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PO Box N, Berthoud, CO 80513
1 800 315 0459 · theenergylogic.com

Steamboat Springs Residence

Project Summary by Zach Kimbrough

Senior Energy Rater & Plans Analyst – LEED® Green Rater, HERS® Rater, ICC® Residential Energy Inspector

Long gone are the days when people do not expect their homes to be sustainable, safe, efficient, comfortable, and healthy. They trust that their homes are built to provide quality indoor air that helps protect them from pollutants, mold, and other health risks. They expect to be protected from extreme weather, natural disasters, and other adverse events such as the global COVID-19 health pandemic.

To deliver on these modern expectations, building professionals must meet or exceed building energy code standards, known as the International Energy Conservation Code (IECC). These codes exist to help ensure that homes perform as expected, are less expensive to operate, are more comfortable to live in, and help to mitigate the effects of climate change by significantly reducing greenhouse gas emissions.

According to Colorado Energy Office (CEO), more than 4.9 million Coloradans, or 86% of the state's population, live in one of the 156 jurisdictions that have adopted a high-efficiency energy code—2018, 2015, or 2012 IECC.

Code compliance pathways come in all shapes and sizes. But keeping up to speed with each jurisdiction's variation and amendments and complying with multiple code versions can be a daunting task. One of EnergyLogic's recent blog posts uncovers the most common building pathways, highlighting the advantages of the performance path—chosen by Colorado Earth for the Steamboat Springs Residence home to allow the most flexible, cost-effective, and high-performing compliance options.

The preliminary compliance review aims to ensure compliance with all relevant building energy codes and programs. In this case, I verified the Steamboat Springs Residence home for the 2018 IECC in Climate Zone 7.

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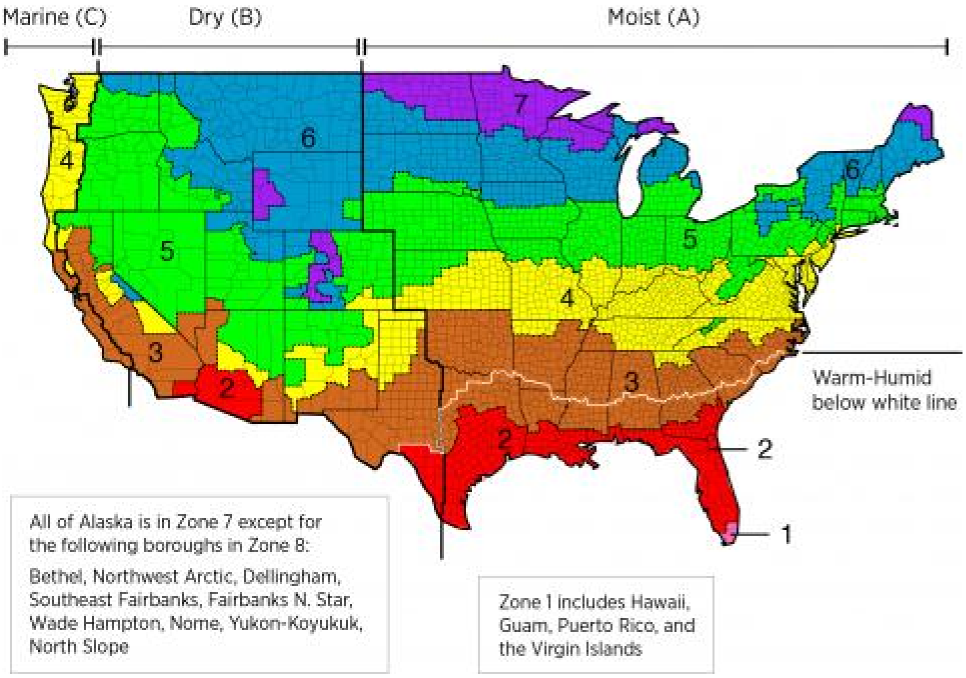


Image Source: IECC climate Zone Map

This climate zone is a challenging area to build as it has the most progressive energy efficiency requirements out of any climate zone for this Colorado code cycle. Beyond the preliminary compliance, I needed to determine the cavity spacing required between the layers of compressed earth blocks to meet compliance with the 2018 IECC. I was specifically asked to look at the difference between a three-inch cavity and a four-inch cavity.

Any review starts with compiling information that will later be used as data points in the review calculation within Ekotrope, a Home Energy Rating System (HERS) rating software. Colorado Earth provided me with a comprehensive list of information and specifications so that I could assess items such as:

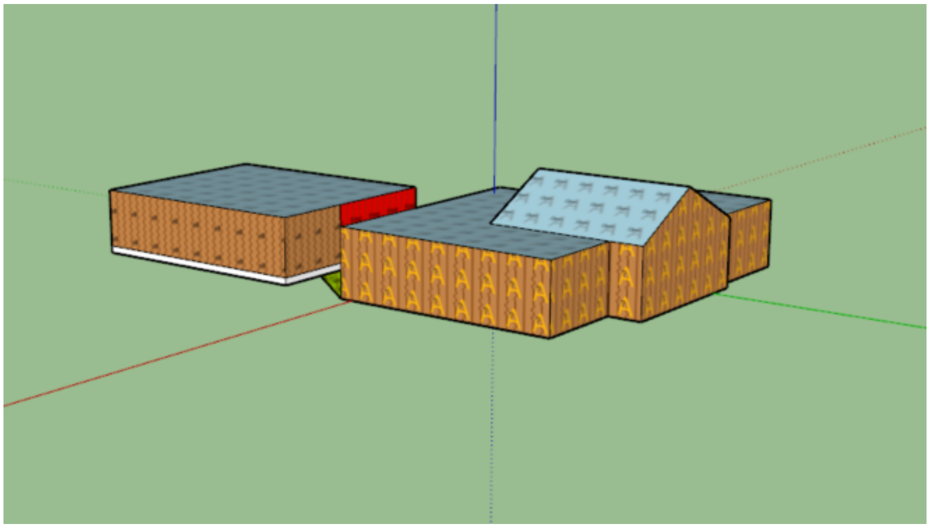
- Insulation materials and the R-Value per assembly
- Window U-Value and Solar Heat Gain Coefficient (SHGC)
- Methods and systems used to heat, cool, and ventilate the home

The Steamboat Springs home is unique in sustainability by using compressed earth blocks to construct the first-floor walls. I will later describe the process that I used to input these blocks' size and thermal properties to create a library entry in the Ekotrope software.

Once I compiled the information provided by the builder, I then analyzed the home's building plans to assess additional components such as the number of bedrooms, the orientation of the house, finished and unfinished sections of the basement, and the number of floors above grade. Additionally, I noted if the foundation was entirely below-grade, garden level, or walkout sections.

Using SketchUp, a 3D Design Software, I started drawing the home's thermal barrier. This process entailed tracing the foundation and moved up the house ending with the ceiling. Using EnergyLogic's custom Sketchup drawing scripts, I could easily calculate:

- The conditioned floor area. Volume, length, or area of each unique building assembly.
- The window take-off, locating and recording the area of each window along with the overhang depth, head height, and orientation. This data is subtracted from the wall areas found with the process described above.



Steamboat Springs Residence plan takeoff created in SketchUp using EnergyLogic's proprietary extensions.

Steamboat Springs Residence.skp

Material type	Value in ft,sqft,cuft
Conditioned	2818.3
Volume	28954.64
Slab	**Area, Perimeter Length**
Name	slab-Ongrade-A
Area	1898.4
Perimeter	179.5
Name	slab-Ongrade-A
Area	29.6
Perimeter	17.8
Framed Floor	**Area**
FFlr-Ambient	133.4
FFlr-Garage	756.8
Foundation Height	**Length**
AGW	**Area**
AGW-x6	837.3
AGW-x6-Garage	70.1
AGW-x6-Knee	121.0
AGW-xA	1743.5
Rim/Band	**Area**
Ceiling	**Area**
Clng-Open-A	2880.9

Steamboat Springs Residence's measurement data calculated by the plan takeoff created in SketchUp using EnergyLogic's proprietary extensions.

The above data was also entered into the Ekotrope software, which automatically identified the relevant climate zone and utility rate once I input additional broad-scope information like the property address. Since the annual cost of utilities is the unit by which we measure compliance, it was essential to know the per-unit cost of electricity and natural gas. We used a quarterly state average for the cost.

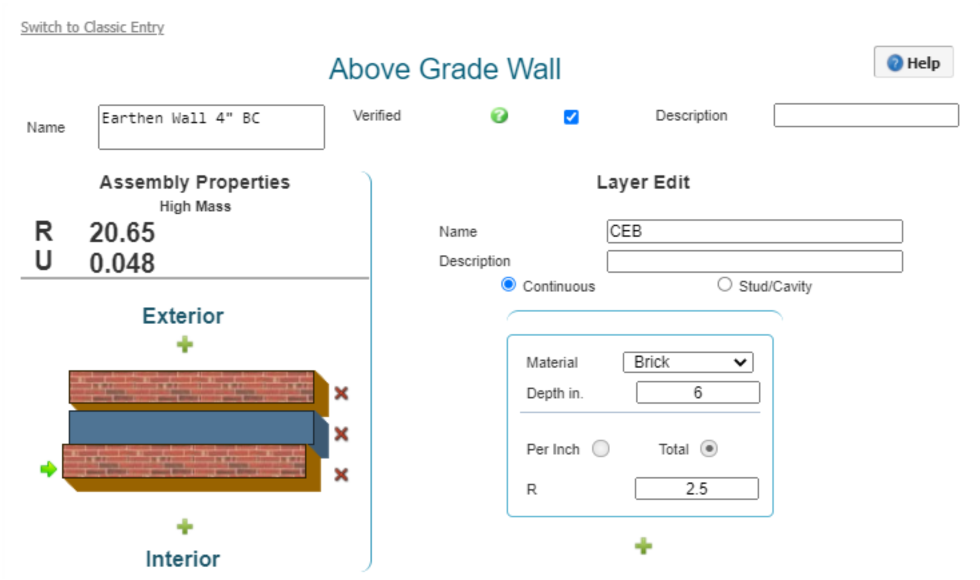
Next, I entered more specific data, such as the number of floors, conditioned floor area, and volume. I then broke the home down to each unique building assembly. I entered the length, area, and structural and insulation information for each foundation, above-grade wall, floor, rim joist, and attic.

Steamboat Springs Residence			
Envelope Assembly	**Nominal R-Value**	**Actual R-Value**	**Actual U-Value**
Foundation Slab Edge	10	10	0.100
Foundation Under Slab	20	20	0.050
Cantilevered Floors	38	34.16	0.029
CEB Wall 3"	17	16.95	0.059
CEB Wall 4"	20	20.65	0.048
2x6 Wall	21	17.67	0.057
Flat Ceiling	60	60.63	0.016
Exterior Door			0.015
Windows			0.24

Steamboat Springs Residence envelope assembly thermal properties data calculated by EnergyLogic.

The Ekotrope software has a Graphical User Interface (GUI) that allows users to construct the assembly to create the library entry virtually. In this case, I made two different entries consisting of a layer of the earth block, a three-inch and a four-inch cavity filled with blown cellulose insulation, and another layer of the earth blocks.

Schematic wall section created in Ekotrope, showing 3" gap between 2 CEB whythes.



Schematic wall section created in Ekotrope, showing 4" gap between 2 CEB whythes.

I then entered all the fenestration and oriented them to either the least efficient direction or the direction they would eventually face. In this case, I knew the orientation of the home and used the latter. This section was vital because windows have significantly lower insulative properties when compared to walls, and each orientation receives significantly different amounts of sunlight.

The last significant step in my process was to add the HVAC information. The Steamboat Springs home used a radiant floor heating system with a 95% efficient boiler and no cooling. Once all the data was entered and double-checked, the software completed the compliance analysis.

Because I was also exploring the efficiency of two assemblies, I processed the home comparing the three-inch wall cavity against the four-inch wall cavity to assess the compliance results. Since the house met all compliance requirements by a large margin, I printed the preliminary compliance reports needed for permitting and delivered them to Colorado Earth for both assemblies.

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About EnergyLogic

EnergyLogic is a Colorado-based applied building science company that partners with building professionals to construct buildings that are efficient, healthy, and resilient. Since 2006, the company has partnered with 100s of builders on over 50,000 homes and buildings as a nationally recognized leader in the building performance industry.

EnergyLogic is recognized as ‘2018 Top Workplaces,' one of America's fastest-growing 'Inc. 5000' private companies, and regional 'BizWest Mercury 100' companies. Distinguished as the ‘2020 Indoor airPLUS™ Leader of the Year,' exemplifying its commitment to excellence, the company is honored with over a decade of ENERGY STAR® Awards.

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