

Summary

The Jones residence is a two-story home built in 1983. Energy Logic was called out to inspect for the following issues:

- Comfort concern areas
- Upgrade options
- Durability issues
- IAQ issues



Upon closer inspection I found several factors that contribute to the above issues.

The main opportunities for improvement your homes comfort and performance would be to replace your furnace with a 90%+ model. This would immediately improve heating performance and noticeably reduce your utility bills.

Other opportunities to improve your homes performance would be air sealing and adding insulation to the attic. Your interest in removing the blown fiber glass insulation will allow the ideal opportunity to thoroughly air seal the attic and make sure all air bypasses are dealt with. Replacing the fiber glass on the side walls of the attic and sky light shaft with spray foam insulation will take care of insulating and air sealing this hard to deal with area.

The whole house fan is the single largest air bypass in the attic and should have an insulation dam built to protect the surrounding insulation from being blown away. A rigid foam lid should be made to seal the top of the fan for the winter season.

The can light in the bathroom should be removed and replaced with an exhaust fan. The ideal bath fan replacement in my opinion is a Panasonic Whisper Green because of it's quite and energy efficient electric motor.

Related to the bathroom issues you might consider replacing the shower glass with full height glass doors to hold more heat in the shower and thus reduce the need for warmer showers.

DIY

Priorities

- 1 Window Caulking
- 2 Fireplace Plug
- 3 Insulated cover for whole house fan
- 4
- 5
- 6
- 7

Contractor Measures

- 1 Upgrade Boiler with 90% model
- 2 Eliminate 2 water heaters
- 3 Air Seal/Insulate attic
- 3 Vent bath fans to outdoors
- 4 Seal crawl vents
- 5

The table above is a prioritized list of measures to be undertaken in the home. They have been broken into measures that can be addressed in a do-it-yourself style and those that should have a professional installer perform the work. The following sections describe explain the reasons the measures are important and provide further research suggestions. Following this section is a section with specific scope of work documents that can be used as both a guide for the do-it-yourselfer or as scope of work for trade contractors.

The following sections are both general in nature, as in the Comfort in Homes section and specific to your home in other cases.

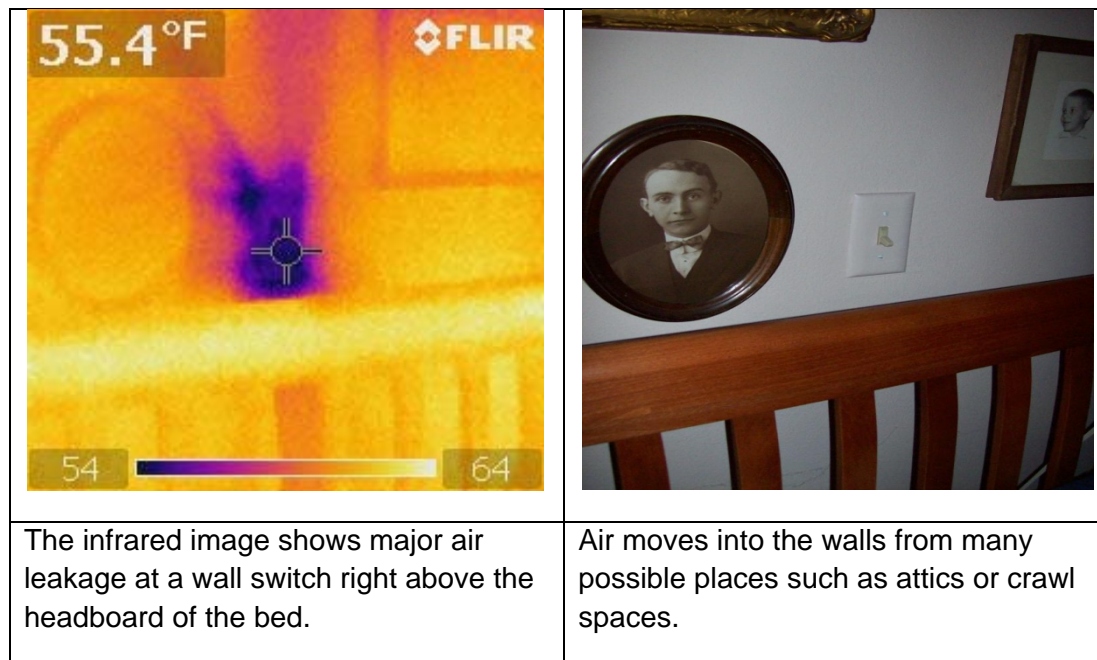
What makes us comfortable in our homes is important to understand as we make decisions about energy upgrades. Energy efficiency and comfort are always tied together, yet how we allocate spending on reducing waste in our homes will impact how much we improve comfort. Comfort is determined by two factors, how much heat are we producing versus how much heat are we gaining and whether our skin temperature and our core body temperature are in balance.

How much heat we are producing versus losing is governed by mean radiant temperature.

*The **mean radiant temperature** of a space is really the measure of the combined effects of temperatures of surfaces within that space. The larger the surface area and the closer one is to it, the more effect the surface temperature of that surface has on the individual. The MRT is the measure of all these surface areas and temperatures acting on a person's location in the room.*

-from www.meanradianttemperature.com

The other factor, how balanced are we, is determined by our clothing level and our activity level. This is why it's important to dress in a seasonally appropriate way to be comfortable without wasting energy and money. We can always spend more money and waste more energy to overcome these factors, but we can also improve our buildings and dress correctly to get to the same place. After all, there is a ski area in Dubai, but it takes a lot of energy to make that happen!



Air sealing a home is one of the most cost-effective means of reducing energy use, improving comfort and enhancing indoor air quality. The air that infiltrates a home through unintended pathways like cracks, gaps and holes in the building is unconditioned and carries with it potential moisture or dryness, pollutants and allergens. In the best situation, we create a very tight home and install ventilation devices that give the occupants control over the ventilation of their home.

Depending on the location of the leaks, air infiltration can cause serious pressurization problems that represent a safety hazard. With a leaky home, the wind is what controls ventilation. With a tighter home, we have the opportunity to not only control where the ventilation comes from, but also its quantity and quality.

Leaky homes use up to 30% more energy than well sealed homes. Sealing all the accessible leaks in a home is always a good deal. Generally speaking, we work from large holes to small ones and concentrate on holes at the top and bottom of the structure. This results in the greatest reduction in natural infiltration. Often, large leaks are located in the attic area and are either hidden or are difficult to see. These large leaks are typically created by chases and soffits that haven't been properly sealed or prepared prior to installing attic insulation. Additional large leaks are located in the basement in the rim joist area, cantilever sections, garage stairs and HVAC chases. When basement leaks are coupled with attic leaks, serious amounts of air can be drawn in and out of the home due to the stack or "chimney" effect that is created.

Materials for air sealing include sheet goods, quality caulking, clear silicone for windows and other areas. All exterior caulking should be performed with one-part urethane caulk for longevity. Expanding foams should be used for larger gaps. All manufacturer's directions should be adhered to and care should be taken around window and door frames.

Further reading

http://www.advancedenergy.org/buildings/knowledge_library/framing/shafts_and_chases.pdf

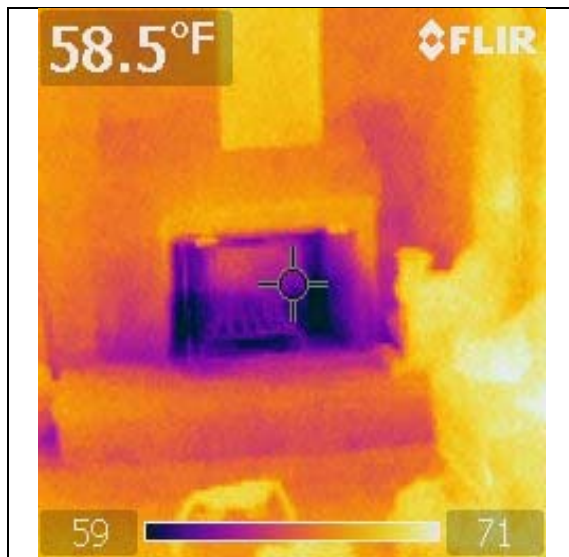
http://www.advancedenergy.org/buildings/knowledge_library/framing/cantilevers.pdf

EnergyLogic tested your homes air tightness with a blower door. That test reveals leakage sites and the quantity of leakage. The overall quantity is less important than finding leakage and assessing the potential for reducing leakage.

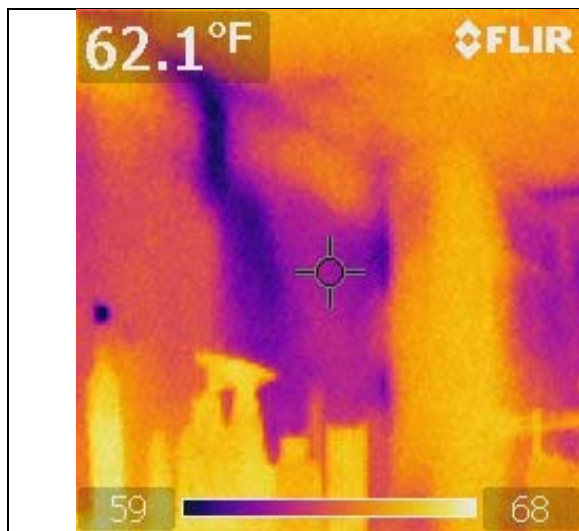
Your homes current air leakage, measured in cubic feet per minute at industry standard pressure of 50 Pascals:

2620 cfm

Each home has a different potential for reducing air leakage. Your inspector should have pointed out leakage sites for possible sealing. In many cases, leakage can be reduced by large amounts, thus stopping energy waste and saving you money.



Fireplaces are one of the largest leakage points



Cold air from the attic infiltrating into the interior walls.





Air bypasses around plumbing and flue vents are common. On occasion they are quite large!



This void for the flue pipe opens to un-insulated interior walls.

Rim-joist Air Leakage

Leakage through the rim joist of the basement can constitute nearly 25% of the leakage in a home. This leakage is particularly prone to moisture and insect problems. Additionally, the often substantial leakage in this area is very easy to address with caulk, expansive foams and backer rod.

When the opportunity exists to seal this area, it is always a wise choice. Air infiltration in the rim joist can later be responsible for comfort issues in addition to dirt and dust problems along with a meaningful energy penalty.



The insulation is acting as a filter as indicated by the dirty spot. Behind this insulation is a cantilever that is poorly air sealed and allowing air to move in and out of the house.

Systems

Mechanical systems are the internal organs of a home. They are the heart and lungs of our homes. Keeping these systems in peak condition or as close as possible is key to both a less wasteful home and a more comfortable, safer home. In many instances there are low-cost measures that dramatically increase the performance of both boilers and forced air systems.

For very old equipment, furnace replacement is warranted on the savings potential alone if the budget for energy retrofits accommodates such upgrades. The condition and age of the equipment are primary considerations when assessing upgrades.

Duct Work

Duct leakage represents one of the most important upgrades that a homeowner can make on their home. This is due to the multiple impacts that leaky ducts have on a home. Leaking ductwork has a negative effect on system efficiency, comfort, and safety. Due to these compound benefits, ductwork sealing is often at or near the top of priority lists.

System Efficiency and Comfort

Leaky ductwork is just like having a garden hose with holes in it; you just don't get all of the water where you wanted it. With your ductwork, the air that should be delivered to rooms or drawn from rooms, is either delivered to places that you don't need it or is drawn from places that it shouldn't come from. This typically results in the system having to work harder to provide adequate comfort.

Safety

Even more importantly, a leaking duct system can create serious safety problems in a home. These include pressure imbalances that can reverse the flow of deadly flue gasses and introduce them into the home. Seriously imbalanced homes can also force moist air into wall systems or draw moist air into walls from outside the home. Moisture should never be introduced to the wall system as damage and decay can result.

http://www.southface.org/web/resources&services/publications/factsheets/sf_factsheet-menu.htm

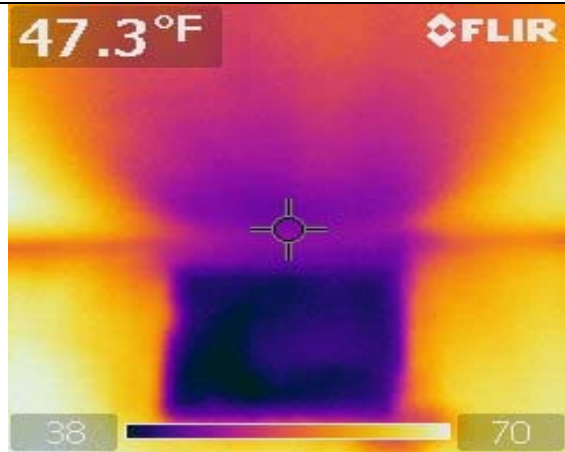
<http://www.aceee.org/Consumer/index.htm>



This image shows a 65% efficient boiler next to 2 water heaters in a 2300 sq/ft home. This all could be accomplished with a single 90%+ efficient boiler.



This humidifier is open to the attic and blows cold damp air laced with fiber glass into the home.





The hydronic heating tubing is left completely exposed in this attic. This home is in the mountains at an elevation of 9500 ft.



The cold water connection on this water heater is corroded and may fail any day. This should be dealt with as soon as possible.



Ventilation is important in homes both for the occupants and the proper operation of atmospherically vented combustion appliances. Proper ventilation reduces indoor pollutant levels and moisture. Kitchens and bathrooms in particular should have good spot ventilation. Good spot ventilators have the following characteristics:

1. Low energy use, under 20 watts in continuous operation for bathrooms
2. Bathroom fans capable of 50cfm, kitchen capable of 150cfm
3. Low noise, under 1.0 sone for baths and 3.0 for kitchens
4. Proper ducting to the outside (see scope of work)
5. Optimally controls that either monitor humidity levels or run for a set period of time or operate on a motion sensor or some combination of the above.

Good ventilation contributes to indoor air quality and when done correctly minimizes energy use and pressurization issues in the home. Kitchen ventilators should not be oversized. For kitchens, the recommended 150cfm is adequate ventilation even for those who cook frequently.

<http://www.hvi.org/consumers.html>

http://www.southface.org/web/resources&services/publications/large_pubs/GA-Power-IAQbooklet.pdf

	
<p>Bath fans that duct directly to the attic will create moisture problems and leak unconditioned air into the home.</p>	<p>Flex duct is relatively fragile and easy to damage. This flex duct is compressed by telephone wiring.</p>

Lights and appliances are one of the primary contributors to electric consumption in the home. In newer homes they can consume more than half of all the energy used by the home. From both an environmental perspective and a utility bill perspective, reducing electric consumption is key to achieving our goals. Reducing electric consumption has the greatest effect on reducing greenhouse gas reductions that can be achieved in the home. The ease with which we can reduce electric consumption makes it one of the first considerations for reducing utility costs.

Guidelines for reducing electric consumption of lights and appliances:

- Replace incandescent lights with compact fluorescent lamps (CFL's)
- When replacing appliances, shop for Energy Star® labeled appliances and shop by energy use
- If considering installing recessed light fixtures, install airtight rated units. Better yet, install track lighting.
- Eliminate second refrigerators. When we buy a new refrigerator and move the old one to the garage, we make things worse not better!
- Use furnace fan settings sensibly. Don't set the fan on your furnace to "on". Leave furnace fans in the "auto" position. Furnace fans use between 350 and 1000 watts. If you turn your furnace fan to "on" and leave it, it will cost you \$438/year at 500 watts and \$.10/kwh!
- Turn computers off. Desktop towers can use as much as half of the energy of your refrigerator.
- Use power strips to plug in items that do not need to be in continuous operation. Many devices today consume energy continuously, sometimes more than when they actually are in operation!

http://www.energystar.gov/index.cfm?fuseaction=find_a_product.

http://kwc.org/mythbusters/2006/12/episode_69_22000_foot_fall_lig.html



Crawlspaces are often a large source of energy loss and contribute to poor indoor air quality when constructed with conventional ventilation. Conventional wisdom regarding crawlspaces and how to properly construct them has changed in recent years. Where we once installed vents and hoped for the best with crawlspaces, we now treat them as spaces that we can and should control.

Crawlspaces with no insulation are large energy losers. In most cases, insulation should be installed on the crawlspace wall, not under the floor. This method is consistent with the strategy of conditioning the crawlspace in order to reduce energy loss and improve indoor air quality and building durability.

Bare dirt floors in crawlspaces allow moisture and other soil gasses to enter the living space. In fact, traditional crawlspace venting almost ensures that moisture and gasses will enter the house and not vent to the outdoors as is hoped. Crawlspace floors that are currently bare should be covered with a durable vapor barrier that is properly installed. All debris should be removed prior to installation.

Crawlspaces should be warm, dry and well-sealed. An appropriate amount of supply air should be introduced to a sealed and insulated crawlspace in order to achieve this goal. Air should be supplied to the crawlspace at the rate of 1cfm per 30ft² of crawl floor area.

Please see the following reference for further detailed guidance on converting crawlspaces.

http://www.advancedenergy.org/buildings/knowledge_library/crawl_spaces/pdfs/Closed%20Crawl%20Spaces_An%20Introduction%20for%20the%20Southeast.pdf



Crawl space venting should be eliminated and sealed shut. This photo shows water pipes adjacent to a vent. It is very likely these pipes will freeze in the winter.

Attic Insulation is particularly important in our homes. It is almost always the first priority in terms of practical, cost-effective improvements to a home. Installing the right amount of attic insulation, typically a minimum of R-38 but often R-50 in our area, is key to reducing not only heating costs, but also cooling costs.

With proper attic insulation, heat rising through the home in the winter is better kept in the home. Similarly, during the summer, the heat generated in an attic space is far less likely to penetrate through a good insulation barrier to the home.



Attic ventilators are not a good means of improving comfort in a home as they are a means of treating the symptom and not the root problem. By installing appropriate levels of attic insulation, the theoretical benefit of attic ventilators is eliminated. Studies have shown that unless your attic is un-insulated, the fan will consume more energy than it saves. Additionally, there are serious concerns in certain homes that air from the home could be drawn into the attic via leaks when powered attic ventilators are used. This can result in unintended safety and moisture issues.

Solar powered fans are no better and are possibly worse as they will run throughout the winter and remove heat from the attic when it should be retained.

Further reading:

[http://www.fsec.ucf.edu/bldg/pubs/pvfan/#\(2\)](http://www.fsec.ucf.edu/bldg/pubs/pvfan/#(2))

http://www.advancedenergy.org/buildings/knowledge_library/ventilation/solar_powered_attic_ventilation.html

	
<p>Personal items should not be stored in attics to avoid compressing the insulation. This will reduce its effective R value.</p>	<p>Transitions in attics are often overlooked and difficult to insulate. This image shows a intersecting open wall cavity.</p>

Insulating Sidewalls

Insulating the sidewall of a home with little or no insulation will have a dramatic effect on the comfort of a home. It should be clear that the energy savings from insulating sidewalls is often disappointing. However, the comfort impact will in most cases outweigh the less than impressive energy savings.

This is directly related to one of the primary components of human comfort, mean radiant temperature.

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-from www.meanradianttemperature.com


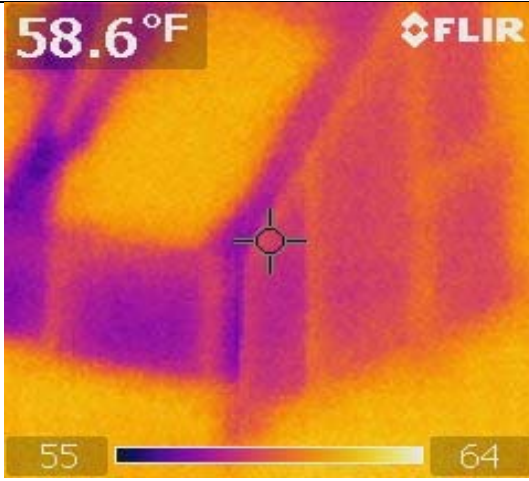
Most homes built before 1970 have little or no insulation in the sidewalls. The older the home, the more likely it is to have no insulation. Often in older homes, unusual materials like newspaper, sawdust and vermiculate were used to insulate homes. In many ways, an empty cavity presents the best situation, as it is relatively easy to retrofit insulation into the wall assembly by blowing the cavity with insulation.

Insulating the sidewalls of a home will accomplish three critical goals:

- Heat loss and gain will be reduced through the sidewall, lowering energy use
- Air infiltration will be reduced, lowering energy use in both heating and cooling seasons
- The temperature of the wall will be maintained closer to the range that results in optimal comfort

Sidewalls can be retrofitted in many homes with either cellulose or fiberglass. Tangential benefits of sidewall insulation include reduced noise and deterrence of insect entry.

	
<p>The sidewalls are poorly insulated under the windows and contribute to the adjacent area being cold.</p>	<p>Living room</p>

	
<p>The walls and ceilings are cold due to air bypasses and poor insulation.</p>	<p>Master bedroom</p>

	
<p>This knee wall was overlooked and entirely un-insulated.</p>	<p>Knee walls should have sheathing on both sides to encapsulate the insulation. This is the only way insulation will perform properly.</p>

Exposed concrete or masonry wall systems lose a great deal of energy to the ground during the heating season. Infrared photos of foundation systems that are uninsulated reveal that the above grade portion of wall loses very high amounts of energy. The below grade portion of the wall loses large amounts of energy as well. This is part of the explanation for why basements are so often much cooler than the rest of the home.


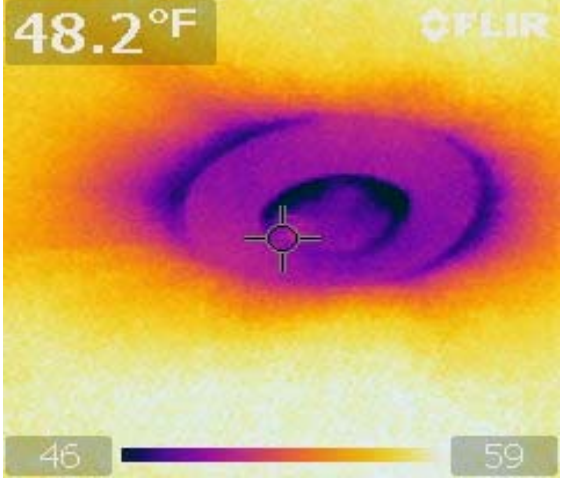
Insulating the basement wall will prevent most heat loss to the ground. There are many ways to insulate the basement wall. Temporary solutions like insulated vinyl drape are probably not the most environmentally sound method unless it is known that they basement will never be finished. If the basement is to be finished, using a conventional method like framing out the basement wall, insulating with at least R-13 fiberglass batts and drywalling for finish is a good choice.

Insulating already finished but uninsulated walls represents a larger challenge. If the finish must be maintained, one method is to insulate the outside of the wall at least four feet down, covering the entire above grade portion. The material to insulate with will typically be an extruded polystyrene (commonly known as blue board, but also comes in pink, green and other colors depending on brand). Insulating to four feet down the foundation wall with a two inch thick layer of this type of insulation will have a dramatic effect on the performance of the basement. The majority of heat loss is through the upper half of the wall.

Dropped soffits often result in both air leakage and thermal problems as the insulation and the air barrier are not aligned properly. Typically, installers will either blow insulation across the dropped soffit or lay batt insulation across the soffit during the installation in order to stop insulation from falling into the cavity.

A better technique is to make the air barrier continuous with the rest of the ceiling and then install the insulation. This eliminates the misalignment and keeps and recessed lights from contact with insulation while simultaneously eliminating air leakage through those fixtures.

Recessed lights typically represent a large leakage site in the home. Most recessed lights in homes today are the unsealed variety. Large amounts of air bypass the home through the unsealed fixtures. When these fixtures are in ceilings that are directly connected to unconditioned space, the impact is particularly meaningful. Fixtures that are connected to floor systems that do not connect directly to outside space may nevertheless be very leaky. This happens typically when the floor system is connected to unconditioned space via any of a number of paths, often leaky rim joists or garage ceiling systems. These fixtures can be connected to spaces that are not obvious.

	
<p>The recessed can light in the bathroom is an air bypass and allows moisture from the shower to escape and condense in the attic. This should be replaced with an exhaust fan/light combo, preferably a Panasonic Whisper Green model.</p>	<p>Can lights can leak an enormous amount of air. By some estimations as much as 10-20 cubic feet per minute.</p>