most people do this in a random, haphazard fashion, trying one thing, maybe something else.**
- **A better way is to do this in a more systematic fashion, looking at all the possible paths for heat to flow into and out of the house and then try to minimize the flow for each of the paths.**
- **Heat can move in and out of a house via:**
  - **Conduction. This is the most often considered flow path and is often attacked with insulation.**
  - **Radiation. Other than shading, this is rarely considered, although it can be very important when cooling a home.**
  - **Air transfer. This is often considered but many paths are overlooked.**
  - **Moisture transfer. This is often overlooked and is again very important, especially when cooling here in Florida.**

Home (On Concrete Slab)



Home (Over Crawl Space)



Radiation

- **Much of the heat entering many buildings in the summer is due to absorbing solar radiation.**
  - **The color of the roof and walls is more important than the material in minimizing this absorption of radiation.**
  - **You want a material with as high a reflectance as possible, with 100% being best.**
  - **You also want a material with the highest emittance possible. Emittance is a measure of how readily a material re-radiates any heat it absorbs, with an emittance of 1.0 being best. Emittance is as dependent upon the material type as it is the color of the material.**
- **Note that white materials, which often have both high reflectance and high emittance, are usually better than shiny metallic materials, which often have high reflectance but very low emittance.**

Comparing Roofing Materials

Material	Color	Reflectance	Emittance	Roof Type
Best Possible	-	100.0%	1.00	
Energy Star, Low Slope	-	55.0%	0.75	Low Slope, Flat
Energy Star, Steep Slope	-	20.0%	0.75	Steep Slope
Asphalt Shingles	Black	3.4%	0.91	Steep Slope
Asphalt Shingles	Green	15.7%	0.91	Steep Slope
Asphalt Shingles	Generic White	25.3%	0.91	Steep Slope
Asphalt Shingles	Super White	31.1%	0.91	Steep Slope
Metal Roofing	White	66.8%	0.89	Steep Slope
Metal Roofing	Green	11.2%	0.89	Steep Slope
Metal Roofing	Red	36.9%	0.89	Steep Slope
Aluminum	Unpainted	71.3%	0.04	Steep Slope
Galvanized	Unpainted	60.9%	0.25	Steep Slope
Cement Tile	White	72.8%	0.93	Steep Slope
Cement Tile	Red	24.0%	0.94	Steep Slope
Cement Tile	Amber Sand	59.1%	0.94	Steep Slope
EPDM	Black	6.2%	0.86	Low Slope, Flat
EPDM	Grey	23.1%	0.87	Low Slope, Flat
EPDM	Super White	80.6%	0.92	Low Slope, Flat
TPO	White	77.0%	0.87	Low Slope, Flat
PVC	White	86.0%	0.86	Low Slope, Flat
Bitumen	Smooth	5.8%	0.86	Low Slope, Flat
Bitumen	Granular	25.8%	0.92	Low Slope, Flat
Kool Seal Elastomeric Coating	White	71.4%	0.91	Low Slope, Flat

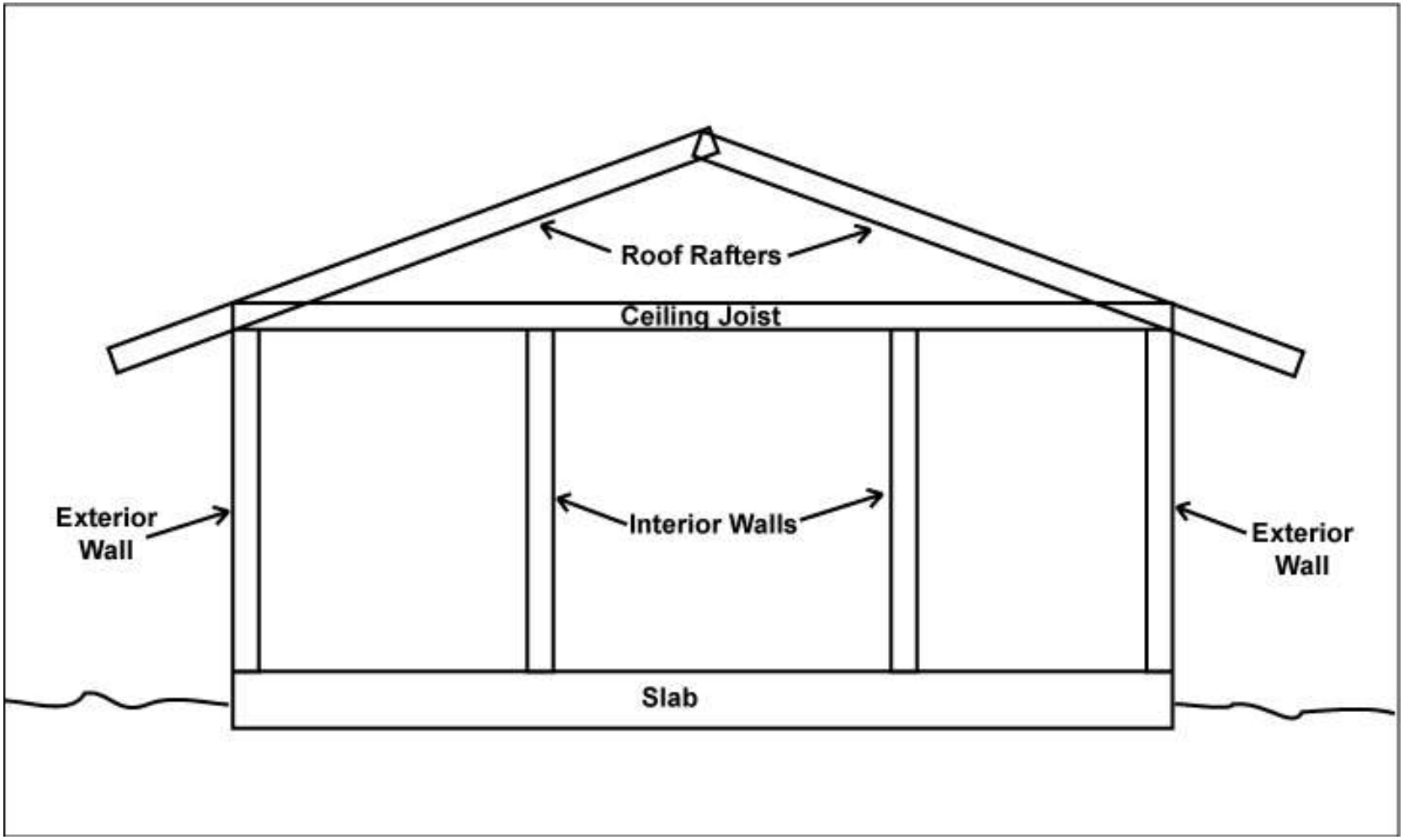
Radiation (Continued)

- **Shading helps keep this solar radiation away from the building in the first place.**
  - **Shade trees are an obvious way to shade the walls and roof.**
  - **Other things can be used to shade walls, such as bushes, rain barrels and tanks, trellises, and arbors.**
  - **Deciduous trees and bushes and annual vines on trellises and arbors can provide shade in the summer and the solar heat in the winter.**
- **For the radiation that is still absorbed, possible ways to keep it out of the house are:**
  - **Air ventilation, particularly in the attic.**
  - **Radiant barriers.**
  - **Insulation.**
- **Roof material info may be found at: http://www.fsec.ucf.edu/en/publications/html/FSEC-CR-670-00/index.htm**

Attic Ventilation

- All attics should be well ventilated.
  - Ventilation reduces the heat buildup in the attic. Proper ventilation can reduce attic temperature by tens of degrees.
  - Ventilation also reduces humidity and condensation problems, which can lead to rot, mold and mildew.
    - Many building codes require at least one square foot of vent per 300 square feet of ceiling to control humidity.
  - There is one exception to be discussed later where you DON'T want to ventilate your attic.
- The best system for attic ventilation is a ridge vent at the peak of the roof with vents in the eaves or soffits.
  - Totally passive, requires no outside energy source, relies on the fact that warm air rises, creating a natural convection current.
  - Requires that total vent area in the eaves or soffits be at least twice the total vent area of the ridge vents.

Home (On Concrete Slab)



Example of Ridge Vent

Example of Eaves Vent

Another Example of Eaves Vent

Example of Soffit Vent

Another Example of Soffit Vent

Alternatives To Ridge Vents

- These alternatives are best used to add attic vents to an existing roof or on roofs that are difficult to add ridge vents to, such as tile roofs, and are generally inferior to ridge vents.
- Among these alternatives are:
  - Passive vents added to the roof.
  - Gable vents for gabled roofs.
  - Wind turbines. These can provide good airflow but need to be maintained, mostly keeping the bearings lubricated.
  - Solar powered fans.
- The closer to the peak of the roof, the better.
- Electric fans run on utility AC power usually use more power than they save and are not recommended.

Example of Added Passive Roof Vent

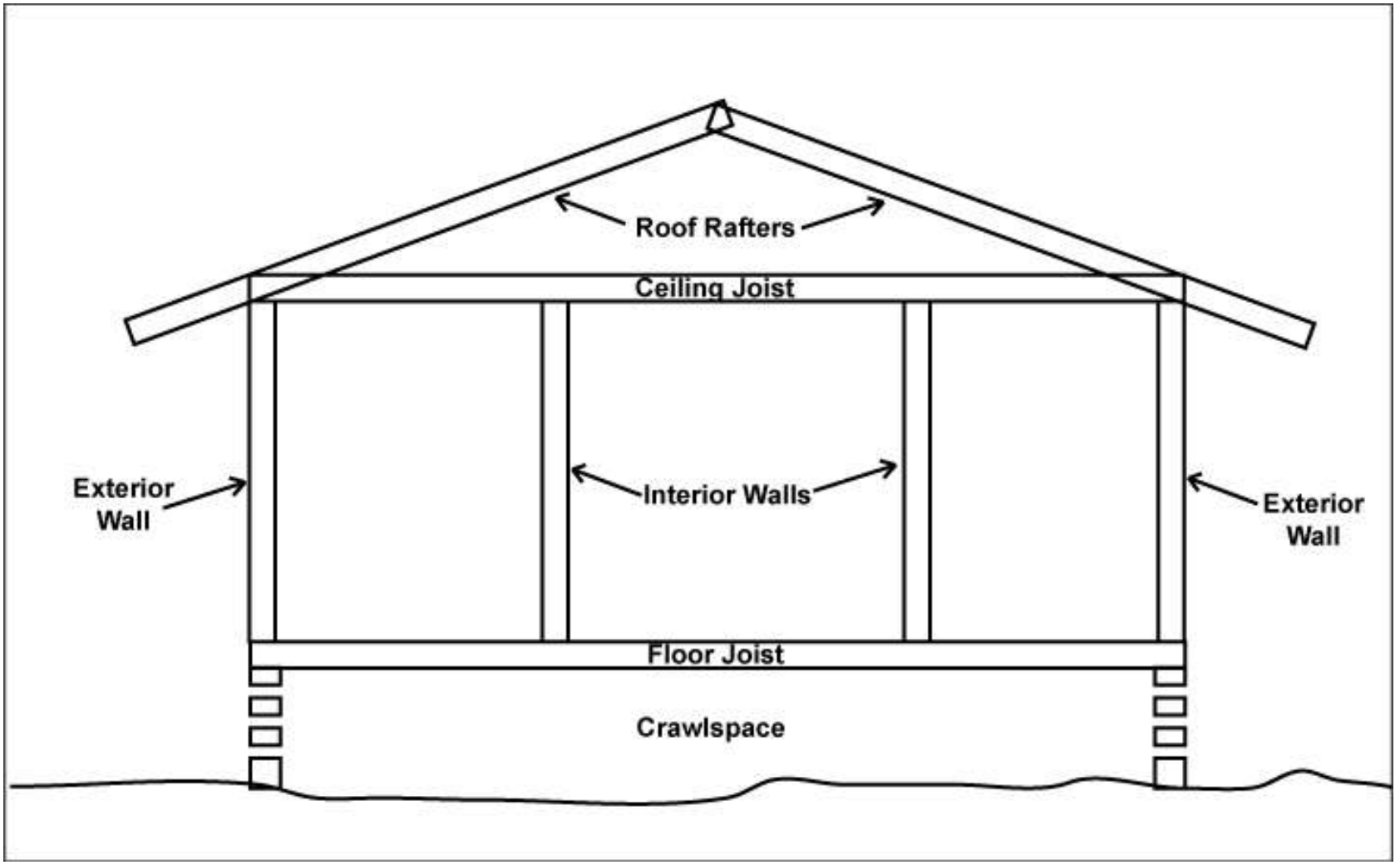
Example of Wind Turbine Vent

Example of Solar Attic Fan

Radiant Barriers

- **Radiant barriers reduce the flow of heat being radiated through an air space.**
  - **Most radiant barriers consist of aluminum foil mounted on a paper or plastic film backing.**
  - **The barrier is placed between a heat source and a cooler space.**
  - **The aluminum foil side of the barrier must face an air space at least ¾ of an inch deep to be effective.**
  - **A properly installed radiant barrier can stop about 95% of the radiated heat flow through the barrier.**
- **Radiant barriers are most effective in attics.**
  - **Radiation accounts for over 90% of the heat flow from the roof into the house in hot weather.**
  - **In cold weather, less than half of the heat flow is due to radiation, with convection accounting for about half of the flow. Consequently, radiant barriers aren't as effective in cold weather.**
  - **Consequently, radiant barriers can't totally replace insulation.**

Home (Over Crawl Space)



Radiant Barrier Stapled To Bottom Of Roof Rafters

Radiant Barrier Stapled Between Roof Rafters

Radiant Barriers (Continued)

- **The barrier doesn't have to be air tight. It just has to be between the heat source and the cooler area, since it is just reflecting the heat.**
- **In attics, radiant barriers are initially equally effective whether mounted with the foil facing up or down.**
  - **It works best long term if the foil faces down, since if it were facing up it tends to accumulate a lot of dirt and dust over time, reducing the reflectivity of the foil.**
- **Radiant barriers are usually much cheaper than insulation for the same effectiveness.**
- **Some insulation, particularly foam sheets, comes with a radiant barrier already installed on one side.**
- **Ventilation from soffit to roof peak improves radiant barrier performance.**
- **Radiant barriers do work in walls, as long as the minimum required air space is on at least one side of the barrier. Equivalent to about R-3 insulation.**

Radiant Barriers (Continued)

- **For more information on radiant barriers, see: http://www.fsec.ucf.edu/en/publications/html/FSEC-EN-15/index.htm**

Insulation

- **A standardized measure of the effectiveness of insulation is its "R" value, which is a measurement of resistance to heat flow.**
  - **Units are (degrees F x hr x square ft) / BTU.**
  - **Recommended minimum values in Florida are R-30 in attic, R-11 in walls, and R-11 under floor over crawlspace.**
  - **When insulation is stacked, the R values add together.**
- **U value is a measure of the conduction of heat flow through a material.**
  - **U value is just the inverse of R value (U = 1/R), and vice versa (R = 1/U).**
  - **U value is often used for comparing the effectiveness of windows and doors.**

Comparing Insulation Types

Material	R factor/inch	Cost/wall section (Note 1), fill wall section	Cost/wall section (Note 1), for R-11 value	R factor/wall section	Notes
Fiberglass batt	3.3	$4.00	$4.00	11.0	Easy to install, no special tools, can't be added to cavities
Fiberglass loose fill	2.2	$3.00	$4.29	7.7	Fills cavities, settles with time, difficult to install without blower
Cellulose loose fill	3.3	$3.00	$3.00	11.0	Fills cavities, settles with time, difficult to install without blower, often made with recycled material
Perlite	2.7	$13.00	$15.05	9.5	Pours very easy, fills spaces well, nonflammable without fire retardant
Polystyrene foam (Styrofoam) board	5.0	$17.00	$10.68	17.5	Gives off toxic fumes when burned, oil based, can be good air and moisture barrier, melts at attic temperatures
Urethane foam board	7.0	$19.00	$8.57	24.4	Gives off toxic fumes when burned, oil based, can be good air and moisture barrier
Polyisocyanurate foam board	7.0	$19.00	$8.57	24.4	Gives off toxic fumes when burned, oil based, can be good air and moisture barrier
Closed cell spray foam	6 to 8	$18.00	$7.07 to $9.42	21 to 28	Gives off toxic fumes when burned, oil based, can be good air and moisture barrier, difficult for do-it-yourself
Open cell spray foam	4 to 5	$10.00	$6.28 to $7.86	14 to 17.5	Gives off toxic fumes when burned, oil based, can be good air and moisture barrier, difficult for do-it-yourself

Note 1: Assumes 8 ft. wall height, 16 in. between studs, 3.5 in. deep. About 2.7 cubic ft. per section.

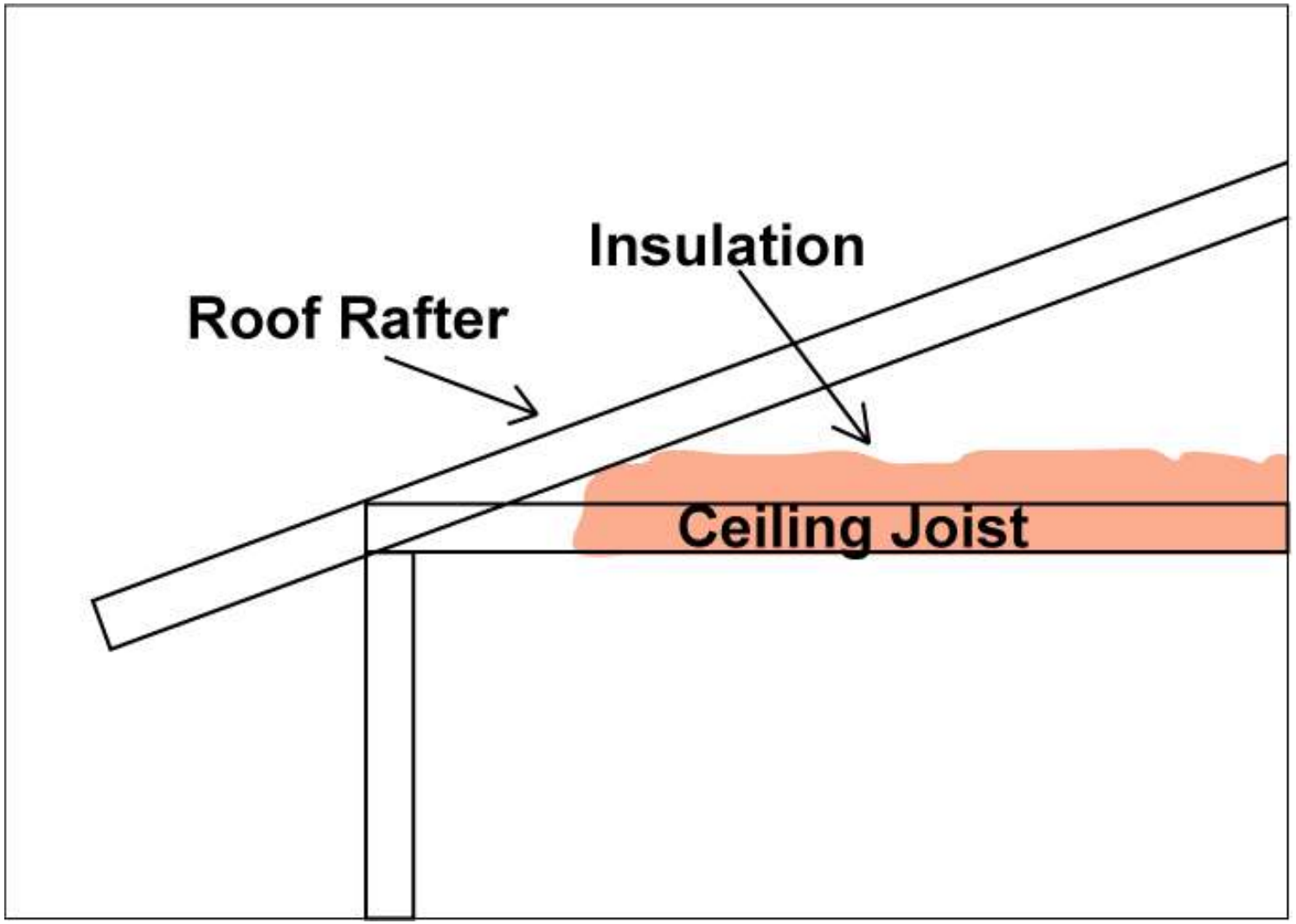
Which Insulation Is Best?

- **It depends:**
  - **Where it is being installed.**
    - **Fiberglass batt or foam work best in new walls and under floors in crawlspace.**
    - **Perlite, cellulose loose fill, or blown in foam work best when filling existing walls.**
    - **Perlite and foam boards too expensive for whole attic.**
    - **Space limitations may require insulation with a high R factor.**
  - **Who is doing the work.**
    - **Spray foam very difficult for do it yourself.**
    - **Fiberglass batt probably easiest for do it yourself.**
    - **Blown fiberglass or cellulose loose fill also not too bad for do it yourself, but need to rent blower for all but tiny jobs.**
    - **Blown fiberglass or cellulose loose fill and spray foam preferred by professional installers, especially for retrofits.**

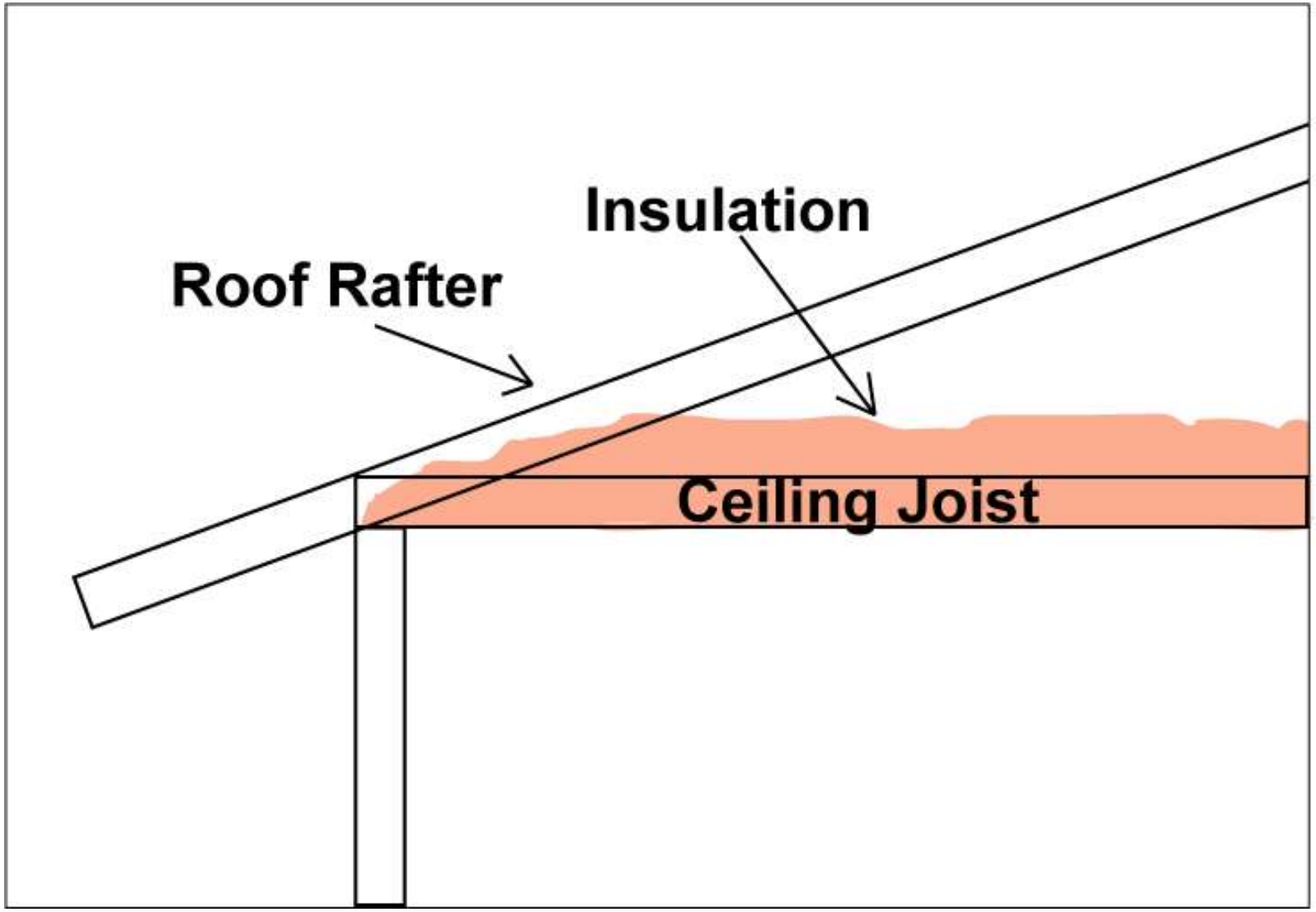
Gaps In Insulation Hurt

- **You need to fill an entire area with insulation because gaps in insulation result in disproportionate energy losses.**
  - **For example, if 90% of a ceiling were covered with R-19 insulation and 10% had no insulation:**
    - **You get about the same improvement in average R value across the entire ceiling if you added R-10 insulation to the 10% that was uninsulated as you would if you left that 10% uninsulated and instead tripled the insulation over the rest of the ceiling.**
    - **Adding R-10 insulation to the 10% that was uninsulated would cost about 3% as much as tripling the insulation over the rest of the ceiling, assuming you used the same insulating material and did the work yourself in both cases.**
    - **The reason that 10% was probably left uninsulated in the first place is probably because it was very difficult to get to or work around.**

Bad Blown-In Insulation

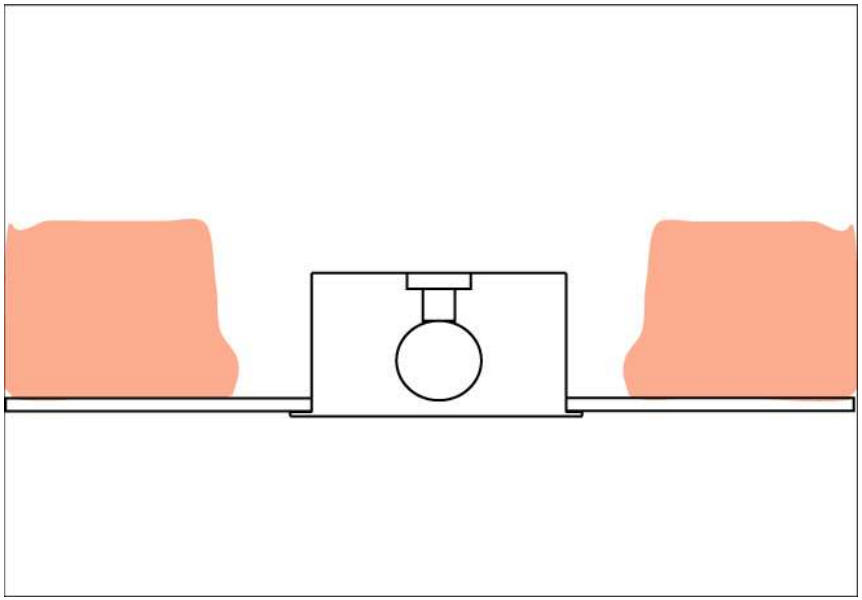


Better Blown-In Insulation



Other Insulation Considerations

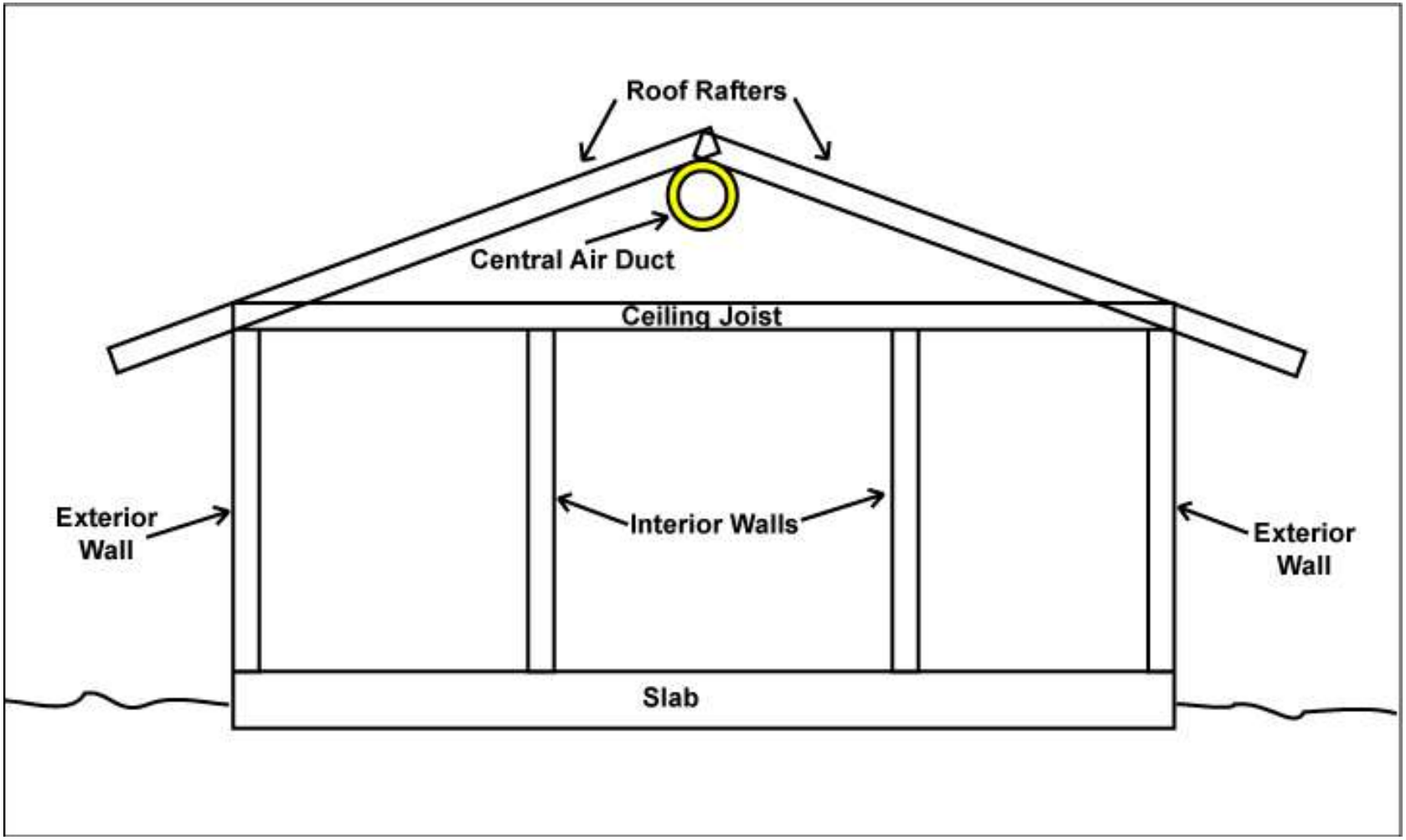
- **Don't cover recessed ceiling lights with insulation and leave a gap of at least three inches on all sides.**
  - **Covering recessed lights with insulation can cause these lights to overheat and start a fire.**
  - **This violates the previous suggestion of not leaving any gaps in your insulation.**
  - **Solution: Get rid of recessed ceiling lights!**



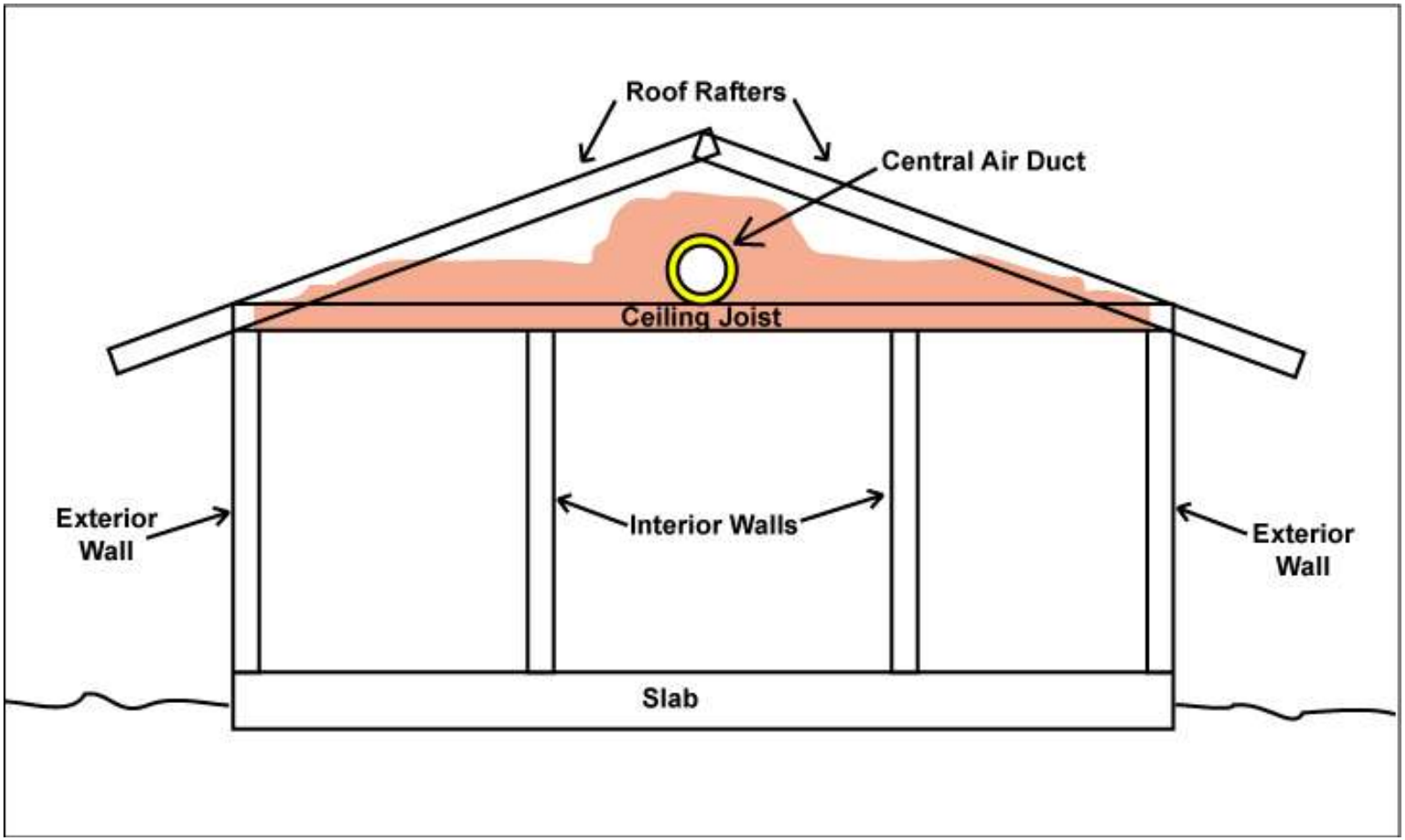
Other Insulation Considerations

- **Bury your central heat and air ductwork in insulation.**
  - **If routed just under the roof peak, lower to on top of ceiling joists. Better yet, recess between ceiling joists.**
  - **Use at least as much insulation over the ductwork as you have over the rest of the ceiling.**
- **If doing yourself, wear suitable protection, like a respirator and a jumpsuit.**

Duct At Roof Peak



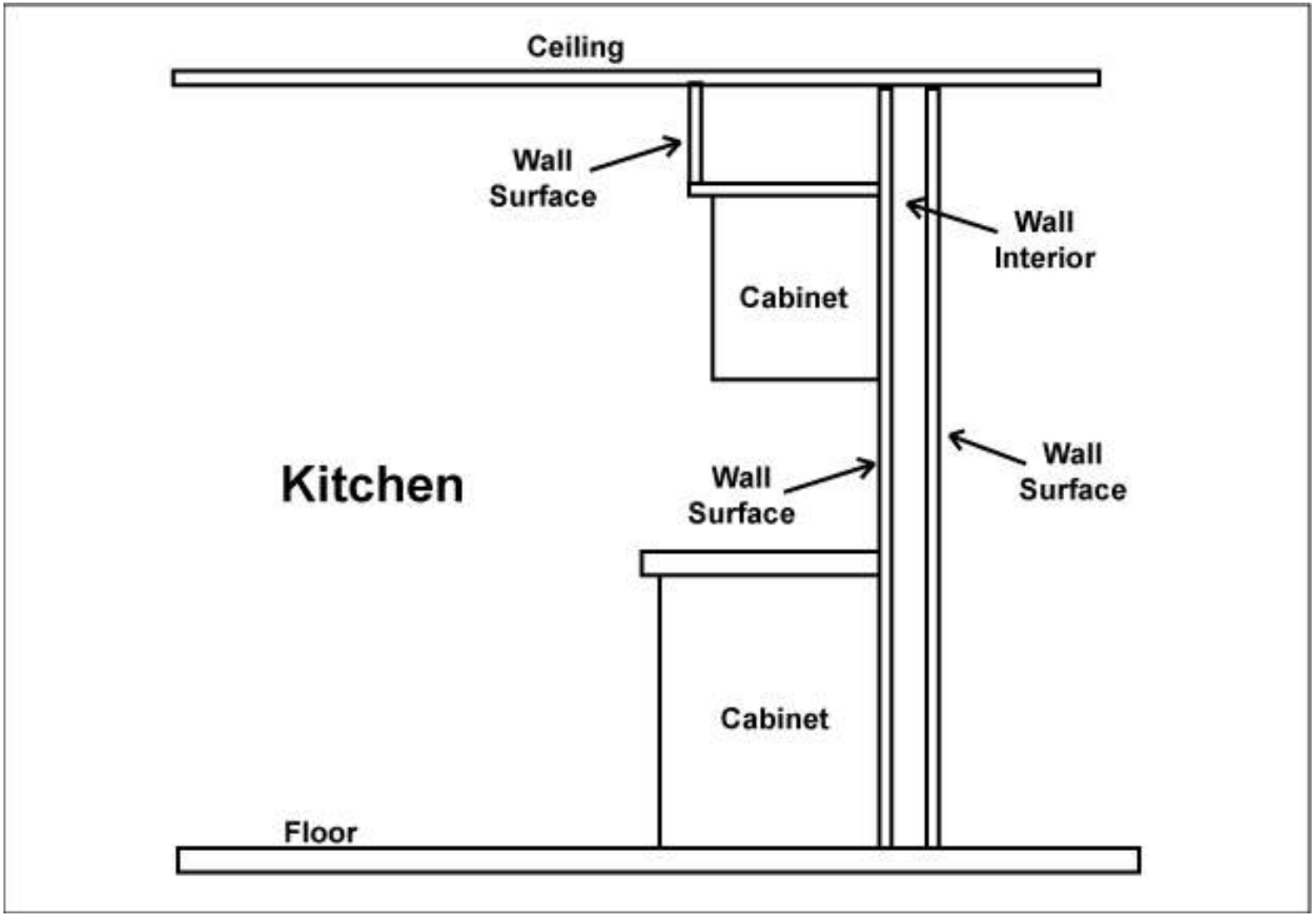
Duct On Ceiling Joists, Insulated



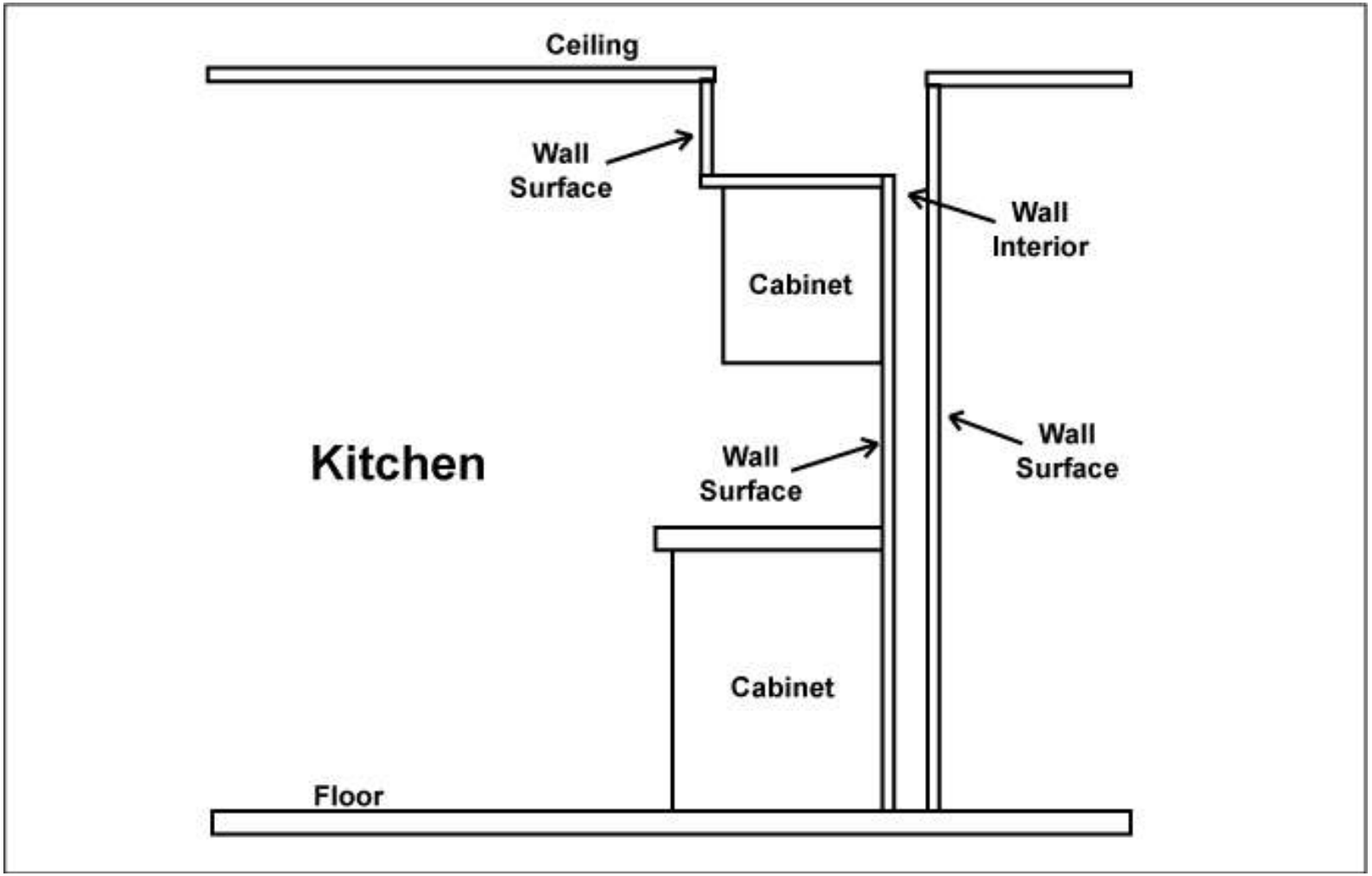
Seal Air And Moisture Leaks

- One of the cheapest ways to significantly reduce heating and air conditioning needs, but tends to be labor intensive and tricky to do correctly.
- Moisture is a very significant carrier of heat, especially here in humid Florida.
- Many common building materials, such as concrete block, plywood, drywall, latex paint, are far more porous and allow more air and especially moisture transfer than most may suspect.
- In new construction, all the walls are wrapped with moisture and air restrictive material (Tyvek, for example).
  - All seams and joints are taped or caulked.
  - Difficult to do for existing house, unless adding or replacing siding.
- Seal holes in tops and bottoms of walls, such as where wires and plumbing goes to attic and to crawlspace.
  - Kitchen cabinet drops are a common problem area.

Good Kitchen Wall Construction



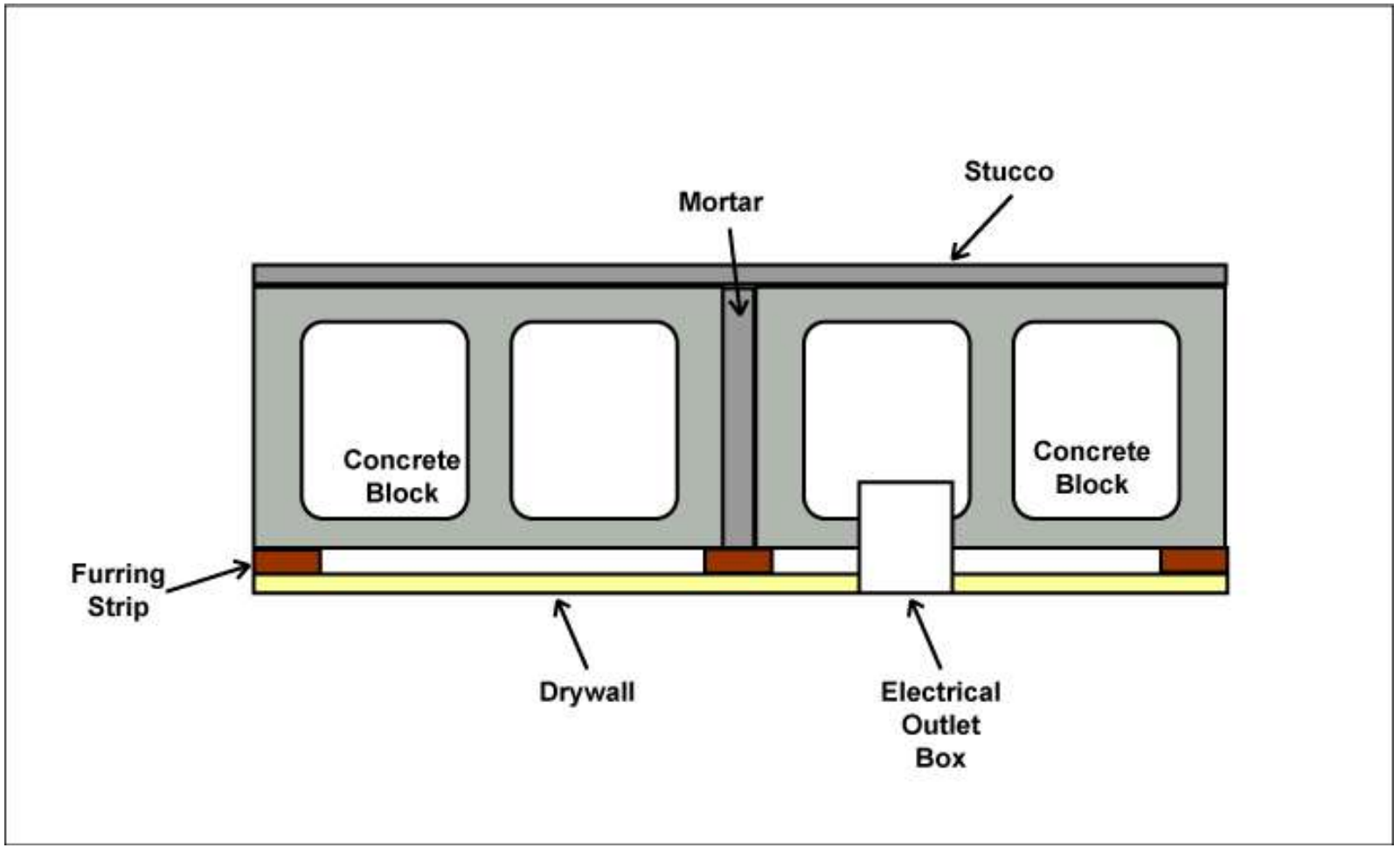
Bad Kitchen Wall Construction



Seal Air And Moisture Leaks (Continued)

- One way to better seal your walls in an existing house and get some insulation in the process is to inject spray foam into the walls.
  - Works well with stud walls, particularly if there is no insulation in them, greatly improves insulation value.
  - Also works to fill the cavities in concrete block walls.
    - Actually contributes little to insulating value of wall, maybe increasing it by R-1 to R-3, due to heat conducted through webs.
    - Still a noticeable improvement in comfort due to the significant drop in air and moisture transfer.
    - Also reduces sound transfer and pest problems.

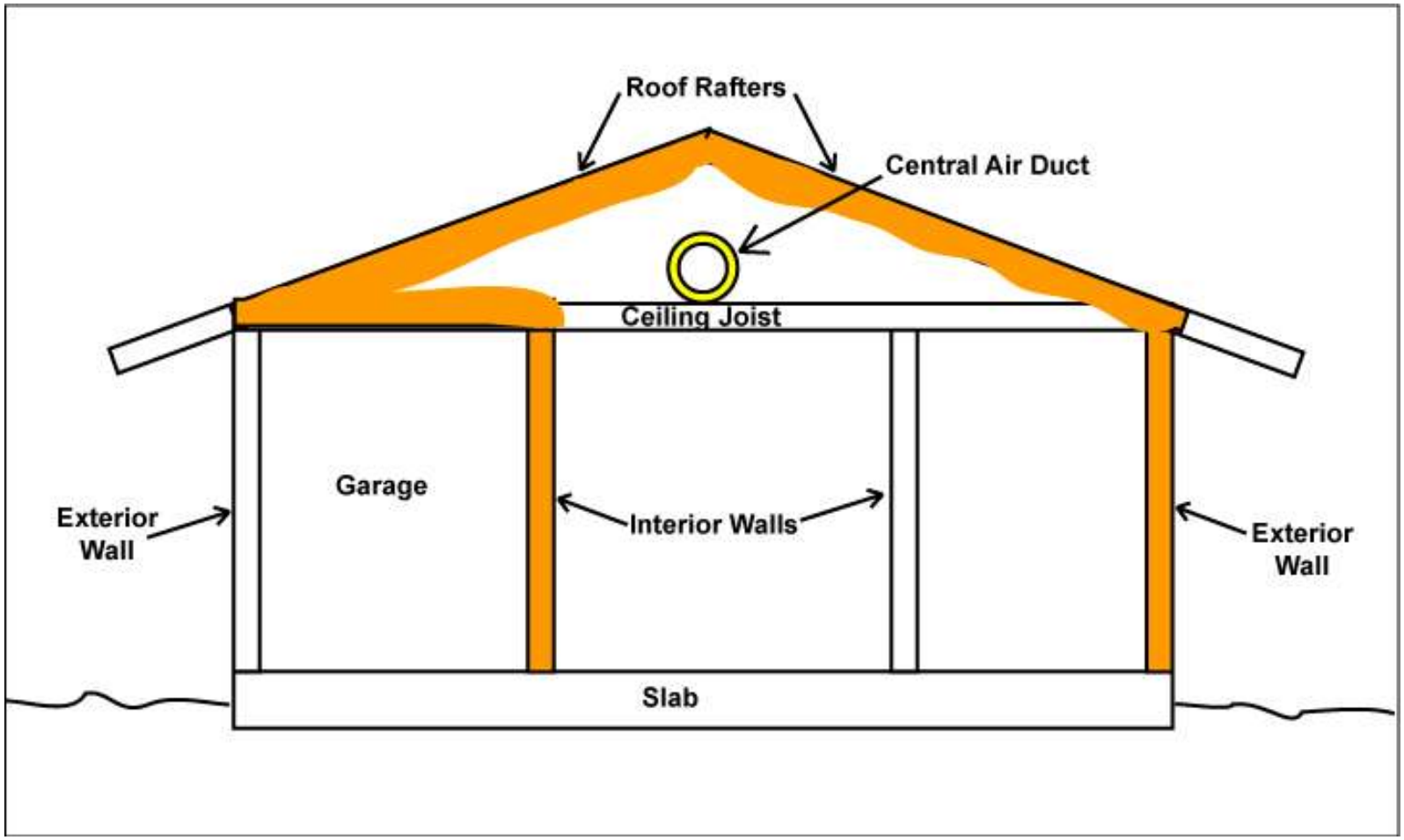
Typical Exterior Concrete Block Wall Construction



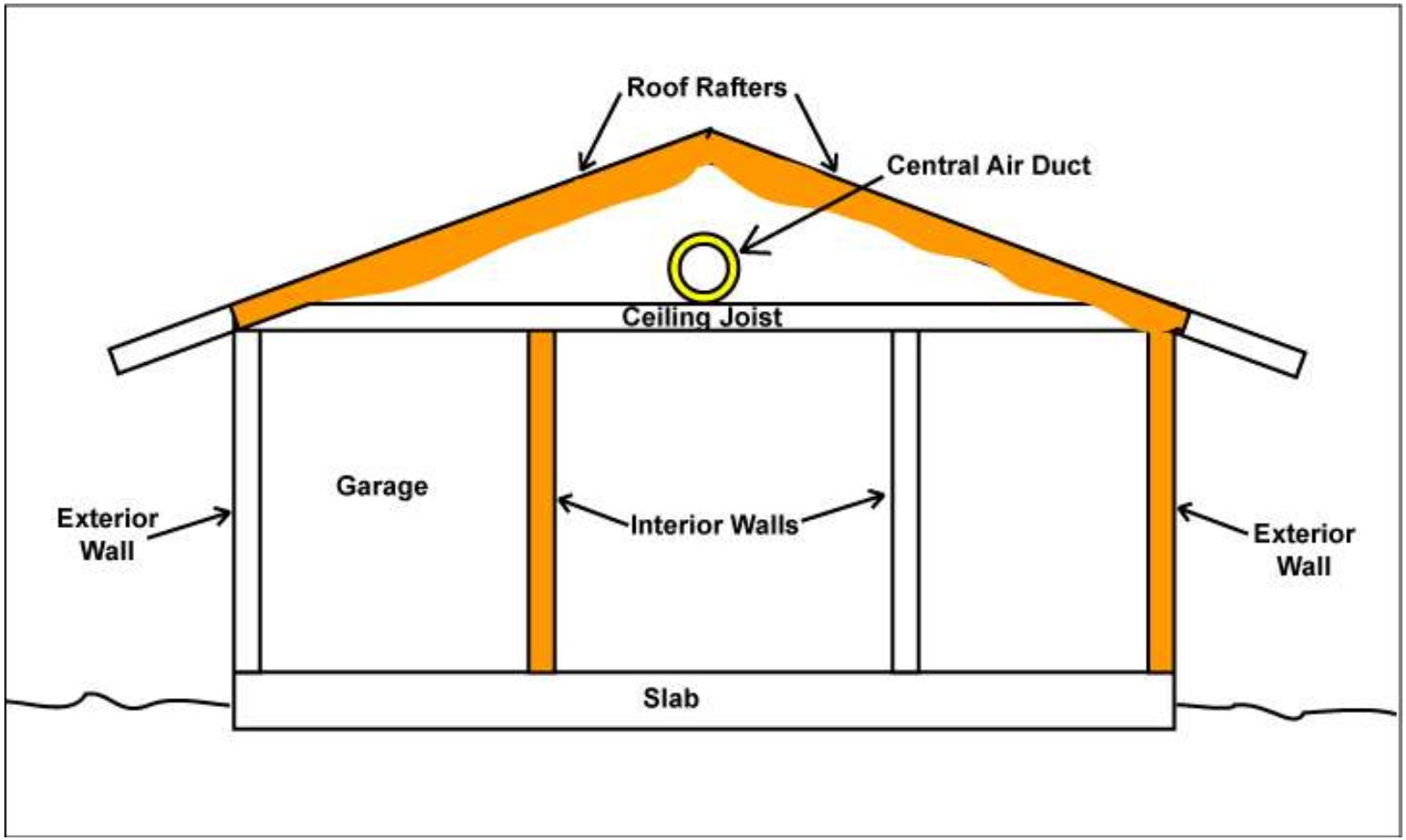
Seal Air And Moisture Leaks (Continued)

- You can also spray foam in your attic on the underside of the roof deck.
  - Works very well in sealing the attic area.
  - Provides very effective insulation.
  - Reduces or eliminates the need for other energy saving measures in the attic, such as:
    - Do not want air vents and fans.
    - Sealing the tops of walls and ductwork is less critical.
    - Insulating the ductwork is less critical.
    - Radiant barriers are no longer needed.
  - Reduces pest problems.
  - Helps adhere roof deck to rafters and trusses, better windstorm resistance.
    - May get a break on your homeowner's insurance.
  - Only works for totally enclosed attics, otherwise possible moisture problems.

Spray Foam Envelope Around Conditioned Space



Spray Foam Envelope – No Garage Ceiling (Bad!)



Many Money Incentives Available

- **Progress Energy is offering incentives to do some of these things.**
  - **Reflective roof products.**
  - **Adding insulation.**
  - **Adding insulation to walls and attic.**
    - **Includes injected foam in block walls.**
  - **Duct testing, repair, and sealing.**
  - **Window replacement.**
  - **See www.savethewatts.com for details.**
- **May still be some federal government rebates or tax credits.**
  - **See energystar.gov and doe.gov for details.**

End Of Part 2

- **A copy of the slides in this presentation may be found at:**
  - **www.stonemarmot.com**
  - **Look for the link to the "Rants and Raves Blog" in the left column of the home page.**
  - **Slides will be in the article called "Reduce Electric Use – Part 2."**
  - **Slides for Part 1 of this talk series will be found in the article called "Reduce Electric Use – Part 1."**
  - **Other articles on saving energy, solar power, and other miscellaneous stuff are in the blog.**