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Building Assessment for the Ulysses Town Hall
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Client Concerns:

- Temperature imbalances
- Discomfort
- General assessment of conditions

Summary of Recommendations:

- Water heater replacement
- Furnace/AC ductwork redesign, sealing, & insulation in main attic
- Attic insulation & general air sealing
- Plan for heating/cooling equipment replacement

Heating, Cooling and Hot Water

Heating system

- Trane 90% efficient condensing single-stage methane furnace. Manufactured 2006. (10 years old)
- A "single-stage" unit operates at one speed, as opposed to two-stage, three-stage, or variable-capacity furnaces. It is a very binary unit – it is either "on" or "off." Such units do not have an ability to modulate their output, and therefore are prone to frequent on/off cycles, especially in the shoulder seasons (spring and fall). During the course of the assessment, however, it was noted that the unit rarely turned off, which is actually ideal for efficiency & mixing of the indoor air, and is an indicator that the unit is somewhat appropriately sized. A subsequent heat loss analysis confirmed this.
- Since the unit operates nearly constantly, and is delivering warm air at a near-constant rate, it highlights flaws in the duct system. The duct system is:
    - Not designed. It shows signs of being haphazardly installed, which contributes to over-delivery of warm air to some locations (upstairs), and under-delivery to others.
    - Leaky. Connections are poor, and therefore a great quantity of conditioned air is not being delivered to its intended areas. Holes in the duct system are, essentially, pressurized air leaks. This puts stress on the system, as it

must work harder to overcome the accompanying energy waste and system efficiency loss.
    - Outside. Much of it is contained within the attic, which is near outdoor temperatures in the winter. "Outside" represents exactly the wrong place to install a space-conditioning distribution system.
    - Under-insulated. The flexible ductwork has a thin layer of insulation on it, but it is insubstantial.
    - Largely made of flexible ductwork. "Flex duct" can be installed in an acceptable manner, but when it is loosely laid with bends and sags, it contributes to reduced airflow and increases stress on the system. It is best used a sound attenuation material to connect the last few feet of a duct run to a diffuser.

Cooling system

- Indoor air handling unit/evaporator coil: 5-ton capacity, manufactured 2006. (10 years old)
- Outdoor compressor/condensing unit: 4-ton capacity, modern EPA-approved R-410A refrigerant (as opposed to older R-22, which is being phased out), 14 SEER, manufactured 2004. (12 years old)
- Initial assessment indicates that the air conditioning system is severely oversized. Oversized equipment, combined with a poorly-performing duct system and a single-speed air handling unit, will over-deliver conditioned air very quickly, which will satisfy the thermostat and turn the system off quickly. This is problematic because air conditioning systems are designed to do two things: (1) cool the air, and (2) dehumidify. If the air is cooled quickly, the shutdown of the system will keep the air from being adequately dehumidified. This leads to a cold, clammy feeling. It is optimal for systems to run at near-continuous rates, which requires that they be appropriately sized by a professional who will perform cooling load calculations.

Hot water

- 40-gallon atmospherically-drafting methane-fueled tank. Installed 1989. **(27 years old)**

Heating & hot water recommendations

- Replace the water heater. A normal good lifetime for a tank water heater is 12-17 years. The water heater is well past its life expectancy. It is recommended to replace it with a **10-gallon electric water heater.** Since there is no bathing or laundry done on site, 40 gallons represents too much domestic hot water capacity for the structure and its occupants, and installation of an electric unit will begin to disconnect the structure from fossil fuel infrastructure.
- Replace the duct system in the attic with a **professionally-designed, metal duct system**. **Insulate it with closed-cell spray foam**, which will both insulate and seal the ductwork. This treatment is intended to "future-proof" the duct system; when it comes time to replace the heating/cooling system, it is recommended to install a heat pump, either an air-source or ground-source (geothermal) unit. This will complete the disconnection from fossil fuels.
- In the meantime, have the furnace serviced at least every two years by a qualified professional to maintain its peak operating efficiency, such as it is.

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Insulation, Air Leakage and Ventilation

Insulation:

Walls:

- When the structure was retrofitted, fiberglass insulation was installed in the walls. Augmentation of wall insulation is not recommended.

Attics and ceilings:

- The attic is insulated with about 12" of blown fiberglass. Its actual depth varies, and there are occasional thin spots (red arrow). The total R value is likely less than R-30. The Department of Energy recommends an attic insulation level of up to R-60 in this climate.
- The infrared scan indicates that the ceilings in the upstairs are insulated.
- The wall between the living space and the attic is poorly insulated. There are gaps in the insulation layer (red arrow, below), and the choice of material is substandard. Fiberglass batting performs best when it is enclosed on all sides with an airtight layer, which prevents air movement from washing heat away from the surface.

Insulation recommendations:

- When the duct system is rebuilt and insulated with spray foam, insulate the wall with spray foam as well.
- Install blown cellulose over the existing insulation to augment the insulation level to R-60.

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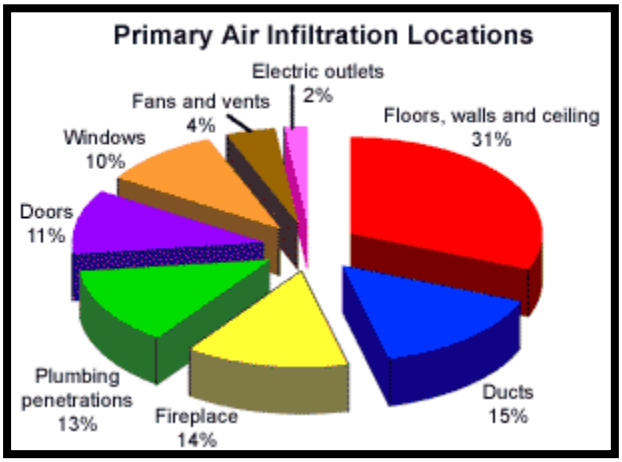
Air leakage:



- Air leakage rates are presumed to be extremely high, due to the observation of several extraordinarily-sized holes in the air barrier. A robust, airtight layer is important because in order to condition the indoor environment, we must first control it.
- Three particular examples stood out:
    - The return air duct system for the furnace is connected to the outdoors. This appears to be a well-intentioned attempt at implementing a ventilation strategy, but it is unreliable & uncontrolled (blue arrows, both pointing to the same opening).
    - Another opening to the outside (green arrow), similar to the above but not connected to anything, simply a hole between the inside & outside.
    - In the old roof through which the duct installers cut large holes. The holes are not sealed around the ductwork, and therefore represent many pathways through which conditioned air escapes.

Air leakage control recommendations:

- Disconnect the return duct system from the outside air intake when the duct system is reconfigured. Seal both holes from the interior.
- Seal the penetrations through which ducts travel from the attic to the conditioned space.

Ventilation:

- A curious contraption was observed in the attic (picture, right). It appears to be a ventilation system; a duct extends upwards, through the roof. It is attached to a belt-driven fan, which presumably brings roof air into the attached ductwork, where it is distributed to the building through the four attached duct runs. No attempt was made to operate it or verify where the ducts terminate. It is recommended not to use it, as it is not entirely clear that the structure requires a ventilation system at all.
- While fresh air is desirable and necessary, the large internal volume of the building dilutes indoor air pollutants, of which there are not many (especially with the designation of the space as a fragrance-free zone). Carbon dioxide from exhalation would be a large contributor to poor indoor air quality, but the low occupancy implies that CO_2 levels are not very high.
- It is reasonable to assume that since there is no basement, full kitchen, or bathing facilities, a needs assessment for a ventilation strategy would best be pursued *after* the previous recommendations are implemented.

Windows and Doors

- Operable and of decent quality. Interior storm windows would help alleviate feelings of draftiness, but the windows themselves are not abnormally drafty. The "draftiness" is likely due more to convection currents, whereby warm interior air meets the cold window surface and sinks.

Lighting

- Replace all incandescent lamps with LEDs for near-immediate savings.

More about Snug Planet LLC

Snug Planet is a Building Performance Institute (BPI) accredited and Energy Star certified contractor. We are members of the Ithaca Green Building Alliance and a certified Tompkins County ReBusiness Partner. We are also a living wage employer certified by the Tompkins County Workers' Center.

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