Energy Audits

Presented By

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I. Introduction

Over the past 15 to 20 years, the focus on energy use and conservation has stepped into the forefront of practically all aspects of our lives. This has been engendered by the rising costs of transportation fuel and residential/commercial energy for heating, cooling and manufacturing. Since the cost of energy is unlikely to be reduced significantly in the near future, controlling its use has become the guiding factor in the effort to provide for some sort of balance between cost and usage. The controlling aspect of energy usage has been directed at innovations in building and construction practices, development of higher efficiency mechanical devices and the use of alternative energy sources.

As a result, numerous entities in both the Public and Private sectors have been established to address these concerns. Among those in the public domain are The Department of Energy programs such as ResCheck, ComCheck and Energy Star. In the Private domain, such entities as the International Energy Conservation Code (IECC), the Building Performance Institute (BPI), the Residential Energy Services Network (ResNet) and the Home Energy Rating System (HERS). Of special interest is the International Code Council (ICC) which is internationally renowned for the development of building and mechanical codes throughout the world. This council is comprised of members in both government and industry to develop standards for building products, practices and procedures.

One of the newest introductions to the code council standards is the establishment of specific codes and practices that will enhance the energy component of buildings known as the International Energy Conservation Code or IECC. These codes specifically

address the implementation of energy related procedures during the construction phases of residences and commercial buildings. As to what types of procedures and code requirements are applicable, this is determined by the areas (regions) of the country which have been segmented into Climate Zones. Most jurisdictions throughout the United States have adopted the IECC standards to be included with existing code standards for other aspects of building construction. What this means is that in order to obtain a building permit, builders must also include an energy plan along with their building construction plans submissions that demonstrates compliance with the IECC. In addition, several other inspections must be performed by a Certified IECC Inspector during the building process before an occupancy permit will be given.

Most have heard of the Energy Star program which is a designation that is given to buildings that have complied with the IECC and other energy related standards. Note that Energy Star ratings are also specified with a variety of appliances which are installed in homes and commercial buildings. To put it simply, a home which has been classified as an Energy Star home is one which has been built and tested (Measured) and complies with standards that designate it as energy efficient with regard to energy use and losses that will subsequently result in lower utility costs.

II. Building Terminology

Building Envelope:

Many types of building construction have what is known as a "Building Envelope". The envelope is nothing more than the building interior which is separated from the exterior environment through walls, ceilings, windows, doors, roof, etc... Such buildings would include any residential living or business structure, a tool shed or outbuilding in the yard or any other free standing type structure which is covered with walls and a roof or any other similar type structure for any purpose. While this concept appears to be straight forward, for the purposes of energy conservation, the areas of concern in any envelope focuses on the separations between "Conditioned" and "Non-Conditioned" spaces.

Conditioned and Non-Conditioned Spaces:

A conditioned space is one that is heated, cooled or both by mechanical means that consume energy through fuels such as gas oil or electricity. Spaces in a building which are conditioned are also referred to as the "Thermal Envelope" Alternatively, a Non-Conditioned space has no cost related energy requirements since it is not heated or cooled and the interior environment is subject to the same or similar conditions as the exterior. Therefore a shed which is used to store garden equipment and tools which is not environmentally controlled is a non-conditioned space as opposed to one which might be heated or cooled which is a conditioned space.

Accordingly, determining the energy efficiency of any structure is primarily focused on the size (area) of the conditioned space in the structure and the subsequent usage of cost related resources such as electricity and natural gas used to condition that area. Of course

this would include those mechanical packages such as the HVAC systems and water heaters since they bear a direct relationship to usage.

III. New Vs. Old

New Construction:

A great deal of what was described in the introduction with regard to Governmental Agencies and the ICC (code development) is applicable almost exclusively to new construction projects. These projects could be for the construction of a new home from foundation up or for a remodeling effort which requires an addition to the thermal envelope (a new room). The ResCheck and ComCheck initiatives with software developed by the Department of Energy directly support the application of the codes set forth in the IECC.

Since the formation of the IECC code structure, more and more jurisdictions are requiring these standards in the construction of new homes which is a good outcome. As a result, homes being built today are very energy efficient as opposed to those built 15 or 20 years ago. Additionally, the mechanical devices used to condition these homes have leaped considerably in energy efficiency as well. Most everyone has heard of the SEER (Seasonal Energy Efficiency Rating) which is now labeled on most every heating or cooling appliance. It is clear that as time goes on, greater emphasis and new developments will emerge in the endeavor to achieve energy efficient products.

Older Construction:

While the road to energy efficiency is under way for new construction, it is important to consider that most of the homes in the country are at least 15 years or older. How is energy efficiency addressed for these structures and what things can be done to improve efficiency? The fact is that, in most cases, much can be done to improve outcomes in older homes as well. Can they be

improved to the point where they would meet the standards of a newly constructed energy efficient home? This is very unlikely since specific building products and procedures used in newer homes were nonexistent at the time older homes were constructed. Nevertheless, significant improvements can be made and this is where the Energy Auditor comes into play.

IV. What is an Energy Audit?

To put it simply, an Energy Audit involves a thorough inspection of a residence for the purpose of locating and identifying unwanted energy losses and gains between the conditioned and non-conditioned areas of the home as well as other factors that include such items as ventilation, AC/Heating systems adequacy, insulation and attic ventilation. The end result is a report, usually with photos, identifying failed areas along with suggestions as to what can be done to correct them. Usually the report includes a prioritized list of issues ordered from the most to least impacting problems.

Specific Areas of Interest:

- The Exterior & Interior Structure: Such items would include penetrations into the exterior wall or siding, sealing around windows, sealing around door casings and at thresholds, weather stripping, insulation and weather stripping at attic access door hatch, sealing/caulking around exterior electrical boxes and panels, exterior mounted receptacle boxes, lighting fixtures, exhaust vents for presence of backdraft preventers, presence of venting at soffits and roof, penetrations into the attic space due to wood decay or other issues and the roof condition.
- The Attic Space: Specific items of interest include the type and depth of both horizontal and vertical insulation, unblocked soffit vents, types of roof exhaust ventilation present, size and area of the attic space, condition of roof decking and the presence of radiant barrier applications at roof deck.
- HVAC & Water Heater: General condition of the Air Handler unit, furnace flues, AC coil secondary pan, AC drain lines, sealing around air handler and ducts at both the return and supply side plenums, issues relating to “Thermal Bridging”

(duct work in insulation or contacting each other), excessive sharp bends in duct runs, sealing of ducts at boots of supply registers (to extent possible that is visible), testing of the AC systems for cooling capacity by measuring temperature drops across coils, condition of supply and return register vents in the home, placement and type(s) of thermostats installed and the general overall whole house ventilation.

V. Energy Audits as an Industry:

At this point, it should be pointed out that energy audit industry is not regulated nor do practitioners require licensing as would be required by a Home Inspector, Termite Inspector or other building related service professional. As such, an individual or company may wish to legally engage in this service simply by advertising that it does. In reality, no other certifications or licensing is required. As can be seen by the many service industries offering this product, most are engaged in other ancillary services as their prime motivation. For example, to name a few; insulation installer companies, plumbing contractors, electrical contractors, power providers and many other industries.

The unfortunate result of this is that many companies and individuals have posted themselves as energy auditors with the purpose of acquiring additional service work based on the outcomes of the audit. Essentially, the audit process is actually a marketing vehicle to sell a company's primary line of services or for an individual to gain additional remediation work which renders the audit as a biased service. Since there is no licensing authority, a minimal standard of practice is nonexistent placing the burden on the consumer to select a practitioner which can provide the best outcome.

Selecting an Energy Auditor:

When considering to hire and entity to perform an Energy Audit, some of the items that should be considered are as follows:

- Is the auditing faction associated with an industry that offers services to remediate issues discovered in the audit

- What specific certifications/qualifications does the auditor have which qualifies him/her as an auditor
- Keep clear of free or $100 to $150 service fees since they are usually a flag that the auditing process is little more than a marketing tool to get additional business. A detailed and complete audit should run anywhere from $300 to $350 for a 2000 Sq.Ft. home
- Is the auditor Unbiased (does not recommend individuals or other contractors by name to perform remedial services). An unbiased auditor will only comment on the types of services that are required and suggest that pricing be shopped for competing cost comparisons.
- What types of equipment will be used by the auditor during the auditing process.
- Specifically, what areas of the home will be reviewed; attic space, HVAC testing and observation, insulation applications, etc…
- What type of reporting will result from the audit – Are the reports detailed and precise offering remedial suggestions and are photos and infrared images included and are the findings prioritized in some manner. Note that some reports utilize a “Checklist” type approach and a series of numerical values comparing your home to others which are considered baseline models.
- Ask to review a “Sample Report” – Any good auditor should be able to provide you with one

The above bullets are only some of the questions that should be considered when searching for an auditor – You may have others as well.

VI. Certification & Qualifications

For the purposes of conducting energy compliance inspections such as with new construction building or remodeling and the designation as Energy Star compliant, practitioners are required to have specific certifications as determined by governmental entities. These would include one or more of the previously mentioned private certification concerns such as the Building Performance Institute (BPI), the Residential Energy Services Network (ResNet), the Home Energy Rating System (HERS) and the International Code Council (ICC). Each of these entities requires training, some of which may include practical hands on in addition to classroom or correspondence study. Certification is predicated on the outcome of testing in both a paper and/or practical environment.

However, the downside to these certifications is that any individual seeking certification is not required to ever have been practically involved in the building or construction industry and training is strictly a mix of some building science training along with instruction on utilizing testing equipment and analyzing results.

Those who have been in construction such as builders, plumbers, contractors, inspectors and similar type trades have a much more detailed insight as to construction practices and procedures among a variety of other systems involved in the construction of a residence such as electrical, plumbing, insulation, roof construction, etc… Generally speaking, one who is involved in the building trades either as a contractor/builder or an inspector along with the tools and training necessary to conduct energy audits is better equipped to assess audit issues and recommend corrective actions which are reasonable and cost effective for the homeowner.

VII. Tools of the Trade

Brief descriptions of some of the tools necessary to conduct an effective audit along with their intended purpose are descried below:

- Blower Door Testing:
  A blower door test is designed to assess the amount of leakage (air intrusions) into the home over a range of depressurization schemes. A large blower (fan) is attached to an exterior door, all HVAC vents, fireplace openings, backdraft preventers at exhausts in baths and kitchen are covered with plastic. The blower is then operated sucking air out of the home causing negative pressures in the house. Pressurization is determined by a probe which measures the exterior atmospheric pressure and that present in the home. Several different depressurization levels are acquired to obtain an average leakage value which is then compared to a given set of parameters for a similar type size and construction to determine adequacy.

- Duct Blaster Testing:
  This type of testing is similar to a blower door except that it is designed to determine the “tightness” leakage in the HVAC system. A blower fan is attached to an HVAC return register and the system is pressurized to determine the amount of leakage in the system.

- Thermal Imaging (Infrared) Camera:
  This instrument is used to determine areas of leakage in and around windows, doors, baseboards, etc… It is also used to determine leakage at ductwork in the HVAC system and air handler units. A valuable use of this tool is determining the

lack of insulation between wall spaces as well as other types of issues such as water leaks. This type of device operates on temperature differentials between surfaces.

- Infrared Thermometer Gun:
  This is a handheld unit which looks like a gun but has a temperature probe at the end which is capable of accurately taking temperature measurements from far distances.

- Handheld Digital Thermometer:
  Used to test cooling system temperature drops across AC cooling coils

- Velocity Probe:
  A probe type instrument used to measure the velocity of airflow from supply register vents in the home to determine low flow or blocked areas in the duct system

- Hygrometer:
  Instrument used to measure the relative humidity, dew point and temperatures in a living space

- Low “E” Glass Detector:
  An instrument used to check for low “e” emissivity presence in widow glass and if installed at proper side of glass panes

- A Sturdy Ladder

VIII. The Energy Audit Process

For purposes of this presentation, the auditing process will be that as performed by Real Horizons Inspection Services. The auditing components are actually in two distinct parts; (1) the general audit procedure which is intended to determine issues in the structural components of the home or building and (2) an Environmental Analysis which is intended to determine the living space from an environmentally healthy and comfort perspective.

In our opinion, an effective energy audit should necessarily include those factors which affect the health and comfort of the buildings occupants. Any home can be made to be energy efficient but not to the extent that it affects comfort and health.

Structural Audit Components:

Exterior: The entire building exterior is examined for penetrations into the wall spaces at siding/brick, caulking and sealing at all window exteriors, caulking/sealing at door casings and trim, door thresholds, caulking and sealing of all lighting and electrical fixtures attached to exterior wall, presence or lack of soffit venting, venting at roof surface, and inspection of exterior mounted AC condensers.

Interior: The interior of the home is examined for caulking at window interiors and separations due to condensation, window types and presence of low “e” coating at glass, back draft preventer operation at all exhaust vents in kitchen baths and laundry rooms, sealing and presence of drafts at windows, doors and electrical outlets and switches, presence of fungal growth, types of recessed lighting installed if any and any other signs that may suggest an undesirable issue.

Attic Space: The attic space is examined for adequacy of installed insulation both vertically and at attic floor, type of attic ventilating devices and adequacy for size of attic area, underside of roof decking for any apparent leaks at boots or other penetrations through roof, cleared and unblocked soffit vents and any other apparent issues that may be present.

Mechanical Equipment: The HVAC air handler equipment is checked for general condition, leaks at chassis, sealing at plenum joints, drainage lines at both primary and secondary drain pans, duct work connections for sealing at both return and supply side plenum boxes and filtration (Media Type). A cooling capacity test is performed on all installed AC systems by measuring the temperature drops across evaporator coils installed in Air Handler unit. All duct work is checked for leakage with thermal camera along runs, for proper suspension (hanging) off attic floor and out of insulation and for sharp restrictive type bends and crushing. Any Thermal Bridging presence is also observed. All installed AC equipment is checked for system sizing and adequacy to area of home.
The water heater installations are examined for proper installation of TPR valves and associated drains, flues extending through roof surface and size and capacity.

Environmental Audit Components:

Exterior: The condition of gutters and drains and roof surface are examined, landscaping around the home for proper drainage and high grade levels along foundation wall and presence of insect activity entering wall space.

Interior: The temperature, relative humidity and dew points are measured at a point 3 feet above the floor at each room in the

home, temperature and velocities of air flow through every supply register vent in home are recorded, the temperatures at the return air registers are recorded for the area that system pertains to, the number and sizing of all return registers are recorded, the placement and types of installed thermostats are noted and an assessment is made of the general overall ventilating properties in the home.

The purpose of this environmental process of the audit is to determine occupant comfort levels and the propensity of mold/mildew formations in the home which can affect health. Additionally, the many measurements taken also allows for the verification of visual findings as well as those not readily observed through visual means. On the average, an energy audit of a typical 2500 Sq.Ft. home will take from 2 to 3 hours to conduct on site and the analysis and report generation will run on average an additional 4 to 5 hours depending on the number and severity of issues noted.

IX. Departure

I would like to take a moment to thank all of you for your interest and participation in this presentation. I hope that you have gained some valuable insight as to what an energy audit actually entails and its purpose in today's environment.

Should any of you wish to contact me in the future with any questions concerning this presentation or other questions regarding energy usage or processes, please feel free to do so at any time. My contact information is:

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I would also extend an invitation to anyone who would desire to accompany me during an Audit to gain a firsthand view of what is involved. Just call me to determine if there is an upcoming audit so that I can advise you of time and location.

Thank you,

Gene Hoyt
Real Horizons Inspection Services, LLC