Case Study:
Auditing an Existing Building

Condense

Building decisions in full context, less time.

This is a case study summary of the use of the Condense tool in auditing an existing building. Because auditing accuracy depends more on auditor observations and inputs than the precision of the modeling platform, we are focusing here on the user input process. (For tests on the precision of the energy modeling platform, see the other cases studies.) This case study includes a real project called the Southern Stove Works Lofts. The facility is located in Richmond, VA, and is a multifamily apartment complex of four buildings ranging from one to four stories. The buildings were originally used to make wood and coal stoves but were converted to apartments in 2007. The audit scope excluded the apartments themselves, but looked at all the shared spaces, lounges, corridors, lobbies, and management offices. This audit project is a great example and test of the Condense tool because it would be a challenging audit to perform in a traditional manner. There are a large number of distinct spaces; floor plans are complex; there is isolation of the spaces being audited (shared spaces, corridors, offices) from other conditioned spaces (the apartment units); and, most significantly, it was difficult to obtain technical specifications from the building Owner or Owner's personnel. (The facility manager was newly hired.)

Background:
The Status Quo Auditing Process

Auditing often involves lots of note-taking during the building walk-through, informed deductions by experienced engineers, and lots of paperwork back at the office.

ASHRAE Level I Audit, typical tasks

- Interview building Owner or Manager
- Inspect mechanical equipment
- Inspect BMS or thermostat programs
- Look for HVAC subcomponents in each space
- Inspect lighting fixtures and controls
- Look for additional plug loads or HVAC loads within spaces
- Interview occupants or Manager about thermal comfort complaints
- Discuss other non-energy efficiency opportunities (water, trash)
- Visually inspect the building envelope and any attics or interstitial spaces
- Write a report on the existing conditions and provide recommendations for any obvious efficiency improvements, such as lighting relamping, HVAC or water heating equipment upgrades for items nearing end-of-life, or thermostat schedule refinements.

ASHRAE (The American Society of Heating, Refrigerating and Air-Conditioning Engineers) has developed a set of guidelines for auditing existing buildings which helps consultants, building Owners and stakeholders communicate better about audit goals and expectations. This is an informal summary.

ASHRAE Level II Audit, typical tasks

- Everything in Level I but also provide a financial analysis illustrating the return on investment (ROI) of the recommended improvements. This may include recommending a specific product with a specific price, showing the energy savings it would probably yield over time compared to the existing (using some simple engineering calculations), and converting this to real dollars based on the Owner's utility rates.

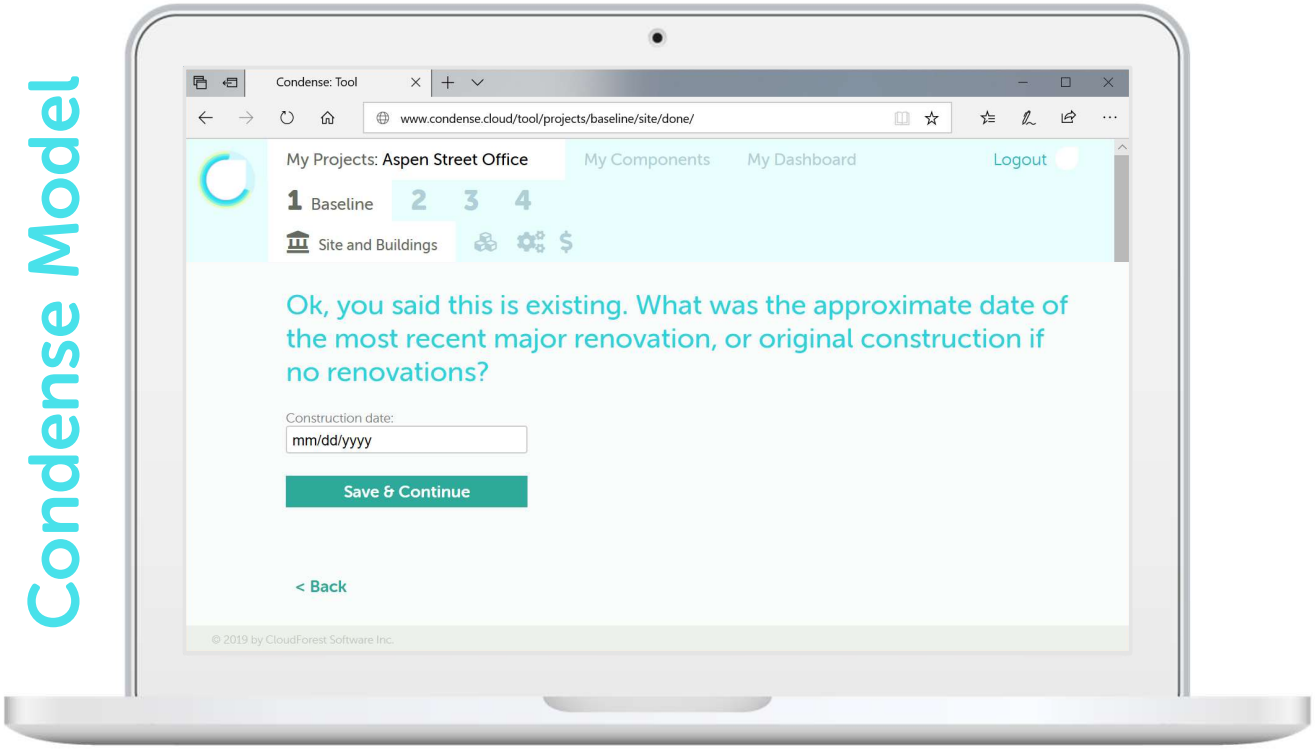
ASHRAE Level III Audit, typical tasks

- Everything in Level I & II but instead of performing simple calculations to illustrate one or two specific improvements, the auditor would produce a whole building energy model of the existing building baseline, calibrate that to existing utility bills, and then produce a contrasting model with improvements, testing a wider range of potential improvements than what would be explored in ASHRAE Level II. At Level III more attention is given to obtaining and inspecting architectural documents, utility bills, and operating data, interviewing personnel, and more carefully inspecting equipment and building envelope by running on-site tests with special instrumentation.

The Condense Process: Get to decisions faster.

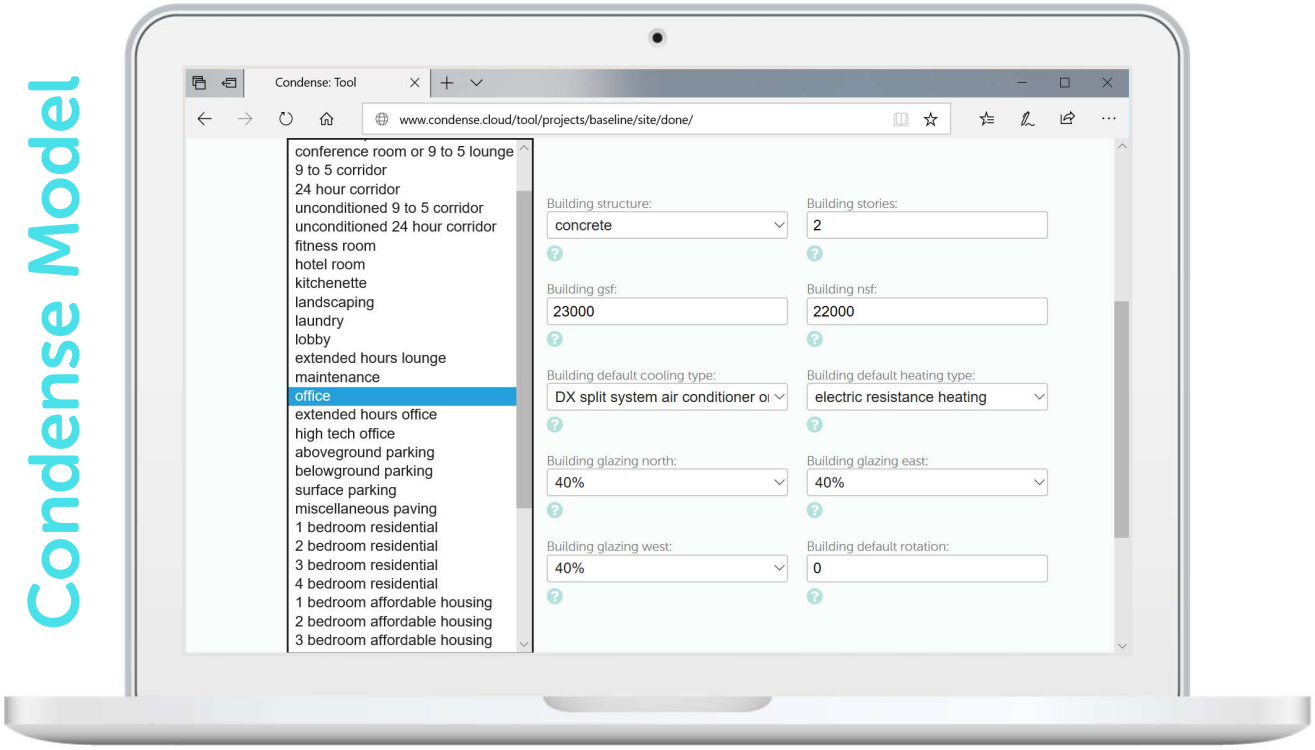
Condense allows auditors to produce any of the previously described audit types with much less effort and expertise than has typically been required.

Condense Model

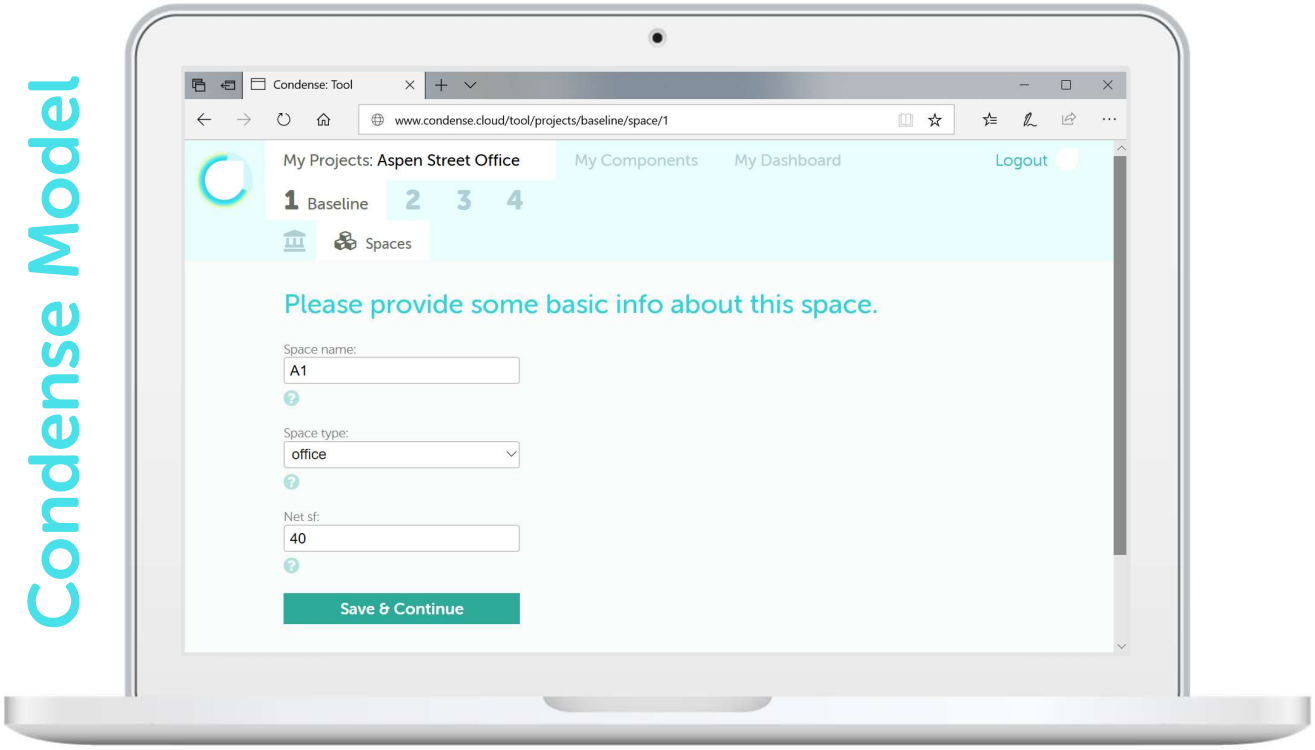


The newest version of Condense is a modern website-based platform that guides you through with zero training required.

Condense Model

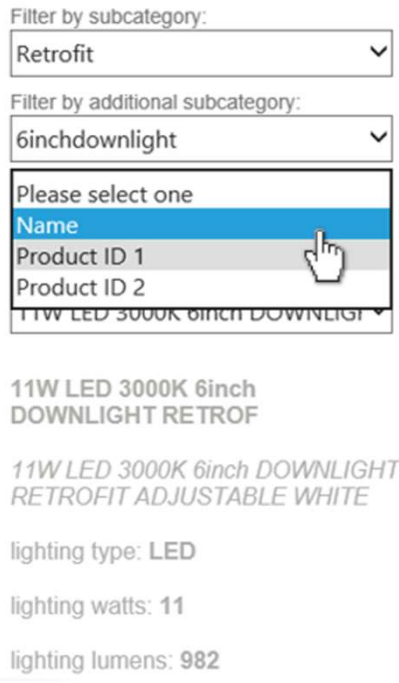


You can model new or existing buildings. You can model at the building level…



... or walk through space by space. There is zero drawing required, no jockeying between CAD programs, and just a few critical geometric inputs (square footage, estimated length of exposed walls only (non-exposed walls are ignored), and estimated window area). So, on geometry, Condense is MUCH faster and more foolproof than the traditional approach. When it comes to specifications (lighting, insulation, HVAC systems), Condense translates your project basics (location, year of construction, etc.) to predict what specifications are most likely in your building. So you start with a completely specified predictive model. You can then check the specs, such as your HVAC system type and equipment efficiency rating, but Condense guides you through in a way that is simple and understandable even to non-experts.. Your simple inputs are translated by powerful algorithms into the 3D and expert engineering inputs required by Energy Plus. You will get automatically produced Energy Plus models, with results automatically summarized, long-term financial outlook, and more.

Condense Model



Either way, you will be able to test energy efficient, cost saving, and green improvements that are modeled for you, and you will get automatically produced Energy Plus models, long-term financial outlook, and more. The Condense work flow for existing building audits is uniquely simple. Because of the powerful algorithms, you will have smart default inputs that you can simply check as you walk through, minimizing clicking and typing.

Project: Southern Stoveworks

With permission from the auditor, we assisted with the audit of Southern Stove Works Lofts. The facility is located in Richmond, VA, and is a multifamily apartment complex of four buildings ranging from one to four stories. The historic buildings were originally used to make wood and coal stoves but were converted to apartments in 2007. The audit scope excluded the apartments themselves, but looked at all the shared spaces, lounges, corridors, lobbies, and management offices. After inputting the facility, we compared energy model results to utility bills to check our work. Because this project was particularly challenging in terms of obtaining actual performance specifications on the building mechanical systems, our calibration process was also very involved, and illustrates a range of techniques that can be used.

Southern Stoveworks: Calibration

Calibrate to HDD/CDD
Using the Calibrate tool, we input 12 months of actual utility bills we obtained from the building Owner, and the corresponding actual Heating Degree Days and Cooling Degree Days for those months and those years (2017-2018). This tool can be checked throughout your calibration process as you adjust the model and check for it to get closer.

Interestingly, even though actual Heating Degree Days and Cooling Degree Days varied by a whopping 20% from the standard weather file for our location, making our predicted model far off the adjusted model in the Calibrate tool, ultimately the predicted savings of the Improved model over the Baseline model did not significantly differ. The difference amounted to $175 per year worth of energy savings. This illustrates that calibration is important mainly for catching gross input errors, not so much for total accuracy.

Southern Stoveworks: Calibration

Round 1
When comparing the initial model to the building's actual utility bills, the model energy was looking extremely high, particularly in heating. Meanwhile, in unconditioned spaces that only had lighting energy, the calculations were spot on. So, at this point at least we knew our lighting calculations are reliable.

Round 2
We reviewed the basic inputs and corrected some spaces that had been set to be conditioned, and changed them to unconditioned. This of course would make a huge difference in the energy model. We then inquired with the Owner about whether perhaps our assumption of electric resistance heat was wrong, and asked him to confirm whether they actually had heat pumps with a heating mode. This turned out to be true. These two changes made the model much better but still a little high.

Southern Stoveworks: Calibration

Round 3
Because no specification data on the heat pumps was obtained, we had to use assumptions. The heat pumps HSPF was set to 7.4 in the default model inputs, using ASHRAE 90.1-2004 as the standard, but there was a big leap in the technology and the energy code between 2004 and 2007, and most likely by the time this building was renovated in 2007, higher HSPF was widely available. We used 7.8 as a best guess for the revised baseline.

We also reviewed our assumptions for setpoints, and adjusted the cooling and heating setpoints in all spaces except the office, where we assume they are held to stricter comfort limits.

This third model attempt was much more aligned and at this point we believe it forms a solid basis for testing improvements.